

Control system to meet the actual functional requirements of the BOP systems offered.

- 1.03.00 Operation and control of various BOP systems like Water system, Coal Handling plant, Ash Handling plant, Compressed air system, Ventilation & AC system, DM plant, PT plant, CW treatment system, DG set, , Fuel unloading system etc. shall be carried out from redundant PLC / Microprocessor based control system. There may be other systems where control is not critical. In such cases hardwired / relay based interlock shall be envisaged.

However, hardware based monitoring / control / annunciation shall be provided for the systems where HMI workstations are not envisaged or need for such back up is strongly recommended by Bidder for the safe shutdown of the BOP systems.

- 1.04.00 In case of any conflict or contradiction between any two or more sections of this specification the more stringent condition shall generally be applicable. Owner, however, reserves the right to relax this condition at his discretion.

~~1.05.00 Type of control vis a vis the plant area are delineated below~~

~~1.05.01 Plant Auxiliaries System:~~

- ~~a) DM Cooling Water System & process Heat exchangers~~
- ~~b) Condenser Cooling Water (CW system) with tube cleaning system.~~
- ~~c) Auxiliary Cooling Water System (ACW system) with self cleaning strainers.~~
- ~~d) Condensate Transfer (CT) pump~~
- ~~e) DM Service Water (DMSW) pumps~~
- ~~f) Mill Reject Handling System~~
- ~~g) Fuel Oil Pressurizing & Heating System~~
- ~~h) Condensate On-line Polishing Unit~~
- ~~i) Chemical Feed system~~

~~1.05.02 Interface with Other Off site Plants under BOP Package~~

~~Data acquisition / indication of selected parameters / selective operation (as required) from the following off site plants to station DCS are foreseen through MODBUS / OPC protocol:~~

- ~~a) Pretreatment Plant;~~
- ~~b) Demineralization Plant;~~
- ~~c) Coal Handling plant;~~
- ~~d) Fuel Oil Unloading & Storage;~~

## TECHNICAL REQUIREMENTS (C&I)

## C&I DELIVERABLES LIST

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| LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT |                    |                                                                                      |          |        |      |         |
|----------------------------------------------|--------------------|--------------------------------------------------------------------------------------|----------|--------|------|---------|
| 1X800 MW WANAKBORI TPP                       |                    |                                                                                      |          |        |      |         |
| DOCUMENT NUMBER PE-GL-408-145-I100           |                    |                                                                                      |          |        |      |         |
| Sl.No.                                       | DRAWING NO.        | DRAWING/DOCUMENT TITLE                                                               | CUSTOMER | FROM   | USER | REMARKS |
|                                              |                    |                                                                                      |          |        |      |         |
| INSTRUMENTATION                              |                    |                                                                                      |          |        |      |         |
| 1                                            | PE-V9-408-XXX-I901 | INSTRUMENT DATA SHEETS                                                               | -        | VENDOR | C&I  |         |
| 2                                            | PE-V9-408-XXX-I902 | INSTRUMENT SCHEDULE                                                                  | -        | VENDOR | C&I  |         |
| 3                                            | PE-V9-408-XXX-I903 | INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS                                            | -        | VENDOR | C&I  |         |
| 5                                            | PE-V9-408-XXX-I905 | INSTRUMENT QP/CHECK LIST                                                             | -        | VENDOR | C&I  |         |
| LOCAL CONTROL PANEL                          |                    |                                                                                      |          |        |      |         |
| 1                                            | PE-V9-408-XXX-I950 | LOCAL CONTROL PANEL DATASHEET                                                        | A        | VENDOR | C&I  |         |
| 2                                            | PE-V9-408-XXX-I951 | WIRING DIAGRAM                                                                       | -        | VENDOR | C&I  |         |
| 3                                            | PE-V9-408-XXX-I952 | PANEL GA DRAWINGS                                                                    | -        | VENDOR | C&I  |         |
| 8                                            | PE-V9-408-XXX-I956 | BILL OF MATERIAL                                                                     | -        | VENDOR | C&I  |         |
| 13                                           | PE-V9-408-XXX-I957 | LOCAL CONTROL PANEL QUALITY PLAN                                                     | -        | VENDOR | C&I  |         |
| 14                                           | PE-V9-408-XXX-I958 | LOCAL CONTROL PANEL O&M MANUAL                                                       | -        | VENDOR | C&I  |         |
| 19                                           | PE-V9-408-XXX-I925 | MANDATORY SPARES BILL OF MATERIAL                                                    | A        | VENDOR | C&I  |         |
|                                              |                    |                                                                                      |          |        |      |         |
|                                              | Notes:             | 408 - Project No.                                                                    |          |        |      |         |
|                                              |                    | XXX -MAX Package Code                                                                |          |        |      |         |
|                                              |                    | \$\$ -Approval by BHEL if Vendor BBU Item. Approval by Customer if Customer BBU Item |          |        |      |         |

  
MUKESH K. SINGH

  
S. A. ICHANI

  
D. H. MAY

|                                                                                          |                                         |                                                     |
|------------------------------------------------------------------------------------------|-----------------------------------------|-----------------------------------------------------|
|                                                                                          | <b>1X800 MW Wanakbori STPP</b>          | SECTION: C<br>SUB SECTION :<br>C&I<br>SHEET 9 of 18 |
|                                                                                          | <b>TECHNICAL REQUIREMENTS (C&amp;I)</b> |                                                     |
| <p style="text-align: center;"><b>SPECIFICATION FOR MOTORISED VALVE<br/>ACTUATOR</b></p> |                                         |                                                     |

MUKESH K. SHARMA  
 S-4-1621041 2011-01-13

|                                                                                   |                                                           |                                       |                                             |                |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------|---------------------------------------|---------------------------------------------|----------------|
|  | <b>SPECIFICATION<br/>FOR<br/>MOTORISED VALVE ACTUATOR</b> | SPECIFICATION NO.: PE-ID-408-145-I902 |                                             |                |
|                                                                                   |                                                           | VOLUME                                | II B                                        |                |
|                                                                                   |                                                           | SECTION                               | D                                           |                |
|                                                                                   |                                                           | REV. NO.                              | 00                                          | DATE: 04.04.15 |
|                                                                                   |                                                           | SHEET                                 | 1                                           | OF 3           |
| <b>Data Sheet A &amp; B</b>                                                       |                                                           |                                       |                                             |                |
| DATA SHEET-A<br>(TO BE FILLED BY PURCHASER)                                       |                                                           |                                       | DATA SHEET-B<br>(TO BE FILLED-UP BY BIDDER) |                |

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|                                |                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                  |
|--------------------------------|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| <b>GENERAL *</b>               | * PROJECT                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                  |
|                                | OFFER REFERENCE                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                  |
|                                | * TAG NO. SERVICE                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                  |
|                                | * DUTY                                              | <input type="checkbox"/> ON / OFF                                                                                                                                                                                                                                                                                                                                                                                                    | <input type="checkbox"/> INCHING |
|                                | * LINE SIZE (inlet/outlet): MATERIAL                |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                  |
|                                | * VALVE TYPE                                        | <input type="checkbox"/> GLOBE <input type="checkbox"/> GATE <input type="checkbox"/> REG. GLOBE<br><input type="checkbox"/> BUTTERFLY                                                                                                                                                                                                                                                                                               |                                  |
|                                | * OPENING / CLOSING TIME                            |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                  |
|                                | * WORKING PRESSURE                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                  |
|                                | AMBIENT CONDITION                                   | SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%                                                                                                                                                                                                                                                                                                                       |                                  |
|                                | VALVE SEAT TEST PRESS                               | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                                                                                                                                                    |                                  |
|                                | REQUIRED VALVE TORQUE                               | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                                                                                                                                                    |                                  |
|                                | ACTUATOR RATED TORQUE                               | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                                                                                                                                                    |                                  |
| <b>CONSTRUCTION AND SIZING</b> | CONSTRUCTION                                        | TOTALLY ENCLOSED, WEATHER PROOF, IPW:55                                                                                                                                                                                                                                                                                                                                                                                              |                                  |
|                                | MECHANICAL POSITION INDICATOR                       | TO BE PROVIDED FOR 0-100% TRAVEL                                                                                                                                                                                                                                                                                                                                                                                                     |                                  |
|                                | BEARINGS                                            | DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.                                                                                                                                                                                                                                                                                                                                                                                    |                                  |
|                                | GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION | METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.                                                                                                                                                                                                                                                                                                               |                                  |
|                                | SIZING                                              | OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER <b>FOR INCHING SERVICE - 150 STARTS/HR MINIMUM &amp; FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.</b>                                                                                                                                      |                                  |
| <b>HANDWHEEL</b>               | * REQUIRED                                          | <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO                                                                                                                                                                                                                                                                                                                                                                  |                                  |
|                                | * ORIENTATION                                       | <input type="checkbox"/> TOP MOUNTED <input type="checkbox"/> SIDE MOUNTED                                                                                                                                                                                                                                                                                                                                                           |                                  |
|                                | *TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION. |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                  |
| <b>ELECTRIC ACTUATOR</b>       | ACTUATOR MAKE/MODEL                                 | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                                                                                                                                                    |                                  |
|                                | MOTOR MAKE / MODEL / TYPE / RATING (KW)             | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                                                                                                                                                    |                                  |
|                                | @ MOTOR TYPE                                        | SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT- <b>INCLUSIVE OF I.S. TOLERANCE</b>                                                                                                                                                                                                                                                                                                           |                                  |
|                                | ACTUATOR APPLICABLE WIRING DIAGRAM                  | <input checked="" type="checkbox"/> ENCLOSED (BIDDER TO CONFIRM)<br>A: <input type="checkbox"/> DRG. NO. 3-V-MISC-24227 R00<br>B: <input type="checkbox"/> DRG. NO. 3-V-MISC-24550 R00<br>C: <input type="checkbox"/> DRG. NO. 3-V-MISC-24283 R00<br>D: <input checked="" type="checkbox"/> DRG. NO. 4-V-MISC-90271 R11<br>E: <input type="checkbox"/> For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram |                                  |
|                                | COLOUR SHADE                                        | <input type="checkbox"/> BLUE (RAL 5012) <input type="checkbox"/> .....<br>(TO BE DECIDED BY BHEL DURING DETAIL ENGG.)                                                                                                                                                                                                                                                                                                               |                                  |
|                                | PAINT TYPE (## Refer Notes)                         | <input type="checkbox"/> ENAMEL <input type="checkbox"/> EPOXY <input type="checkbox"/> .....<br>(TO BE DECIDED BY BHEL DURING DETAIL ENGG.)                                                                                                                                                                                                                                                                                         |                                  |
|                                | SHAFT RPM                                           | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                                                                                                                                                    |                                  |
|                                | OLR SET VALUE                                       | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                                                                                                                                                    |                                  |
|                                | @ STARTING / FULL LOAD CURRENT                      | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                                                                                                                                                    |                                  |
|                                | NO. OF REV FOR FULL TRAVEL                          | BIDDER TO SPECIFY                                                                                                                                                                                                                                                                                                                                                                                                                    |                                  |



# **SPECIFICATION FOR MOTORISED VALVE ACTUATOR**

SPECIFICATION NO.: PE-ID-408-145-I902

VOLUME II B

SECTION D

REV. NO.

00

DATE: 04.04.15

SHEET

2

OF

3

## **Data Sheet A & B**

DATA SHEET-A  
(TO BE FILLED BY PURCHASER)

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

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|                                                                                   |                                                                                                     |                                                                                                                                                        |  |  |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
|                                                                                   | @ PWR SUPP TO MTR / STARTER                                                                         | 415V, 3PH, AC                                                                                                                                          |  |  |
|                                                                                   | @ CONTROL VOLTAGE REQUIREMENT                                                                       | TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER <input type="checkbox"/> 230 V <input checked="" type="checkbox"/> 110 V                            |  |  |
|                                                                                   | @ ENCLOSURE CLASS OF MOTOR                                                                          | <input checked="" type="checkbox"/> IP 65 <input type="checkbox"/> FLAME PROOF                                                                         |  |  |
|                                                                                   | @ INSULATION CLASS                                                                                  | CLASS-F TEMP. RISE LIMITED TO CLASS-B                                                                                                                  |  |  |
|                                                                                   | @ WINDING TEMP PROTECTION                                                                           | <input checked="" type="checkbox"/> THERMOSTAT (3 Nos., 1 IN EACH PHASE)<br><input checked="" type="checkbox"/> ---THERMOSTAT- 1 NO+1 NC CONTACT ----- |  |  |
|                                                                                   | SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION                                                      | REQUIRED                                                                                                                                               |  |  |
| <b>INTEGRAL STARTER</b>                                                           | INTEGRAL STARTER                                                                                    | <input type="checkbox"/> REQUIRED <input checked="" type="checkbox"/> NOT REQUIRED                                                                     |  |  |
|                                                                                   | TYPE OF SWITCHING DEVICE                                                                            | <input type="checkbox"/> CONTACTORS <input type="checkbox"/> THYRISTORS                                                                                |  |  |
|                                                                                   | TYPE                                                                                                | <input type="checkbox"/> CONVENTIONAL <input type="checkbox"/> SMART (NON-INTRUSIVE)                                                                   |  |  |
|                                                                                   | IF SMART                                                                                            |                                                                                                                                                        |  |  |
|                                                                                   | a) SERIAL LINK INTERFACE                                                                            | <input type="checkbox"/> INTEGRAL <input type="checkbox"/> FIELD MOUNTED                                                                               |  |  |
|                                                                                   | b) SERIAL LINK PROTOCOL                                                                             | <input type="checkbox"/> FOUNDATION FIELD-BUS <input type="checkbox"/> PROFI-BUS<br><input type="checkbox"/> DEVICE NET <input type="checkbox"/> ..... |  |  |
|                                                                                   | c) SERIAL LINK MEDIA                                                                                | <input type="checkbox"/> TWISTED PAIR Cu-CBL <input type="checkbox"/> CO-AXIAL Cu-CBL<br><input type="checkbox"/> OFC                                  |  |  |
|                                                                                   | d) HAND HELD PROGRAMMER                                                                             | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                                |  |  |
|                                                                                   | e) TYPE OF HAND HELD PROGRAMMER                                                                     | <input type="checkbox"/> BLUETOOTH <input type="checkbox"/> INFRARED <input type="checkbox"/> .....                                                    |  |  |
|                                                                                   | f) MASTER STATION                                                                                   | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                                |  |  |
|                                                                                   | g) MASTER STN INTRFACE WITH DCS                                                                     | <input type="checkbox"/> MODBUS <input type="checkbox"/> TCP/IP                                                                                        |  |  |
|                                                                                   | h) DETAILS OF SPECIAL CABLE                                                                         | <input type="checkbox"/> ENCLOSED <input type="checkbox"/> NOT REQUIRED                                                                                |  |  |
|                                                                                   | STEP DOWN CONT. TRANSFORMER                                                                         | <input type="checkbox"/> REQUIRED                                                                                                                      |  |  |
|                                                                                   | OPEN / CLOSE PB                                                                                     | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                                |  |  |
|                                                                                   | STOP PB                                                                                             | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                                |  |  |
|                                                                                   | INDICATING LAMPS                                                                                    | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                                |  |  |
|                                                                                   | LOCAL REMOTE S/S                                                                                    | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                                                |  |  |
| STATUS CONTACTS FOR MONITORING                                                    | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                             |                                                                                                                                                        |  |  |
| INTEGRAL STARTER DISTURBED SIGNAL                                                 | REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY) |                                                                                                                                                        |  |  |
| <b>INTERPOSING RELAY/OPTO COUPLER</b><br>(Applicable for integral Starter)        | TYPE OF ISOLATING DEVICE                                                                            | <input type="checkbox"/> INTERPOSING RELAY <input type="checkbox"/> OPTO COUPLER<br><input type="checkbox"/> EITHER                                    |  |  |
|                                                                                   | QUANTITY                                                                                            | <input type="checkbox"/> 2 NOs. <input type="checkbox"/> 3 NOs.                                                                                        |  |  |
|                                                                                   | DRIVING VOLTAGE                                                                                     | <input checked="" type="checkbox"/> 20.5 – 24V DC <input type="checkbox"/> _____ V DC                                                                  |  |  |
|                                                                                   | DRIVING CURRENT                                                                                     | <input checked="" type="checkbox"/> 125mA MAX <input type="checkbox"/> _____ mA MAX                                                                    |  |  |
|                                                                                   | LOAD RESISTANCE                                                                                     | <input checked="" type="checkbox"/> > 192 ohms - <25 k ohms<br><input type="checkbox"/> > _____ ohms - < _____ ohms                                    |  |  |
| <b>TORQUE SWITCH</b><br>(Not Applicable for Smart Actuator)<br>(\$\$ Refer Notes) | MFR & MODEL NO.                                                                                     | BIDDER TO SPECIFY                                                                                                                                      |  |  |
|                                                                                   | OPEN / CLOSE                                                                                        | <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos. / <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos     |  |  |
|                                                                                   | CONTACT TYPE                                                                                        | 2 NO + 2 NC                                                                                                                                            |  |  |
|                                                                                   | RATING                                                                                              | 5A 240V AC AND 0.5A 220V DC                                                                                                                            |  |  |
|                                                                                   | CALIBRATED KNOBS(OPEN&CLOSE TS)                                                                     | REQUIRED FOR SETTING DESIRED TORQUE                                                                                                                    |  |  |
|                                                                                   | ACCURACY                                                                                            | +3% OF SET VALUE                                                                                                                                       |  |  |

|                                                                                   |                                                           |                                             |      |                |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------|---------------------------------------------|------|----------------|
|  | <b>SPECIFICATION<br/>FOR<br/>MOTORISED VALVE ACTUATOR</b> | SPECIFICATION NO.: PE-ID-408-145-I902       |      |                |
|                                                                                   |                                                           | VOLUME                                      | II B |                |
|                                                                                   |                                                           | SECTION                                     | D    |                |
|                                                                                   |                                                           | REV. NO.                                    | 00   | DATE: 04.04.15 |
|                                                                                   |                                                           | SHEET                                       | 3    | OF 3           |
| <b>Data Sheet A &amp; B</b>                                                       |                                                           |                                             |      |                |
| DATA SHEET-A<br>(TO BE FILLED BY PURCHASER)                                       |                                                           | DATA SHEET-B<br>(TO BE FILLED-UP BY BIDDER) |      |                |

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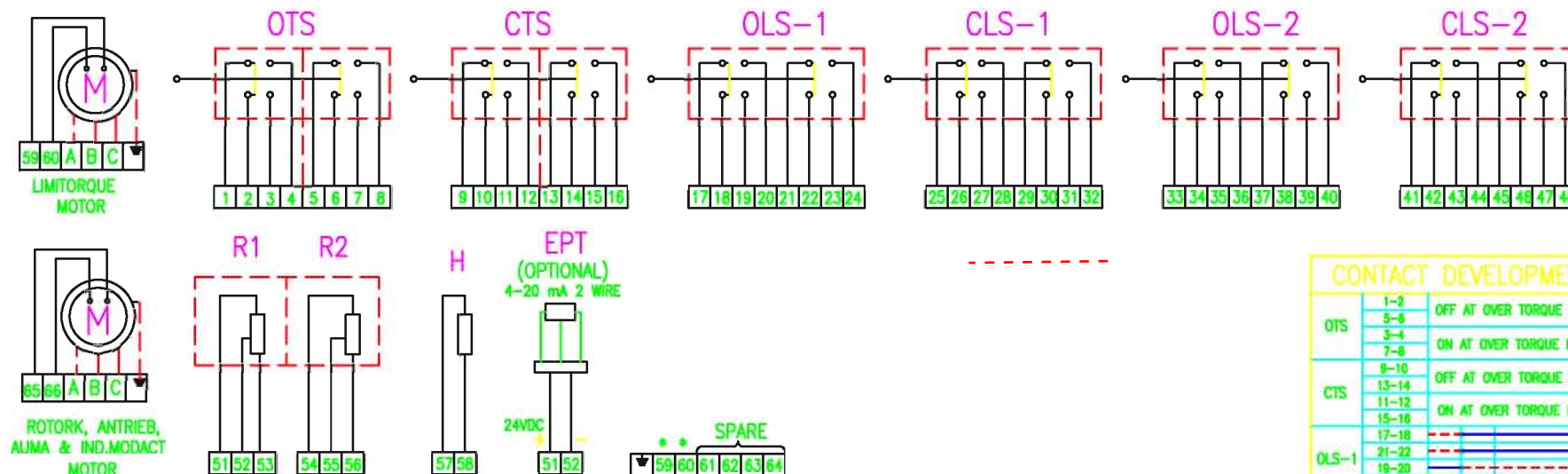
|                                                                                        |                    |                                                                              |               |                                                                             |
|----------------------------------------------------------------------------------------|--------------------|------------------------------------------------------------------------------|---------------|-----------------------------------------------------------------------------|
| <b>LIMIT SWITCH</b><br>(Not Applicable<br>for Smart<br>Actuator) (\$\$<br>Refer Notes) | MFR & MODEL NO.    | BIDDER TO SPECIFY                                                            |               |                                                                             |
|                                                                                        | OPEN : INT : CLOSE | <input type="checkbox"/> 1 No.<br><input checked="" type="checkbox"/> 2 Nos. | 2 Nos. (ADJ.) | <input type="checkbox"/> 1 No.<br><input checked="" type="checkbox"/> 2Nos. |
|                                                                                        | CONTACT TYPE       | 2 NO + 2 NC                                                                  |               |                                                                             |
|                                                                                        | RATING (AC / DC)   | 5A 240V AC AND 0.5A 220V DC                                                  |               |                                                                             |

|                                 |                                                                       |                                                                                                                                           |  |
|---------------------------------|-----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|--|
| <b>POSITION<br/>TRANSMITTER</b> | POSITION TRANSMITTER (For inching duty & other specific applications) | <input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED                                                        |  |
|                                 | MFR & MODEL NO.                                                       | BIDDER TO SPECIFY                                                                                                                         |  |
|                                 | TYPE                                                                  | <input checked="" type="checkbox"/> ELECTRONIC (2 WIRE) R/I CONVERTER<br><input type="checkbox"/> ELECTRONIC (2 WIRE) CONTACTLESS         |  |
|                                 | SUPPLY                                                                | <input checked="" type="checkbox"/> 24V DC <input type="checkbox"/> .....                                                                 |  |
|                                 | OUTPUT                                                                | <input checked="" type="checkbox"/> 4-20mA                                                                                                |  |
|                                 | ACCURACY                                                              | <input checked="" type="checkbox"/> ± 1% FS                                                                                               |  |
| <b>SPACE<br/>HEATER</b>         | @SPACE HEATER                                                         | REQUIRED                                                                                                                                  |  |
|                                 | @ POWER SUPPLY (NON INTEGRAL)                                         | 230V AC, 1 PH., 50 Hz                                                                                                                     |  |
|                                 | @ POWER SUPPLY (INTEGRAL)                                             | BIDDER TO SPECIFY                                                                                                                         |  |
|                                 | @ RATING                                                              | decided as per load data received tender stage                                                                                            |  |
| <b>TERMINAL<br/>BOX</b>         | ACTUATOR/MOTOR TERMINAL BOX                                           | REQUIRED                                                                                                                                  |  |
|                                 | ENCL CLASS ACTUATOR/MOTOR T.B.                                        | <input type="checkbox"/> IP 68      @ <input type="checkbox"/> .....                                                                      |  |
|                                 | @ EARTHING TERMINAL                                                   | REQUIRED                                                                                                                                  |  |
|                                 | PLUG & SOCKET (9 PIN)<br>(FOR COMMD, LS/TS FEED BACK, PoT)            | <input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED<br><input type="checkbox"/> 2 NOS. <input type="checkbox"/> ..... |  |
| <b>CABLE GLANDS</b>             | @ POWER CABLE GLAND                                                   | SIZE: decided as per load data received tender stage                                                                                      |  |
|                                 | @ SPACE HEATER CABLE GLAND                                            | SIZE: decided as per load data received tender stage                                                                                      |  |
|                                 | OTHER CONTROL CABLE GLANDS-1                                          | <input type="checkbox"/> 1No. for BFV of CW PUMP (Cable size 2Px1.5mm2)                                                                   |  |
|                                 | OTHER CONTROL CABLE GLANDS-2                                          | QUANTITY & SIZE :-----                                                                                                                    |  |

|                                             |                                                           |                                       |                                             |                |
|---------------------------------------------|-----------------------------------------------------------|---------------------------------------|---------------------------------------------|----------------|
|                                             | <b>SPECIFICATION<br/>FOR<br/>MOTORISED VALVE ACTUATOR</b> | SPECIFICATION NO.: PE-ID-408-145-I902 |                                             |                |
|                                             |                                                           | VOLUME                                | II B                                        |                |
|                                             |                                                           | SECTION                               | D                                           |                |
|                                             |                                                           | REV. NO.                              | 00                                          | DATE: 04.04.15 |
|                                             |                                                           | SHEET                                 | 4                                           | OF 3           |
| <b>Data Sheet A &amp; B</b>                 |                                                           |                                       |                                             |                |
| DATA SHEET-A<br>(TO BE FILLED BY PURCHASER) |                                                           |                                       | DATA SHEET-B<br>(TO BE FILLED-UP BY BIDDER) |                |

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|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|-------------------|-------------|--------------------------------------------------|
| <b>WEIGHT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | TOTAL WEIGHT (ACTUATOR + ACCESSORIES) | BIDDER TO SPECIFY | _____ Kg.   |                                                  |
| <b>NOTES:</b> <ol style="list-style-type: none"> <li><b>SCOPE:</b> DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.</li> <li><b>CODES &amp; STANDARDS:</b> DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:<br/>IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722</li> <li>TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.</li> <li>CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.</li> <li>THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.</li> <li>THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE &amp; FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.</li> <li>THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.</li> <li>CANOPY FOR OUTDOOR SERVICES SHALL BE PROVIDED.</li> </ol> <p><b>\$\$ TORQUE SWITCH &amp; LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.</b></p> <p><b>## EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.</b></p> |                                       |                   |             |                                                  |
| NAME<br>SIGNATURE<br>DATE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | PREPARED BY                           | CHECKED BY        | APPROVED BY | VENDOR COMPANY SEAL<br>NAME<br>SIGNATURE<br>DATE |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                       |                   |             |                                                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                       |                   |             |                                                  |
| NOTES* = TO BE FILLED BY MPL (LEAD AGENCY).      @ = TO BE FILLED BY ES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                       |                   |             |                                                  |



\* - SPARE FOR ROTORK, AUMA, ANTRIEB & IND.MODACT

SWITCHES - ALL ARE POTENTIAL FREE AND TWO PAIR OF CONTACTS CAN BE USED FOR DIFFERENT SUPPLY  
THERMOSTAT - 65-66 (ROTORK, AUMA, ANTRIEB & IND.MODACT), 59-60 (LIMITORQUE).

EPT - ELECTRONIC POSITION TRANSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)

THERMOSTAT TERMINALS - TERMINATED IN MOTOR TB IN ANTRIEB & IND.MODACT AND IN MAIN TB IN OTHER MAKES

CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE) - 2 NO+2 NC

OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN) - 2 NO+2 NC

OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN - 2 NO+2 NC

CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE - 2 NO+2 NC

OTS, CTS - TWO INDEPENDENT SWITCHES IN ANTRIEB & LIMITORQUE

OLS-2 & CLS-2 - CAM DISC IN ROTORK & ANTRIEB

R1-R2- POTENTIOMETER 2 x 100 OHMS

H - SPACE HEATER 1 $\phi$  240V AC SUPPLY

M - MOTOR 3 $\phi$  415V 50 Hz AC SUPPLY

#### SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

| VALVES                                                      | OPEN |         | CLOSE |         |
|-------------------------------------------------------------|------|---------|-------|---------|
|                                                             | MAIN | BACK UP | MAIN  | BACK UP |
| GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS | OLS  | OTS     | CLS   | CTS     |
| ALL OTHER GATE & GLOBE VALVES                               | CLS  | OTS     | CTS   | ●       |

● - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

#### NOTE:

1. BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)
2. CONNECT THERMOSTAT WITHOUT FAIL IN THE STARTER CIRCUIT

| CONTACT DEVELOPMENT DIAGRAM |              |                                          |              |            |
|-----------------------------|--------------|------------------------------------------|--------------|------------|
| OTS                         | 1-2          | OFF AT OVER TORQUE DURING OPENING TRAVEL |              |            |
|                             | 3-4          | ON AT OVER TORQUE DURING OPENING TRAVEL  |              |            |
| CTS                         | 5-6          | OFF AT OVER TORQUE DURING CLOSING TRAVEL |              |            |
|                             | 7-8          | ON AT OVER TORQUE DURING CLOSING TRAVEL  |              |            |
| OLS-1                       | 9-10         |                                          |              |            |
|                             | 11-12        |                                          |              |            |
|                             | 13-14        |                                          |              |            |
|                             | 15-16        |                                          |              |            |
|                             | 17-18        |                                          |              |            |
| CLS-1                       | 19-20        |                                          |              |            |
|                             | 21-22        |                                          |              |            |
|                             | 23-24        |                                          |              |            |
|                             | 25-26        |                                          |              |            |
|                             | 27-28        |                                          |              |            |
|                             | 29-30        |                                          |              |            |
|                             | 31-32        |                                          |              |            |
| OLS-2                       | 33-34        |                                          |              |            |
|                             | 35-36        |                                          |              |            |
|                             | 37-38        |                                          |              |            |
|                             | 39-40        |                                          |              |            |
| CLS-2                       | 41-42        |                                          |              |            |
|                             | 43-44        |                                          |              |            |
|                             | 45-46        |                                          |              |            |
|                             | 47-48        |                                          |              |            |
| SWITCH                      | TERMINAL NO. | VALVE POSITION                           |              |            |
|                             |              | FULL OPEN                                | INTERMEDIATE | FULL CLOSE |
|                             |              | a                                        | b            |            |
|                             |              | INDICATES CONTACT CLOSED                 |              |            |
|                             |              | INDICATES CONTACT OPEN                   |              |            |

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

MUKESH K. SINGH

S. A. ICHMAN

D. H. MAY

|     |            |     |      |                          |                                                         |                |
|-----|------------|-----|------|--------------------------|---------------------------------------------------------|----------------|
|     |            |     |      |                          | BHARAT HEAVY ELECTRICALS LTD.                           |                |
|     |            |     |      |                          | UNIT: HIGH PRESSURE BOILER PLANT, TIRUCHIRAPALLI 60014. |                |
|     |            |     |      |                          | 365-139                                                 |                |
|     |            |     |      |                          | DRAWN                                                   | N.P.ESWAR      |
|     |            |     |      |                          | CHECKED                                                 | KARUNACHALAM   |
|     |            |     |      |                          | APPROVED                                                | P. LOGANATHAN  |
| 11  | 09.09.2000 |     |      | CONTACT DEV. FIG. ADDED. | DATE                                                    | 09.09.2000     |
| REV | DATE       | CHD | APPD | DESCRIPTION              | DRAWING No.                                             | 4-V-MISC-90271 |
|     |            |     |      |                          | REV                                                     | 11             |

RETRACED WITH REVISION 11

**VOLUME : IIF/1****SECTION-III****TECHNICAL SPECIFICATION  
FOR  
ELECTRIC MOTOR ACTUATORS****1.00.00 SCOPE**

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

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

**2.00.00 STANDARDS**

2.01.00 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.

2.02.00 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed

i) IS-9334

ii) IS-325

**3.00.00 SERVICE CONDITIONS**

3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the general specification.

3.03.00 For actuator motor installed outdoor and exposed to direct sun rays , the effect of solar heat [manufacturer to decide] shall be considered or overhead shed shall be provided locally to avoid direct sun rays.

**4.00.00 RATING**

4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer.

4.02.00 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

## 5.00.00 **PERFORMANCE**

The actuator shall meet the following performance requirements:

5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.

5.02.00 Attain full speed operation before valve load is encountered and impart an unseating blow to start the valve in motion (hammer blow effect).

5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.

5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.

5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

## 6.00.00 **SPECIFIC REQUIREMENT**

### 6.01.00 **Construction**

6.01.01 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring. Actuator shall be non integral type.

6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy.

6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

### 6.02.00 **Motor**

6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service. Canopy shall be provided for outdoor service.

6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.

6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.

- 6.02.04 Motor leads shall be terminated in the limit switch compartment.
- 6.02.05 Motor actuators for valves/dampers shall be non-integral type with separate starter units and operable from remote.
- 6.02.06 Earthing terminals shall be provided on either side of the motor.
- 6.03.00 **Limit Switches**
- Each actuator shall be provided with following limit switches: -
- 6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.
- 6.03.02 4 end-of-travel limit switches, two for each direction of travel.
- 6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.
- 6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.
- 6.04.00 **Hand Wheel**
- Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.
- 6.05.00 **Position Indicator/Transmitter**
- The actuator shall have:
- 6.05.01 One (1) built-in local position indicator for 0-100% travel.
- 6.05.02 One (1) position transmitter, potentiometer type, for remote indicator.
- 6.06.00 **Space Heater**
- A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.
- 6.07.00 **Wiring**
- All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules. All wires shall be fire resistance type.
- 6.08.00 **Terminal Box**
- The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.

**7.00.00 ACCESSORIES**

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

- 7.01.00 One (1) triple pole MCCB for local isolation near the actuator
- 7.02.00 One (1) reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC auxiliary contacts for each contactor.
- 7.03.00 One (1) remote-local selector switch.
- 7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights.
- 7.05.00 415/240 V or 415/110V control transformer with primary protected by fuse & secondary protected by Miniature Circuit Breaker (MCB).

**8.00.00 TEST**

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

**9.00.00 DRAWINGS, DATA & MANUALS****9.01.01 To be Submitted with Bid**

Data sheet for each type of actuator shall be furnished along with internal wiring diagram, suggested control schematic and torque limit switch contact development and manufacturer's catalogues.

**9.01.02 To be Submitted after Award of Contract**

- a) Actuator Data Sheet
- b) Internal wiring diagram and suggested control schematic
- c) Torque switch and limit switch contact development
- d) Manufacturer's Catalogue
- e) Instruction manual indicating clearly the installation methods, check ups and tests to be carried out before commissioning of the equipment.
- f) Any other relevant drawings, documents or data necessary for satisfactory installation , operation and manufacturing.

**9.02.00** The Bidder may note that the drawings, data and manuals listed herein are minimum requirements only. The Bidder shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment are submitted with his bid.

|                                                   |                              |                                                      |
|---------------------------------------------------|------------------------------|------------------------------------------------------|
|                                                   | 1X800 MW Wanakbori STPP      | SECTION: C<br>SUB SECTION :<br>C&I<br>SHEET 10 of 18 |
|                                                   | TECHNICAL REQUIREMENTS (C&I) |                                                      |
| <p><b>SPECIFICATION FOR FIELD INSTRUMENTS</b></p> |                              |                                                      |

REVISION  
DATE  
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## 1.00.00 FIELD INSTRUMENTS

This section provides general hardware guidelines for field instruments and equipment to be supplied under this specification.

### 1.01.00 Pressure Transmitter

01. Working Principle : Smart (HART Compatible)
02. Type : 2 - Wire
03. Output Signal : 4-20 mA DC.
04. Signal Processing : Silicon solid state electronic circuitry
05. Measuring Element : Capsule / Diaphragm
06. Element material : AISI-316 (Stainless Steel) or better
07. Static Pressure : 150 % of maximum span continuously, without affecting the calibration.
08. Turn-down ratio : 60: 1.
09. Span and Zero : Locally adjustable non-interacting. Facility for elevation and suppression by 100% of span
10. Enclosure Class : IP-65
11. Output Indicator : LCD
12. Nameplate : Tag number, service engraved in SS tag plate
13. Body : Forged Carbon Steel for air and flue gas application and SS for other application.
14. Operating Voltage : 16 - 48 Volts D.C.
15. Load : 600 Ohms (min.) at 24 Volts D.C.
16. Ambient Temperature : 0 - 50 °C
17. Performance:
  - i) Accuracy :  $\pm 0.1\%$  of Span or better
  - ii) Repeatability :  $\pm 0.05\%$  of Span or better
  - iii) Response time : 100 msec or better
18. Sealing/Isolation : Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.
19. Accessories :
  - a) Universal mounting bracket suitable for 2" pipe mounting.
  - b) High tensile carbon steel U- bolts.
  - c) Siphon for steam and hot water services.
  - d) 1/2" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock.
  - e) Companion flange with nuts, bolts and gaskets.

f) ½" NPT cable gland

## 1.02.00 Differential Pressure Transmitter / Flow transmitter

- |     |                                       |   |                                                                                                                                                                                                                                    |
|-----|---------------------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 01. | Working Principle                     | : | Smart (HART compatible)                                                                                                                                                                                                            |
| 02. | Type                                  | : | 2-Wire                                                                                                                                                                                                                             |
| 03. | Output signal                         | : | 4-20 mA DC.                                                                                                                                                                                                                        |
| 04. | Signal Processing Unit                | : | Silicon solid-state electronic circuitry                                                                                                                                                                                           |
| 05. | Measuring element                     | : | Capsule/Diaphragm                                                                                                                                                                                                                  |
| 06. | Element material                      | : | AISI-316 (Stainless Steel) or better                                                                                                                                                                                               |
| 07. | Static Pressure/<br>Overload Pressure | : | Maximum line (or static) pressure on either side without permanent deformation or loss of accuracy                                                                                                                                 |
| 08. | Turn-down ratio                       | : | 60 : 1 minimum                                                                                                                                                                                                                     |
| 09. | Span and Zero                         | : | Locally adjustable, non-interacting                                                                                                                                                                                                |
| 10. | Enclosure class                       | : | IP-65                                                                                                                                                                                                                              |
| 11. | Zero suppression /<br>elevation       | : | At least 100% of Span                                                                                                                                                                                                              |
| 12. | Output Indicator                      | : | LCD type                                                                                                                                                                                                                           |
| 13. | Nameplate                             | : | Tag number and Service engraved in SS tag plate                                                                                                                                                                                    |
| 14. | Body                                  | : | Forged Carbon Steel for air and flue gas application and SS for other application                                                                                                                                                  |
| 15. | Ambient temperature                   | : | 0 - 50 °C                                                                                                                                                                                                                          |
| 16. | Operating Voltage                     | : | 16 - 48 Volts DC                                                                                                                                                                                                                   |
| 17. | Load                                  | : | 600 Ohms (min.) at 24 Volts DC                                                                                                                                                                                                     |
| 18. | Performance:-                         |   |                                                                                                                                                                                                                                    |
|     | i) Accuracy                           | : | ±0.1 % of span or better                                                                                                                                                                                                           |
|     | ii) Repeatability                     | : | ± 0.05 % of span or better                                                                                                                                                                                                         |
|     | iii) Response time                    | : | 100 msec or better                                                                                                                                                                                                                 |
| 19. | Sealing / Isolation                   | : | Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.                                                                                                                                             |
| 20. | Accessories                           | : | a) Universal mounting bracket suitable for 2" pipe mounting.<br>b) High tensile carbon steel U-bolts.<br>c) Siphon for steam and hot water services.<br>d) Companion flange with nuts, bolts and gaskets.<br>e) ½" NPT cable gland |

- f) ½" NPT generally 5-valve stainless steel manifold, constructed from SS316 bar stock. 3 valve manifold for DP application in flue gas and air.

1.03.00 Displacer Type Level Transmitters

01. Type : Smart (HART compatible)
02. Stages of operation : Continuous
03. Material -
  - i) Displacer : AISI 316 SS
  - ii) Suspension wire : AISI 316 SS
  - iii) Torque tube housing : Carbon steel or SS as per application
  - iv) Torque tube : Inconel
  - v) Displacer chamber : CS or SS as per process application
  - vi) Transmitter Housing : Die cast aluminium or better
04. Operating Voltage : 16-48 Volts D.C.
05. Transmission : 2-wire
06. Output Signal : 4-20 mA DC.
07. Signal processing : Solid-state electronic circuitry
08. Static / overload pressure : Maximum static pressure without permanent deformation or loss of accuracy.
09. Turn-down ratio : 10 : 1 or better
10. Zero & Span : Easily accessible (local zero & span adjustment and non-interactive type)
11. Enclosure Class : IP-65
12. Output Indicator : LCD type
13. Nameplate : Tag number and Service engraved in stainless steel tag plate
14. Ambient Temperature : 0 - 50 °C
15. Load Impedance : 600 Ohms at 24 Volts (minimum)
16. Process Connection : 2" Companion flange with nuts, bolts and gaskets
17. Performance -
  - Accuracy : ± 0.5 % of span or better
18. Accessories :
  - a) Counter Flange, nuts, bolts, gaskets etc.
  - b) Weights for 5 point calibration of instruments.
  - c) Vent and drain plugs
  - d) Special calibration tool/configurator, if any.
  - e) ½"NPT cable gland

19. Preferred Features : a) Test plug connection and cutout terminals physically separated from other electronics.  
b) Electronic Damping facility (adjustable).
- 1.04.00 Mass Flow meter
- 1.04.01 Sensor
01. Measuring Principle : Coriolis Mass flow.
02. Primary Element : Flow Tube of 316SS or better
03. Heating Arrangement : Integral.
04. Temperature Control : For heavy fuel oil application.
05. Process Connection : Flanged of rating as per process requirement.
06. Drain : Self-draining facility
07. Enclosure : Stainless steel
08. Accessories : Counter flanges, Mounting nuts, bolts, gaskets etc.
- 1.04.02 Transmitter
01. Measured quantities : Mass Flow rate, Total Mass Flow, Density.
02. Input Signal Processing : Digital Processing.
03. Display : Digital Display (LCD).
04. Output : 2 off. isolated 4-20mA DC output.
05. Load : < 750 ohms.
06. Power supply : 240V AC, 50 Hz.
07. Turn Down : 100:1
08. Accuracy :  $\pm 0.2$  % of measured value
09. Housing : IP 65
10. Nameplate : Tag number, service engraved in stainless steel tag plate
11. Accessories : a) Handheld configurator  
b) Mounting U-bolts, nuts, bolts, prefab cable etc.  
c)  $\frac{1}{2}$ "NPT cable gland
- 1.05.00 Pressure Gauge and Differential Pressure Gauge
01. Type : Bourdon/Bellows/Diaphragm
02. Sensing & Socket : AISI-316 SS
03. Movement Material : AISI-304 SS
04. Case Material : Stainless steel. IP-65.
05. Dial Size : Generally 150 mm
06. Scale : Black lettering on white in  $270^\circ$  arc.

- |     |                       |   |                                                                                                                                                                                                                                                                                                                                 |
|-----|-----------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 07. | Window                | : | Shatterproof glass                                                                                                                                                                                                                                                                                                              |
| 08. | Range Selection       | : | Normal process pressure: 50~70 % of range                                                                                                                                                                                                                                                                                       |
| 09. | Over-range Protection | : | 125% of maximum range by internal stop. External stop at zero.                                                                                                                                                                                                                                                                  |
| 10. | Adjustment            | : | Micrometer screw for zero. Internal micrometer screw for range.                                                                                                                                                                                                                                                                 |
| 11. | Element Connection    | : | Argon welding                                                                                                                                                                                                                                                                                                                   |
| 12. | Process Connection    | : | 1/2" NPT (M) Bottom for local, back for panel mounting.                                                                                                                                                                                                                                                                         |
| 13. | Performance           | : | Accuracy of $\pm 1.0$ % of span or better.                                                                                                                                                                                                                                                                                      |
| 14. | Operating ambient     | : | 0 - 50 °C                                                                                                                                                                                                                                                                                                                       |
| 15. | Safety Feature        | : | Blow out disc /diaphragm at the back                                                                                                                                                                                                                                                                                            |
| 16. | Accessories           | : | a) Snubbers and Glycerin filled for pulsating fluid applications and at pump discharge.<br>b) Stainless steel Diaphragm seals for viscous fluids.<br>c) 3-Way SS316 Gauge cock for pressure gauges.<br>d) 5-valve SS316 manifold from barstock for differential pressure gauge.<br>e) Siphons for steam and hot water services. |
| 17. | Applicable standard   | : | IS-3624 / 1996                                                                                                                                                                                                                                                                                                                  |
| 18. | Nameplate             | : | Tag number, service engraved in stainless steel tag plate                                                                                                                                                                                                                                                                       |

**1.06.00 Temperature Gauge**

- |     |                          |   |                                        |
|-----|--------------------------|---|----------------------------------------|
| 01. | Type                     | : | Bimetallic or gas filled.              |
| 02. | Sensing Element Material | : | Bourdon - AISI-316 SS                  |
| 03. | Capillary Armoring       | : | Stainless steel flexible               |
| 04. | Movement Material        | : | AISI 304 SS                            |
| 05. | Bulb / Stem Diameter     | : | 12 mm                                  |
| 06. | Bulb / Stem Material     | : | AISI 316                               |
| 07. | Capillary                | : | Stainless Steel                        |
| 08. | Connection to well       | : | 1/2" NPT                               |
| 09. | Case Material            | : | Stainless steel                        |
| 10. | Dial Size                | : | 150 mm in general                      |
| 11. | Scale                    | : | Black lettering on white in 270 ° arc. |
| 12. | Mounting                 | : | Surface/Panel                          |
| 13. | Over range Protection    | : | 125 % of range or more                 |

- |     |                       |   |                                                                                                                                                                                                                                                            |
|-----|-----------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14. | Instrument connection | : | Bottom for local and back for panel mounting.                                                                                                                                                                                                              |
| 15. | Range                 | : | Normal temperature–50~70% of range.                                                                                                                                                                                                                        |
| 16. | Zero adjuster         | : | Micrometer screw adjustable from front.                                                                                                                                                                                                                    |
| 17. | Window                | : | Shatterproof glass.                                                                                                                                                                                                                                        |
| 18. | Accuracy              | : | ± 1 % or better                                                                                                                                                                                                                                            |
| 19. | Enclosure Class       | : | IP-65                                                                                                                                                                                                                                                      |
| 20. | Capillary             | : | 5 meters (local surface)/15.0 meters (local panel) - armoured stainless steel                                                                                                                                                                              |
| 21. | Compensation          | : | Capillary and Case Compensation                                                                                                                                                                                                                            |
| 22. | Accessories           | : | a) Forged barstock thermowell screwed as per ASME PTC code. Process connection M 33X2 (M).<br><br>Material of construction of Thermowell:<br>- SS 316: In general<br>- Inconel: For flue gas application<br>- Tungsten carbide: For coal mill application. |
| 23. | Nameplate             | : | Tag number, service engraved in stainless steel tag plate                                                                                                                                                                                                  |
- 1.07.00 Thermocouples
- |     |                      |   |                                                                                                                                                                          |
|-----|----------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 01. | Type                 | : | a) Type-J (Iron Constantan) / Type-K (Chromel Alumel) / Type-R (Pt.-Rhodium Pt.) / Type-S (90% Pt – 10% Rhodium). [As per application]<br><br>b) Duplex<br>c) Ungrounded |
| 02. | Wire gauge           | : | 16 AWG for Type-K, 24 AWG for Type-R                                                                                                                                     |
| 03. | Standard             | : | ANSI-MC 96.1.                                                                                                                                                            |
| 04. | Protecting Tube :-   |   |                                                                                                                                                                          |
|     | i) O.D.              | : | 8 mm                                                                                                                                                                     |
|     | ii) Material         | : | 316-SS Seamless                                                                                                                                                          |
|     | iii) Filling         | : | Magnesium Oxide (Purity above 99.4%)                                                                                                                                     |
| 05. | Response time        | : | a) < 20 seconds for measurement.<br>b) < 10 seconds for control.                                                                                                         |
| 06. | Accuracy             | : | ± 1.1 <sup>0</sup> C up to 300 <sup>0</sup> C & 0.4% of measured temperature range above 300 <sup>0</sup> C.                                                             |
| 07. | Head:                |   |                                                                                                                                                                          |
|     | i) Type              | : | IP-65 universal screwed type.                                                                                                                                            |
|     | ii) Material         | : | Die cast aluminum or better                                                                                                                                              |
|     | iii) Terminal blocks | : | Nickel plated Brass - screw type/ silver plated                                                                                                                          |

- iv) Instrument connection : ½" NPT to well
- v) Cable connection : ½" NPT gland and grommet.
- vi) Others : Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells.

08. Accessories :
- a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT (M)] with thermowell connection
  - b) Compression fittings/unions
  - c) Flanges etc. (for flanged connections only)
  - d) Forged barstock thermowell as per ASME PTC code. Process connection M 33X2 (M) in general or 1½" Flanged for Flue gas/Furnace/Air etc. application.

Material of construction of Thermowell:

SS 316: In general

Inconel: For flue gas application

Tungsten carbide: For coal mill application.

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

#### 1.08.00 Resistance Temperature Detector

- 01. Type : Platinum (Duplex), Ungrounded
- 02. Resistance : 100 ohm at 0 °C
- 03. Base : Wound on ceramic (anti-inductive)
- 04. Wiring : 3 /4 Wire
- 05. Protecting Tube :-
  - i) O.D. : 8 mm
  - ii) Material : SS-316, Seamless
  - iii) Filling : Magnesium oxide (Purity above 99.4%).
- 06. Response time :
  - a) < 20 seconds for measurement.
  - b) < 10 seconds for control.
- 07. Calibration : DIN 43760
- 08. Accuracy : ± 0.5%
- 09. Head :

- i) Type : IP-65 universal screwed type.
  - ii) Material : Die cast aluminum or better
  - iii) Terminal blocks : Nickel plated Brass-screw type / silver plated
  - iv) Cable connection : ½" NPT gland and grommet.
  - v) Others : Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells
10. Accessories :
- a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT (M)] with thermowell connection
  - b) Compression fittings/unions
  - c) Flanges etc. (for flanged connections only)
  - d) Forged/barstock thermowell as per ASME PTC code. Process connection M33X2 (M).

Material of construction of Thermowell:

SS 316: In general

Inconel: For flue gas application

Tungsten carbide: For coal mill application.

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

#### 1.09.00 Pressure Switch

01. Type :
- i) Piston for high pressure application
  - ii) Bellow / Diaphragm for low pressure application
02. Sensing element material : AISI SS-316. All other wetted part SS316.
03. Case Material : Die-cast aluminum alloy, neoprene gasket.
04. Setter Scale : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points.
05. Over range : 150 % of maximum pressure
06. Adjustments :
- a) Internal Set Point
  - b) Differential adjustment
07. End Connection : 1/2" NPT (M) bottom connected
08. Switch configuration : Two SPDT
09. Switch Rating : 240V, 5A AC/220V, 0.5A DC

- |     |                     |   |                                                                                                                                                                                                                                                                    |
|-----|---------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10. | Switch Type         | : | Snap acting, shock & vibration proof                                                                                                                                                                                                                               |
| 11. | Terminal Block      | : | Suitable for full ring lugs.                                                                                                                                                                                                                                       |
| 12. | Cable connection    | : | ½" NPT conduit connection.                                                                                                                                                                                                                                         |
| 13. | Enclosure Class     | : | IP-65.                                                                                                                                                                                                                                                             |
| 14. | Performance         | : | a) Repeat accuracy $\pm 1.0\%$<br>b) Accuracy of Setting Indication of $\pm 1.5\%$                                                                                                                                                                                 |
| 15. | Ambient temperature | : | 0 – 50 Deg.C                                                                                                                                                                                                                                                       |
| 16. | Nameplate           | : | Tag number, service engraved in SS tag plate                                                                                                                                                                                                                       |
| 17. | Accessories         | : | a) Remote diaphragm seal with SS-316 capillary for viscous & corrosive application.<br>b) Siphons for steam and hot water services.<br>c) Retention ring and screws for surface mounting.<br>d) 1/2" NPT 2 Valve SS-316 barstock manifold<br>e) ½" NPT cable gland |

**1.10.00 Differential Pressure Switch**

- |     |                          |   |                                                                                                               |
|-----|--------------------------|---|---------------------------------------------------------------------------------------------------------------|
| 01. | Type                     | : | Bellows / Diaphragm / Piston actuated                                                                         |
| 02. | Sensing element material | : | AISI SS-316. For all other wetted part SS 316                                                                 |
| 03. | Case Material            | : | Die-cast aluminum alloy with neoprene gasket.                                                                 |
| 04. | Setter Scale             | : | Black graduation on white scale with 0-100% graduation and provided with red pointer for set point adjustment |
| 05. | Over range               | : | Static pressure on any one side, the other side being open to atmosphere.                                     |
| 06. | Adjustments              | : | a) Internal set point adjustment<br>b) Differential adjustment                                                |
| 07. | Process Connection       | : | 1/2" NPT (M) bottom / back connected.                                                                         |
| 08. | Switch configuration     | : | Two SPDT                                                                                                      |
| 09. | Switch rating            | : | 240V, 5A AC/220V, 0.5A DC.                                                                                    |
| 10. | Switch type              | : | Snap acting type contacts, shock and vibration proof.                                                         |
| 11. | Terminal Blocks          | : | Suitable for full ring lugs for cable connection.                                                             |
| 12. | Cable Connection         | : | ½" NPT conduit connection or compression gland.                                                               |
| 13. | Performance              | : | a) Repeat accuracy $\pm 1.0\%$<br>b) Accuracy of set point Indication: $\pm 1.5\%$                            |

- |                                              |   |                                                                                                                                                                                                                                                |
|----------------------------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14. Operating Ambient                        | : | 0 - 50 °C (Maximum Continuous)                                                                                                                                                                                                                 |
| 15. Enclosure                                | : | IP-65                                                                                                                                                                                                                                          |
| 16. Accessories                              | : | a) Snubbers for pulsating fluid application.<br>b) Syphons for steam and hot water services.<br>c) Retention ring and screws for surface mounting.<br>d) 1/2" NPT 3-Valve SS-316 manifold constructed from barstock<br>e) 1/2" NPT Cable gland |
| 17. Nameplate                                | : | Tag number, service engraved in stainless steel tag plate                                                                                                                                                                                      |
| 18. Remote Seal type for special application | : | a) Silicone oil / fluorolube filled remote diaphragm seal for dirty / viscous / corrosive fluid.<br>b) SS armoured capillary at least 3 meters each.<br>c) Adapter flanges with nuts, bolts and gaskets for instrument and process side.       |

**1.11.00 Level Switch**

- |                                  |   |                                                                                                                                                                           |
|----------------------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 01. Type                         | : | External cage float operated. Magnetically coupled.                                                                                                                       |
| 02. Float Material               | : | AISI-316 stainless steel or better                                                                                                                                        |
| 03. Other wetted parts           | : | AISI-316 stainless steel or better                                                                                                                                        |
| 04. External Cage                | : | Carbon steel / Stainless steel as per process requirements, welded type / flanged construction. Cage pressure rating shall equal or exceed the rating of the main vessel. |
| 05. External cage mounting       | : | Side-Side.                                                                                                                                                                |
| 06. External cage connection     | : | 25 NB socket welded.                                                                                                                                                      |
| 07. Switch housing               | : | Epoxy coated die-cast aluminum alloy with neoprene gasket conforming to IP-65.                                                                                            |
| 08. Type of switch configuration | : | 2 SPDT (two nos.)                                                                                                                                                         |
| 09. Contact rating               | : | 5A, 240V/AC, 0.25A, 220V DC                                                                                                                                               |
| 10. Accessories                  | : | a) Counter flange, nuts & bolts, suitable gasket etc.                                                                                                                     |

- b) Steel globe type drain valve.
- c) ½"NPT cable gland
- d) Stainless steel nameplate with alpha-numeric engraved for service and tag.
11. Preferred feature : Switch operating point marked on cage
12. Mounting : On standpipe
- 1.12.00 Conductivity Type Level Switch
01. Type : Conductivity discrimination.
02. Application : Drain pots viz. on CRH line
03. Mounting : Flanged – on external cage.
04. Probe MOC : Stainless steel with high purity ceramic.
05. Probe rating : > Maximum design pressure of vessel.
06. Input : Four independent channel with selectable switching threshold for water conductivity.
07. Relay Output : Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.
08. Contact type & rating : 2SPDT or 1 DPDT @ 5A 30V DC.
09. Local Display : Coloured LEDs for Hi, Lo, Hi-Hi, Lo-Lo, Power & fault.
10. Power supply : Dual 240V AC, 50 Hz, 1Ph.
11. Enclosure : IP-65, corrosion resistant & wall mounting type (Explosion proof for NEC Class-1, Division-1 area).
12. Accessories : a) PTFE cable from probe to electronics  
b) Mounting accessories  
c) External cage  
d) Washer & gasket
13. Test pressure : Two times rated pressure
14. Cable connection : ½" NPT with cable gland
- 1.13.00 Orifice Plate
01. Application : Low fluid velocity flow measurement
02. Design Standard : BS-1042, Part-I
03. Number of Tappings : As required plus one additional pair of taps
04. Diameter Ratio : Between 0.4 to 0.7
05. Thickness : 3 mm for main pipe diameter up to 250 mm, 6 mm for main pipe diameter above 250 mm and 10 mm for main pipe diameter of 500 mm and above.

- |                                          |                    |   |                                                                                                                                                                             |
|------------------------------------------|--------------------|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 06.                                      | Document           | : | Beta ratio calculation, assembly drawing and Flow vs. DP curve.                                                                                                             |
| 07.                                      | Meter run pipe     | : | Same as pipe material                                                                                                                                                       |
| 08.                                      | Accessories        | : | Flanges, gaskets, nuts & bolts, root valves jack screw, meter run pipe, Drain & vent hole as per application etc..                                                          |
| 1.14.00      Flow Nozzle                 |                    |   |                                                                                                                                                                             |
| 01.                                      | Application        | : | High fluid velocity flow measurement                                                                                                                                        |
| 02.                                      | Design Standard    | : | ASME PTC 19.5                                                                                                                                                               |
| 03.                                      | Number of Tapings  | : | As required plus one additional pair of taps                                                                                                                                |
| 04.                                      | Diameter Ratio     | : | Between 0.4 and 0.7                                                                                                                                                         |
| 05.                                      | Thickness          | : | Suitable for the application                                                                                                                                                |
| 06.                                      | Document           | : | Beta ratio calculation, assembly drawing and Flow vs. DP curve.                                                                                                             |
| 07.                                      | Meter run pipe     | : | Same as pipe material                                                                                                                                                       |
| 08.                                      | Accessories        | : | Meter run pipe, nipples and root valves.<br>(Inspection port assembly for nozzles used in plant performance purpose)                                                        |
| 1.15.00      Gauge Glass                 |                    |   |                                                                                                                                                                             |
| 01.                                      | Type               | : | Reflex                                                                                                                                                                      |
| 02.                                      | Glass              | : | Toughened borosilicate. Resistant to mechanical and thermal shocks.                                                                                                         |
| 03.                                      | Body material      | : | Carbon steel / stainless steel- As per process requirements (Flanged Connection)                                                                                            |
| 04.                                      | Pressure rating    | : | Twice the maximum working pressure                                                                                                                                          |
| 05.                                      | Temperature rating | : | As required                                                                                                                                                                 |
| 06.                                      | Bolts and nuts     | : | Rust proof alloy steel                                                                                                                                                      |
| 07.                                      | Accessories        | : | Suitable ball check valves of SS-304/316 body, gaskets, companion flange etc.                                                                                               |
| 1.16.00      Power Cylinders (Pneumatic) |                    |   |                                                                                                                                                                             |
| 01.                                      | Mounting Type      | : | a) Fixed position mounting (End mounting).<br>b) Trunnion mounting                                                                                                          |
| 02.                                      | Control Signal     | : | 4-20 mA DC to electro-pneumatic positioner. 24V DC operated solenoid valve operating on pneumatic line for open & closing purpose of on & off drive.                        |
| 03.                                      | Supply Air         | : | 0-7 Kg / Cm <sup>2</sup> .                                                                                                                                                  |
| 04.                                      | Selection          | : | Based upon thrust / torque, stroke length, angular movement, full-scale travel time, repeatability, space factor etc. Provision for air-to-open and air-to-close operation. |

- |     |                       |   |                                                                                                                                                                                                                                                                                                                                                  |
|-----|-----------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 05. | Casing                | : | IP-65.                                                                                                                                                                                                                                                                                                                                           |
| 06. | Accessories           | : | a) Air lock relay<br>b) Hand wheel.<br>c) Air filter regulator with gauge.<br>d) Volume Booster.<br>e) Limit Switches.<br>f) Positioner with Input and Output pressure gauges, local keypad & display.<br>g) Solenoid Valve<br>h) Integral non contact type position Transmitter (4-20 mA DC linear output).<br>i) Junction box with cable gland |
| 07. | Fail-safe operation   | : | For regulating duty- stay put against power & air fail.                                                                                                                                                                                                                                                                                          |
| 08. | Repeatability         | : | Better than 0.5% of full travel.                                                                                                                                                                                                                                                                                                                 |
| 09. | Hysteresis            | : | Less than $\pm 1\%$ of full travel                                                                                                                                                                                                                                                                                                               |
| 10. | Operating Temp. limit | : | 50 Deg. C (min.)                                                                                                                                                                                                                                                                                                                                 |

**1.17.00 ~~Smoke Density Analyzer~~**

- |                |                                             |   |                                                                            |
|----------------|---------------------------------------------|---|----------------------------------------------------------------------------|
| <del>01.</del> | <del>Type</del>                             | : | <del>In situ infra red</del>                                               |
| <del>02.</del> | <del>Principle of measurement</del>         | : | <del>Transmission &amp; absorption (Dual beam type)</del>                  |
| <del>03.</del> | <del>Light source</del>                     | : | <del>Modulated high intensity LED</del>                                    |
| <del>04.</del> | <del>Display</del>                          | : | <del>Back Lit LCD</del>                                                    |
| <del>05.</del> | <del>Measurement range</del>                | : | <del>0-999 mg/m<sup>3</sup>, 0-999 mg/Nm<sup>3</sup>, 0-100% opacity</del> |
| <del>06.</del> | <del>Measurement averaging</del>            | : | <del>Selectable 10 sec to 60 minutes</del>                                 |
| <del>07.</del> | <del>Accuracy</del>                         | : | <del>0.2% opacity</del>                                                    |
| <del>08.</del> | <del>Resolution</del>                       | : | <del>0.1% opacity</del>                                                    |
| <del>09.</del> | <del>Linearity</del>                        | : | <del>0.1% opacity</del>                                                    |
| <del>10.</del> | <del>Repeatability</del>                    | : | <del>0.1% opacity</del>                                                    |
| <del>11.</del> | <del>Flue gas temperature</del>             | : | <del>350 °C (max 600 °C)</del>                                             |
| <del>12.</del> | <del>Ambient temperature</del>              | : | <del>0-60 °C</del>                                                         |
| <del>13.</del> | <del>Operating temperature</del>            | : | <del>Transmitter &amp; receiver 0-90 °C, Electronic unit -70 °C</del>      |
| <del>14.</del> | <del>Mounting</del>                         | : | <del>Transceiver on opposite side of the duct</del>                        |
| <del>15.</del> | <del>Analog output</del>                    | : | <del>4-20mA DC (in 500 ohm resistance) to</del>                            |
| <del>16.</del> | <del>Alarm output</del>                     | : | <del>2 SPCO potential free rated at 230 VAC, 5A</del>                      |
| <del>17.</del> | <del>Power Supply</del>                     | : | <del>240V AC, 50 Hz, 1 Phase</del>                                         |
| <del>18.</del> | <del>Automatic misalignment detection</del> | : | <del>Required</del>                                                        |

22. Accessories : a) ~~Blower unit, tubes & fittings for calibration and purging, purge fail alarm in GCR~~  
b) ~~Calibration gas cylinders for NO<sub>x</sub> and CO filled in 10 Ltrs. of WC carbon cylinder with necessary SS regulator, SS gauges, SS tubings and SS fittings etc. as required.~~  
c) ~~Mounting flanges, gasket etc.~~
23. Application : ~~At economizer outlet~~
- 1.22.00 ~~H<sub>2</sub> + CO<sub>2</sub> + Air Analyzer~~
01. Type : ~~Thermal Conductivity~~
02. Range Selection : ~~3 ranges (H<sub>2</sub> in CO<sub>2</sub>, H<sub>2</sub> in air and CO<sub>2</sub> in air)~~
03. Range : ~~As required~~
04. Output : ~~4-20mA DC (Isolated)~~
05. Operating ambient temp. : ~~10 ° C to 50 Deg. C~~
06. Power Supply : ~~240V AC, 50Hz~~
07. Sample gas flow control : ~~Required~~
08. Reference gas flow : ~~Required~~
09. Reference gas pressure regulator : ~~Required~~
10. Cell response : ~~95% of change in 30 Sec.(Approx.)~~
11. Accuracy : ~~2% of full scale~~
12. Repeatability : ~~1% of full scale~~
13. Local Indicator : ~~Indicating meter of 1% accuracy~~
14. Alarm facility : ~~Dual (High & Low) independently adjustable.~~
15. Contact rating : ~~0.5A at 220 V AC~~
16. Enclosure : ~~Flame Proof~~
17. Accessories : ~~Calibration gas, mounting accessories and others as required to be provided~~
18. Application : ~~Generator Gas Purity.~~
- 1.23.00 Radar Type Level Measurement
01. Type : Radar based on Time Domain Reflectometry
02. Antenna : Co axial / single rod type guided wave or Horn type as required for the application
03. Communication : Two wire 4-20mA DC, HART or Field Bus protocol.
04. Environmental temperature : 0 – 50 °C
05. Enclosure : Explosion proof /IP 65 as per application
06. Cable Entry : ½" NPT

- |         |                           |   |                                                                                                                                                                                          |
|---------|---------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 07.     | Calibration               | : | a) Self calibration with internal reference<br>b) Zero & Span calibration                                                                                                                |
| 08.     | Programming               | : | Handheld programmer & Local keypad                                                                                                                                                       |
| 09.     | Process Connection        | : | Flanged /screwed                                                                                                                                                                         |
| 10.     | Electronic Housing        | : | Epoxy painted Die-Cast aluminium alloy                                                                                                                                                   |
| 11.     | Antenna / Flange assembly | : | 316 SS or Hest alloy (as required)                                                                                                                                                       |
| 12.     | Output Indicator          | : | Digital Integral Display                                                                                                                                                                 |
| 13.     | Accuracy                  | : | 5 mm or 0.1% of probe length                                                                                                                                                             |
| 14.     | Accessories               | : | a) Programming tool kit<br>b) Gasket                                                                                                                                                     |
| 1.24.00 | Temperature Switch        |   |                                                                                                                                                                                          |
| 01.     | Type                      | : | Bimetallic or gas filled.                                                                                                                                                                |
| 02.     | Sensing Element Material  | : | Bellow / Bourdon AISI SS-316                                                                                                                                                             |
| 03.     | Bulb Material             | : | AISI SS-316                                                                                                                                                                              |
| 04.     | Capillary                 | : | Stainless steel armored                                                                                                                                                                  |
| 05.     | Movement Material         | : | AISI SS-304                                                                                                                                                                              |
| 06.     | Case material             | : | Epoxy coated steel plate or die-cast aluminum alloy with neoprene gasket and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area). |
| 07.     | Scale                     | : | Black lettering on white background                                                                                                                                                      |
| 08.     | Over range Protection     | : | 120 %                                                                                                                                                                                    |
| 09.     | Instrument connection     | : | Bottom                                                                                                                                                                                   |
| 10.     | Switch configuration      | : | Two SPDT                                                                                                                                                                                 |
| 11.     | Switch rating             | : | 240V, 5A AC/220V, 0.5A DC                                                                                                                                                                |
| 12.     | Switch type               | : | Snap acting, shock and vibration-proof.                                                                                                                                                  |
| 13.     | Adjustability             | : | Internal Set point adjustable over span range                                                                                                                                            |
| 14.     | Cable connection          | : | 3/4" ET conduit connection or compression gland.                                                                                                                                         |
| 15.     | Compensation              | : | a) Capillary compensation with invar wire throughout the capillary length.<br>b) Case compensation                                                                                       |
| 16.     | Performance :             |   |                                                                                                                                                                                          |
|         | i) Scale Accuracy         | : | $\pm 1.0$ % of full scale                                                                                                                                                                |
|         | i) Repeatability          | : | < 0.5 % of full range                                                                                                                                                                    |
|         | ii) Response time         | : | Less than 40 seconds with thermowell                                                                                                                                                     |
| 17.     | Capillary length          | : | 5 meters (minimum) for local mounting/15 meters for local panel mounting.                                                                                                                |

|         |                               |   |                                                                                                                                                                                |
|---------|-------------------------------|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         | 18. Nameplate                 | : | Tag number, service engraved in stainless steel tag plate                                                                                                                      |
|         | 19. Accessories               | : | Mounting accessories, 3/4"ET cable gland.                                                                                                                                      |
| 1.25.00 | Rotameter                     |   |                                                                                                                                                                                |
|         | 01. Type                      | : | On-line up to 2". By-pass above 2"                                                                                                                                             |
|         | 02. Metering tube             | : | Borosilicate glass                                                                                                                                                             |
|         | 03. Float                     | : | AISI 316-SS unless the process fluid demands some other material.                                                                                                              |
|         | 04. Body MOC                  | : | AISI 316-SS                                                                                                                                                                    |
|         | 05. Scale                     | : | Graduated- Engraved black on white background.                                                                                                                                 |
|         | 06. Process connection        | : | Flanged                                                                                                                                                                        |
|         | 07. Accuracy                  | : | ± 2% of full scale detection or better for on-line type and ±4% of full-scale detection or better for by-pass type.                                                            |
|         | 08. Nameplate                 | : | Tag number, service engraved in stainless steel tag plate                                                                                                                      |
|         | 09. Accessories               | : | Slip-on orifice plate of 316-SS and taps of Stainless Steel as per application requirements. Applicable SS Isolation valves and SS Range Orifice - for bypass type rotameters. |
| 1.26.00 | I/P Converter                 |   |                                                                                                                                                                                |
|         | 01. Type                      | : | Electro-pneumatic (Outdoor Type)                                                                                                                                               |
|         | 02. Input level               | : | 4-20 mA DC                                                                                                                                                                     |
|         | 03. Output range              | : | 0.2 to 1.0 Kg/Sq. cm With 'Fail Freeze' feature. ( i.e in case of wire snapping the last good value of pneumatic signal out put will hold for at least six hours )             |
|         | 04. Split range               | : | For typical application wherever required.                                                                                                                                     |
|         | 05. Control Action            | : | Selectable air to close, air to open and fail freeze application                                                                                                               |
|         | 06. Supply pressure           | : | 1.2 to 1.6 Kg/cm <sup>2</sup> (1.4 typical)                                                                                                                                    |
|         | 07. Max. supply pressure      | : | 7 Kg/ sq.cm.                                                                                                                                                                   |
|         | 08. Response Time             | : | 5 Seconds for 0 to 90% output pressure                                                                                                                                         |
|         | 09. Housing                   | : | IP 55                                                                                                                                                                          |
|         | 10. Repeatability             | : | ±0.1% of span                                                                                                                                                                  |
|         | 11. Accuracy                  | : | ± 0.25% of span                                                                                                                                                                |
|         | 12. Supply pressure effect    | : | Less than 1%                                                                                                                                                                   |
|         | 13. Span and Zero adjustments | : | Screw                                                                                                                                                                          |
|         | 14. Pneumatic connection      | : | ¼" NPT                                                                                                                                                                         |

- |                                   |                     |   |                                                                                                                                       |
|-----------------------------------|---------------------|---|---------------------------------------------------------------------------------------------------------------------------------------|
| 15.                               | Stability           | : | Less than 0.25% of Span / Zero for six months.                                                                                        |
| 16.                               | Cable connection    | : | $\frac{3}{4}$ " ET                                                                                                                    |
| 17.                               | Mounting            | : | Field (pipe/wall mounting)                                                                                                            |
| 18.                               | Accessories         | : | Air filter regulator, mounting accessories, cable gland etc.                                                                          |
| 1.27.00      Air Filter Regulator |                     |   |                                                                                                                                       |
| 01.                               | Filter Element      | : | Sintered Bronze                                                                                                                       |
| 02.                               | Filter Size         | : | 5 microns                                                                                                                             |
| 03.                               | Input Air           | : | 10.0 Kg/Sq. cm (maximum)                                                                                                              |
| 04.                               | Output              | : | Adjustable from 0-2.0 Kg / Sq. cm or 0-7.0 Kg / Sq. cm (continuous) as applicable for I/P converter, control drives and control valve |
| 05.                               | Effect of Supply    | : | Maximum 0.02 Kg/Sq. cm for a change pressure variation in supply pressure of 4 Kg/Sq. cm                                              |
| 06.                               | Bowl Material       | : | Metallic cover around high temperature area / clear transparent polycarbonate with metallic cover for ordinary applications.          |
| 07.                               | Accessories         | : | 2" dial size output pressure gauge                                                                                                    |
| 08.                               | Desirable Feature   | : | No perceptible drop of pressure on opening the drain port.                                                                            |
| 1.28.00      Solenoid Valve       |                     |   |                                                                                                                                       |
| 01.                               | Operating Principle | : | Electromagnetic (noiseless)                                                                                                           |
| 02.                               | Coil voltage rating | : | 240 V AC / 220 V DC/24 V DC/110 V (as required)                                                                                       |
| 03.                               | Ways                | : | Generally 3-ways other depending on requirement                                                                                       |
| 04.                               | Port size           | : | $\frac{1}{4}$ " NPT all ports                                                                                                         |
| 05.                               | Body                | : | SS bar stock                                                                                                                          |
| 06.                               | Trim                | : | SS-316                                                                                                                                |
| 07.                               | Duty                | : | Suitable for continuous energization                                                                                                  |
| 08.                               | Sealing             | : | Airtight and leak proof                                                                                                               |
| 09.                               | Ambient Temperature | : | 0 - 50 ° C                                                                                                                            |
| 10.                               | Fluid Temperature   | : | 0-150 ° C (approx.)                                                                                                                   |
| 11.                               | Coil Enclosure      | : | Stainless Steel                                                                                                                       |
| 12.                               | Insulation          | : | Class-H                                                                                                                               |
| 13.                               | Coil Casing         | : | IP-65 (Explosion proof for NEC Class-1, Division-1 area)                                                                              |
| 14.                               | Mounting            | : | On pipe or on panel                                                                                                                   |
| 15.                               | Cable Connection    | : | $\frac{3}{4}$ " ET                                                                                                                    |
| 16.                               | Accessories         | : | Mounting brackets, nuts and bolts                                                                                                     |

17. Preferred feature : a) Solenoid valve directly integral to actuator body shall have NAMOOR interface for uniformity  
b) Local indication for power
- 1.29.00 Sight Glass
01. Type : Flap-type
02. End connection : Screwed / Flanged
03. Material:
- a) Body : CS/SS as per process medium
- b) Indicator : Stainless steel
04. Sight Glass : Toughened Borosilicate
05. Gasket : Neoprene
06. Bolts & Nuts : High tensile steel
07. Hydraulic Test Pressure : 1.5 times maximum working pressure
08. Accessories : As required
- 1.30.00 Flow Indicating Switch
01. Type : On line metal tube Rotameter
02. End connection : Flanged
03. Material:
- a) Body : CS/SS as per process medium
- b) Float : Stainless steel
- c) End fittings/flange : Stainless steel
- d) Other wetted part : Stainless steel
- b) Casing : Di cast Alluminium
04. Accuracy : +/- 2.0% of FSR
05. Rangeability : 10:1
06. Electrical connection : 3/4" ET
07. Switch type : Snap acting hermitically sealed 2 nos. SPDT
08. Contact rating : 5A, 240V AC
09. Protection class : IP-65
10. Accessories : As required
- 2.00.00 ~~CLOSED CIRCUIT TELEVISION SYSTEM~~
- ~~2.01.00 Closed Circuit Television System~~
- ~~2.01.01 Closed Circuit Television System (CCTV) with all equipment and accessories shall be installed for the purpose of surveillance of major plant areas. Also, cameras shall be installed at the Main plant (TG Hall, Boiler ESP) and other common auxiliary plants.~~
- ~~2.01.02 The CCTV system shall meet the specific functional & design requirements towards collecting live video information from the various areas of the plant and displaying that information at monitors.~~

~~CCTV network configuration shall be built on the Stackable Managed Ethernet switches for better control of data traffic & performance and future expansion. Switch configuration shall be redundant with seamless changeover without any upset in the CCTV operation. MTBF of the switch shall be more than 20 Years. Configuration shall be automatic.~~

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

3.01.00 Coupling Relay

- |                     |   |                                                      |
|---------------------|---|------------------------------------------------------|
| 01. Type            | : | Octal base plug-in type/ DIN rail Mounting           |
| 02. Coil voltage    | : | 24 V D.C. in general / other as required             |
| 03. Contact         | : | 2 NO & 2 NC (Minimum)                                |
| 04. Contact rating  | : | 250 V/5A (A.C)/220V/2A (D.C)                         |
| 05. Operating range | : | 70 to 110% of rated voltage.                         |
| 06. Insulation      | : | 2 KV for 1 minutes between terminal & earth.         |
| 07. Mechanical life | : | 20 million operations                                |
| 08. Coil protection | : | Diode                                                |
| 09. Indication      | : | Coil on LED                                          |
| 10. Enclosure       | : | Transparent cover                                    |
| 11. Connection      | : | Screw terminals.                                     |
| 12. Mounting        | : | Projection mounting inside panel / DIN rail mounting |

3.02.00 Bar graph Indicator

- |                             |   |                                                                                   |
|-----------------------------|---|-----------------------------------------------------------------------------------|
| 01. Type                    | : | Bar graph                                                                         |
| 02. Number of channels      | : | One / Two (as required)                                                           |
| 03. Input                   | : | 4-20 mA/1-5 V/Thermocouple/RTD                                                    |
| 04. Indication              | : | Green LED / LCD                                                                   |
| 05. Scale                   | : | 100 mm vertical one for each channel graduated in engineering unit (linear scale) |
| 06. Readable Distance       | : | 3 meters (minimum)                                                                |
| 07. Mounting                | : | Flush panel                                                                       |
| 08. Face Dimension          | : | 36(W) x 144(H) mm (approx) / 72 x 144 (H) mm                                      |
| 09. Resolution              | : | 1% of scale or better                                                             |
| 10. Power Supply            | : | 240V, 1 Phase, 50 Hz AC                                                           |
| 11. Operating Conditions :- |   |                                                                                   |
| a) Temperature              | : | 0-50 ° C                                                                          |
| b) Relative Humidity        | : | 5%-95%                                                                            |
| c) Supply Voltage           | : | -15% to +10%                                                                      |
| 12. Connection between      |   |                                                                                   |

- |                                     |   |                                                                                                                                        |
|-------------------------------------|---|----------------------------------------------------------------------------------------------------------------------------------------|
| Indicator and Tray                  | : | Prefab Cable                                                                                                                           |
| 13. Accessories                     | : | i) Mounting Tray                                                                                                                       |
|                                     |   | ii) Engraved phenolic nameplate affixed to front flange to identify each indicator by tag number and each point by measured variables. |
| 14. Alarm Facility                  | : | 1 HI and 1 LO for each channel independently adjustable over span. Voltage free outputs                                                |
| 15. Reference Junction Compensation | : | Built-in cold junction compensation for thermocouple inputs                                                                            |
| 16. Feature                         | : | i) Alarm level indication by flashing cursor                                                                                           |
|                                     |   | ii) Green Digital display of parameter value in front panel with a 3.1/2 digit display.                                                |

**3.03.00 Valve Position Indicator**

- |                             |   |                                      |
|-----------------------------|---|--------------------------------------|
| 01. Input                   | : | 4-20 mA DC/1-5 Volts DC              |
| 02. Indication              | : | Pointer and Scale. Moving Coil Meter |
| 03. Readable Distance       | : | 3 meters (minimum)                   |
| 04. Pointer Deflection      | : | 90 Deg Sector or linear              |
| 05. Mounting                | : | Flush Panel (Horizontal/vertical)    |
| 06. Accuracy                | : | ±1% or better                        |
| 07. Protection Class        | : | IP-42                                |
| 08. Operating Ambient Temp. | : | 0-50 °C                              |
| 09. Scale                   | : | 0-100%                               |
| 10. Bezel Size              | : | DIN Standard                         |

**3.04.00 Digital Indicator**

- |                             |   |                                                            |
|-----------------------------|---|------------------------------------------------------------|
| 01. Type                    | : | Four and half digit LED seven-segment display with sign.   |
| 02. Face Dimension          | : | 72 x 144 mm / 48 x 96 mm (as applicable)                   |
| 03. Display Character       | : | 13.8 mm, Green (LED)                                       |
| 04. Accuracy                | : | 0.1% of reading, ±2 digit                                  |
| 05. Input                   | : | 4-20mA DC/1-5 V DC/RTD/Thermocouple                        |
| 06. Mounting                | : | Flush Panel                                                |
| 07. Power Supply            | : | 240V ±10%, 50 ±2.5 Hz                                      |
| 08. Output Contact          | : | 2 nos SPDT, contact rating 5A at 240V AC/ 0.25A at 220V DC |
| 09. Power/Signal Connection | : | Screwed                                                    |

Large Display (150x300 mm) indicators shall be provided for MW, MVAR and frequency indications.

**3.05.00 Push Button**

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

**3.06.00 Illuminated Push Button**

- |     |                       |   |                                                    |
|-----|-----------------------|---|----------------------------------------------------|
| 01. | Type                  | : | Square format                                      |
| 02. | Face Dimension        | : | 32 x 32 mm (maximum)                               |
| 03. | Contact Configuration | : | 2 NO + 2 NC (minimum)                              |
| 04. | Contact Addition      | : | Add-on-Block up to 4 each with 2 pairs of contacts |
| 05. | Contact Material      | : | Hard Silver Alloy                                  |
| 06. | Contact Rating        | : | 500 V/ 10A                                         |
| 07. | Utilization Category  | : | A C11 / DC11                                       |
| 08. | Insulation Voltage    | : | 2 KV for 1 minute between terminals and earth      |
| 09. | Mechanical Life       | : | 1 Million Operation                                |
| 10. | Lamp                  | : | LED with built-in resistors as required            |
| 11. | Lamp Rating :-        |   |                                                    |
|     | a) Voltage            | : | 240 V AC                                           |
|     | b) Watt               | : | 2 Watt (approx.)                                   |
| 12. | Lamp and Lens         |   |                                                    |
|     | Replacement           | : | From front                                         |
| 13. | Construction          | : | Transparent Plastic Lens                           |
| 14. | Color                 | : | Red, Green, Amber, Yellow etc.                     |
| 15. | Connection            | : | Screw terminals                                    |

- |         |                               |   |                                                                                           |
|---------|-------------------------------|---|-------------------------------------------------------------------------------------------|
|         | 16. Enclosure Class           | : | IP-52                                                                                     |
|         | 17. Legend                    | : | Engraving                                                                                 |
| 3.07.00 | Selector Switch               |   |                                                                                           |
|         | 01. Type                      | : | 2/3/4 position stay put type with rotary lever actuator.                                  |
|         | 02. Face Dimension            | : | 32 x 32 mm (maximum)                                                                      |
|         | 03. Contact Configuration     | : | 4 pair of contacts                                                                        |
|         | 04. Contact Addition          | : | Add-on-Block up to 4 each with 2 pairs of contact                                         |
|         | 05. Contact Material          | : | Hard silver Alloy                                                                         |
|         | 06. Contact Rating            | : | 500 V/10 A                                                                                |
|         | 07. Utilization Category      | : | AC11 / DC11                                                                               |
|         | 08. Insulation Voltage        | : | 2 KV for 1 minute between terminals and earth                                             |
|         | 09. Mechanical Life           | : | 1 million operation                                                                       |
|         | 10. Construction              | : | Aluminum shrouding                                                                        |
|         | 11. Connection                | : | Screw terminals                                                                           |
|         | 12. Enclosure Class           | : | IP-52                                                                                     |
| 3.08.00 | Indicating Lamp               |   |                                                                                           |
|         | 01. Type                      | : | LED with built-in resistor                                                                |
|         | 02. Face Dimension            | : | 32 x 32 mm (maximum)                                                                      |
|         | 03. Voltage                   | : | 240 V AC                                                                                  |
|         | 04. Watt                      | : | 2.5 Watt (approximate)                                                                    |
|         | 05. Lamp and Lens Replacement | : | From front                                                                                |
|         | 06. Construction              | : | Transparent Plastic lens                                                                  |
|         | 07. Color                     | : | Red, Green, Amber, Yellow etc.                                                            |
|         | 08. Connection                | : | Screw terminals                                                                           |
|         | 09. Legend                    | : | Engraving                                                                                 |
| 3.09.00 | Indicating Meters (A.C)       |   |                                                                                           |
|         | 01. Type                      | : | Rectifier type                                                                            |
|         | 02. Face Dimension            | : | 96 x 96 mm                                                                                |
|         | 03. Scale                     | : | Radial arc of 240 Deg.                                                                    |
|         | 04. Accuracy                  | : | 1.5% of full scale.<br>±0.5 Hz for frequency meter                                        |
|         | 05. Input                     | : | 0-1/0-5A for current measurement, 0-240V, 50 ± 2.5 Hz for voltage / frequency measurement |
|         | 06. Zero Adjustment           | : | Screw on meter face                                                                       |

- |     |                       |   |                                                     |
|-----|-----------------------|---|-----------------------------------------------------|
| 07. | Enclosure             | : | Shielded Case                                       |
| 08. | Mounting              | : | Flush Panel                                         |
| 09. | End Scale Suppression | : | 6 times the measuring range only for motor ammeters |

**3.10.00 Indicating Meters (D.C)**

- |     |                       |   |                                                                          |
|-----|-----------------------|---|--------------------------------------------------------------------------|
| 01. | Type                  | : | Taut band moving coil                                                    |
| 02. | Face Dimension        | : | 96 x 96 mm                                                               |
| 03. | Scale                 | : | Radial arc of 240 Deg.                                                   |
| 04. | Accuracy              | : | 1.5% of full scale                                                       |
| 05. | Input                 | : | 0-75 mA for current measurement. Direct reading for voltage measurement. |
| 06. | Zero Adjustment       | : | Screw on meter face                                                      |
| 07. | Enclosure             | : | Shielded case                                                            |
| 08. | Mounting              | : | Flush Panel                                                              |
| 09. | End Scale Suppression | : | 2 times the measuring range only for motor ammeters.                     |

For electrical system's meter and for synchronization, Bidder shall refer to electrical volume of the specification

**3.11.00 Auxiliary Relay**

- |     |                       |   |                                                                                                                     |
|-----|-----------------------|---|---------------------------------------------------------------------------------------------------------------------|
| 01. | Type                  | : | Electromagnetic                                                                                                     |
| 02. | Coil voltage          | : | 240 V A.C / 220V DC. For any other voltage bidder to make his own arrangement.                                      |
| 03. | Contact Configuration | : | 2 NO & 2 NC (Minimum), additional contacts as per requirement with provision for additional contact block expansion |
| 04. | Contact rating        | : | 250V/5A (A.C/D.C.)                                                                                                  |
| 05. | Operating range       | : | 80 to 110% of rated voltage                                                                                         |
| 06. | Insulation            | : | 2 KV for 1 minute between terminals & earth.                                                                        |
| 07. | Mechanical life       | : | 20 million operations                                                                                               |
| 08. | Coil protection       | : | Diode/surge suppressor                                                                                              |
| 09. | Connection            | : | Screw terminals.                                                                                                    |
| 10. | Mounting              | : | Projection mounting inside panel                                                                                    |

**3.12.00 Electrical Transducer**

Transducers shall be provided for conversion of AC electrical quantities such as voltage, current and power. Transducer shall be suitable for 220V DC auxiliary supply. Transducers shall be of low burden type having 4 – 20 mA DC linear galvanically isolated output compatible with secondary indicating instrument. Transducer shall be dual channel type. Accuracy class of Transducers shall be as per IS14570:1998 or IEC688:992

**3.13.00 Synchroscope**

Synchroscope shall be designed to provide an illuminate and indication of phase and frequency difference between bus voltage and Generator voltage. It shall denote the actual frequency difference corresponding to the inverse of time taken for one rotation of the illuminated vector spot. The instrument shall be designed for industrial applications, which require precise, reliable and robust instruments for the display range and indication. Synchroscope shall be designed as per the DIN / IEC / BS standards.

#### 4.00.00 ~~CONTROL VALVES, ACTUATORS & ACCESSORIES~~

~~General Technical Guidelines for the Control Valves shall be as follows :~~

- ~~a) Bidder shall exercise caution in selecting severe service control valves like BFP recirculation valves, HP & LP bypass valves, superheater & reheater attenuator valves, PRDS valves for Boiler & Turbine, Soot blower steam pressure control valve, control valves whose down stream are connected to vacuum such as HP/LP heater emergency level control, condenser make up water control valve, separator level control and CEP minimum flow control valve. For such critical applications, Bidder shall offer valves which are proven for similar application. Above valves shall have leakage class equal or better than class V with metal to metal seating.~~
- ~~b) Wherever, steam conditioning calls for Pressure reducing & desuperheating, combined PRDS type valves shall be offered.~~
- ~~c) Bidder shall provide redundant control valves for Main condensate flow control, Superheat attenuation control and Reheat attenuation control as a minimum for high availability. For other application, if the availability criteria for the plant cannot be met even with the best established product, redundant control valves shall be provided.~~
- ~~d) Control valves shall be located near floor or platform for ease of access and with adequate clearances for maintenance and lay-down and shall be placed as station with upstream motorized isolating valve, down-stream isolating valve, inching duty motorized bypass valve and manual drain valves. Each redundant control valve shall have its upstream motorized and down stream manual isolating valves. Where quick shut off requirement is foreseen such as in case of SH & RH attenuation valves, upstream isolation valve shall be pneumatic type.~~

#### 4.01.00 General

~~4.01.01 Control valves for regulating service shall normally be globe body, preferably cage guided, metal to metal seated, pneumatically operated and shall be provided with characterized plugs having ANSI leakage class IV except for the control valves indicated above.~~

~~4.01.02 Where the operating time is critical for the operation of the plant, as in case of HP or LP bypass valves, hydraulic actuators with electro-hydraulic interface shall be offered.~~

~~4.01.03 Bonnet joints for all control valves shall be of flanged and bolted type.~~

~~4.01.04 Flanged valve shall be rated at no less than class 300 lbs.~~

~~4.01.05 Valve Body / End Connections~~

~~4.09.00 Valve Accessories~~

~~Accessories shall include side mounted hand wheels, limit switches, junction boxes, airlock relays etc.. Solenoid valve wherever required shall be furnished.~~

5.00.00 **CONTROL DESK / PANEL / RACK**

5.01.00 Convenient and logical approach to operational interfaces and aesthetics in the overall view of the panel /desk shall be considered.

5.02.00 For items susceptible to vibration, suitable anti-vibration padding shall be provided to prevent damage or malfunction.

5.03.00 All items inside the panels/cabinets shall be neatly arranged with easy access/ maintenance approach.

5.04.00 Incoming power supply feeders shall be duplicated. Alarm shall be provided for failure of a power supply feed.

5.05.00 Desk / panel shall be provided with interior illumination, utility receptacles with plug and cooling fan.

5.06.00 Panel / Desk shall have gland plate at cable entry to panel. Thickness of gland plate shall not be less than 3 mm.

5.07.00 Wire shall be routed / laid through covered trough.

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

5.09.00 Nameplate

a) Nameplate shall be provided for instrument or device mounted on the panel.

b) Nameplates for panels shall be provided both in front and rear.

5.10.00 Control Desks

5.10.01 Devices mounted on the desks shall be flush type. Devices shall be so mounted that their removal and replacement can be accomplished without interruption of services to others.

5.10.02 Desk shall be ergonomically designed to suit working on a 24 X 7 basis. Aesthetics, ergonomics and illumination shall be considered while positioning of the desk, large video screen and panels in control room.

5.10.03 Control desk shall be free standing floor mounting type of table-top design with compartments for locating the hardware. Desk shall be constructed from aluminum extrusion with high pressure laminate MDF board for work surface of approved colour. Aluminium structure shall be anodized or powder coated paint finish.

5.10.04 Monitors with retractable keyboard, emergency push buttons shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate..

5.10.05 Desks shall be of modular, scalable and industrially ruggedized design and shall have Telephones and Intercom connections.

5.10.06 Desks shall have concealed cable trays for wire dressing.

- 5.10.07 Design shall include Earthing bolts.
- 5.10.08 Back installed items shall be suitably concealed from front view.
- 5.11.00 Back Up Panel
- 5.11.01 Construction shall be from sheet steel of thickness not less than 3mm.
- 5.11.02 Electrical upright Panel construction & design shall be similar to back up panel. Control switches, meters, indicators, synchronizer, excitation control switch, annunciation window etc. along with associated mimic diagram, as recommended, shall be provided for manual synchronization of generator.
- 5.12.00 Cabinets / Enclosure / Panels
01. Material of construction : Cold rolled steel sheet
  02. Thickness of Sheet :
    - a) 3.0 mm for faces supporting instruments / terminals.
    - b) 2 mm for other sides and top.
  03. Construction : Welded throughout as per approved National Standards.
  04. Panel height : 2300 mm (approx)
  05.
    - i) Corners : 7 mm inner radius
    - ii) Dimensional Tolerances :
      - a) In height & length - 3 mm
      - b) In height between adjacent sections - 2 mm.
      - c) Total for a group - 6 mm
  06. Doors : Double, recessed, turned back edges
    - i) Thickness of Sheet : 2 mm
    - ii) Hinges : Stainless steel
    - iii) Door latches : Three point type
    - iv) Door gaskets : Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure.
    - v) Opening of the doors : Outward
    - vi) Louvers : With removable wire mesh to ensure dust and vermin proof.
  07. Color of interior : Brilliant white
  08. Colour external : RAL 7032
  09. Painting : Epoxy powder coated or better
  10. Gland plates : Removable 4 mm thick (bottom)
  11. Cable entry : Bottom
  12. Hardware :
    - a) Anti vibration pad- 15 mm
    - b) Predrilled base channel ISMC - 100 or equivalent for all sides.

- c) Stainless steel buff- finished 2 mm thick kick plate for all sides.
- d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws.
- e) Rubber strips to ensure air tightness between kick plate and finished floor.
- f) Lifting hook / Eye bolt
- g) Drawing pocket
- h) Door switch, lamps, thermostat, heaters and fans

13. Enclosure Protection : As per environment condition of the area of installation. Refer section-I of this vol.

#### 5.13.00 Local Instrument Racks & Enclosure

#### 5.13.01 General Requirements

- a) Devices located in the field shall be grouped and installed in the enclosure (Open / Closed Rack) in Boiler and TG Building.
- b) Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc.
- c) No more than six instruments shall be grouped in a single rack / enclosure.
- d) Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point.
- e) Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.
- f) Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.
- g) Instrument piping and tubing shall be hydrostatically tested at one and one-half times the maximum system pressure except for low pressure and vacuum measurement for which the test pressure will be as per piping standard.
- h) Service air connection shall be provided for continuous and intermittent purging of impulse pipe in dusty medium. Continuous purging shall be adopted for differential pressure measurement such as flue gas and coal air mixture application. Pressure measurement shall have only intermittent purging whenever required. In case of continuous purging, an air header shall be formed this shall receive service air through isolation valve and air filter regulator. Air shall be fed from the air header to both the impulse pipes near to take off points through isolation valves and flow regulators. Air header shall be constructed from stainless steel. Impulse pipe for such applications shall have a four-way valve. One port of the valve shall have an adaptor to connect flexible stainless steel braided nylon hose to the service air. Rating of the hose shall not be less than 10 Kg/sq.cm.

Four way valve shall have two position operations. One position for service and other one for purging. Required pressure gauges shall be provided for monitoring of air pressure. Complete purging arrangement shall be integral to the enclosure and racks.

- i) Gate or ball type (full ported) instrument isolation valve and globe type blow down drain valve adequate for duty requirement and for withstanding continuous design pressure and temperature of main process medium shall be provided in the hook up plumbing. For process pressure equal or above 40 kg / sq.cm single instrument isolation valve and double blowdown valves shall be used before connecting to blowdown header. Whereas for line pressure less than 40 kg/ sq.cm, single instrument isolation valve and single blow down valves can be used before connecting to blow down header. Instrument manifolds shall be non integral and shall be installed close to the instrument.
- j) Drawing K9213R-DWG-I-0200 shall be referred for typical arrangement of Local instrument enclosure and rack.

#### 5.13.02 Closed Instrument Rack

- a) Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load-bearing posts shall be suitably supported by gusset plates or moment members.
- b) Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.
- c) 2" NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any member, which would reduce access, shall be avoided.
- d) Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior. Key shall be of identical for all enclosures.
- e) Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box.
- f) Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket. Impulse lines within the enclosures shall be properly clamped.
- g) All internal wirings between the instruments and junction box shall run through flexible conduits.
- h) Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Header shall be of 2" NB ASTM A 106, Sch-80 Gr. C installed at a slope of 1:25 and extended beyond the rack for connection to plant drain header.
- i) Each rack shall be provided with one receptacle, light fixtures each at instrument & Junction box compartments with wire guard.

#### 5.13.03 Open Instrument Rack

- a) Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or falling objects and shall be epoxy painted. Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable protective grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project. Canopy shall be of CRCA steel sheet of at least 3 mm thickness. Center posts or any member, which would reduce access, shall be avoided.
- b) 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments.
- c) All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible.
- d) All racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Header shall be of 2" NB ASTM A 106, Sch-80 Gr. C installed at a slope of 1:25 and extended beyond the rack for connection to plant drain header.

#### 5.13.04 Junction Box

Junction boxes of FRP construction with protection class conforming to IP 55.

- a) Junction box shall be provided at a dry compartment at one side of the enclosure / rack with front opening type door. Earth stud shall be furnished at rack for safety grounding.
- b) Terminals shall be screwless cage clamp type of reputed make and 20% spare terminals shall be furnished in the junction box.

#### ~~6.00.00 DISTRIBUTED CONTROL SYSTEM (DCS)~~

##### ~~6.01.00 System Functional Description~~

~~6.01.01 Integrated functionally distributed and hierarchically structured real time control (both binary and modulating), Data acquisition, Man machine interface, Historization units and Management Information System (MIS) system synthesized from one general family of identical interchangeable multifunction hardware has been envisaged.~~

~~6.01.02 System shall be highly reliable with the availability of not less than 99.7% with adequate redundancy and fault tolerant configuration.~~

~~6.01.03 The system shall be unitized and connectivity with other plant control system.~~

~~6.01.04 Remote input output stations as a data concentrator for acquisition and monitoring of Boiler metal temperature are foreseen. RIO shall be industrially ruggedized and shall be provided with integral air conditioner considering the harsh environment.~~

~~6.01.05 For Power supply to system refer Volume IIE Section I.~~

~~6.01.06 Controls of some plant auxiliaries for CW & ACW Pumps and Fuel oil heating & pressurizing system controls shall be realized in DCS through Remote I/O (RIO) cabinets.~~

~~6.01.07 Off-site & BOP plants such as Coal Handling Plant, Ash Handling Plant, Raw water & Pretreatment plant, Compressed Air System, Mill Reject System and Demineralized water plant etc. having microprocessor based or PLC based~~

~~8.18.01 A Portable data collector shall be provided for taking periodic collection of non critical machine data. Machine condition monitoring system shall be capable to analyze the data. Instrument shall be microprocessor based and ready for use in harsh environment. Integral LCD display shall provide the necessary display of readings & spectral data. Minimum 02 channels along with additional input for phase reference measurement shall be available with the instrument.~~

~~8.18.02 Instrument shall include necessary accelerometers and other devices with accessories for collection of machine parameters. A long life Ni Cd battery pack shall be used. Replacement of battery shall not lead to loss of stored data.~~

~~8.18.03 Shaker table shall be provided for testing & calibration.~~

#### 9.00.00 INSTRUMENTATION & CONTROL CABLE

9.01.00 Cables shall be flame retardant low smoke (FRLS) type. In hazardous areas cables of suitable R/L ratio shall be provided for intrinsic safety.

9.02.00 Durable marking shall be provided on the surface of the cable at intervals not exceeding 5 mtrs. Marking shall include Manufacturer's name, Year of manufacture, Voltage grade, Type of cables (Conductor size & no. of pairs / triads / type of compensating / extension cable), Insulation material, FRLS etc.

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

9.04.00 Standard seasoned wooden drum containing minimum 500 /1000 M  $\pm$  5% length. Drum shall be anti rodent, anti termite and smooth finish. Both end of cable shall be capped by means of non hygroscopic sealing material.

#### 9.05.00 Thermocouple Extension & Compensating Cable

- |                             |   |                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 01. Conductor               | : | Solid conductor                                                                                                                                                                                                                                                                                                                                                                    |
| 02. Conductor size          | : | 0.75 sq.mm                                                                                                                                                                                                                                                                                                                                                                         |
| 03. Type                    | : | KX (Extension) (Chromel Alumel)<br>RX (Compensating) (Copper-Copper alloy) JX (Extension) (Iron Constantan)                                                                                                                                                                                                                                                                        |
| 04. Conductor Insulation    | : | HR PVC Type-C (IS-5831,1984) 0.6 mm thick                                                                                                                                                                                                                                                                                                                                          |
| 05. Operating Voltage       | : | 300V /500V RMS (Core to earth / core to core)                                                                                                                                                                                                                                                                                                                                      |
| 06. Twisting                | : | Pair twisted with lay of 60 mm (max)                                                                                                                                                                                                                                                                                                                                               |
| 07. Twisting Direction      | : | All pairs in the same direction. Lapped to form bunch with mylar tape.                                                                                                                                                                                                                                                                                                             |
| 08. Screen (Pair & Overall) | : | Aluminium mylar tape with a thickness of 28 $\mu$ m (min.) for individual pair screen and 60 $\mu$ m (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire. |

- |     |                       |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----|-----------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 09. | Drain wire            | : | Annealed tinned copper wire, stranded.<br>Size 0.5 Sq. mm. (No. of strands / size:-<br>7 / 0.3mm)                                                                                                                                                                                                                                                                                                                                                                                                          |
| 10. | Inner Sheath          | : | Extruded FRLS PVC (anti rodent, anti<br>termite & moisture resistant properties)<br><br>HR PVC Type ST2 of IS-5831,1984<br><br>Thickness as per IS-1554Part-I 1976                                                                                                                                                                                                                                                                                                                                         |
| 11. | Rip Cord              | : | Non metallic under sheath                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 12. | Armouring             | : | GI wire / strip as per IS 3975                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 13. | Outer Sheath          | : | Extruded FRLS PVC (anti rodent, anti<br>termite & moisture resistant properties)<br><br>HR PVC Type ST2 of IS-5831,1984<br><br>Thickness as per IS-1554Part-I 1976                                                                                                                                                                                                                                                                                                                                         |
| 14. | Filler                | : | Non hygroscopic with FRLS property                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 15. | Temperature Range     | : | Up to 85 °C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 16. | Insulation at 20° C   | : | 100 MOhms/Km [Min]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 17. | Capacitance at 800 Hz | : | 120 nf/km                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 18. | Cross talk            | : | 60 dB                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 19. | Attenuation           | : | 1.2 dB/Km                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 20. | Codes & Standards     | : | a) IEC 332-1<br>b) ANSI MC 96.1<br>c) IS-8784-1987                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 21. | Tests                 | : | a) Oxygen Index: Min.29 at room<br>temp. (ASTM-D-2863)<br>b) Acid Gas Gen.: Max.20% by weight<br>as per IEC 754 Part-I<br>c) Temp Index : Min 250 DEG C at<br>21Oxy. Ind. (ASTM-D-2863)<br>d) Smoke Density Rating : Max.60%<br>(ASTM-D-2843).<br>e) Flammability Test : as per IEC 332<br>Part-I /IEEE-383<br>Swedish Chimney Test - SS-424-<br>1475 F3<br>f) High voltage test<br>Core to core- 1.5 KV for 1 min.<br>Core to screen- 1.0 KV for 1 min.<br>g) Insulation Resistance 100 M Ohm /<br>Km Min |

- h) Rodent & Termite repulsion test  
(Presence of lead shall be confirmed)

22. Conductor material & sheath color for thermocouple cable as per ANSI MC 96.1

| CABLE TYPE | OVERALL SHEATH COLOR | WIRE     | SHEATH COLOR | CONDUCTOR MATERIAL  |
|------------|----------------------|----------|--------------|---------------------|
| KX         | Yellow               | Positive | Yellow       | Nickel / Chromium   |
|            |                      | Negative | Red          | Nickel / Aluminum   |
| JX         | Black                | Positive | White        | Iron                |
|            |                      | Negative | Red          | Constantan          |
| RX         | Green                | Positive | Black        | Copper              |
|            |                      | Negative | Red          | Copper Nickel Alloy |

23. Durable printed or embossed numbering at regular interval of 50mm shall be provided for identification of pairs.

9.06.00 Instrumentation multi Paired Signal Cable

01. Conductor type : Stranded (7) annealed tinned copper
  02. Conductor size : 0.5 / 1.0 / 1.5 Sq.mm (as required)
  03. Conductor resistance : 39 Ω/Km/18 Ω/Km/12 Ω/Km
  04. Conductor Insulation : HR PVC Type-C (IS-5831,1984) 0.6 mm thick
  05. Operating Voltage : 300 / 500V RMS (Core to earth / core to core)
  06. Twisting : Twin twisted with lay of 60 mm
  07. Twisting Direction : All pairs in the same direction. Lapped to form bunch with mylar tape.
  08. Screen (Pair & Overall) : Aluminium mylar tape with a thickness of 28 μm (min.) for individual pair screen and 60 μm (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire.
- \* Analog signals- Individual pair & overall shield to be considered.
  - \* Binary signals- overall shield to be considered.

- |     |                        |   |                                                                                                                                                                                                                                                                                                                                                                           |
|-----|------------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 09. | Drain wire             | : | Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm)                                                                                                                                                                                                                                                                               |
| 10. | Inner Sheath           | : | Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)<br>HR PVC Type ST2 of IS-5831,1984<br>Thickness as per IS-1554, Part-I 1976                                                                                                                                                                                                                 |
| 11. | Rip Cord               | : | Non metallic under sheath                                                                                                                                                                                                                                                                                                                                                 |
| 12. | Armouring              | : | GI wire / strip as per IS 3975                                                                                                                                                                                                                                                                                                                                            |
| 13. | Outer Sheath           | : | Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)<br>HR PVC Type ST2 of IS-5831,1984<br>Thickness as per IS-1554, Part-I 1976                                                                                                                                                                                                                 |
| 14. | Filler                 | : | Non hygroscopic with FRLS property.                                                                                                                                                                                                                                                                                                                                       |
| 15. | Temperature Range      | : | 85 °C                                                                                                                                                                                                                                                                                                                                                                     |
| 16. | Insulation at 20 Deg.C | : | 100 MOhms/Km [Min]                                                                                                                                                                                                                                                                                                                                                        |
| 17. | Capacitance at 800 Hz  | : | 120 nf/km                                                                                                                                                                                                                                                                                                                                                                 |
| 18. | Cross talk             | : | 60 dB                                                                                                                                                                                                                                                                                                                                                                     |
| 19. | Attenuation            | : | 1.2 dB/Km                                                                                                                                                                                                                                                                                                                                                                 |
| 20. | Codes & Standards      | : | a) IPCEA-S-61-402<br>b) BS 5308<br>c) IEC 332-1<br>d) ASTM-B-33<br>e) IS-8130-1984<br>f) IS 1554 Part-1<br>g) IS 10810                                                                                                                                                                                                                                                    |
| 21. | Sheath colour          | : | Inner- Black and Outer- Gray                                                                                                                                                                                                                                                                                                                                              |
| 22. | Tests                  | : | a) Oxygen Index: Min.29 at room temp. (ASTM-D-2863)<br>b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I<br>c) Temp Index : Min 250 ° C at 21Oxy. Ind. (ASTM-D-2863)<br>d) Smoke Density Rating : Max.60% (ASTM-D-2843).<br>e) Flammability Test : as per IEC 332 Part-I<br>f) Swedish Chimney Test-SS-424-1475 F3<br>g) Insulation Resistance 100 M Ohm / Km Min |

- h) High voltage test
  - Core to core- 1.5 KV for 1 min.
  - Core to screen- 1.0 KV for 1 min.
- i) Rodent & Termite repulsion test  
(Presence of lead shall be confirmed)

23. Colour of core for Instrumentation Cable (As per IS-9938)

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

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

9.07.00 Cables near high temperature zone shall be capable of withstanding high temperature and terminated in junction box / panel in normal temperature zone. Teflon insulated and sheathed thermocouple extension cables and copper conductor cables shall be used in high temperature zone. Conductor and sheath shall be extruded FEP (Teflon) as per VDE 0207 Part 6 and ASTM D 2116. These cables shall be pair, multipair, triad, multitriad and twisted & shielded.

9.08.00 Control & power Cable

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

10.00.00 **ERECTION HARDWARE**

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

10.01.00 Electrical Accessories

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

- a) Rigid Steel Conduit
  - i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm.

- ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.
- iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with ANSI C 80.1 and UL6. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.
- iv) All conduit fittings shall conform to the requirements of ANSI C 80.4 and UL-514 where these standards apply.
- b) Flexible Conduit
  - i) Flexible conduit shall be of three layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material.
  - ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/Sq. cm and temperature up to 200 °C.
- c) Special Fittings
  - i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed.
  - ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.

10.02.00

## Electrical Junction Box

|     |                       |                                                                             |
|-----|-----------------------|-----------------------------------------------------------------------------|
| 1.  | Type of Enclosure     | : Dust tight & weatherproof conforming to IP 65                             |
| 2.  | Material              | : 3 mm sheet steel                                                          |
| 3.  | Type of Cover         | : Solid unhinged with retention chain                                       |
| 4.  | Paint                 | : RAL 7032                                                                  |
| 5.  | Mounting              | : Surface                                                                   |
| 6.  | Cable Entry           | : 3 mm (min) Gland plate                                                    |
| 7.  | Gasket                | : Neoprene                                                                  |
| 8.  | Grounding             | : Brass earth lug with green screw head<br>External-2 nos , Internal-1no.M6 |
| 9.  | Number of Drain Holes | : Two at bottom capped                                                      |
| 10. | Identification        | : Label for JB and Tags for cable                                           |

|     |             |                                                                                                       |
|-----|-------------|-------------------------------------------------------------------------------------------------------|
| 11. | Accessories | : Rail mounted cage clamp type screwless terminals with markers, Cable gland, Ferrules, Canopy at top |
|-----|-------------|-------------------------------------------------------------------------------------------------------|

10.03.00 Cable Gland

|    |              |                                           |
|----|--------------|-------------------------------------------|
| 1. | Type         | : Double compression                      |
| 2. | Entry Thread | : NPT                                     |
| 3. | Material     | : Brass                                   |
| 4. | Finish       | : Cadmium Plated.                         |
| 5. | Protection   | : IP 54 or better                         |
| 6. | Accessories  | : Neoprene gasket, locknuts, reducers etc |

10.04.00 Cable Tray

1. Material : Mild steel, slotted
2. Thickness : not less than 2.0 mm
3. Finish : Hot dip galvanized
4. Perforation : As per MFR standard
5. Cover : Suitable for tray

10.05.00 Process Hook Up Accessories & specification

Material and rating of the hook up items shall suit the piping and fluid condition. Hook up materials shall be IBR certified for applicable cases. Bidder shall furnish hook up drawings and the drawings for open racks & closed racks for owner's approval.

10.05.01 Seamless Stainless Steel Pipe

1. Reference : ASTM A-312 TP 316
2. Material Grade : TP 316
3. Type : Seamless /Plain end
4. Size : ½" NB
5. Schedule : 40
6. Standard Length : 5 meter

10.05.02 Stainless Steel Pipe Fittings

1. Reference : ASTM A-182 F 316 / ANSI B16.11

2. Type : Forged
3. Rating : 3000 lbs / 6000 lbs / 9000 lbs
4. Size : ½" NB
5. End connection : Generally socket weld
6. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

#### 10.05.03 Seamless Stainless Steel Tube

1. Reference : ASTM A-213 TP 316
2. Material Grade : TP 316
3. Size : ½" OD X 2.1 MM Thick
4. Type : Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
5. Properties : The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
6. Test Pressure : 400 Kg/Sq. cm (minimum)
7. Tolerance : ± 0.13 mm for outside diameter  
: ± 15 % for wall thickness
8. Standard Length : 5 meter
9. Test : Flare, Hardness, Ball and Bubble Test

#### 10.05.04 Stainless Steel Tube Fittings

1. Reference : ASTM-A-182
2. Type : Double ferrule double compression
3. Material : 316 Stainless steel forged
4. Ferrule : 316 Stainless Steel
5. Type of Fittings : Male / female connector, elbow, cross /equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation.
6. Size : To suit SS tubing and NPT end connection

**10.05.05 C.S. Pipe**

1. Reference : ASTM-A 106 Gr. C
2. Material : Cold drawn seamless black C.S.
3. Type : Seamless / Plain ends
4. Size : ½" NB
5. Schedule : 80, 160, XXS as required
6. Standard Length : 5 meter

**10.05.06 C.S. Pipe Fittings**

1. Reference : ASTM-A 105 / ANSI B16.11
2. Type : Forged
3. Rating : 3000 lbs / 6000 lbs / 9000 lbs
4. Size : ½" NB
5. End connection : Generally socket weld
6. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

**10.05.07 A.S. Pipe**

1. Reference : ASTM-A 335 P22 AS PER ANSI B 36.10
2. Material : Cold drawn seamless A.S.
3. Type : Seamless / Plain ends
4. Size : ½" NB
5. Schedule : XXS
6. Standard Length : 5 meter

**10.05.08 A.S. Pipe Fittings**

1. Reference : ASTM-A 182 F22 AS PER ANSI B 16.11
2. Type : Forged
3. Rating : 9000 lbs
4. Size : ½" NB
5. End connection : Generally socket weld

6. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

10.05.09 Carbon Steel Globe Valve

1. Reference : ASTM A-105
2. Type : Globe
3. Construction : Forged Body Cadmium Plated
4. End Connection : ½" Socket Weld
5. Rating : Cl. 800 / CL. 2500
6. Material : Body - Carbon steel  
: Stem - Hardened Steel  
: Plug - AISI 316 SS  
: Seat- Stainless steel stellited
7. Packing : Teflon / Grafoil as required
8. Yoke : ASTM A105
9. Hand wheel : Carbon steel
10. Design standard : As per ANSI B 16.34

10.05.10 Stainless Steel Globe Valve

1. Reference : ASTM A-182 F316
2. Type : Globe
3. Construction : Forged Body
4. End Connection : Socket Weld
5. Proof Pressure : 400 Kg/Cm2
6. Material : Body - Stainless steel  
: Stem - Hardened Steel  
: Plug - AISI 316 SS  
: Seat- Stainless steel stellited
7. Packing : Teflon as required
8. Yoke : ASTM A182 F316

- |          |                           |                 |                                                 |
|----------|---------------------------|-----------------|-------------------------------------------------|
|          | 9.                        | Handwheel       | : Carbon steel                                  |
|          | 10.                       | Design standard | : As per ANSI B 16.34                           |
| 10.05.11 | Alloy Steel Globe Valve   |                 |                                                 |
|          | 1.                        | Reference       | : ASTM A-182 F22                                |
|          | 2.                        | Type            | : Globe                                         |
|          | 3.                        | Construction    | : Forged Body                                   |
|          | 4.                        | End Connection  | : ½" Socket Weld                                |
|          | 5.                        | Rating          | : CL. 2500                                      |
|          | 6.                        | Material        | : Body - Alloy steel                            |
|          |                           |                 | : Stem - Hardened Steel                         |
|          |                           |                 | : Plug - AISI 316 SS                            |
|          |                           |                 | : Seat- Stainless steel stellited               |
|          | 7.                        | Packing         | : Grafoil as required                           |
|          | 8.                        | Yoke            | : ASTM A182 F22                                 |
|          | 9.                        | Handwheel       | : Carbon steel                                  |
|          | 10.                       | Design standard | : As per ANSI B 16.34                           |
| 10.05.12 | Condensate Pot            |                 |                                                 |
|          | 1.                        | Reference       | : ASTM A182 F22 /ASTM A105                      |
|          | 2.                        | Material        | : Alloy steel / carbon steel as per application |
|          | 3.                        | Construction    | : Drilled from barstock                         |
|          | 4.                        | End connection  | : 3 nos. ½" socket weld end                     |
|          | 5.                        | Accessories     | : Vent valves                                   |
| 10.05.13 | Instrument Valve Manifold |                 |                                                 |
|          | 1.                        | Type            | : Two valve manifold                            |
|          |                           |                 | : Five valve manifold                           |
|          | 2.                        | Mounting        | : Remote 2" Pipe Mounting                       |
|          | 3.                        | Construction    | : Single block (bar stock)                      |
|          | 4.                        | Material        | : Forged body and bonnet AISI 316 stainless     |

steel

5. Ports : 1/2 " NPT (F)
6. Rating : 420 Kg/Sq. cm at ambient
7. Operating Temperature : (-)30 to (+)170 Deg C
8. Packing : PTFE Wafer
9. Seat & Stem : AISI 316 SS
10. Plug : AISI 316 SS free to turn on stem / 17-4 PH
11. Handle Bar : AISI 316 SS
12. Connection : Straight
13. Accessories : Plugs for all ports, Mounting Bracket , bolts , nuts

10.06.00 Pneumatic Hook Up Accessories

10.06.01 Air Header

| Technical Particulars    | For Panel                        | For Field                         |
|--------------------------|----------------------------------|-----------------------------------|
| Material of Construction | : Stainless steel                | : Stainless steel                 |
| Inlet Connection         | : 2" NPT (M)                     | : 1" NPT (M)                      |
| Header Take-off Material | : Stainless steel                | : Stainless steel                 |
| Take off connection      | : 1 / 2" NPT (M)                 | : 1/ 2" NPT (M)                   |
| Take-off Valves Material | : stainless steel                | : stainless steel                 |
| Tube Take-off            | : Tube adapter on valve          | : Tube adapter on valve           |
| Drain                    | : SS drain valve at lowest point | : SS drain valves at lowest point |

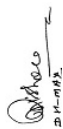
10.06.02 Seamless Stainless Steel Tube

1. Reference : ASTM A-269 TP 316
2. Material Grade : TP 316
3. Size : 1/4" OD X 0.049" wall thickness

4. Type : Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
5. Properties : The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
6. Test Pressure : 400 Kg/Sq. cm
7. Tolerance :  $\pm 0.13$  mm for outside diameter  
:  $\pm 15$  % for wall thickness
8. Standard Length : 5 meter
9. Test : Flare, Hardness, Ball and Bubble Test

11.00.00 **SPECIAL TOOLS & TACKLE AND TEST EQUIPMENT FOR AND OTHER SYSTEMS**

- 11.01.00 Bidder shall supply a complete set of new, unused and reliable type of special tools and tackle and test equipment which are necessary or convenient for erection, commissioning, maintenance and overhaul of the plant and equipment provided under this specification.
- 11.02.00 The tools & tackle and Test Equipment shall be shipped in separate container, clearly marked with names of the equipment for which they are intended.
- 11.03.00 Bidder shall furnish list of tools & tackle and test equipment proposed to be supplied along with the bid.

  
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~~material with suitably colored lettering engraved on the back.~~

- ~~c) The nameplates shall be held by self tapping screws. The size of nameplate shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for the panels.~~
- ~~d) Items of plant such as valves, which are subject to handling, are to be provided with an engraved chromium plated nameplate or label with engraving filled with enamel, suitably mounted or affixed with strong rustproof chain.~~
- ~~e) All such nameplates, instruction plates, lubrication charts etc. shall be with English inscriptions.~~

#### 8.00.00 ~~METERING BASES AND CHART UNITS~~

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

- ~~i) Pressure : Kg/cm<sup>2</sup>~~
- ~~Differential Pressure : mm of H<sub>2</sub>O column / Kg/cm<sup>2</sup>~~
- ~~ii) Draught : mm of H<sub>2</sub>O column~~
- ~~iii) Vacuum : Kg/cm<sup>2</sup> (abs)/mm of Hg column~~
- ~~iv) Temperature : Degree Celsius (°C)~~
- ~~v) Flow (Steam, Water) : Tonnes / hr, M<sup>3</sup>/Hr~~
- ~~vi) Flow (Oil) : M<sup>3</sup> / Hr, Litter/Hr~~
- ~~vii) Flow Air : Tonnes / hr / M<sup>3</sup> / Hr.~~
- ~~viii) Density : gms / c.c.~~
- ~~ix) Level : mm /%~~
- ~~x) Conductivity : μS / cm or mS/cm~~
- ~~xi) Gas Analyzer : Percentage by weight or as specified in respective case.~~
- ~~xii) Dissolved Oxygen / Silica / Sodium : ppm /ppb~~

#### 9.00.00 ~~PROCESS CONNECTION & INSTRUMENT HOOK UP~~

- 9.01.00 Instrument connection to the process system (piping, vessel etc.) shall be according to the process & piping specification upto and including the root valves. Root valves shall be installed as close as possible to the piping or vessel.

- 9.02.00 Each instrument shall have its own independent connection to the process except for instruments located on standpipe. Each instrument shall be connected independently to the standpipe through isolation valve.
- 9.03.00 Isolation and blowdown drain valves adequate for duty and capable of withstanding continuous design condition of main process shall be provided. Instrument blow down valve near to the instrument shall be of gradual opening type. For process pressure equal or above 40 kg/ sq.cm double blowdown valves shall be used connecting to blowdown header. Instrument manifold / gauge valve shall be installed close to the instrument.
- 9.04.00 The nominal size of the takeoff connections on line shall not be less than NPS ½" for source conditions not in excess of either 900 psi or 425OC and NPS ¾" (for adequate physical strength) for design conditions exceed either of these limits. Where the size of the main is smaller than the limits given above, the takeoff connections shall not be less than the size of the main line.
- 9.05.00 Process connection for instruments lines and vessels shall be in accordance to standards such as ASME or other recognized international standards. Table below indicates the type of connection generally to be used.

| INSTRUMENTS                 | EQUIPMENT / PIPE SIDE                                                                                               | INSTRUMENT SIDE |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------|-----------------|
| <b>Level Instruments</b>    |                                                                                                                     |                 |
| Internal Displacer          | 4" - Flanged                                                                                                        | 4" - Flanged    |
| External Displacer          | 2" - Flanged                                                                                                        | 2" - Flanged    |
| Level gauge                 | ¾" -Flanged                                                                                                         | ¾" - Flanged    |
| DP Type                     | ½" (min.)-welded<br>1" – welded for vessel like HP heaters, LP heaters, De-aerator etc. application                 | ½"- NPT         |
| External cage Level switch  | 1"- welded                                                                                                          | 1"- welded      |
| <b>Flow Instruments</b>     |                                                                                                                     |                 |
| DP Type                     | ½" - welded in general<br>1" – welded for high pressure / temperature main steam, feed water, PRDS etc. application | ½" - NPT        |
| <b>Pressure Instruments</b> |                                                                                                                     |                 |
| Conventional                | ½" (min.)-welded<br>1"- welded for high pressure/                                                                   | ½" - NPT        |

| INSTRUMENTS                    | EQUIPMENT / PIPE SIDE                                                | INSTRUMENT SIDE |
|--------------------------------|----------------------------------------------------------------------|-----------------|
|                                | temperature main steam, feed water, PRDS etc. application            |                 |
| Diaphragm type-HFO application | 3"- Flanged                                                          | 3"- Flanged     |
| <b>Temperature Instruments</b> |                                                                      |                 |
| Thermowell                     | Generally - M 33 X2 (M);<br>1½" Flanged- For air/FG path application | ½" NPT          |
| <b>Analyzer</b>                |                                                                      |                 |
| Liquid analyzer                | ½"- 1" - welded                                                      | ½"              |

- 9.06.00 Size of impulse pipe for pressure measurement in air and flue gas duct path of boiler shall not be less than ¾" NB.
- 9.07.00 Separate stubs and take-off points with thermo well / root vlves shall be provided for performance guarantee test.
- 9.08.00 Impulse pipes shall be clamped at suitable interval not exceeding 1.5 meter. Process pipe shall not be used for supporting the impulse pipe.
- 9.09.00 Fittings shall conform to ANSI B 16.11. Threads of piping component shall be of tapered construction.
- 9.10.00 Instrument blowdown header shall in no case be lower than the material grade ASTM A 106 Gr. C.
- 9.11.00 Impulse pipe shall be laid at least with slope of gradient 1:10 to avoid any air pocket or water accumulation.
- 9.12.00 Expansion loop shall be provided at least at every 2.5 meter interval without affecting the gradient of slope in long run impulse pipe to avoid stress on the piping.
- 9.13.00 Siphon shall be provided in the impulse pipe or tube to protect the instruments where fluid temperature is 100 OC or more.
- 9.14.00 Orientation of tappings shall be as follows :
- For liquid service within 45 ° at lower half of the pipe horizontal plane.
  - For gas service within 90 ° at upper half of the pipe horizontal plane.
  - For steam service within 45 ° at upper half of the pipe horizontal plane.

As a rule tap orientation of high and low pressure side should be parallel and symmetrical.

- 9.15.00 Pressure & Differential pressure instruments in steam and liquid services shall be located below the taps and the piping shall be sloped to avoid formation of air pocket.
- 9.16.00 Pressure & Differential pressure instruments in air and flue gas service shall be located above the taps and the piping shall be sloped back to process to avoid formation of any liquid.
- 9.17.00 Impulse pipe including taps for furnace, flue gas and coal mill application shall be provided with air purge connection. Differential instruments for such application shall have continuous and as well as intermittent purging. Whereas, pressure measurement shall have only intermittent purging.
- 9.18.00 Material of impulse pipe for the instruments mounted on rack and enclosure shall be same as that of main process pipe except stainless steel tube of Gr. 316 or better shall be provided for connection in between impulse pipe (from tee connection on impulse pipe) and instrument manifold valve & instruments. Impulse pipe, tubes, fittings and accessories shall have the same design pressure and temperature applicable for the related main pipe.

#### ~~10.00.00 POWER SUPPLY SYSTEMS~~

~~10.01.00 Instrumentation power supply system shall include all conditioning equipment required to accommodate normal variations in the electrical supply. All panels and cabinets shall accept redundant power feeds from two different sources.~~

~~10.02.00 Type of power supply systems envisaged for the various I & C system including DCS are as follows:~~

- ~~a) 240V AC Redundant UPS system HMIs, Main Plant Field devices / equipment, CCTV, EWLI, CEMS, SWAS etc. and PLC of package System~~
- ~~b) 24V / 48 VDC Supply for DCS~~

#### ~~11.00.00 ENVIRONMENTAL CONSIDERATIONS~~

~~I & C components should operate properly with no degradation in expected lifetime or in operation parameter in the normal power plant environment. I & C system shall be designed considering all the operating conditions which may be encountered during installation and operation.~~

~~11.01.00 Temperature~~

~~11.01.01 Where the environmental extreme exceeds the capabilities of the selected system, Bidder should take appropriate steps to control the environment.~~

~~11.02.00 Humidity~~

~~11.02.01 I & C system shall be designed to withstand the humidity limits specified for the project. Condensation shall not be allowed to form in the cabinets nor~~

~~For Other details as given in sub-section of Battery & Battery charger specification~~

#### 4.07.00 ~~Step-down transformer and voltage stabilizer~~

- a) ~~A three phase to single phase transformer along with associated voltage stabilizer shall be furnished with the UPS system.~~
- b) ~~The transformer and stabilizer shall be sized for 100% UPS load and shall coordinate with the largest branch circuit protection device for feeder short circuit current without sacrificing voltage regulation.~~
- c) ~~The voltage stabilizer shall employ silicon solid state circuitry and shall maintain the specified output voltage for 0 to 100% load with maximum input voltage variation as indicated in the annexure.~~
- d) ~~Provision shall be kept for dead closing of static transfer switch from stabilizer circuit to inverter when the output of the stabilizer is zero, but at that time the inverters are running.~~

#### 4.08.00 **A.C. Distribution Boards**

- a) The distribution boards shall be fixed type, of modular design in freestanding gasketed sheet steel enclosure conforming to IP-52. Sheet steel thickness shall be 2 mm minimum for load bearing members and 1.6mm for non-load bearing members.
- b) Each module shall be housed in a separate compartment complete with individual front access door. Working height shall be limited to 1800 mm from floor level.
- c) A full height vertical cable alley shall be provided in each panel to facilitate module wiring. The alley shall be liberally sized and shall have removable cover at the front. Removable back covers shall be provided at the back of the panels.
- d) Incomer shall be provided with Moulded Case Circuit Breaker (MCCB) and outgoing feeders shall be provided with Switch-fuse units.

MCCB shall be suitable to make & break rated short-circuit current (25kA minimum) having in-built short circuit & over-load (adjustable type) protections.

- e) Switches shall be double pole, air break, heavy duty (AC 22) type, capable of safely making and breaking the full load current of associate circuit.
- f) Switch handle shall have position indicator and provision of padlocking in ON & OFF positions. Further it shall be interlocked with access door for safety.
- g) Fuses shall be HRC, preferably link type, design to permit easy & safe replacement. Visible indication shall be provided for indication of fuse.

- h) Incomer feeder shall be provided with Ammeter, Voltmeter, Power factor meter & bus energizes indicating lamp with fuse and outgoing feeders with feeder energizes indicating lamp with fuse.
- i) All indicating meters are 96 mm sq. digital type with LED display and all indicating lamps are clustered LED type so that lamp can be replaceable from front of the panel.

~~4.09.00~~~~UPS Cabinets/Enclosures~~

- a) ~~The UPS system components shall be housed in a sheet steel freestanding IP-42 enclosure with all access from the front. Sheet steel thickness shall be 2 mm minimum.~~
- b) ~~The enclosure shall consist of vertical cabinets housing modules in rack type sub-assemblies, connected mechanically and electrically to form a rigid, self-supporting, metal enclosed structure.~~
- c) ~~The modular units shall be mounted in pull out and/or swing trays. Each module shall be capable of being easily removed to provide for the ready inspection of major solid state devices.~~
- d) ~~Vertical wiring trough shall be provided for the entire height of the UPS cabinet. Cable entry shall be from bottom only.~~
- e) ~~Adequate ventilating louvers and screens shall be provided. The top of the panel shall be protected by a suitable drip cover to prevent entrance of falling liquid and foreign material.~~
- f) ~~If the equipment supplied requires forced air cooling, the cooling system furnished shall meet the following requirement :~~
  - i) ~~Two (2) nos. 100% cooling fans shall be provided for each vertical panel.~~
  - ii) ~~Completely independent duplicate protection, control and wiring systems shall be provided for the cooling fans for redundancy.~~
  - iii) ~~The cooling fans shall be powered from the output of the associated inverter. Normally one fan will be running while the other is on stand-by.~~
  - iv) ~~Each cooling fan shall be equipped with an airflow switch having an alarm contact that closes upon failure of airflow.~~

~~4.10.00~~~~Alarms~~

- a) ~~Solid state audio-visual annunciation system shall be provided for inverters, static transfer switch, battery charger.~~
- b) ~~Alarm facia shall be provided on each charger and inverter panel, complete with proper actuating devices, circuitry and legends.~~

|                    |                                                                                                                                                                                                                   |              |                                                                                                       |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------------------------------------------------------------------------------------------------|
| <del>5.05.00</del> | <del>Cooling</del>                                                                                                                                                                                                | <del>:</del> | <del>Natural convection or forced cooling using redundant fans.</del>                                 |
| <del>5.06.00</del> | <del>Design Ambient Temperature</del>                                                                                                                                                                             | <del>:</del> | <del>50 Deg.C</del>                                                                                   |
| <del>5.07.00</del> | <del>A.C. input :</del>                                                                                                                                                                                           |              |                                                                                                       |
|                    | <del>a) Supply</del>                                                                                                                                                                                              | <del>:</del> | <del>415V, 3 phase, 50 Hz</del>                                                                       |
|                    | <del>b) Voltage variation</del>                                                                                                                                                                                   | <del>:</del> | <del>±10%</del>                                                                                       |
|                    | <del>c) Frequency variation</del>                                                                                                                                                                                 | <del>:</del> | <del>± 5%</del>                                                                                       |
|                    | <del>d) Combined volt frequency variation</del>                                                                                                                                                                   | <del>:</del> | <del>10% (absolute sum)</del>                                                                         |
|                    | <del>e) Short circuit level</del>                                                                                                                                                                                 | <del>:</del> | <del>50 KA</del>                                                                                      |
|                    | <del>f) System earthing</del>                                                                                                                                                                                     | <del>:</del> | <del>Solidly grounded</del>                                                                           |
| <del>5.08.00</del> | <del>D.C. output</del>                                                                                                                                                                                            | <del>:</del> | <del>100% UPS load plus restoring fully discharged battery to full charge condition in 8 hours.</del> |
| <del>5.09.00</del> | <del>Blocking Diode, Peak inverse voltage</del>                                                                                                                                                                   | <del>:</del> | <del>800 V (minimum)</del>                                                                            |
| <del>5.10.00</del> | <del>Performance Requirement</del>                                                                                                                                                                                |              |                                                                                                       |
|                    | <del>a) The output voltage of the charger shall be regulated within ± 1% of the set value for any load variation from 0 to 100% and A.C input voltage and frequency variation as indicated above in 4.06.00</del> |              |                                                                                                       |
|                    | <del>b) The ripple content in charger D.C. output shall be limited to less than ± 1% with battery and less than ± 2% without battery.</del>                                                                       |              |                                                                                                       |
| 6.00.00            | DISTRIBUTION BOARDS                                                                                                                                                                                               |              |                                                                                                       |
| 6.01.00            | Type                                                                                                                                                                                                              | :            | Fixed, Modular construction.                                                                          |
| 6.02.00            | Enclosure                                                                                                                                                                                                         | :            | Sheet Steel, IP52                                                                                     |
| 6.03.00            | Mounting                                                                                                                                                                                                          | :            | Free standing<br>(can be attended from both front & back)                                             |



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

### CHECK LIST FOR PRESSURE SWITCH

| Sl. No. | Test / Checks                         | Quantum of check | Reference Doc. / Acceptance Norms | Agency ** |   |   | Remarks |
|---------|---------------------------------------|------------------|-----------------------------------|-----------|---|---|---------|
|         |                                       |                  |                                   | M         | C | B |         |
| 1       | CHECK FOR                             | SEE NOTE-1 BELOW | APPROVED SPEC./ DATA SHEETS       | P         | V | V |         |
|         | 1.1 MODEL NO/TAG NO                   |                  |                                   |           |   |   |         |
|         | 1.2 RANGE                             |                  |                                   |           |   |   |         |
|         | 1.3 END CONN                          |                  |                                   |           |   |   |         |
|         | 1.4 NO. OF CONTACT                    |                  |                                   |           |   |   |         |
| 2       | CALIBRATION                           |                  |                                   | P         | V | V |         |
|         | 2.1 REPEATABILITY                     |                  |                                   |           |   |   |         |
|         | 2.2 SET POINT ADJUSTMENT              |                  |                                   |           |   |   |         |
|         | 2.3 DIFFERENTIAL                      |                  |                                   |           |   |   |         |
| 3       | OVER PR & LEAK TEST                   | P                |                                   | V         | V |   |         |
| 4       | ELECT. INSULATION/HV TEST             | ONE              |                                   | P         | V | V |         |
| 5       | REVIEW OF TC FOR MATERIALS OF         | FOR LOT          |                                   | V         | V | V |         |
|         | 5.1 SENSOR                            |                  |                                   |           |   |   |         |
|         | 5.2 MOVEMENT                          |                  |                                   |           |   |   |         |
|         | 5.3 PROCESS CONNECTION                |                  |                                   |           |   |   |         |
|         | 5.4 HOUSING                           |                  |                                   |           |   |   |         |
| 6       | REVIEW OF TC FOR DEGREE OF PROTECTION | TYPE TEST        |                                   | V         | V | V |         |
| 7       | REVIEW OF TC OF MICROSWITCH           | FOR LOT          |                                   | V         | V | V |         |

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#### Note :

- Quantum of check shall be as below :  
100 % - By Manufacturer
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and the same alongwith test certificates to be verified by BHEL



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

### CHECK LIST FOR TRANSMITTER

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

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#### Note :

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



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

### CHECK LIST FOR PRESSURE & DP GAUGE

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

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#### Note :

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



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

### CHECK LIST FOR LEVEL GAUGE

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

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#### Note :

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



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

### CHECK LIST FOR ANNUNCIATORS

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

#### Legend :

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P = Perform, W = Witness, V = Verification

#### Note :

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

|                                         |                              |                                                      |
|-----------------------------------------|------------------------------|------------------------------------------------------|
|                                         | 1X800 MW Wanakbori STPP      | SECTION: C<br>SUB SECTION :<br>C&I<br>SHEET 13 of 18 |
|                                         | TECHNICAL REQUIREMENTS (C&I) |                                                      |
| <div>CONTROL PANELS SPECIFICATION</div> |                              |                                                      |

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7.12.00 Panels, Cubicles and Enclosures

7.12.01 General

- a) All panels, cubicles and enclosures shall be furnished complete with integral piping, internal wiring, convenience outlets, internal lighting, grounding, ventilation, space heating, vibration isolating pads and other accessories.
- b) Unless otherwise specified cable entry for panels / desks / cabinets shall be through bottom via glanding plate. Fireproof seal shall be used to seal the bottom to prevent entry of dust.
- c) Panels and cabinets shall be constructed from steel sheet reinforced as required to provide true surface and adequate support for devices mounted thereon. Thickness of the steel plate shall conform to the requirements of UL 50 or equivalent standard. Panels and cabinets shall be of adequate strength to support mounted components during shipment and to support a concentrated load of 100 Kilograms on their top after erection.
- d) Panel /cabinet shall have eyebolt on top for lifting.

7.12.02 Surface Preparation and Painting

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

- a) Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale. Oil, grease and salts etc. shall be removed from by one or more solvent cleaning methods prior to blasting.
- b) Two spray coats of epoxy primer surfacer shall be applied to all exterior and interior surfaces, each coat of primer surfacer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades:
  - i) Exterior – RAL 7032.
  - ii) Interior - Brilliant White.
- c) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections shall not be acceptable.

7.12.03 Wiring

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

- a) All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks.
- b) Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized print shall be used with cross- identification.
- c) Wire termination shall be made with insulated sleeve and crimping type lugs. All external connections shall be made with one wire per terminal. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs shall not be used.
- d) Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables.
- e) Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring.
- f) All low-level signal cables shall be separately bundled from control cable.
- g) Wires shall be dressed and run in troughs with clamp-on type covers. Wirings shall be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.
- h) Shield wires shall be terminated on separately.
- i) Common connections shall be limited to two wires per terminal.
- j) Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue to the conductor.
- k) Wiring shall be arranged to enable instruments or devices to be removed and/or serviced without disturbing the wiring. No wire shall be routed across the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices.
- l) Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.
- m) Panels /cabinets /desks shall be provided with removable gasketed cable gland plates and cable glands. Split type grommets shall be used for prefab cables.
- n) Wire shall be multistranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-1981.

- a) System cabinet AC and DC ground shall be electrically isolated from each other and also electrically isolated from the Instrumentation signal ground. All the above ground shall be individually connected to the single point on the ground pit. Dedicated redundant earth pit shall be provided which shall be away from the HV equipment. This earth pit shall not be shared with other electrical equipment ground and shall also be insulated from other electrical system ground to ensure single point grounding of the system. Grounding resistance shall be better than 1.0 ohm. IEEE guideline shall be followed while designing the grounding system.
- b) Panels and cabinets shall be provided with a continuous tinned copper ground bus bar of minimum 25 mm x 3 mm cross section, extending along the entire length of the panel / desk / cabinet assembly. The ground bus shall be bolted to the panel structure and effectively ground the entire structure.
- c) The panel /desk /enclosure /JB ground shall have two (2) bolt drilling with GI bolts and nuts at each end to connect to GI/ copper flat ground riser by means of insulated copper ground cable of required cross section with lug.
- d) Circuits requiring grounding shall be individually and directly connected to the panel ground bus.
- e) For electronic system cabinets, the electronic system ground bus shall be similar but insulated from the cabinet and shall be separately connected to the system ground. Signal cable shields shall be grounded at the panel end only and shall not be left open. The ground in between panels of a shipping section shall be firmly looped.
- f) Electrical meters, relays, transmitters and switching devices, operating at a voltage less than 50V may be grounded through the steel structure.

7.12.05 Panel / Cabinet/ Desk/Enclosures Environmental Protections

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

| SL. NO. | LOCATION                                                    | ENCLOSURE TYPE                                                          |
|---------|-------------------------------------------------------------|-------------------------------------------------------------------------|
| 1.      | Indoor type non- ventilated enclosure in non-hazardous area | IP-54                                                                   |
| 2.      | Indoor type ventilated enclosure in non-hazardous area      | IP -42                                                                  |
| 3.      | Enclosure in Air conditioned area                           | IP-22 with suitable canopy at top to prevent ingress of dripping water. |
| 4.      | Outdoor type in non-hazardous areas                         | IP-55                                                                   |
| 5.      | Outdoor in hazardous areas                                  | As per requirements of the NEC Code for the location                    |

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

7.12.06 Terminal Blocks

- a) Terminals shall be chromated galvanized DIN rail mounted screwless cage clamp type. Terminals shall have screwed connection for conductor cross-section above 2.5 mm<sup>2</sup>. Terminal blocks shall conform to IEC 947-7-1.
- b) The characteristics of the terminal blocks shall be as follows.
- High contact force, independent of conductor cross-section and large contact surface area.
  - Self-loosening protection.
  - Resistant to thermal aging and vibration.
  - Low and constant voltage drop
- c) Tension spring shall be made of high quality, non-rusting, acid-resistant steel. The current bar shall be of tin-lead plated copper or brass.

- d) Terminals shall be of non flammable suitable thermoplastic material such as polyamide.
- e) Terminal blocks shall be mounted vertically in panels and cubicles with clearance for at least 100 mm between two sets and between wall and terminal block.
- f) Terminal blocks shall be provided with white marking strips / self-adhesive marker cards. Power terminals shall have protection covers.
- g) At least 10%percent spare unwired terminals shall be provided for all panels /cabinets /desks /junction box etc.. This shall be in addition to 10%spare wired terminals of spare IO channels and 10% wired spare modules.
- h) Bottom of the terminal block shall be at least 200 mm above the cable gland plate for bottom entry type panels.
- i) For extending 24 V / 48 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.
- j) Other requirements of the terminal blocks are as follows:
  - i) The last block in a rail-mounted assembly shall be closed with an end plate and end bracket.
  - ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.
  - iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.
  - iv) It shall be possible to use jumper plugs through the test plug socket to connect adjacent terminals.
  - v) Where more than one connection to a terminal block is required, two tier terminals shall be used.
  - vi) Terminal blocks shall be of different colors depending on voltage levels.

#### 7.12.07 Nameplates and Labels

- a) Each item shall have permanently attached to it, in a prominent position, a rating plate of non-corrosive material upon which is to be engraved the manufacturer's name, equipment, type / model number, range, serial number, together with details of the loading conditions under which the item of plant in question has been designed to operate.
- b) Such nameplates or labels are to be of white non-hygroscopic material with engraved black lettering, or alternatively of transparent plastic

material with suitably colored lettering engraved on the back.

- c) The nameplates shall be held by self-tapping screws. The size of nameplate shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for the panels.
- d) Items of plant such as valves, which are subject to handling, are to be provided with an engraved chromium plated nameplate or label with engraving filled with enamel, suitably mounted or affixed with strong rustproof chain.
- e) All such nameplates, instruction plates, lubrication charts etc. shall be with English inscriptions.

#### 8.00.00 METERING BASES AND CHART UNITS

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

- i) Pressure : Kg/cm<sup>2</sup>  
Differential Pressure : mm of H<sub>2</sub>O column / Kg/cm<sup>2</sup>
- ii) Draught : mm of H<sub>2</sub>O column
- iii) Vacuum : Kg/cm<sup>2</sup> (abs)/mm of Hg column
- iv) Temperature : Degree Celsius (°C)
- v) Flow (Steam, Water) : Tonnes / hr, M<sup>3</sup>/Hr
- vi) Flow (Oil) : M<sup>3</sup> / Hr, Litter/Hr
- vii) Flow Air : Tonnes / hr / M<sup>3</sup> / Hr.
- viii) Density : gms / c.c.
- ix) Level : mm /%
- x) Conductivity : μS / cm or mS/cm
- xi) Gas Analyzer : Percentage by weight or as specified in respective case.
- xii) Dissolved Oxygen / Silica / Sodium : ppm /ppb

#### ~~9.00.00 PROCESS CONNECTION & INSTRUMENT HOOK UP~~

~~9.01.00 Instrument connection to the process system (piping, vessel etc.) shall be according to the process & piping specification upto and including the root valves. Root valves shall be installed as close as possible to the piping or vessel.~~

~~As a rule tap orientation of high and low pressure side should be parallel and symmetrical.~~

~~9.15.00 Pressure & Differential pressure instruments in steam and liquid services shall be located below the taps and the piping shall be sloped to avoid formation of air pocket.~~

~~9.16.00 Pressure & Differential pressure instruments in air and flue gas service shall be located above the taps and the piping shall be sloped back to process to avoid formation of any liquid.~~

~~9.17.00 Impulse pipe including taps for furnace, flue gas and coal mill application shall be provided with air purge connection. Differential instruments for such application shall have continuous and as well as intermittent purging. Whereas, pressure measurement shall have only intermittent purging.~~

~~9.18.00 Material of impulse pipe for the instruments mounted on rack and enclosure shall be same as that of main process pipe except stainless steel tube of Gr. 316 or better shall be provided for connection in between impulse pipe (from tee connection on impulse pipe) and instrument manifold valve & instruments. Impulse pipe, tubes, fittings and accessories shall have the same design pressure and temperature applicable for the related main pipe.~~

#### ~~10.00.00 POWER SUPPLY SYSTEMS~~

~~10.01.00 Instrumentation power supply system shall include all conditioning equipment required to accommodate normal variations in the electrical supply. All panels and cabinets shall accept redundant power feeds from two different sources.~~

~~10.02.00 Type of power supply systems envisaged for the various I & C system including DCS are as follows:~~

- ~~a) 240V AC Redundant UPS system HMIs, Main Plant Field devices / equipment, CCTV, EWLI, CEMS, SWAS etc. and PLC of package System~~
- ~~b) 24V / 48 VDC Supply for DCS~~

#### ~~11.00.00 ENVIRONMENTAL CONSIDERATIONS~~

~~I & C components should operate properly with no degradation in expected lifetime or in operation parameter in the normal power plant environment. I & C system shall be designed considering all the operating conditions which may be encountered during installation and operation.~~

~~11.01.00 Temperature~~

~~11.01.01 Where the environmental extreme exceeds the capabilities of the selected system, Bidder should take appropriate steps to control the environment.~~

~~11.02.00 Humidity~~

~~11.02.01 I & C system shall be designed to withstand the humidity limits specified for the project. Condensation shall not be allowed to form in the cabinets nor~~

should water be allowed to be admitted through conduit entering the cabinets from top or sides.

11.03.00 Atmospheric Contamination

11.03.01 Particulate contamination from fly ash and coal dust and gaseous contaminants such as SO<sub>2</sub> and other flue gas constituents in the coal fired plant are foreseen. This hazard shall be taken into design considerations.

11.04.00 Vibration

11.04.01 Design of the systems shall include features such as locking devices, anti vibration pads etc, to withstand vibration. In general, I&C equipment shall be installed away from the vibration zone.

11.05.00 Lightning

11.05.01 Protection against lightning shall be considered by providing proper grounding, metal oxide varistors, spark gap lightning arrestor, optical isolator and isolation transformer.

12.00.00 **SECURITY**

12.01.00 Door lock shall be provided in all Panels, Cabinets and Enclosures.

12.02.00 System mode key switch or password to prevent tampering of system program.

12.03.00 Redundant elements of the system shall not be exposed to the common hazards. For example routing of the redundant network cable through separate cable raceway, using separate cabinet / separate rack for redundant controller and redundant IO modules.

~~13.00.00 **ACCEPTANCE TESTS**~~

~~The Bidder shall be required, as part of his Tender, to fully integrate and test all the equipment, included in his Tender, at site and respective Control packages at the manufacturer's works. Owner / Consultants shall witness these tests.~~

~~However, for DCS the Bidder shall consider in his Tender the following tests:~~

~~(a) Factory Acceptance Test (FAT)~~

~~After completion of manufacture of DCS and prior to delivery to Site, the manufacturer shall functionally test the assembled system. The test shall be carried out with all input / output cubicles, control processors, data highway, operator's consoles, Engineer's console and peripheral devices connected in the specified configuration. The fully configured software shall also be loaded and tested at the same time.~~

~~The FAT shall include the following activities:~~

- ~~• Complete hardware inspection;~~



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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 3.0 mm for load bearing sections (Mounted with instruments)  
2.0 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-55 unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).
- 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 as given in data sheet-A (No. PES-145A-DS1-0). 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 as given in data sheet-A (No. PES-145A-DS1-0) 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 as specified in data sheet-A (No. PES-145A-DS1-0) 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 as called for in the data sheet-A (No. PES-145-54A-DS1-0). 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

### 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 no. PES-145A-DS1-0
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 No. PES-145A-DS2-0
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, corrosion, incidental damage due



## SPECIFICATION FOR LOCAL PANELS

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

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DATE : 16-09-2013

SHEET 6 OF 6

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.

### 8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Local Panels : Data sheet no. PES-145A-DS1-0
- Data sheet C for Local Panels : Data sheet no. PES-145A-DS2-0

मुकुन्द एस. शर्मा  
 मंत्रालय पंचायत  
 सचिव



# DATA SHEET FOR LOCAL PANELS

SPECIFICATION NO.: PES-145-054A

VOLUME

SECTION

REV. NO. 01

DATE: 22.03.2011

SHEET 1 OF 2

TAG No. .... Qty.....

Data Sheet No.: PES-145A-DS1-0

## Data Sheet A & B

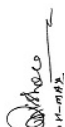
DATA SHEET-A FOR LOCAL PANEL  
(TO BE FILLED BY PURCHASER)

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

|                           |                                                |                                                                    |                                                                                                                                                                                                                    |
|---------------------------|------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>GENERAL</b>            | MANUFACTURER                                   |                                                                    |                                                                                                                                                                                                                    |
|                           | CONSTRUCTION                                   |                                                                    | <input type="checkbox"/> FOLDED <input type="checkbox"/> WELDED<br>(As per requirement EDN)                                                                                                                        |
|                           | ENCLOSURE SHEET THICKNESS                      | FRONT                                                              | <input checked="" type="checkbox"/> 3.0 mm (FOR FACES SUPPORTING INSTRUMENTS/TERMINALS)                                                                                                                            |
|                           |                                                | OTHER                                                              | <input checked="" type="checkbox"/> 2.0 mm (FOR OTHER SIDES AND TOP)                                                                                                                                               |
|                           |                                                | DOOR                                                               | <input checked="" type="checkbox"/> 2.0 mm                                                                                                                                                                         |
|                           |                                                | HEIGHT                                                             | <input type="checkbox"/> 2365 mm for stand alone panels. (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)                                                                                                     |
|                           | OTHER                                          | <input type="checkbox"/>                                           |                                                                                                                                                                                                                    |
| <b>TECHNICAL</b>          | INPUT POWER SUPPLY *                           |                                                                    | <input type="checkbox"/> 240V 50 Hz AC <input type="checkbox"/> 220V DC<br><input type="checkbox"/> 415V 3 PHASE 3W <input type="checkbox"/> 415V 3 PHASE 4W                                                       |
|                           | NO. OF FEEDERS                                 |                                                                    | <input type="checkbox"/> ONE <input checked="" type="checkbox"/> TWO                                                                                                                                               |
|                           | CONTROL SUPPLY                                 |                                                                    | <input type="checkbox"/> 110V AC <input type="checkbox"/> 220V AC<br><input type="checkbox"/> 220V DC <input type="checkbox"/> Other.<br>(As per requirement)                                                      |
|                           | ALARM ANNUNCIATOR WINDOW<br>(EXCLUDING SPARES) |                                                                    | _____ NOS. (AS REQUIRED)                                                                                                                                                                                           |
|                           | PAINT TYPE                                     |                                                                    | <input type="checkbox"/> EPOXY ENAMEL<br><input checked="" type="checkbox"/> EPOXY POWDER COATED OR BETTER (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)                                                   |
|                           | PANEL COLOUR (EXTERNAL)                        |                                                                    | <input type="checkbox"/> LIGHT GREY (Shade 631 IS-5)<br><input type="checkbox"/> OPALINE GREEN (Shade 275) .<br><input checked="" type="checkbox"/> RAL 7032 (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.) |
|                           | FINISH (EXTERNAL)                              |                                                                    | <input type="checkbox"/> MATT<br><input type="checkbox"/> GLOSSY <input type="checkbox"/> SEMI GLOSSY                                                                                                              |
|                           | PANEL COLOUR (INTERNAL)                        |                                                                    | <input type="checkbox"/> WHITE <input type="checkbox"/> CREAM<br><input type="checkbox"/> OFF WHITE <input checked="" type="checkbox"/> BRILLIANT WHITE                                                            |
|                           | FINISH (INTERNAL)                              |                                                                    | <input type="checkbox"/> MATT<br><input type="checkbox"/> GLOSSY <input type="checkbox"/> SEMI GLOSSY                                                                                                              |
|                           | CLASS OF PROTECTION                            |                                                                    | <input type="checkbox"/> IP-42 (FOR INDOOR SERVICE)<br><input checked="" type="checkbox"/> IP-55 (FOR OUTDOOR SERVICE) <input type="checkbox"/> ANY OTHER                                                          |
|                           | CONTROL HARDWARE                               |                                                                    | <input checked="" type="checkbox"/> RELAY BASED                                                                                                                                                                    |
|                           | FOUNDATION ARRANGEMENT                         |                                                                    | <input type="checkbox"/> FOUNDATION BOLTS <input type="checkbox"/> ANCHOR FASTENERS                                                                                                                                |
|                           | WEIGHT OF PANEL (Kg.)                          |                                                                    |                                                                                                                                                                                                                    |
|                           | PANEL TYPE                                     |                                                                    | <input type="checkbox"/> PRESSURISED <input type="checkbox"/> UNPRESSURISED<br>As per Requirement                                                                                                                  |
|                           | CABLE GLAND                                    |                                                                    | <input checked="" type="checkbox"/> DOUBLE COMPRESSION                                                                                                                                                             |
| AMMETER (TYPE OF INPUT) * |                                                | <input type="checkbox"/> 1 Amp CT <input type="checkbox"/> 4-20 mA |                                                                                                                                                                                                                    |

FORM NO. PEM-6666-0

|                                                                                   |                                    |            |                                       |                                                  |                  |
|-----------------------------------------------------------------------------------|------------------------------------|------------|---------------------------------------|--------------------------------------------------|------------------|
|  | <b>DATA SHEET FOR LOCAL PANELS</b> |            |                                       | SPECIFICATION NO.: PES-145-054A                  |                  |
|                                                                                   |                                    |            |                                       | VOLUME                                           |                  |
|                                                                                   |                                    |            |                                       | SECTION                                          |                  |
|                                                                                   |                                    |            |                                       | REV. NO. 01                                      | DATE: 22.03.2011 |
|                                                                                   |                                    |            |                                       | SHEET 2                                          | OF 2             |
| TAG No. .... Qty.....                                                             |                                    |            | Data Sheet No.: <b>PES-145A-DS1-0</b> |                                                  |                  |
| <b>Data Sheet A &amp; B</b>                                                       |                                    |            |                                       |                                                  |                  |
| DATA SHEET-A FOR LOCAL PANEL<br>(TO BE FILLED BY PURCHASER)                       |                                    |            |                                       | DATA SHEET-B<br>(TO BE FILLED-UP BY BIDDER)      |                  |
| * TO BE CO-ORDINATED WITH PEM ELECTRICAL                                          |                                    |            |                                       |                                                  |                  |
| NAME<br>SIGNATURE<br>DATE                                                         | PREPARED BY                        | CHECKED BY | APPROVED BY                           | COMPANY SEAL<br><br>NAME:<br>SIGNATURE:<br>DATE: |                  |
|                                                                                   |                                    |            |                                       |                                                  |                  |
|                                                                                   |                                    |            |                                       |                                                  |                  |
|                                                                                   |                                    |            |                                       |                                                  |                  |

  
 MUKESH K. SINGH  
 S-416/PMH 2011-11-15



# DATA SHEET FOR LOCAL PANELS

SPECIFICATION NO.: PES-145-054A

VOLUME

SECTION

REV. NO. 01

DATE: 22.03.2011

SHEET 2 OF 2

TAG No. .... Qty.....

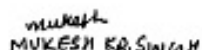
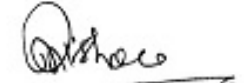
Data Sheet No.: PES-145A-DS1-0

## Data Sheet C

DATA SHEET-C FOR LOCAL PANEL  
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

|                           |                                                |                  |                                                                                             |                                                  |
|---------------------------|------------------------------------------------|------------------|---------------------------------------------------------------------------------------------|--------------------------------------------------|
| <b>GENERAL</b>            | MANUFACTURER                                   |                  |                                                                                             |                                                  |
|                           | CONSTRUCTION                                   |                  | <input type="checkbox"/> FOLDED <input type="checkbox"/> WELDED<br>(As per requirement EDN) |                                                  |
|                           | ENCLOSURE SHEET THICKNESS                      | FRONT            |                                                                                             |                                                  |
|                           |                                                | OTHER            |                                                                                             |                                                  |
|                           |                                                | DOOR             |                                                                                             |                                                  |
|                           |                                                | HEIGHT           |                                                                                             |                                                  |
|                           | OTHER                                          |                  |                                                                                             |                                                  |
| <b>TECHNICAL</b>          | INPUT POWER SUPPLY                             |                  |                                                                                             |                                                  |
|                           | NO. OF FEEDERS                                 |                  |                                                                                             |                                                  |
|                           | CONTROL SUPPLY                                 |                  |                                                                                             |                                                  |
|                           | ALARM ANNUNCIATOR WINDOW<br>(EXCLUDING SPARES) |                  |                                                                                             |                                                  |
|                           | PAINT TYPE                                     |                  |                                                                                             |                                                  |
|                           | PANEL COLOUR (EXTERNAL)                        |                  |                                                                                             |                                                  |
|                           | FINISH (EXTERNAL)                              |                  |                                                                                             |                                                  |
|                           | PANEL COLOUR (INTERNAL)                        |                  |                                                                                             |                                                  |
|                           | FINISH (INTERNAL)                              |                  |                                                                                             |                                                  |
|                           | CLASS OF PROTECTION                            |                  |                                                                                             |                                                  |
|                           | CONTROL HARDWARE                               |                  |                                                                                             |                                                  |
|                           | FOUNDATION ARRANGEMENT                         |                  |                                                                                             |                                                  |
|                           | WEIGHT OF PANEL (Kg.)                          |                  |                                                                                             |                                                  |
|                           | PANEL TYPE                                     |                  |                                                                                             |                                                  |
|                           | CABLE GLAND                                    |                  |                                                                                             |                                                  |
|                           | AMMETER (TYPE OF INPUT)                        |                  |                                                                                             |                                                  |
| NAME<br>SIGNATURE<br>DATE | PREPARED BY                                    | CHECKED BY       | APPROVED BY                                                                                 | COMPANY SEAL<br><br>NAME:<br>SIGNATURE:<br>DATE: |
|                           | Shiv Kumar                                     | Anisha B Singhal | Anisha B Singhal                                                                            |                                                  |
|                           |                                                |                  |                                                                                             |                                                  |
|                           |                                                |                  |                                                                                             |                                                  |

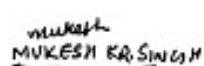
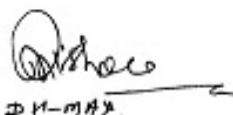
| <br>PEM :: C&I                                                                                                                                                                      |                                            | STANDARD QUALITY PLAN<br>FOR<br>LOCAL CONTROL PANEL |            |                      |                 |                                  |                                  | STD QUALITY PLAN NO.: <b>PE-QP-999-145-I056</b> |                     |     |     |         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|-----------------------------------------------------|------------|----------------------|-----------------|----------------------------------|----------------------------------|-------------------------------------------------|---------------------|-----|-----|---------|
|                                                                                                                                                                                                                                                                      |                                            |                                                     |            |                      |                 |                                  |                                  | VOLUME IIB                                      |                     |     |     |         |
|                                                                                                                                                                                                                                                                      |                                            |                                                     |            |                      |                 |                                  |                                  | SECTION D                                       |                     |     |     |         |
|                                                                                                                                                                                                                                                                      |                                            |                                                     |            |                      |                 |                                  |                                  | REV. NO. <b>01</b> DATE: <b>22-02-2008</b>      |                     |     |     |         |
|                                                                                                                                                                                                                                                                      |                                            |                                                     |            |                      |                 |                                  |                                  | SHEET 1 OF 7                                    |                     |     |     |         |
| Sl. No.                                                                                                                                                                                                                                                              | Component / operation                      | Characteristics Checked                             | * Category | Type/Method of Check | Extent of Check | Reference documents              | Acceptance Norms                 | Format of Records                               | Agency <sup>s</sup> |     |     | Remarks |
|                                                                                                                                                                                                                                                                      |                                            |                                                     |            |                      |                 |                                  |                                  |                                                 | P                   | W   | V   |         |
| 1.0                                                                                                                                                                                                                                                                  | <b>INCOMING</b><br>Sheet Steel (CRCA & HR) | 1. Chemical Composition                             | MA         | Chemical analysis    | Sample          | IS:1079<br>IS:513                | IS:1079<br>IS:513                | Test Certificate                                | 3                   | --- | 2   |         |
|                                                                                                                                                                                                                                                                      |                                            | 2. Bend Test                                        | CR         | Mech. test           | Sample          | IS:1079<br>IS:513                | IS:1079<br>IS:513                | Log Book                                        | 2                   | --- | --- |         |
|                                                                                                                                                                                                                                                                      |                                            | 3. Surface finish                                   | MA         | Visual               | 100%            | Factory Standard / Sample        | Factory Standard / Sample        | Log Book                                        | 2                   | --- | --- |         |
|                                                                                                                                                                                                                                                                      |                                            | 4. Waviness                                         | MA         | Visual               | 100%            | Factory Standard                 | No Waviness                      | Log Book                                        | 2                   | --- | --- |         |
|                                                                                                                                                                                                                                                                      |                                            | 5. Thickness                                        | MA         | Measurement          | 100%            | BHEL Spec.                       | BHEL Spec.                       | Log Book                                        | 2                   | --- | --- |         |
|                                                                                                                                                                                                                                                                      |                                            | 6. Mill marking                                     | MA         | Visual               | 100%            | Factory Standard                 | Factory Standard                 | Log Book                                        | 2                   | --- | 1   |         |
| 2.0                                                                                                                                                                                                                                                                  | Flats / Angles / Channels                  | 1. Dimensions                                       | MA         | Measurement          | Sample          | IS:2062                          | IS:2062                          | Log Book                                        | 2                   | --- | --- |         |
|                                                                                                                                                                                                                                                                      |                                            | 2. Surface Defects                                  | MA         | Visual               | 100%            | Factory Standard / Sample        | Factory Standard / Sample        | Log Book                                        | 2                   | --- | --- |         |
|                                                                                                                                                                                                                                                                      |                                            | 3. Straightness                                     | MA         | Measurement          | 100%            | Factory Std.                     | Factory Std.                     | Log Book                                        | 2                   | --- | --- |         |
|                                                                                                                                                                                                                                                                      |                                            | 4. Mill marking                                     | MA         | Visual               | 100%            | IS:2062                          | IS:2062                          | Log Book                                        | 2                   | --- | 1   |         |
| 3.0                                                                                                                                                                                                                                                                  | Cables / Wires                             | 1. Visual / Surface defects                         | MA         | Visual               | 100%            | BHEL Spec. and IS:1554 or IS:694 | BHEL Spec. and IS:1554 or IS:694 | Log Book                                        | 2                   | --- | --- |         |
|                                                                                                                                                                                                                                                                      |                                            | 2. IR and HV                                        | MA         | Electrical           | 100%            | BHEL Spec. and IS:1554 or IS:694 | BHEL Spec. and IS:1554 or IS:694 | Log Book                                        | 2                   | --- | --- |         |
| LEGEND: * CR - Critical characteristics<br>MA - Major characteristics<br>MI - Minor characteristics<br><sup>s</sup> P - Agency Performing the Test.<br>W - Agency Witnessing the Test.<br>V - Agency Verifying the Test.<br>1 - BHEL<br>2 - Vendor<br>3 - Sub-vendor |                                            |                                                     |            |                      |                 |                                  |                                  |                                                 |                     |     |     |         |

  
 MUKESH K. SINGH  
  
 S.A. KHAN  
  
 D.K. MAH

| <br>PEM :: C&I                                                                                                                                                                              |                                                                                                                                                                                  | STANDARD QUALITY PLAN<br>FOR<br>LOCAL CONTROL PANEL                                                                                                                                                          |                                                      |                                                                                                                        |                                                                                        |                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                          | STD QUALITY PLAN NO.: <b>PE-QP-999-145-I056</b>                                                          |                                                         |                                                                       |                                                                     |                                                                                       |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                              |                                                                                                                                                                                  |                                                                                                                                                                                                              |                                                      |                                                                                                                        |                                                                                        |                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                          | VOLUME IIB                                                                                               |                                                         |                                                                       |                                                                     |                                                                                       |
|                                                                                                                                                                                                                                                                              |                                                                                                                                                                                  |                                                                                                                                                                                                              |                                                      |                                                                                                                        |                                                                                        |                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                          | SECTION D                                                                                                |                                                         |                                                                       |                                                                     |                                                                                       |
|                                                                                                                                                                                                                                                                              |                                                                                                                                                                                  |                                                                                                                                                                                                              |                                                      |                                                                                                                        |                                                                                        |                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                          | REV. NO. <b>01</b> DATE: <b>22-02-2008</b>                                                               |                                                         |                                                                       |                                                                     |                                                                                       |
|                                                                                                                                                                                                                                                                              |                                                                                                                                                                                  |                                                                                                                                                                                                              |                                                      |                                                                                                                        |                                                                                        |                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                          | SHEET 2 OF 7                                                                                             |                                                         |                                                                       |                                                                     |                                                                                       |
| Sl. No.                                                                                                                                                                                                                                                                      | Component / operation                                                                                                                                                            | Characteristics Checked                                                                                                                                                                                      | * Category                                           | Type/Method of Check                                                                                                   | Extent of Check                                                                        | Reference documents                                                                                                                                                                                                                      | Acceptance Norms                                                                                                                                                                                                                         | Format of Records                                                                                        | Agency <sup>s</sup>                                     |                                                                       |                                                                     | Remarks                                                                               |
|                                                                                                                                                                                                                                                                              |                                                                                                                                                                                  |                                                                                                                                                                                                              |                                                      |                                                                                                                        |                                                                                        |                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                          |                                                                                                          | P                                                       | W                                                                     | V                                                                   |                                                                                       |
|                                                                                                                                                                                                                                                                              |                                                                                                                                                                                  | 3. Conductor<br>a) Resistance<br>b) Size<br>c) Sheet colour<br><br>4. Type / Routine Test Certificates                                                                                                       | MA<br>MA<br>MA<br><br>MA                             | Electrical Measurement<br>Visual<br><br>Verification                                                                   | 100%<br>100%<br>100%<br><br>100%                                                       | BHEL Spec. and IS:1554 or IS:694<br><br>BHEL Spec. and IS:1554 or IS:694                                                                                                                                                                 | BHEL Spec. and IS:1554 or IS:694<br><br>BHEL Spec. and IS:1554 or IS:694                                                                                                                                                                 | Log Book<br><br>Log Book                                                                                 | 2<br><br>3                                              | ---<br><br>---                                                        | ---<br><br>2                                                        |                                                                                       |
| 4.0                                                                                                                                                                                                                                                                          | Electrical Components like<br>Annunciator<br>Transformers<br>Lamps<br>Switches<br>PBs<br>Contactors<br>Relays<br>Timers<br>Space Heaters<br>Thermostat<br>Indicating meters etc. | 1. Verification at make and Type<br><br>2. Verification of Test Certificates<br><br>3. Operation / Functional check<br><br>4. I.R.<br><br>5. H.V.<br><br>6. Calibration<br><br>7. Pick up / Drop off Voltage | CR<br><br>CR<br><br>CR<br><br>MA<br><br>MA<br><br>MA | Visual<br><br>Scrutiny of Type / Routine T.Cs.<br><br>Electrical<br><br>Electrical<br><br>Electrical<br><br>Electrical | Sample<br><br>100%<br><br>Sample+ 100%<br><br>100%<br><br>100%<br><br>100%<br><br>100% | BHEL Spec. and BOM<br><br>Relevant IS<br><br>Relevant Indian Std & Catalogue<br><br>Relevant Indian Std & Catalogue<br><br>Relevant Indian Std & Catalogue<br><br>Relevant Indian Std & Catalogue<br><br>Relevant Indian Std & Catalogue | BHEL Spec. and BOM<br><br>Relevant IS<br><br>Relevant Indian Std & Catalogue<br><br>Relevant Indian Std & Catalogue<br><br>Relevant Indian Std & Catalogue<br><br>Relevant Indian Std & Catalogue<br><br>Relevant Indian Std & Catalogue | Log Book<br><br>Log Book<br><br>Log Book<br><br>Log Book<br><br>Log Book<br><br>Log Book<br><br>Log Book | 2<br><br>2<br><br>2<br><br>2<br><br>2<br><br>2<br><br>2 | ---<br><br>---<br><br>---<br><br>---<br><br>---<br><br>---<br><br>--- | ---<br><br>---<br><br>---<br><br>---<br><br>---<br><br>1<br><br>--- | + for relay & contactors only<br><br>@ for all components except relays & contactors. |
| LEGEND: * CR - Critical characteristics<br>MA - Major characteristics<br>MI - Minor characteristics<br><br><sup>s</sup> P - Agency Performing the Test.<br>W - Agency Witnessing the Test.<br>V - Agency Verifying the Test.<br><br>1 - BHEL<br>2 - Vendor<br>3 - Sub-vendor |                                                                                                                                                                                  |                                                                                                                                                                                                              |                                                      |                                                                                                                        |                                                                                        |                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                          |                                                                                                          |                                                         |                                                                       |                                                                     |                                                                                       |

MUKESH K. SINGH  
 S.A. KHAN  
 20-02-08

| <br>PEM :: C&I                                                                                                                                                                      |                                                            | STANDARD QUALITY PLAN<br>FOR<br>LOCAL CONTROL PANEL |            |                      |                 |                                |                                | STD QUALITY PLAN NO.: <b>PE-QP-999-145-I056</b> |                     |     |          |         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|-----------------------------------------------------|------------|----------------------|-----------------|--------------------------------|--------------------------------|-------------------------------------------------|---------------------|-----|----------|---------|
|                                                                                                                                                                                                                                                                      |                                                            |                                                     |            |                      |                 |                                |                                | VOLUME IIB                                      |                     |     |          |         |
|                                                                                                                                                                                                                                                                      |                                                            |                                                     |            |                      |                 |                                |                                | SECTION D                                       |                     |     |          |         |
|                                                                                                                                                                                                                                                                      |                                                            |                                                     |            |                      |                 |                                |                                | REV. NO. <b>01</b> DATE: <b>22-02-2008</b>      |                     |     |          |         |
|                                                                                                                                                                                                                                                                      |                                                            |                                                     |            |                      |                 |                                |                                | SHEET 3 OF 7                                    |                     |     |          |         |
| Sl. No.                                                                                                                                                                                                                                                              | Component / operation                                      | Characteristics Checked                             | * Category | Type/Method of Check | Extent of Check | Reference documents            | Acceptance Norms               | Format of Records                               | Agency <sup>s</sup> |     |          | Remarks |
|                                                                                                                                                                                                                                                                      |                                                            |                                                     |            |                      |                 |                                |                                |                                                 | P                   | W   | V        |         |
| 5.0                                                                                                                                                                                                                                                                  | Misc. Components like <b>Gaskets, Terminal Blocks etc.</b> | 1. Verification of Type / Make                      | MA         | Visual               | Sample          | BHEL Spec. & Mfrs. Catalogue   | BHEL Spec. & Mfrs. Catalogue   | Log Book                                        | 2                   | --- | ---      |         |
|                                                                                                                                                                                                                                                                      |                                                            | 2. Surface defects                                  | MA         | Visual               | Sample          | BHEL Spec. & Mfrs. Catalogue   | BHEL Spec. & Mfrs. Catalogue   | Log Book                                        | 2                   | --- | ---      |         |
|                                                                                                                                                                                                                                                                      |                                                            | 3. IR / HV on Terminal Blocks                       | MA         | Electrical           | Sample          | BHEL Spec. & Mfrs. Catalogue   | BHEL Spec. & Mfrs. Catalogue   | Log Book                                        | 2                   | --- | ---      |         |
| 6.0                                                                                                                                                                                                                                                                  | <b>IN PROCESS</b><br>Blanking / Bending / Forming          | 1. Dimensions                                       | MI         | Measurement          | 100%            | Approved Mfr. drgs.            | Approved Mfr. drgs.            | Log Book                                        | 2                   | --- | ---      |         |
|                                                                                                                                                                                                                                                                      |                                                            | 2. Surface defects after bending                    | MA         | Visual               | 100%            | <b>Factory Standard</b>        | <b>Factory Standard</b>        | Log Book                                        | 2                   | --- | ---      |         |
| 7.0                                                                                                                                                                                                                                                                  | Nibbling / Punching                                        | 1. Cutout Sizes                                     | MI         | Measurement          | 100%            | Approved Mfr. drgs.            | Approved Mfr. drgs.            | Log Book                                        | 2                   | --- | ---      |         |
|                                                                                                                                                                                                                                                                      |                                                            | 2. Deburring                                        | MA         | Visual               | 100%            | Approved Mfr. drgs.            | Approved Mfr. drgs.            | Log Book                                        | 2                   | --- | ---      |         |
| 8.0                                                                                                                                                                                                                                                                  | <b>ASSEMBLY</b><br>Frame Assembly & Sheet fixing           | 1. Dimensions                                       | MA         | Measurement          | 100%            | Approved drg. / Mfr. Standards | Approved drg. / Mfr. Standards | Log Book                                        | 2                   | --- | <b>2</b> |         |
|                                                                                                                                                                                                                                                                      |                                                            | 2. Alignment                                        | MA         | Measurement          | 100%            | Approved drg. / Mfr. Standards | Approved drg. / Mfr. Standards | Log Book                                        | 2                   | --- | <b>2</b> |         |
|                                                                                                                                                                                                                                                                      |                                                            | 3. Welding Quality                                  | MA         | Visual               | 100%            | Approved drg. / Mfr. Standards | Approved drg. / Mfr. Standards | Log Book                                        | 2                   | --- | <b>2</b> |         |
|                                                                                                                                                                                                                                                                      |                                                            | 4. Surface defects                                  | MA         | Visual               | 100%            | Approved drg. / Mfr. Standards | Approved drg. / Mfr. Standards | Log Book                                        | 2                   | --- | <b>2</b> |         |
| LEGEND: * CR - Critical characteristics<br>MA - Major characteristics<br>MI - Minor characteristics<br><sup>s</sup> P - Agency Performing the Test.<br>W - Agency Witnessing the Test.<br>V - Agency Verifying the Test.<br>1 - BHEL<br>2 - Vendor<br>3 - Sub-vendor |                                                            |                                                     |            |                      |                 |                                |                                |                                                 |                     |     |          |         |

 MUKESH K. SINGH  
 S.A. KHAN  
 D.H. MAH

| <br>PEM :: C&I                                                                                                                                                                      |                            | STANDARD QUALITY PLAN<br>FOR<br>LOCAL CONTROL PANEL        |            |                                                 |                 |                             |                             | STD QUALITY PLAN NO.: <b>PE-QP-999-145-I056</b> |                     |                         |   |         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------------------------------------------------|------------|-------------------------------------------------|-----------------|-----------------------------|-----------------------------|-------------------------------------------------|---------------------|-------------------------|---|---------|
|                                                                                                                                                                                                                                                                      |                            |                                                            |            |                                                 |                 |                             |                             | VOLUME IIB                                      |                     |                         |   |         |
|                                                                                                                                                                                                                                                                      |                            |                                                            |            |                                                 |                 |                             |                             | SECTION D                                       |                     |                         |   |         |
|                                                                                                                                                                                                                                                                      |                            |                                                            |            |                                                 |                 |                             |                             | REV. NO. <b>01</b>                              |                     | DATE: <b>22-02-2008</b> |   |         |
|                                                                                                                                                                                                                                                                      |                            |                                                            |            |                                                 |                 |                             |                             | SHEET 4                                         |                     | OF 7                    |   |         |
| Sl. No.                                                                                                                                                                                                                                                              | Component / operation      | Characteristics Checked                                    | * Category | Type/Method of Check                            | Extent of Check | Reference documents         | Acceptance Norms            | Format of Records                               | Agency <sup>s</sup> |                         |   | Remarks |
|                                                                                                                                                                                                                                                                      |                            |                                                            |            |                                                 |                 |                             |                             |                                                 | P                   | W                       | V |         |
| 9.0                                                                                                                                                                                                                                                                  | Pre-treatment and Painting | 1. Pretreatment Process                                    | MA         | Visual                                          | 100%            | Factory Standard & IS: 6005 | Factory Standard & IS: 6005 | Log Book                                        | 2                   | ---                     | 1 |         |
|                                                                                                                                                                                                                                                                      |                            | 2. Process parameters like bath temp. concentration etc.   | MA         | Measurement                                     | Periodic        | Factory Standard & IS: 6005 | Factory Standard & IS: 6005 | Log Book                                        | 2                   | ---                     | 1 |         |
|                                                                                                                                                                                                                                                                      |                            | 3. Dipping / Removal Time                                  | MA         | Measurement                                     | 100%            | Factory Standard & IS: 6005 | Factory Standard & IS: 6005 | Log Book                                        | 2                   | ---                     | 1 |         |
|                                                                                                                                                                                                                                                                      |                            | 4. Surface quality after every dip                         | MA         | Visual                                          | 100%            | Factory Standard & IS: 6005 | Factory Standard & IS: 6005 | Log Book                                        | 2                   | ---                     | 1 |         |
|                                                                                                                                                                                                                                                                      |                            | 5. Primer after phosphating                                | MA         | Visual, Thickness                               | 100%            | Factory Standard & IS: 6005 | Factory Standard & IS: 6005 | Log Book                                        | 2                   | ---                     | 1 |         |
|                                                                                                                                                                                                                                                                      |                            | 6. Putty Application & Rubbing after primer                | MA         | Visual                                          | 100%            | Factory Standard & IS: 6005 | Factory Standard & IS: 6005 | Log Book                                        | 2                   | ---                     | 1 |         |
|                                                                                                                                                                                                                                                                      |                            | 7. Paint first coat                                        | MA         | Visual, Thickness                               | 100%            | Factory Standard & IS: 6005 | Factory Standard & IS: 6005 | Log Book                                        | 2                   | ---                     | 1 |         |
|                                                                                                                                                                                                                                                                      |                            | 8. Putty Application and Rubbing after first coat of paint | MA         | Visual                                          | 100%            | Factory Standard & IS: 6005 | Factory Standard & IS: 6005 | Log Book                                        | 2                   | ---                     | 1 |         |
|                                                                                                                                                                                                                                                                      |                            | 9. Paint second coat                                       | MA         | Visual, Thickness, Scratch test Colour adhesion | 100%            | Factory Standard & IS: 6005 | Factory Standard & IS: 6005 | Log Book                                        | 2                   | ---                     | 1 |         |
| LEGEND: * CR - Critical characteristics<br>MA - Major characteristics<br>MI - Minor characteristics<br><sup>s</sup> P - Agency Performing the Test.<br>W - Agency Witnessing the Test.<br>V - Agency Verifying the Test.<br>1 - BHEL<br>2 - Vendor<br>3 - Sub-vendor |                            |                                                            |            |                                                 |                 |                             |                             |                                                 |                     |                         |   |         |

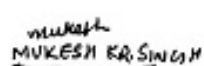
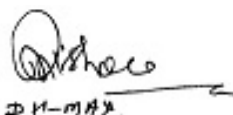
  
 MUKESH K. SINGH  
  
 S.A. KHAN  
  
 D.K. MAH

| <br>PEM :: C&I |                           | STANDARD QUALITY PLAN<br>FOR<br>LOCAL CONTROL PANEL                                               |            |                      |                 |                              |                              | STD QUALITY PLAN NO.: <b>PE-QP-999-145-I056</b> |                     |     |     |                                                                 |
|-------------------------------------------------------------------------------------------------|---------------------------|---------------------------------------------------------------------------------------------------|------------|----------------------|-----------------|------------------------------|------------------------------|-------------------------------------------------|---------------------|-----|-----|-----------------------------------------------------------------|
|                                                                                                 |                           |                                                                                                   |            |                      |                 |                              |                              | VOLUME IIB                                      |                     |     |     |                                                                 |
|                                                                                                 |                           |                                                                                                   |            |                      |                 |                              |                              | SECTION D                                       |                     |     |     |                                                                 |
|                                                                                                 |                           |                                                                                                   |            |                      |                 |                              |                              | REV. NO. <b>01</b> DATE: <b>22-02-2008</b>      |                     |     |     |                                                                 |
|                                                                                                 |                           |                                                                                                   |            |                      |                 |                              |                              | SHEET 5 OF 7                                    |                     |     |     |                                                                 |
| Sl. No.                                                                                         | Component / operation     | Characteristics Checked                                                                           | * Category | Type/Method of Check | Extent of Check | Reference documents          | Acceptance Norms             | Format of Records                               | Agency <sup>s</sup> |     |     | Remarks                                                         |
|                                                                                                 |                           |                                                                                                   |            |                      |                 |                              |                              |                                                 | P                   | W   | V   |                                                                 |
| 10.                                                                                             | Panel Wiring              | 1. Wiring Layout                                                                                  | MA         | Visual               | 100%            | Approved drgs. & Specs.      | Approved drgs. & Specs.      | Log Book                                        | 2                   | --- | --- |                                                                 |
|                                                                                                 |                           | 2. Wiring Termination (Crimped Lugs)                                                              | MA         | Visual               | 100%            | Approved drgs. & Specs.      | Approved drgs. & Specs.      | Log Book                                        | 2                   | --- | --- |                                                                 |
|                                                                                                 |                           | 3. Ferrule numbers                                                                                | MA         | Visual               | 100%            | Approved drgs. & Specs.      | Approved drgs. & Specs.      | Log Book                                        | 2                   | --- | --- |                                                                 |
|                                                                                                 |                           | 4. Colour of wiring                                                                               | MA         | Visual               | 100%            | Approved drgs. & Specs.      | Approved drgs. & Specs.      | Log Book                                        | 2                   | --- | 1   |                                                                 |
|                                                                                                 |                           | 5. Size of Conductor                                                                              | MA         | Measurement          | 100%            | Approved drgs. & Specs.      | Approved drgs. & Specs.      | Log Book                                        | 2                   | --- | 1   |                                                                 |
| 11.                                                                                             | Component Mounting        | 1. Correct components                                                                             | MA         | Visual               | 100%            | Approved drgs., Specs. & BOM | Approved drgs., Specs. & BOM | Log Book                                        | 2                   | --- | --- |                                                                 |
|                                                                                                 |                           | 2. Fixing                                                                                         | MA         | Visual               | 100%            | Approved drgs., Specs. & BOM | Approved drgs., Specs. & BOM | Log Book                                        | 2                   | --- | --- |                                                                 |
| 12.                                                                                             | FINAL<br>Final Inspection | 1. Workmanship                                                                                    | MA         | Visual               | 100%            | Factory Standard             | Factory Standard             | Inspection Report                               | 2                   | 1   | 1   | At Random by BHEL, based on 100 % internal test reports by Mfr. |
|                                                                                                 |                           | 2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components | MA         | Visual               | 100%            | BHEL approved drg. / Spec.   | BHEL approved drg. / Spec.   | Inspection Report                               | 2                   | 1   | 1   |                                                                 |
|                                                                                                 |                           | 3. Components identification Marking / Name plates                                                | MA         | Visual               | 100%            | BHEL approved drg. / Spec.   | BHEL approved drg. / Spec.   | Inspection Report                               | 2                   | 1   | 1   |                                                                 |

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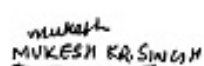
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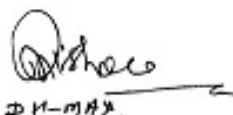
| <br>PEM :: C&I |                       | STANDARD QUALITY PLAN<br>FOR<br>LOCAL CONTROL PANEL |            |                      |                 |                                 |                                 | STD QUALITY PLAN NO.: <b>PE-QP-999-145-I056</b> |                     |          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

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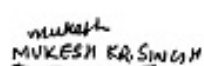
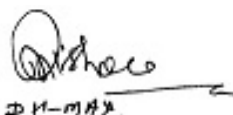


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|-------------------------------------------------------------------------------------------------|-----------------------|-----------------------------------------------------|------------|----------------------|-----------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------|---------------------|-------------------------|---|---------|
|                                                                                                 |                       |                                                     |            |                      |                 |                                                             |                                                             | VOLUME IIB                                      |                     |                         |   |         |
|                                                                                                 |                       |                                                     |            |                      |                 |                                                             |                                                             | SECTION D                                       |                     |                         |   |         |
|                                                                                                 |                       |                                                     |            |                      |                 |                                                             |                                                             | REV. NO. <b>01</b>                              |                     | DATE: <b>22-02-2008</b> |   |         |
|                                                                                                 |                       |                                                     |            |                      |                 |                                                             |                                                             | SHEET 7                                         |                     | OF 7                    |   |         |
| Sl. No.                                                                                         | Component / operation | Characteristics Checked                             | * Category | Type/Method of Check | Extent of Check | Reference documents                                         | Acceptance Norms                                            | Format of Records                               | Agency <sup>s</sup> |                         |   | Remarks |
|                                                                                                 |                       |                                                     |            |                      |                 |                                                             |                                                             |                                                 | P                   | W                       | V |         |
| 13.                                                                                             | TYPE TEST             | Degree of Protection                                | CR         | Mech. Protection     | Sample          | BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148. | BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148. | Type Test Certificate                           | 3                   | ---                     | 1 |         |
| 14                                                                                              | ROUTINE TEST          | IR before & after HV Test                           | CR         | Electrical           | 100%            | BHEL approved spec., drg., BOM & relevant IS.               | BHEL approved spec., drg., BOM & relevant IS.               | Test Report                                     | 2                   | 1                       | 1 |         |
| 15                                                                                              | FUNCTIONAL TEST       | 1. Control Logic Operation                          | CR         | Electrical           | 100%            | BHEL approved spec. / drg.                                  | BHEL approved spec. / drg.                                  | Inspection Report                               | 2                   | 1                       | 1 |         |
|                                                                                                 |                       | 2. Instrument Calibration                           | CR         | Electrical           | 10%             | BHEL approved spec. / drg.                                  | BHEL approved spec. / drg.                                  | Inspection Report                               | 2                   | 1                       | 1 |         |
|                                                                                                 |                       | 3. Temperature rise                                 | CR         | Electrical           | 100%            | BHEL approved spec/drg. & relevant IS.                      | BHEL approved spec/drg & relevant IS.                       | Inspection Report                               | 2                   | 1                       | 1 |         |

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 MUKESH K. SINGH  
 S.A. KHAN  
 D.K. MAHAPATRA

|                                                                          |                                         |                                                      |
|--------------------------------------------------------------------------|-----------------------------------------|------------------------------------------------------|
|                                                                          | <b>1X800 MW Wanakbori STPP</b>          | SECTION: C<br>SUB SECTION :<br>C&I<br>SHEET 15 of 18 |
|                                                                          | <b>TECHNICAL REQUIREMENTS (C&amp;I)</b> |                                                      |
| <p style="text-align: center;"><b>APPLICABLE CODES AND STANDARDS</b></p> |                                         |                                                      |

MUKESH K. SHARMA  
 S-4-162100-1  
 20-11-2013

~~box or enclosure shall leave from terminal blocks and not from other devices in the enclosure.~~

~~The required quantities of cable accessories shall be similarly estimated on the basis of number of terminations and proposed routing of the cables. Any shortfall in the quantity of accessories observed during actual laying shall be compensated at no extra cost.~~

#### 5.00.00 **PROVEN PRODUCT**

~~If Bidder is offering their own system or through their collaborator, then same is acceptable subject to satisfactory performance in last 3 years for at least one unit of not less than 600 MW capacity.~~

~~If DCS is bought out for bidder then same shall be from following vendors meeting specification and satisfactory performance in last 3 years for at least one unit of not less than 600 MW capacity.~~

~~Latest system from following vendors~~

~~M/s Siemens~~

~~M/s Yokagawa~~

~~M/s Honeywell~~

~~M/s ABB~~

~~Ovation.~~

5.01.00 ~~Similarly, all other I & C equipment / systems / sub-systems / instruments and accessories in the power cycle shall also be of make and model whose guaranteed and trouble free performance has been proven at least for two (2) years in not less than two (2) different reheat type pulverized coal fired units of unit size not less than 600 MW.~~

5.02.00 ~~Bidder shall furnish required information to fully satisfy Owner regarding successful operation and high reliability of products / systems furnished.~~

#### 6.00.00 **CODES AND STANDARDS**

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

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

#### 1) Temperature Measurement

- a) Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).
  - b) Temperature Measurement - Thermocouples - ANSI - MC 96.1 - 1982.
  - c) Temperature Measurement by electrical resistance thermometers - IS: 2806
  - d) Thermometer-element-Platinum resistance - IS: 2848 / DIN 43760.
- 2) Pressure Measurement
- a) Instrument and apparatus for pressure measurement - ASME PTC 19.2 (1964).
  - b) Bourdon tube pressure and vacuum gauges - IS: 3624/1996.
- 3) Flow Measurement
- a) Instruments and apparatus for flow measurement - ASME PTC 19.5 (1972) Interim supplement, Part-II
  - b) Measurements of fluid flow in closed conduit - BS 1042.
- 4) Electronic Measuring Instruments and Control Hardware
- a) Automatic null balancing electrical measuring instruments -ANSI C 39.4 (Rev. 1973), IS 9319
  - b) Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 / 1974.
  - c) Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1: ANSI MC 12.1 / 1975.
  - d) Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975) - ISA -S26 (1968).
  - e) Surge withstand capability (SWC) tests - ANSI C 37.90A (1989), IEC-255.4.
  - f) Printed circuit boards - IPC TM-650, IEC 326C.
  - g) General requirements and tests for printed wiring boards - IS-7405 (Part-I)/1973.
  - h) Edge socket connectors - IEC 130-11.
  - i) Requirements and methods of testing of wire wrap terminations--DIN 41611 Part-2.
  - j) Dimensions of attachment plugs and receptacles- ANSI C73-1973.(Supplement ANSI C73a – 1980)
- 5) Instrument Switches and Contacts

- a) Contact Rating - AC services NEMA ICS Part-2 125, A-600
- b) Contact Rating - DC services NEMA ICS Part-2 125, N-600
- 6) Enclosures
  - a) Enclosures for Industrial Controls and Systems–NEMA ICS-6-110.15 through 110.22
  - b) Racks, panels and associated equipment -EIA: RS-310-B-1983 (ANSI C83.9 - 1972).
- 7) Apparatus, Enclosures and Installation Practices in Hazardous Area
  - a) Classification of hazardous area - NEMA Article 500, Volume-6, 1978.
  - b) Electrical Instruments in hazardous dust locations - ISA-RP 12.11.
  - c) Intrinsically safe apparatus - NFPA Article 493 Volume-4 1978.
  - d) Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Article 496 Volume-4, 1978.
- 8) Sampling System
  - a) Stainless Steel material of tubing and valves, for sampling system - ASTM A 269-79 GRTO-316.
  - b) Submerged helical coil heat exchangers for sample coolers -- ASTM D11-98.
- 9) Annunciators
  - a) Specifications and guides for the use of general-purpose annunciators - ISA RP 18.1.
  - b) Surge withstand capability tests -ANSI C37.90 a -1971 and IEEE Standard 472-1974.
- 10) Interlocks, Protections
  - a) Relays and relay system associated with electric power apparatus - IEEE Standards 3.13.
  - b) Surge withstand capability tests - ANSI C37.90 a - 1971 and IEEE Standard 472-1974.
  - c) General requirements and tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I)/1973.
  - d) Turbine water damage prevention - ASME-TDP-1-1980.
  - e) Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.
- 11) UPS System

- a) Practice and requirements for semi-conductor power rectifiers - ANSI C34.2.
- b) Relays and relay systems associated with electrical power apparatus IEEE Standard - 3.13.
- c) Surge withstand capability tests - ANSI C 70.90 A/1971, IEC-255.4.
- d) Recommended practice for sizing large lead storage batteries for generating stations and sub-stations - -IEEE-485.

#### 12) Control Valves

- a) Control valve sizing (Incompressible fluids) - ISA-S39.2 / 1972.
- b) Control valve sizing (Compressible fluids) - ISA-S39.4 / 1972.
- c) Control Valve seat leakage – ANSI / FCI 70.2
- d) Face to face dimensions of Control Valves - ANSI B16.10
- e) Control Valve Capacity Test Procedure – ISA – S75.02

#### 13) Instrument Tubing

- a) Seamless Carbon Steel Pipe - ASTM-A-106.
- b) Forged carbon steel fittings - ASTM-A-105.
- c) Dimensions of fittings - ANSI-B16.11.
- d) Code for pressure piping, welding, hydrostatic testing - ANSI-B 31.1.
- e) Nomenclature for instrument tube fittings - ISA-RP 42.1 / 1982.
- f) Seamless Stainless Steel Tube ASTM A-213 TP 316 / ASTM A-269 TP 316
- g) Seamless Alloy Steel Pipe ASTM A 335 P22
- h) Seamless Stainless Steel Pipe ASTM A-312 TP 316

#### 14) Cables

- a) Thermocouple extension wires / cables - ANSI MC96.1.
- b) Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy-IPCEA S-61-402
- c) Guide for design and installation of cable system in power generating station (insulation, jacket materials) -IEEE Standard 422.
- d) Requirements of vertical tray flame test - IEEE 383
- e) Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B33.

15) Electronic Cards, Subassemblies and Components

a) Unpackaged

- i) Vibration : IEC-68.2.6
- ii) Shock : IEC-68.2.27
- iii) Drop & Topple : IEC-68.2.31

b) Packaged

Vibration, Drop & Static Compression - NSTA.

c) Electromagnetic Compatibility

- i) Electrical Fast Transient : IEC-801.4
- ii) Surge Withstand : IEC-255.4
- iii) Radiated Electromagnetic Field : IEC-801.3
- iv) Electrostatic Discharge : IEC-801.2
- v) Electromagnetic Emissions : VDE 0871, Class-B

16) Cable Trays, Conduits

- a) Guide for the design and installation of cable system in power generating station (cable trays, support systems, conduits)- IEEE Standard 422, NEMA VE-1, NEC-1981. Test Standards NEMA VE-1-1979.
- b) Galvanizing of carbon steel cable trays - ASTM A-386.

~~7.00.00 DESIGN CRITERIA~~

~~This section lays down the general design criteria to be adapted in designing the instrumentation and control system of the plant.~~

~~7.01.00 General Requirements~~

~~7.01.01 Instrumentation, control and automation devices and accessories shall be designed with the following considerations:~~

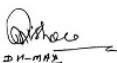
- ~~a) Stable in spite of temperature fluctuations.~~
- ~~b) Able to withstand high humidity.~~
- ~~c) Weather proof.~~
- ~~d) Dust proof.~~
- ~~e) Corrosion resistant.~~
- ~~f) Erosion resistant.~~

|                             |                              |                                                      |
|-----------------------------|------------------------------|------------------------------------------------------|
|                             | 1X800 MW Wanakbori STPP      | SECTION: C<br>SUB SECTION :<br>C&I<br>SHEET 17 of 18 |
|                             | TECHNICAL REQUIREMENTS (C&I) |                                                      |
| <div>MANDATORY SPARES</div> |                              |                                                      |

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|          |                                                                             |                                                                                                 |                                                                                                                              |  |         |
|----------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|--|---------|
| 10.2.1.1 | Feeder/Transformer Protection                                               | 4 Nos.each type and rating                                                                      | 4No's of Numerical relays.<br><br>Incomer protection of breakers is applicable.<br>Transformer protection is not applicable. |  | BAP     |
| 10.2.1.2 | Motor Protection                                                            | 5 Nos.each type and rating                                                                      | Not Applicable                                                                                                               |  | BAP     |
| 10.2.2   | Conventional (Electromagnetic/Static type) Relay                            | 10% for each type and rating or minimum one (1) no. whichever is more                           | Not Applicable                                                                                                               |  | BAP     |
| 10.3     | Generator Protection System                                                 |                                                                                                 |                                                                                                                              |  |         |
| 10.3.1   | Numerical microprocessor based Relay                                        | 10% for each type and rating or minimum one (1) no. whichever is more                           | Lot Price for applicable items under Sno 10.3 and Sno 10.4                                                                   |  | BPL SCS |
| 10.4     | Generator Transformer Protection System                                     |                                                                                                 |                                                                                                                              |  |         |
| 10.4.1   | Numerical microprocessor based Relay                                        | 10% for each type and rating or minimum one (1) no. whichever is more                           | Price for applicable items included at Sno 10.3 above                                                                        |  | BPL SCS |
| 11.0     | UPS (Main UPS for DCS System)                                               |                                                                                                 |                                                                                                                              |  |         |
| 11.1     | Fuse                                                                        | 3 (Three) times of total quantity of each type of fuses used in the system                      |                                                                                                                              |  | EDN     |
| 11.2     | SCR                                                                         | 10% of total quantity of each type used in the system or minimum 2(two) nos. whichever is more. |                                                                                                                              |  |         |
| 11.3     | Diode                                                                       | 10% of total quantity of each type used in the system or minimum 2(two) nos. whichever is more. |                                                                                                                              |  | EDN     |
| 11.4     | IGBT                                                                        | 2 (two) nos.                                                                                    |                                                                                                                              |  | EDN     |
| 11.5     | Electronic Module/ PCB                                                      |                                                                                                 |                                                                                                                              |  |         |
| 11.5.1   | Static Switch                                                               | 1 (one) no. each type of Electronic Card/PCB/modules used in the system                         |                                                                                                                              |  | EDN     |
| 11.5.2   | Inverter                                                                    | 1 (one) no. each type of Electronic Card/PCB/modules used in the system                         |                                                                                                                              |  | EDN     |
| 11.5.3   | Static voltage Regulator                                                    | 1 (one) no. each type of Electronic Card/PCB/modules used in the system                         |                                                                                                                              |  | EDN     |
| 11.5.4   | Charger                                                                     | 1 (one) no. each type of Electronic Card/PCB/modules used in the system                         |                                                                                                                              |  | EDN     |
| 11.6     | UPS Battery                                                                 |                                                                                                 |                                                                                                                              |  |         |
| 11.6.1   | Battery Cell (Uncharged, Dry)                                               | 8 nos.                                                                                          |                                                                                                                              |  | EDN     |
| 11.6.2   | Inter connecting cell strips                                                | 10 nos.                                                                                         |                                                                                                                              |  | EDN     |
| 11.6.3   | Vent cap                                                                    | 10 nos.                                                                                         |                                                                                                                              |  | EDN     |
| 11.6.4   | Hydrometer                                                                  | 1 no.                                                                                           |                                                                                                                              |  | EDN     |
| 11.6.5   | Rubber gloves                                                               | 1 pair                                                                                          |                                                                                                                              |  | EDN     |
| 11.6.6   | Voltmeter for measuring cell voltage (Center zero type)                     | 1 no.                                                                                           |                                                                                                                              |  | EDN     |
| 11.6.7   | Funnel                                                                      | 1 no.                                                                                           |                                                                                                                              |  | EDN     |
| 11.6.8   | Jug                                                                         | 1 no.                                                                                           |                                                                                                                              |  | EDN     |
| 11.6.9   | Apron & Goggles                                                             | 1 set                                                                                           |                                                                                                                              |  | EDN     |
| 11.6.10  | Cell lifting puller                                                         | 1 no.                                                                                           |                                                                                                                              |  | EDN     |
| 11.6.11  | Insulated socket spanner with handle                                        | 1 no.                                                                                           |                                                                                                                              |  | EDN     |
| 11.6.12  | Terminal screw with bellaville washer                                       | 5% of total quantity used                                                                       |                                                                                                                              |  | EDN     |
| 11.6.13  | Plastic filling bottle                                                      | 1 no.                                                                                           |                                                                                                                              |  | EDN     |
| 11.6.14  | Thermometer                                                                 | 1 no.                                                                                           |                                                                                                                              |  | EDN     |
| 11.7     | For other applicable items SI No.12 & 8 of this document shall be followed. |                                                                                                 | Not quoted as the spec. is not clear                                                                                         |  | EDN     |
| 12.0     | Control Panel/Desk Mounted Items                                            |                                                                                                 |                                                                                                                              |  | EDN     |
| 12.1     | Push Button                                                                 |                                                                                                 |                                                                                                                              |  |         |
| 12.1.1   | Complete assembly                                                           | 5Nos for each colour                                                                            |                                                                                                                              |  | EDN     |
| 12.1.2   | Contact Element (1NO + 1NC) Block                                           | 20Nos.                                                                                          |                                                                                                                              |  | EDN     |
| 12.2     | Selector Switch                                                             | 10Nos. for each type and rating                                                                 |                                                                                                                              |  | EDN     |
| 12.3     | Meter (Analog or Digital)                                                   |                                                                                                 |                                                                                                                              |  |         |
| 12.3.1   | Ammeter                                                                     | 10% for each type and range or minimum one (1) no. whichever is more                            |                                                                                                                              |  | EDN     |





|        |                                                               |                                                                         |                                                                                                           |                                          |                            |
|--------|---------------------------------------------------------------|-------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|------------------------------------------|----------------------------|
| 12.3.2 | Voltmeter                                                     | 10% for each type and range or minimum one (1)<br>no. whichever is more |                                                                                                           |                                          | EDN                        |
| 12.3.3 | Frequency                                                     | 10% for each type and range or minimum one (1)<br>no. whichever is more |                                                                                                           |                                          | EDN                        |
| 12.3.4 | MW                                                            | 10% for each type and range or minimum one (1)<br>no. whichever is more |                                                                                                           |                                          | EDN                        |
| 12.3.5 | MVAR                                                          | 10% for each type and range or minimum one (1)<br>no. whichever is more |                                                                                                           |                                          | EDN                        |
| 12.3.6 | Power Factor                                                  | 10% for each type and range or minimum one (1)<br>no. whichever is more |                                                                                                           |                                          | EDN                        |
| 12.3.7 | Synchroscope                                                  | 10% for each type and range or minimum one (1)<br>no. whichever is more |                                                                                                           |                                          | EDN                        |
| 12.4   | Indicating Lamps complete assembly                            | 10Nos. for each Colour and type                                         |                                                                                                           |                                          | EDN                        |
| 12.5   | Mimic Lamps                                                   | 10Nos. for each Colour and type                                         |                                                                                                           |                                          | EDN                        |
| 12.6   | MCB                                                           | 2Nos. for each type and rating                                          |                                                                                                           |                                          | EDN                        |
| 12.7   | Door Limit Switch                                             | 2Nos.                                                                   |                                                                                                           |                                          | EDN                        |
| 12.8   | Annunciation system                                           |                                                                         |                                                                                                           |                                          | EDN                        |
| 12.8.1 | Lamp Box with Facia & Lamps (LED type)                        | 25Nos.                                                                  |                                                                                                           |                                          | EDN                        |
| 12.8.2 | Hooter                                                        | 1No.                                                                    |                                                                                                           |                                          | EDN                        |
| 12.8.3 | Each type of PCB (for non-PLC driven system)                  | 1(one) no.                                                              | Part of DCS                                                                                               |                                          | EDN                        |
| 13.0   | Actuator                                                      |                                                                         | ( LOT PRICE FOR APPLICABLE ITEMS IN THE LIST OF ITEMS INDICATED BELOW IN SL NO 13.1 TO 13.4, 13.6 & 13.7) |                                          | Trichy/ Trichy Valves      |
| 13.1   | Complete set of Actuator                                      | 1No. for each type and rating                                           |                                                                                                           |                                          | Trichy/ Trichy Valves/ BAP |
| 13.2   | Limit Switch                                                  | 2 Nos each type and rating                                              |                                                                                                           |                                          | Trichy/ Trichy Valves      |
| 13.3   | Torque Switch                                                 | 2 Nos each type and rating                                              |                                                                                                           |                                          | Trichy/ Trichy Valves      |
| 13.4   | Auxiliary Contact                                             | 1 no each type and rating                                               |                                                                                                           |                                          | Trichy/ Trichy Valves      |
| 13.5   | Motor                                                         | 1 no each type and rating                                               | Not envisaged. Hence not offered                                                                          | Refer Sno 15 of BH-29 attached herewith. | Trichy/ Trichy Valves      |
| 13.6   | Complete Seal kit                                             | 1Set for each type and rating                                           |                                                                                                           |                                          | Trichy/ Trichy Valves      |
| 13.7   | Complete O-Ring Set                                           | 1Set                                                                    |                                                                                                           |                                          | Trichy/ Trichy Valves      |
| 14.0   | Illumination                                                  |                                                                         | LOT PRICE for applicable items under Sno 14.0 Illumination                                                |                                          | TBG/PEM                    |
| 14.1   | Comptalux Lamp 100 W                                          | 40 nos.                                                                 |                                                                                                           |                                          | TBG/PEM                    |
| 14.2   | High Pressure Mercury Vapour Lamp 125W                        | 20 nos.                                                                 |                                                                                                           |                                          | TBG/PEM                    |
| 14.3   | High Pressure Sodium Vapour Lamp 70W                          | 150 nos.                                                                |                                                                                                           |                                          | TBG/PEM                    |
| 14.4   | High Pressure Sodium Vapour Lamp 150W                         | 40 nos.                                                                 |                                                                                                           |                                          | TBG/PEM                    |
| 14.5   | High Pressure Sodium Vapour Lamp 250W                         | 40 nos.                                                                 |                                                                                                           |                                          | TBG/PEM                    |
| 14.6   | High Pressure Sodium Vapour Lamp 400W                         | 40 nos.                                                                 |                                                                                                           |                                          | TBG/PEM                    |
| 14.7   | Ignitors (Separate type) for High Pressure Sodium Vapour Lamp | 200nos.                                                                 |                                                                                                           |                                          | TBG/PEM                    |
| 14.8   | Ballast for 1 x 125 W High Pressure Mercury Vapour Lamp       | 30 nos.                                                                 |                                                                                                           |                                          | TBG/PEM                    |
| 14.9   | Ballast for 1 x 70 W High Pressure Sodium Vapour Lamp         | 150 nos.                                                                |                                                                                                           |                                          | TBG/PEM                    |
| 14.10  | Ballast for 1 x 150 W High Pressure Sodium Vapour Lamp        | 100 nos.                                                                |                                                                                                           |                                          | TBG/PEM                    |
| 14.11  | Ballast for 1 x 250 W High Pressure Sodium Vapour Lamp        | 50 nos.                                                                 |                                                                                                           |                                          | TBG/PEM                    |
| 14.12  | Capacitor for 1 x 125 W High Pressure Mercury Vapour Lamp     | 50 Nos.                                                                 |                                                                                                           |                                          | TBG/PEM                    |

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S.A. 16/10/2020 20/10/2020

| GSECL                                                                                                                                                                                                                                                         | BHEL                                                                |                                                         |                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|---------------------------------------------------------|----------------------------------------|
| Equipment/Package Name                                                                                                                                                                                                                                        | Remarks                                                             | Remarks as per post-bid resolution dt 9.01.2013 (BH-29) | Name of Unit                           |
| <b>General</b>                                                                                                                                                                                                                                                |                                                                     |                                                         |                                        |
| The Bidder shall offer mandatory spares of the same make, model and type for items which are offered in the main offer. Further, offered spare parts shall be of the same grade and shall have same performance as the instruments which they are to replace. |                                                                     |                                                         |                                        |
| <b>Field Instruments (Transmitters/temperature elements (TC / RTD) / Gauges / Switches etc. along with relevant accessories)</b>                                                                                                                              |                                                                     |                                                         |                                        |
|                                                                                                                                                                                                                                                               |                                                                     |                                                         | Trichy/ HWR/ HYD/ BAP/ PC Chennai/ EDN |
| 10 (ten) percent of total of each type or at least one (whichever is higher) of each type along with accessories.                                                                                                                                             | Lot Price for applicable items                                      |                                                         |                                        |
| <b>Steam &amp; Water Analysis System (SWAS)</b>                                                                                                                                                                                                               |                                                                     |                                                         |                                        |
| 2 (two) numbers conductivity / pH transmitter along with probes.                                                                                                                                                                                              |                                                                     |                                                         | EDN                                    |
| Electronic modules of each type for conductivity, pH, silica, dissolved oxygen, Hydrazine etc.                                                                                                                                                                |                                                                     |                                                         | EDN                                    |
| Other items as recommended by Supplier.                                                                                                                                                                                                                       | No other items offered.                                             | Refer Sno 15 of BH-29 attached herewith.                | EDN                                    |
| <b>Continuous Emissions Monitoring System (CEMS)</b>                                                                                                                                                                                                          |                                                                     |                                                         | EDN                                    |
| Analyzer spares like transmitter lens & receiver lens, protection windows for transmitter & receiver, integral pressure & temperature sensors, Signal processing unit - one set of each type.                                                                 | Lot Price for applicable items                                      |                                                         | EDN                                    |
| Cooling and purging air blower unit and set of filters -1 (one) number for each type.                                                                                                                                                                         |                                                                     |                                                         |                                        |
| Light source and detector unit for opacity - 1(one) number.                                                                                                                                                                                                   |                                                                     |                                                         |                                        |
| Other items as recommended by Supplier.                                                                                                                                                                                                                       | No other items offered.                                             | Refer Sno 15 of BH-29 attached herewith.                |                                        |
| <b>Vibration Monitoring System (TG, TDBFP &amp; HT drives covered in supplied package)</b>                                                                                                                                                                    | Lot price for applicable items in the list of items indicated below |                                                         | Trichy/ HYD/ EDN                       |
| 10 (ten) percent of total of each of velocity coil type, accelerometer type and proximity type vibration transducer (as applicable) or at least one (whichever is higher).                                                                                    |                                                                     |                                                         | Trichy/ HYD/ EDN                       |
| 2 (two) numbers of power supply modules.                                                                                                                                                                                                                      |                                                                     |                                                         | Trichy/ HYD/ EDN                       |
| 10 (ten) percent of each type of vibration monitor cards and other electronic cards or 2 (two) nos. of each type, whichever is higher.                                                                                                                        |                                                                     |                                                         | Trichy/ HYD/ EDN                       |
| <b>Control System (DCS, PLC etc.)</b>                                                                                                                                                                                                                         | Lot price for applicable items                                      |                                                         | HWR/ EDN                               |
| 2 (two) numbers each of keyboard and cursor control devices.                                                                                                                                                                                                  |                                                                     |                                                         |                                        |
| 2 (two) numbers of LCD TFT (24") Monitors.                                                                                                                                                                                                                    |                                                                     |                                                         |                                        |
| 10 (ten) sets of spare interface cables with connecting plugs for each type of peripherals & I / O hardware.                                                                                                                                                  |                                                                     |                                                         |                                        |
| 10 (ten) percent of power supply modules of the total qty. offered for each type or 4 (four) numbers, whichever is higher.                                                                                                                                    |                                                                     |                                                         |                                        |
| 10 (ten) percent of the total qty. offered for each type of electronic modules (I / O) or 5 (five) numbers of each electronic type of module, whichever is higher.                                                                                            |                                                                     |                                                         |                                        |
| 10 (ten) percent of total bus couplers and communication interface cards of each type or 2 (two) numbers of bus couplers and communication interface cards whichever is higher.                                                                               | Price Included in electronic modules above                          |                                                         |                                        |
| Controllers for DCS,Control panel ST,Boiler control system,Balance of plant system,PLC system/Sub-systems                                                                                                                                                     |                                                                     |                                                         |                                        |
| 10%of each type(at least 1 no. of each type) whichever is higher.                                                                                                                                                                                             | For applicable                                                      |                                                         | EDN                                    |
| <b>CCTV</b>                                                                                                                                                                                                                                                   | Lot price for applicable items in the list of items indicated below |                                                         | Trichy/ EDN                            |
| 2 (two) numbers of cameras and fixing accessories.                                                                                                                                                                                                            |                                                                     |                                                         | Trichy/ EDN                            |

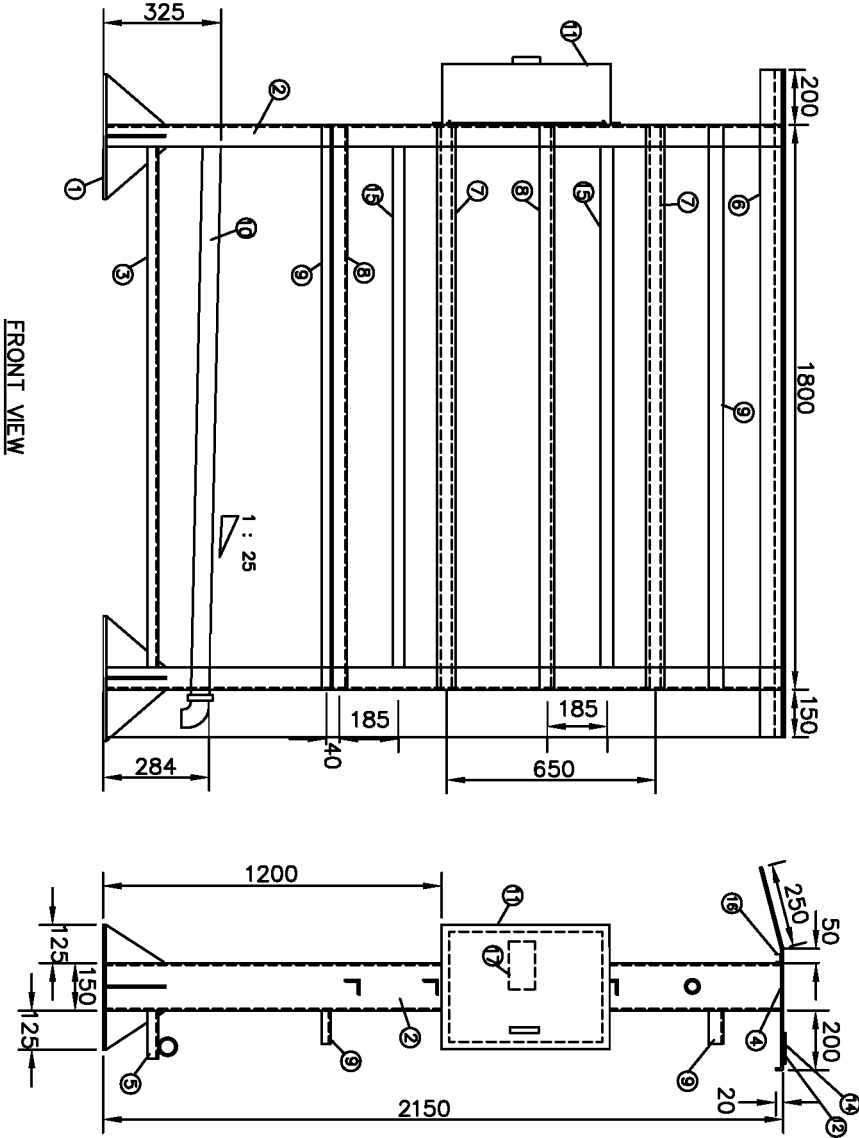


GA DRAWING  
TRANSMITTER RACK

|          |         |       |  |             |      |          |                                                                                                                                                                                                          |                                                                                                                                                                    |                                                   |           |               |        |
|----------|---------|-------|--|-------------|------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|-----------|---------------|--------|
|          |         |       |  |             |      |          | GA DRAWING—TRANSMITTER RACK<br>1x800W SUPER CRITICAL THERMAL POWER PROJECT<br>(UNIT #8 AT WAMKORNI THERMAL POWER STATION, GUJARAT)<br>GUJARAT STATE ELECTRICITY CORPORATION LIMITED<br>VADODARA, GUJARAT | <br>DEVELOPMENT CONSULTANTS PVT. LTD.<br>KOLKATA · MUMBAI · CHENNAI · NEW DELHI | JOB NO. DCPL-K9213R<br>DWG. NO. K9213R-DWG-I-0200 | SCALE NIL | SHEET 1 OF 10 | REV. 0 |
|          |         |       |  |             |      |          |                                                                                                                                                                                                          |                                                                                                                                                                    |                                                   |           |               |        |
|          |         |       |  |             |      |          |                                                                                                                                                                                                          |                                                                                                                                                                    |                                                   |           |               |        |
|          |         |       |  |             |      |          |                                                                                                                                                                                                          |                                                                                                                                                                    |                                                   |           |               |        |
| SB       | SR      | SD    |  |             | 0    | 21.04.10 |                                                                                                                                                                                                          |                                                                                                                                                                    |                                                   |           |               |        |
| APPROVED | CHECKED | DRAWN |  | DESCRIPTION | REV. | DATE     |                                                                                                                                                                                                          |                                                                                                                                                                    |                                                   |           |               |        |

PRELIMINARY  
TENDER PURPOSE ONLY

UNLESS OTHERWISE SPECIFIED  
ALL DIMENSIONS ARE IN MM



**LEGEND:**

- 1..M.S. PLATE 400 X 400 X 10 mm.
- 2..ISMC 150 X 75 X 6 mm.
- 3..ISMC 75 X 40 X 5 mm.
- 4..CANOPY MOUNTING PLATE 5 mm THICK.
- 5..BRACKET FOR DRAIN PIPE.
- 6..CANOPY ASSEMBLY 3.0 mm THICK CRCA SHEET.
- 7..GI PIPE 2" NB CLASS B FOR TRANSMITTER MOUNTING.
- 8..M.S. ANGLE 40 X 40 X 5 mm.
- 9..BRACKET FOR IMPULSE PIPE SUPPORT.
- 10..DRAIN PIPE MATERIAL ASTM A106 GR. 'C' SIZE 2" NB SCH 80.
- 11..JUNCTION BOX SIZE: 480 (H) X 360 (W) X 180 (D).
- 12..BULKHEAD M.S. PLATE 5 mm THICK.
- 13..COMPACT FLUORESCENT LAMP FOR RACK ILLUMINATION.
- 14..XLPE GASKET IN BETWEEN BULKHEAD PLATE & CANOPY. MOUNTING PLATE.
- 15..PVC CABLE TRAY/FLEXIBLE CONDUIT FOR CABLE.
- 16..'C' CHANNEL FOR LIGHT FITTING.
- 17..TAG PLATE.

**NOTES:**

- 1..POWER SOCKET & TB SHALL BE PROVIDED IN JB.
- 2..COLOUR: GREY IS5-631. OVERALL THICKNESS > 100 MICRONS.
- 3..TAG PLATES SHALL BE PROVIDED FOR EACH INSTRUMENT.
- 4..20% TERMINALS SHALL BE PROVIDED AS SPARE.
- 5..ANTIVIBRATION PAD & FOUNDATION BOLTS SHALL BE PROVIDED.
- 6..DIMENSIONS SHOWN ARE TENTATIVE AND SHALL BE FINALISED AT DETAILING.

|                                               |  |  |  |                                                                                                      |  |  |  |
|-----------------------------------------------|--|--|--|------------------------------------------------------------------------------------------------------|--|--|--|
| G.A. DRAWING FOR LOCAL INSTRUMENT RACK        |  |  |  | 1800MM SUPER CRITICAL THERMAL POWER PROJECT<br>(UNIT #8 AT WANDARBON THERMAL POWER STATION, GUJARAT) |  |  |  |
| GUJARAT STATE ELECTRICITY CORPORATION LIMITED |  |  |  | VADODARA, GUJARAT                                                                                    |  |  |  |
| JOB NO. DGPL-K9213R                           |  |  |  | SCALE NIL                                                                                            |  |  |  |
| DWG. NO. K9213R-DWG-I-0200                    |  |  |  | SHEET 2 OF 10                                                                                        |  |  |  |
| APPROVED                                      |  |  |  | REV. 0                                                                                               |  |  |  |
| CHECKED                                       |  |  |  | DATE 21.04.10                                                                                        |  |  |  |
| DRAWN                                         |  |  |  | DESCRIPTION                                                                                          |  |  |  |
| SR                                            |  |  |  | SD                                                                                                   |  |  |  |
| SB                                            |  |  |  | 0                                                                                                    |  |  |  |



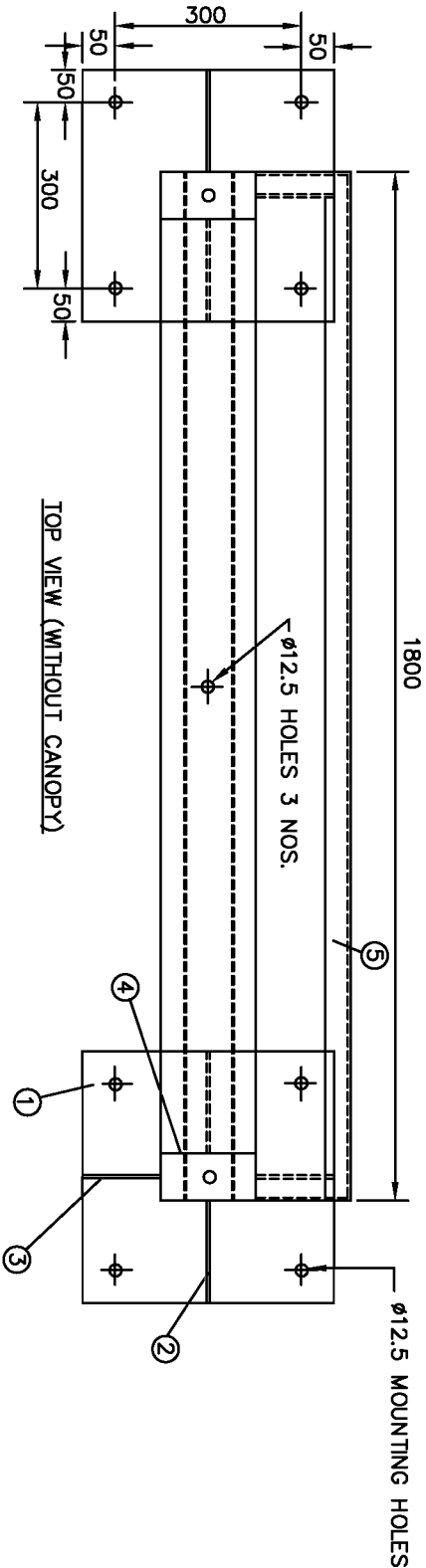
DEVELOPMENT CONSULTANTS PVT. LTD.  
CONSULTING ENGINEERS  
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

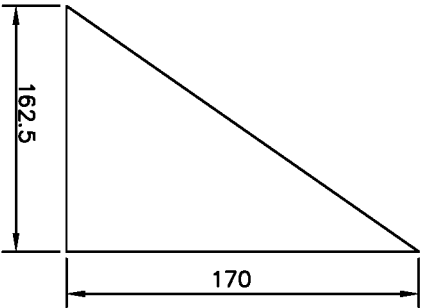
PRELIMINARY  
TENDER PURPOSE ONLY

|          |         |       |             |      |      |                                                                                                                                                                                                                          |                                                                                                                                                                    |                                            |                            |        |
|----------|---------|-------|-------------|------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|----------------------------|--------|
| APPROVED | CHECKED | DRAWN | DESCRIPTION | REV. | DATE | VIEW OF<br>LOCAL INSTRUMENT RACK W/O CANOPY<br>1x800W SUPER CRITICAL THERMAL POWER PROJECT<br>(UNIT #8 AT WAMAGORI THERMAL POWER STATION, GUJARAT)<br>GUJARAT STATE ELECTRICITY CORPORATION LIMITED<br>VADODARA, GUJARAT | <br>DEVELOPMENT CONSULTANTS PVT. LTD.<br>KOLKATA · MUMBAI · CHENNAI · NEW DELHI | JOB NO. DGPL-K9213R SCALE NIL SHT. 3 OF 10 | DWG. NO. K9213R-DWG-I-0200 | REV. 0 |
|----------|---------|-------|-------------|------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|----------------------------|--------|

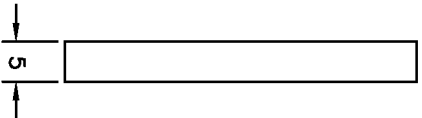
UNLESS OTHERWISE SPECIFIED  
ALL DIMENSIONS ARE IN MM

- NOTES:
- 1.M.S. PLATE 400 X 400 X 10 mm.
  - 2.RIB M.S. PLATE 162.5 X 170 X 5 mm THICK.
  - 3.RIB M.S. PLATE 125 X 170 X 5 mm THICK.
  - 4.RIB M.S. PLATE 134 X 165 X 5 mm THICK.  
(CANOPY MOUNTING PLATE SUPPORT)
  - 5.BRACKET FOR IMPULSE PIPE SUPPORT.

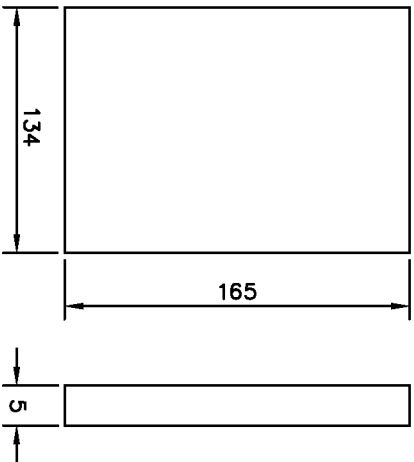




DETAIL OF-1



DETAIL OF-2



DETAIL OF-3

UNLESS OTHERWISE SPECIFIED  
ALL DIMENSIONS ARE IN MM

NOTES:

- 1.RIB M.S. PLATE 162.5 X 170 X 5 mm THICK.
- 2.RIB M.S. PLATE 125 X 170 X 5 mm THICK.
- 3.RIB M.S. PLATE 134 X 165 X 5 mm THICK.

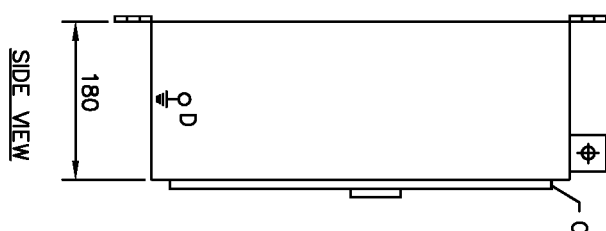
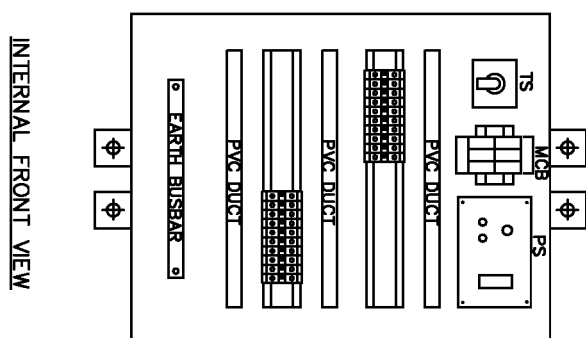
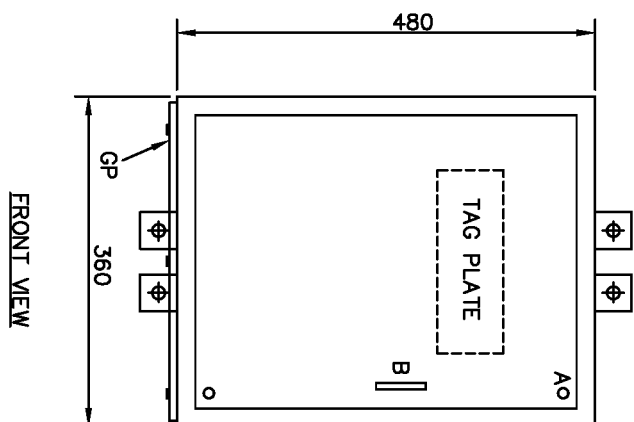
|          |         |       |  |      |          |                                                                                                     |                   |              |
|----------|---------|-------|--|------|----------|-----------------------------------------------------------------------------------------------------|-------------------|--------------|
|          |         |       |  |      |          | G.A. DRAWING OF CLEATS FOR<br>LOCAL INSTRUMENT RACK                                                 |                   |              |
|          |         |       |  |      |          | 1x800W SUPER CRITICAL THERMAL POWER PROJECT<br>(UNIT #8 AT WAMANGOM THERMAL POWER STATION, GUJARAT) |                   |              |
| SB       | SR      | SD    |  | 0    | 21.04.10 | GUJARAT STATE ELECTRICITY CORPORATION LIMITED<br>VADODARA, GUJARAT                                  |                   |              |
| APPROVED | CHECKED | DRAWN |  | REV. | DATE     | JOB NO.                                                                                             | DCPL-K9213R       | SCALE NIL    |
|          |         |       |  |      |          | DWG. NO.                                                                                            | K9213R-DWG-I-0200 | SHT. 4 OF 10 |
|          |         |       |  |      |          |                                                                                                     |                   | REV. 0       |

PERMANENT  
TENDER PURPOSE ONLY



DEVELOPMENT CONSULTANTS PVT. LTD.  
CONSULTING ENGINEERS  
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

Handwritten signature and date: 21.04.10



**LEGEND:**

- A – DOOR LOCK
- B – DOOR HANDLE
- C – HINGES
- D – EARTH STUD
- GP – GLAND PLATE
- PS – POWER SOCKET
- TS – TOGGLE SWITCH
- TBS – TERMINAL BLOCKS
- MCB – MINIATURE CIRCUIT BREAKER

NOTES:

- 1..JB WILL BE MADE OUT OF 2.0 mm CRCA SHEET.
- 2..PROTECTION CLASS IP-65.
- 3.COLOUR EXT—GREY IS5-631, INTERNAL—BRILLIANT WHITE.
- 4..NUTS FOR MOUNTING THE JUNCTION BOX SHALL BE PROVIDED.
- 5..3 MM THICK CRCA GLAND PLATE (GP) AT BOTTOM SHALL BE PROVIDED.

6. SCREWLESS CAGE CLAMP TERMINALS SHALL BE USED.
  7. EARTH BUS BAR SHALL BE OF 25X6 MM TINNED COPPER.
  8. INSTRUMENT TAG VS-A-VS SERVICE AND TERMINAL DETAILS SHALL BE PRINTED ON PHENOLIC BOARD MOUNTED ON BACK SIDE OF DOOR.
  9. COLOUR CODE FOR POWER SUPPLY- PHASE-RED, NEUTRAL-BLACK & EARTH-GREEN
  10. CABLE FOR PANEL LIGHTING SHALL BE 1.5 SQ.MM, 1100V GRADE
  11. SIGNAL WIRING SHALL BE 4 PAIR X 0.5 SQ.MM ANNEALED TINNED COPPER, TWISTED PAIR, OVERALL SHIELDED
  - 500V GRADE, UNARMoured FRLS PVC.
- |                                            |
|--------------------------------------------|
| <p>PRELIMINARY<br/>TENDER PURPOSE ONLY</p> |
|--------------------------------------------|

|                                                                                                                                                                                             |                   |       |       |          |      |                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------|-------|----------|------|-----------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                             |                   |       |       |          |      | G.A. DRAWING OF JUNCTION BOX FOR<br>LOCAL INSTRUMENT RACK                                           |
|                                                                                                                                                                                             |                   |       |       |          |      |                                                                                                     |
|                                                                                                                                                                                             |                   |       |       |          |      |                                                                                                     |
|                                                                                                                                                                                             |                   |       |       |          |      | 1x800W SUPER CRITICAL THERMAL POWER PROJECT<br>(UNIT #8 AT WANDKORI THERMAL POWER STATION, GUJARAT) |
| S8                                                                                                                                                                                          | S8                | S0    | 0     | 21.04.10 |      |                                                                                                     |
| APPROVED                                                                                                                                                                                    | CHECKED           | DRAWN | REV.  | DATE     |      | GUJARAT STATE ELECTRICITY CORPORATION LIMITED<br>VADODARA, GUJARAT                                  |
|  <b>DEVELOPMENT CONSULTANTS PVT. LTD.</b><br><b>CONSULTING ENGINEERS</b><br>MUMBAI · CHENNAI · NEW DELHI |                   |       |       |          |      |                                                                                                     |
| JOB NO.                                                                                                                                                                                     | DCPL-K9213R       |       | SCALE | NIL      | SHT. | 5 OF 10                                                                                             |
| DWG. NO.                                                                                                                                                                                    | K9213R-DWG-I-0200 |       |       |          | REV. | 0                                                                                                   |

LOCAL INSTRUMENT ENCLOSURE

NOTES:

- 1..DIMENSIONS SHOWN ARE TENTATIVE AND SHALL BE FINALIZED AT DETAILING.
- 2..ALL SHEETS SHALL BE 3 mm THICK CRCA SHEET.
- 3.. ALL DOORS SHALL BE FLUSH/CONCEALED TYPE.

**EXTERIOR : GREY 155-631**

**INTERIOR : BRILLIANT WHITE**

OVER ALL THICKNESS WILL BE > 100 MICRONS

- 5..BASE FRAME WILL BE MADE OUT OF ISMC 100 AND COLOUR WILL BE BLACK PAINT FINISH.

- 6..BULKHEAD PLATE FOR TOP AND BOTTOM SHALL BE 1150 X 650 X 6 MM.**

7. CABLE GLAND PLATE OF THICKNESS 3 mm CRCA SHEET SHALL BE PROVIDED AT BOTTOM OF JUNCTION BOX.

- 8. ENCLOSURE PROTECTION CLASS SHALL BE IP-65.**

- 9..TERMINALS INSIDE JUNCTION BOX SHALL BE SCREWLESS CAGE CLAMP TYPE.

- 10..DOORS SHALL BE PROVIDED WITH CONCEALED HINGES, THREE POINT LOCKING FOR FRONT, REAR AND SIDE DOOR HINGES SHALL BE OF STAINLESS STEEL.

- 11..XLPE GASKET SHALL BE PROVIDED BETWEEN BULKHEAD PLATE & ENCLOSURE.

- 12..EARTH BUSBAR 25 X 6 mm TINNED COPPER.**

- 13..DRAIN PIPE SLOPE SHALL BE 1:25 APPROX.

- 14..COMMON LOCK/KEY SHALL BE PROVIDED FOR ALL LIE'S & JB'S.**

- 15. FOUNDATION BOLTS SHALL BE PROVIDED.**

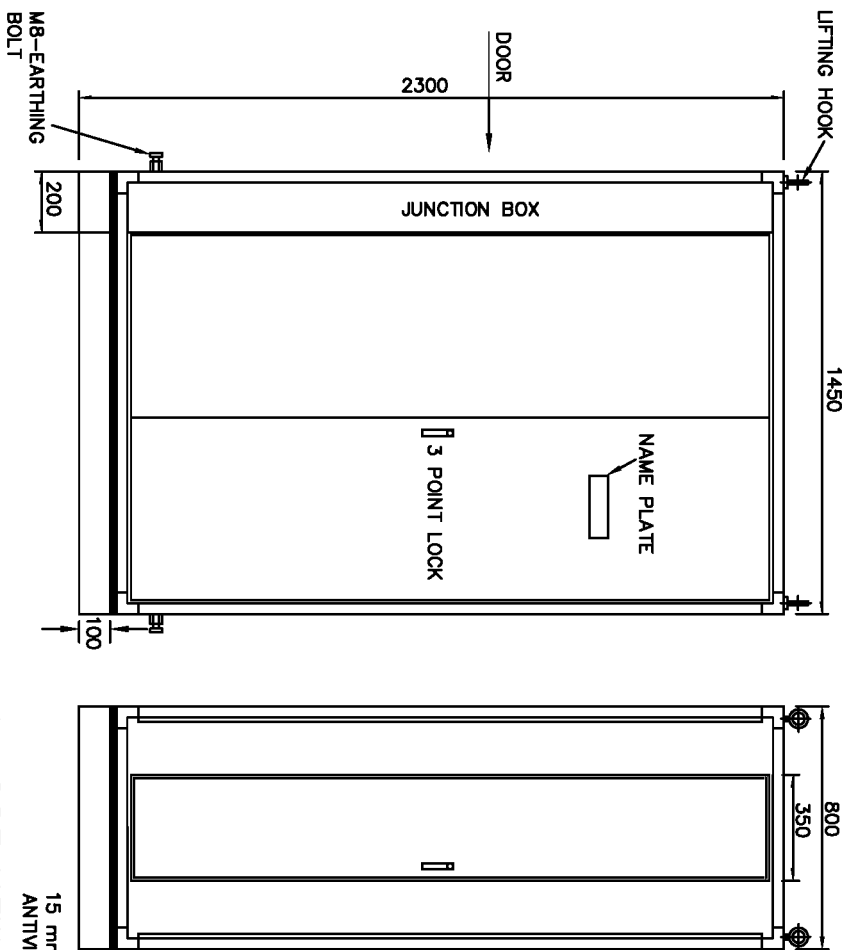
- 16..TAG PLATES SHALL BE PROVIDED FOR EACH INSTRUMENT.**

- 17..INSTRUMENT TAG VS-A-VS SERVICE AND TERMINAL DETAILS SHALL BE  
PRINTED ON PHENOLIC BOARD MOUNTED ON BACK SIDE OF JUNCTION

- BOX DOOR.**

- 18..20% TERMINALS SHALL BE PROVIDED AS SPARE.**

- 19..NAME PLATE OF PANEL SHALL BE FIXED ON FRONT DOOR.



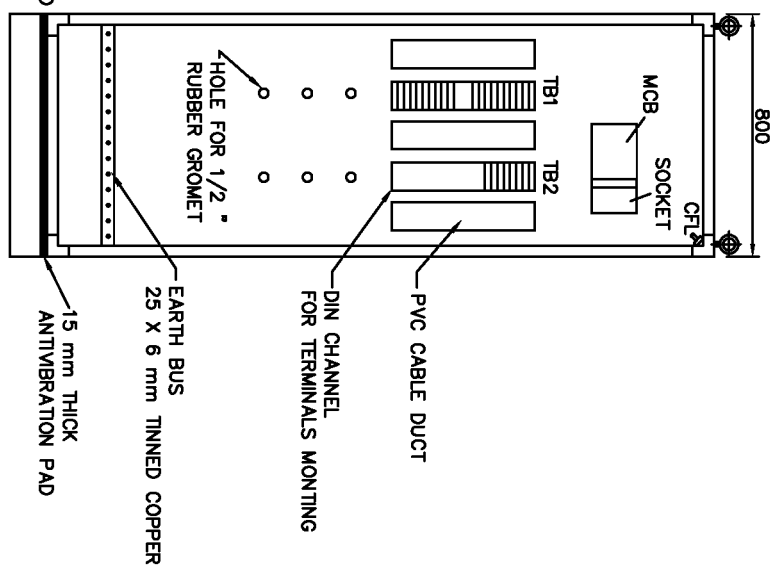
15 mm THICK  
ANTIVIBRATION PAD

FRONT VIEW

LH SIDE VIEW

UNLESS OTHERWISE SPECIFIED  
ALL DIMENSIONS ARE IN MM

|                                                         |                |              |             |                 |                                                                                                               |                                                                                                                                                                                                    |
|---------------------------------------------------------|----------------|--------------|-------------|-----------------|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                         |                |              |             |                 | <b>G.A. DRAWING FOR<br/>LOCAL INSTRUMENT ENCLOSURE</b>                                                        | <br><b>DEVELOPMENT CONSULTANTS PVT. LTD.</b><br>CONSULTING ENGINEERS<br>KOLKATA · BILIMUN · CHENNAI · NEW DELHI |
|                                                         |                |              |             |                 |                                                                                                               |                                                                                                                                                                                                    |
|                                                         |                |              |             |                 |                                                                                                               |                                                                                                                                                                                                    |
|                                                         |                |              |             |                 |                                                                                                               |                                                                                                                                                                                                    |
|                                                         |                |              |             |                 | <b>1x800MW SUPER CRITICAL THERMAL POWER PROJECT<br/>(UNIT #8 AT WANDAKORI THERMAL POWER STATION, GUJARAT)</b> |                                                                                                                                                                                                    |
|                                                         |                |              |             |                 | <b>GUJARATI STATE ELECTRICITY CORPORATION LIMITED<br/>VADODARA, GUJARAT</b>                                   |                                                                                                                                                                                                    |
| <b>S8</b>                                               | <b>SR</b>      | <b>SD</b>    | <b>0</b>    | <b>21.04.10</b> |                                                                                                               |                                                                                                                                                                                                    |
| <b>APPROVED</b>                                         | <b>CHECKED</b> | <b>DRAWN</b> | <b>REV.</b> | <b>DATE</b>     |                                                                                                               |                                                                                                                                                                                                    |
| <b>JOB NO. DCPL-K9213R    SCALE NIL    SHT. 6 OF 10</b> |                |              |             |                 |                                                                                                               |                                                                                                                                                                                                    |
| <b>DWG. NO. K9213R-DWG-I-0200    REV. 0</b>             |                |              |             |                 |                                                                                                               |                                                                                                                                                                                                    |



3..DRAIN HEADER IS APPLICABLE FOR STEAM/WATER PROCESS IMPULSE LINES ONLY.  
4..DRAIN PIPE SHALL BE 2" NB ASTM A106 GRC SCH.80.



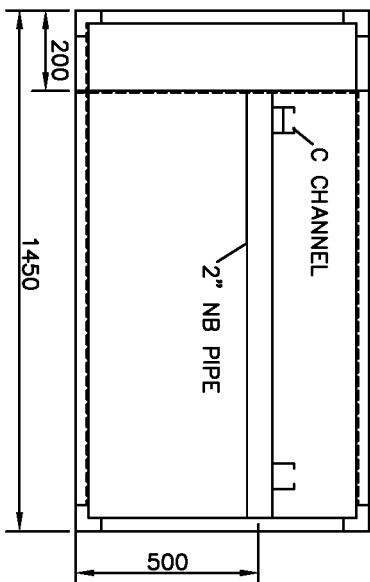
**DEVELOPMENT CONSULTANTS PVT. LTD.**  
**CONSULTING ENGINEERS**  
 KOLKATA · MUMBAI · CHENNAI · NEW DELHI

|          |         |       |             |      |          |                                                                                                        |                                                                                                                                                                                             |              |        |
|----------|---------|-------|-------------|------|----------|--------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------|
|          |         |       |             |      |          | INNER G.A. DRAWING FOR<br>LOCAL INSTRUMENT ENCLOSURE                                                   | <br>DEVELOPMENT CONSULTANTS PVT. LTD.<br>CONSULTING ENGINEERS<br>KOLAKATA · BOMBAY · CHENNAI · NEW DELHI |              |        |
|          |         |       |             |      |          |                                                                                                        |                                                                                                                                                                                             |              |        |
|          |         |       |             |      |          |                                                                                                        |                                                                                                                                                                                             |              |        |
|          |         |       |             |      |          |                                                                                                        |                                                                                                                                                                                             |              |        |
|          |         |       |             |      |          | 1x800MW SUPER CRITICAL THERMAL POWER PROJECT<br>(UNIT #9 AT WANDARBORI THERMAL POWER STATION, GUJARAT) |                                                                                                                                                                                             |              |        |
| S8       | SR      | SD    |             | 0    | 21.04.10 | GUJARAT STATE ELECTRICITY CORPORATION LIMITED<br>VADODARA, GUJARAT                                     |                                                                                                                                                                                             |              |        |
| APPROVED | CHECKED | DRAWN | DESCRIPTION | REV. | DATE     |                                                                                                        |                                                                                                                                                                                             |              |        |
|          |         |       |             |      |          | JOB NO. DCPL-K9213R                                                                                    | SCALE NIL                                                                                                                                                                                   | SHT. 7 OF 10 |        |
|          |         |       |             |      |          | DWG. NO. K9213R-DWG-I-0200                                                                             |                                                                                                                                                                                             |              | REV. 0 |

K9213-DWG-I-0200-7-10



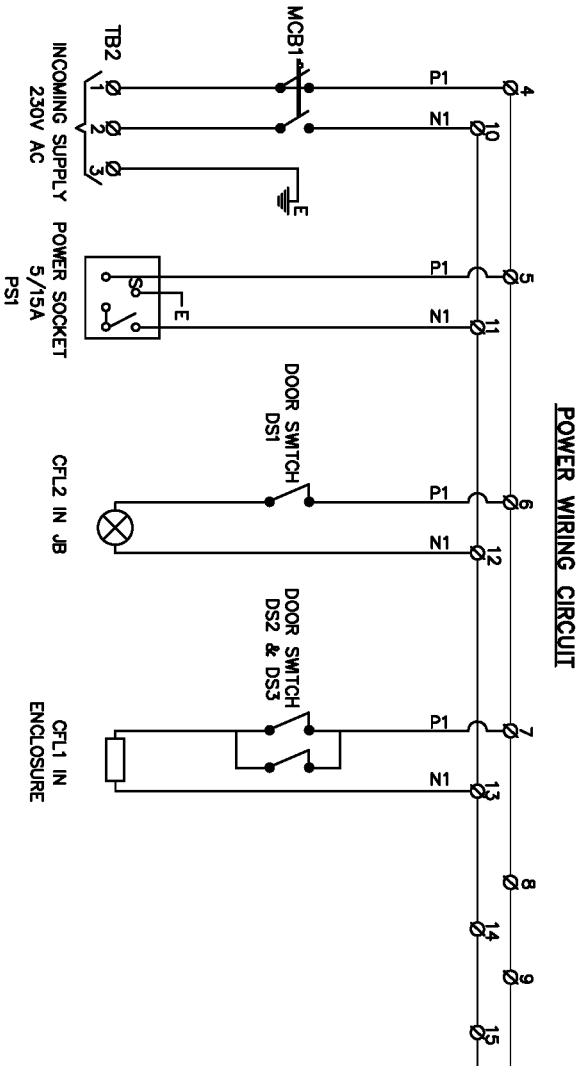
- 1..BULK HEAD PLATE DIMENSION ARE AS FOLLOWS: 1150 X 650 X 6 mm.
- 2..IMPULSE PIPE ENTRY : BOTTOM ENTRY FOR AIR/FLUE GAS APPLICATIONS.
- 3..IMPULSE ENTRY : TOP ENTRY FOR STEAM/WATER APPLICATIONS.



TOP VIEW WITHOUT BULKHEAD PLATE

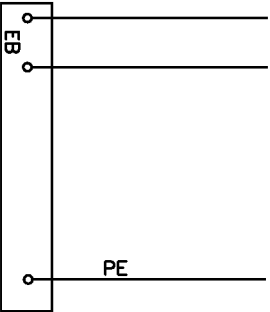
UNLESS OTHERWISE SPECIFIED  
ALL DIMENSIONS ARE IN MM

|                            |             |       |       | BULKHEAD PLATE DETAILS FOR<br>LOCAL INSTRUMENT ENCLOSURE | <br><b>DEVELOPMENT CONSULTANTS PVT. LTD.</b><br>CONSULTING ENGINEERS<br>MUMBAI - BOMBAY · CHENNAI · NEW DELHI |
|----------------------------|-------------|-------|-------|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
|                            |             |       |       |                                                          |                                                                                                               |
|                            |             |       |       |                                                          |                                                                                                               |
|                            |             |       |       |                                                          |                                                                                                               |
| SERIAL NO.                 | SR          | SD    | 0     | 21.04.10                                                 |                                                                                                               |
|                            |             |       |       |                                                          |                                                                                                               |
| APPROVED                   | CHECKED     | DRAWN | REV.  | DATE                                                     | GUJARAT STATE ELECTRICITY CORPORATION LIMITED<br>VADODARA, GUJARAT                                            |
| JOB NO.                    | DCPL-K9213R |       | SCALE | NIL                                                      | SHT. 8 OF 10                                                                                                  |
| DWG. NO. K9213B-DWG-I-0200 |             |       |       |                                                          | REV. 0                                                                                                        |

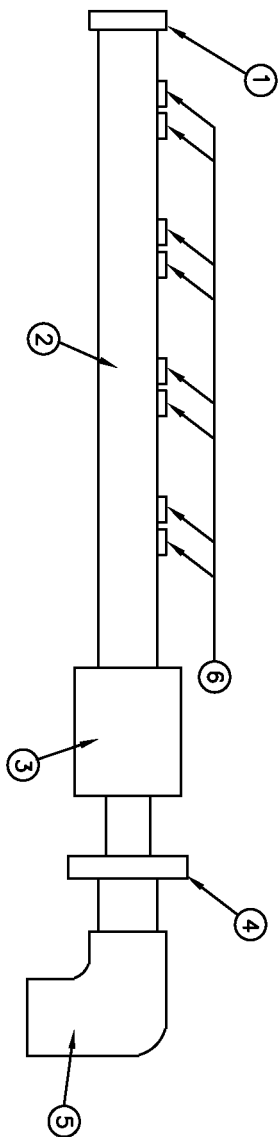


NOTES :

- 1.. COLOUR CODING FOR POWER SUPPLY : PHASE – RED, NEUTRAL – BLACK, EARTH – GREEN
- 2.. CABLE ROUTING FROM TB TO PANEL LIGHT WILL BE 1.5 Sq.mm 1100V AC GRADE.
- 3.. SIGNAL WIRING WILL BE DONE BY 4 PAIR X 0.5 Sq.mm ANNEALED TINNED COPPER, PAIR TWISTED OVERALL & SHIELDED, VOLTAGE GRADE 1100V, UNARMoured FRLS PVC SHIELDED CABLE.



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| BILL OF MATERIAL |                                                    |         |
|------------------|----------------------------------------------------|---------|
| SL.NO.           | DESCRIPTION                                        | QTY     |
| 1                | 2" S.W. CAP, CS                                    | 1       |
| 2                | 2" NB, ASTM A-106, SCH 80/Gr. C                    | 1       |
| 3                | 2" SW X 1" NPT(F) COUPLING CS                      | 1       |
| 4                | 1" NPT(M) X 1" BSP(M) HEX. NIPPLE WITH FITTING, CS | 1       |
| 5                | 1" BSP(F) ELBOW, CS (BOTH ENDS THREADED)           | 1       |
| 6                | HALF COUPLING; SIZE: 1/2" NB SW                    | AS REQD |
|                  |                                                    |         |

|          |         |       |             |      |          |                                                                                                      |
|----------|---------|-------|-------------|------|----------|------------------------------------------------------------------------------------------------------|
|          |         |       |             |      |          | DRAIN HEADER DETAILS FOR<br>LOCAL INSTRUMENT ENCLOSURE                                               |
|          |         |       |             |      |          |                                                                                                      |
|          |         |       |             |      |          |                                                                                                      |
|          |         |       |             |      |          |                                                                                                      |
|          |         |       |             |      |          | 1x800MW SUPER CRITICAL THERMAL POWER PROJECT<br>(UNIT #8 AT WAMBAKON THERMAL POWER STATION, GUJARAT) |
| SB       | SR      | SD    |             | 0    | 21.04.10 |                                                                                                      |
| APPROVED | CHECKED | DRAWN | DESCRIPTION | REV. | DATE     | GUJARAT STATE ELECTRICITY CORPORATION LIMITED<br>VADODARA, GUJARAT                                   |

|                                                                                                 |  |                   |  |       |     |      |          |  |
|-------------------------------------------------------------------------------------------------|--|-------------------|--|-------|-----|------|----------|--|
|              |  |                   |  |       |     |      |          |  |
| DEVELOPMENT CONSULTANTS PVT. LTD.<br>CONSULTING ENGINEERS<br>KOKATA, BAMBAY, CHENNAI, NEW DELHI |  |                   |  |       |     |      |          |  |
| JOB NO.                                                                                         |  | DCPL-K9213R       |  | SCALE | NIL | SHT. | 10 OF 10 |  |
| DWG. NO.                                                                                        |  | K9213R-DWG-I-0200 |  |       |     | REV. | 0        |  |

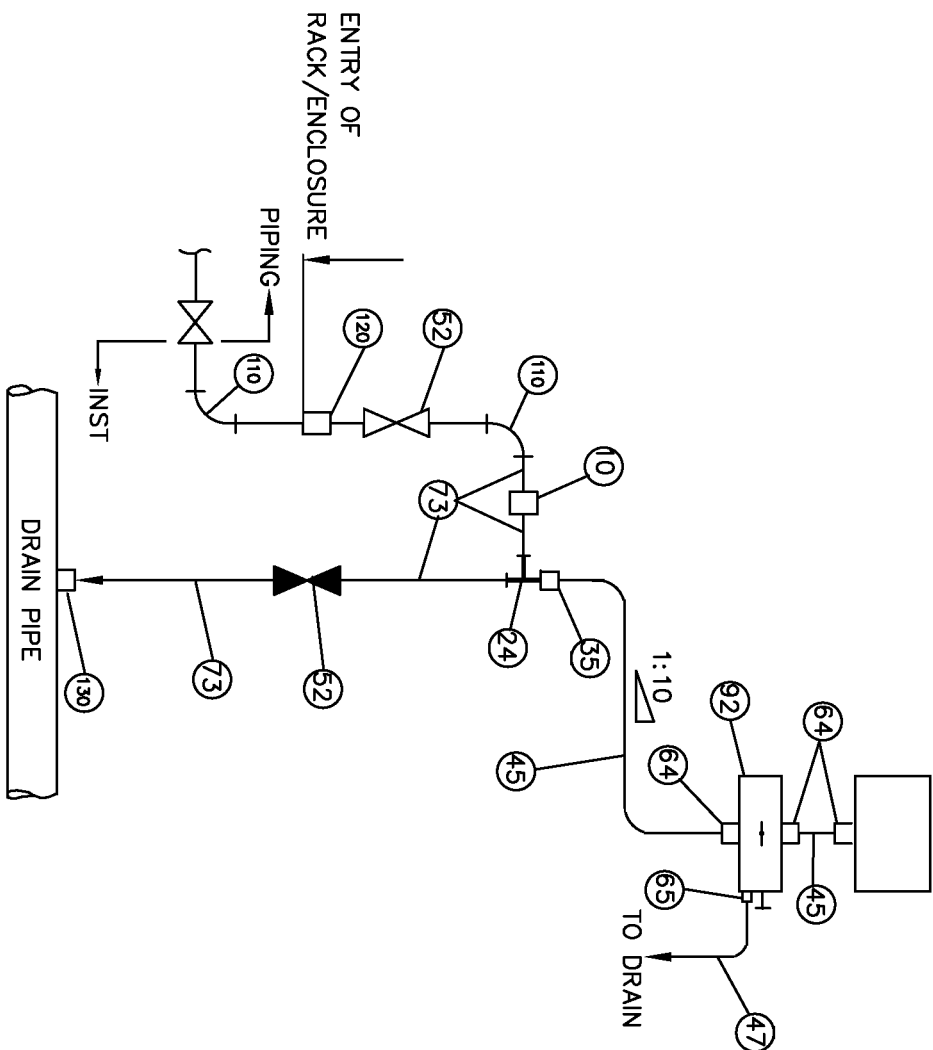
NOTES :

- 1..PROVISION OF SINGLE OR DOUBLE ROOT VALVE AND DRAIN VALVE SHALL BE IN ACCORDANCE WITH THE PRESSURE/TEMPERATURE REQUIREMENT. FOR LINE PRESSURE EQUAL TO OR GREATER THAN 40 KG/SQ.CM  
2 NOS ROOT VALVE AND 2 NOS DRAIN VALVE SHALL BE REQUIRED.
- 2..MATERIAL, SIZE AND RATING OF THE PROCESS HOOK UP ITEMS SHOWN IN THE DRAWING ARE INDICATIVE ONLY.  
ACTUAL REQUIREMENT SHALL BE AS PER PROCESS CONDITION & SPECIFICATION VOL.II-E.
- 3..DRAIN PIPE IN RACK AND ENCLOSURE SHALL BE 2" NB SCH 80.

|          |         |       |             |      |          |                                                                                                      |  |                                                                                                                                                                    |  |
|----------|---------|-------|-------------|------|----------|------------------------------------------------------------------------------------------------------|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|          |         |       |             |      |          | TYPICAL INSTRUMENT INSTALLATION DIAGRAM                                                              |  | <br>DEVELOPMENT CONSULTANTS PVT. LTD.<br>KOLKATA · BOMBAY · CHENNAI · NEW DELHI |  |
|          |         |       |             |      |          | 1x800MW SUPER CRITICAL THERMAL POWER PROJECT<br>(UNIT #9 AT WAMAGORI THERMAL POWER STATION, GUJARAT) |  | JOB NO. DCPL-K9213R   SCALE NIL   SHT. 2 OF 20                                                                                                                     |  |
|          |         |       |             |      |          | GUJARAT STATE ELECTRICITY CORPORATION LIMITED<br>VADODARA, GUJARAT                                   |  | DWG. NO. K9213R-DWG-I-0060                                                                                                                                         |  |
| APPROVED | CHECKED | DRAWN | DESCRIPTION | REV. | DATE     |                                                                                                      |  | REV. 0                                                                                                                                                             |  |
| gp       | AT      | SD    |             | 0    | 21.04.10 |                                                                                                      |  |                                                                                                                                                                    |  |

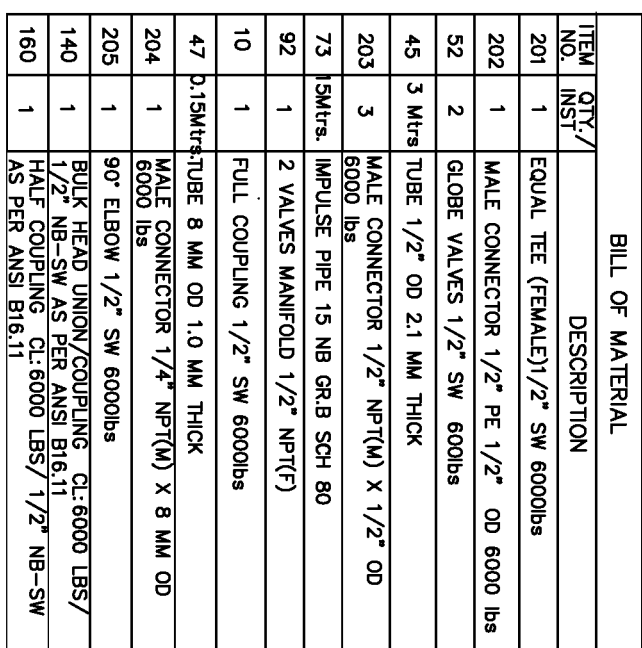
PRELIMINARY  
TENDER PURPOSE ONLY

# PRESSURE TRANSMITTER/



**SERVICE : CONDENSER PRESSURE, INSTRUMENT AIR ETC.**

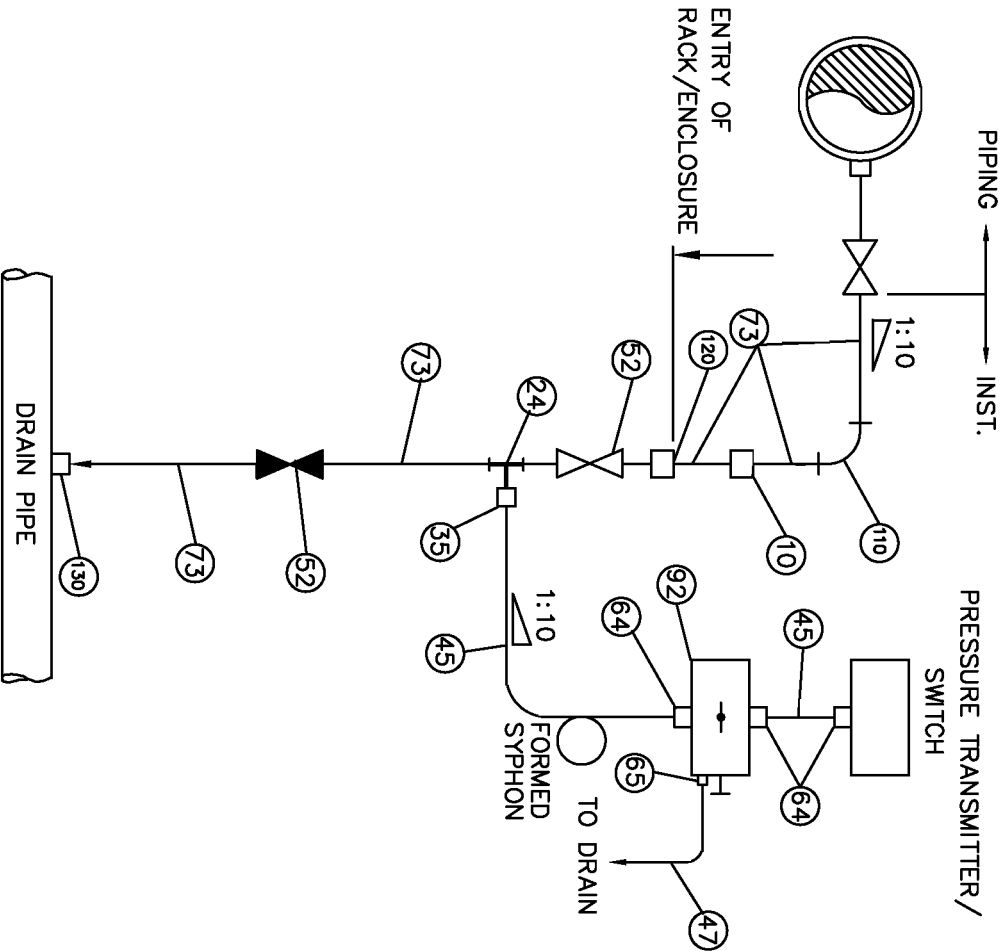
**PRELIMINARY  
TENDER PURPOSE ONLY**



**PRELIMINARY  
TENDER PURPOSE ONLY**

**DEVELOPMENT CONSULTANTS PVT. LTD.**  
**CONSULTING ENGINEERS**  
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

**PRESSURE TRANSMITTER/PRESSURE SWITCH  
MOUNTED BELOW SOURCE POINT(WITH SYPHON)**



**BILL OF MATERIAL**

| ITEM NO. | QTY./INST. | DESCRIPTION                                                          |
|----------|------------|----------------------------------------------------------------------|
| 24       | 1          | EQUAL TEE (FEMALE) 1/2" SW 3000lbs                                   |
| 35       | 1          | MALE CONNECTOR 1/2" PE 1/2" OD 3000 lbs                              |
| 52       | 2          | GLOBE VALVES 1/2" SW 600lbs                                          |
| 45       | 3 Mtrs     | TUBE 1/2" OD 2.1 MM THICK                                            |
| 64       | 3          | MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 3000 lbs                        |
| 73       | 15Mtrs.    | IMPULSE PIPE 15 NB SCH 80                                            |
| 92       | 1          | 2 VALVES MANIFOLD 1/2" NPT(F)                                        |
| 10       | 1          | FULL COUPLING 1/2" SW 3000lbs                                        |
| 47       | 0.15Mtrs.  | TUBE 8 MM OD 1.0 MM THICK                                            |
| 65       | 1          | MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 3000 lbs                        |
| 110      | 1          | 90° ELBOW 1/2" SW 3000lbs                                            |
| 120      | 1          | BULK HEAD UNION/COUPLING CL: 3000 LBS/ 1/2" NB-SW AS PER ANSI B16.11 |
| 130      | 1          | HALF COUPLING CL: 3000 LBS/ 1/2" NB-SW AS PER ANSI B16.11            |

SERVICE : LOW PRESSURE STEAM

PRELIMINARY  
TENDER PURPOSE ONLY

**TYPICAL INSTRUMENT INSTALLATION DIAGRAM**

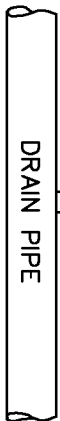
1X800MW SUPER CRITICAL THERMAL POWER PROJECT  
(UNIT #8 AT WANDKORRI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED  
VADODARA, GUJARAT



**DEVELOPMENT CONSULTANTS PVT. LTD.**  
CONSULTING ENGINEERS  
KOLKATA - MUMBAI - CHENNAI - NEW DELHI

JOB NO. DCP-1-K9213R SCALE NIL SHT. 5 OF 20  
DWG. NO. K9213R-DWG-I-0060 REV. 0



**PRELIMINARY  
TENDER PURPOSE ONLY**

### TYPICAL INSTRUMENT INSTALLATION DIAGRAM



**DEVELOPMENT CONSULTANTS PVT. LTD.**

KOLKATA • MUMBAI • CHENNAI • NEW DELHI

|         |             |       |     |      |         |
|---------|-------------|-------|-----|------|---------|
| JOB NO. | DCPL-K9213R | SCALE | NIL | SHT. | 6 OF 20 |
|---------|-------------|-------|-----|------|---------|

DWG. NO. K9213R-DWG-I-0060

**1x800MW SUPER CRITICAL THERMAL POWER PROJECT  
(UNIT #8 AT MANAKORI THERMAL POWER STATION, GUARAT)**  
**GUARAT STATE ELECTRICITY CORPORATION LIMITED**  
**VADODARA, GUARAT**

**VADODARA, GUJARAT**

|      |          |
|------|----------|
| 0    | 21.04.10 |
| REV. | DATE     |

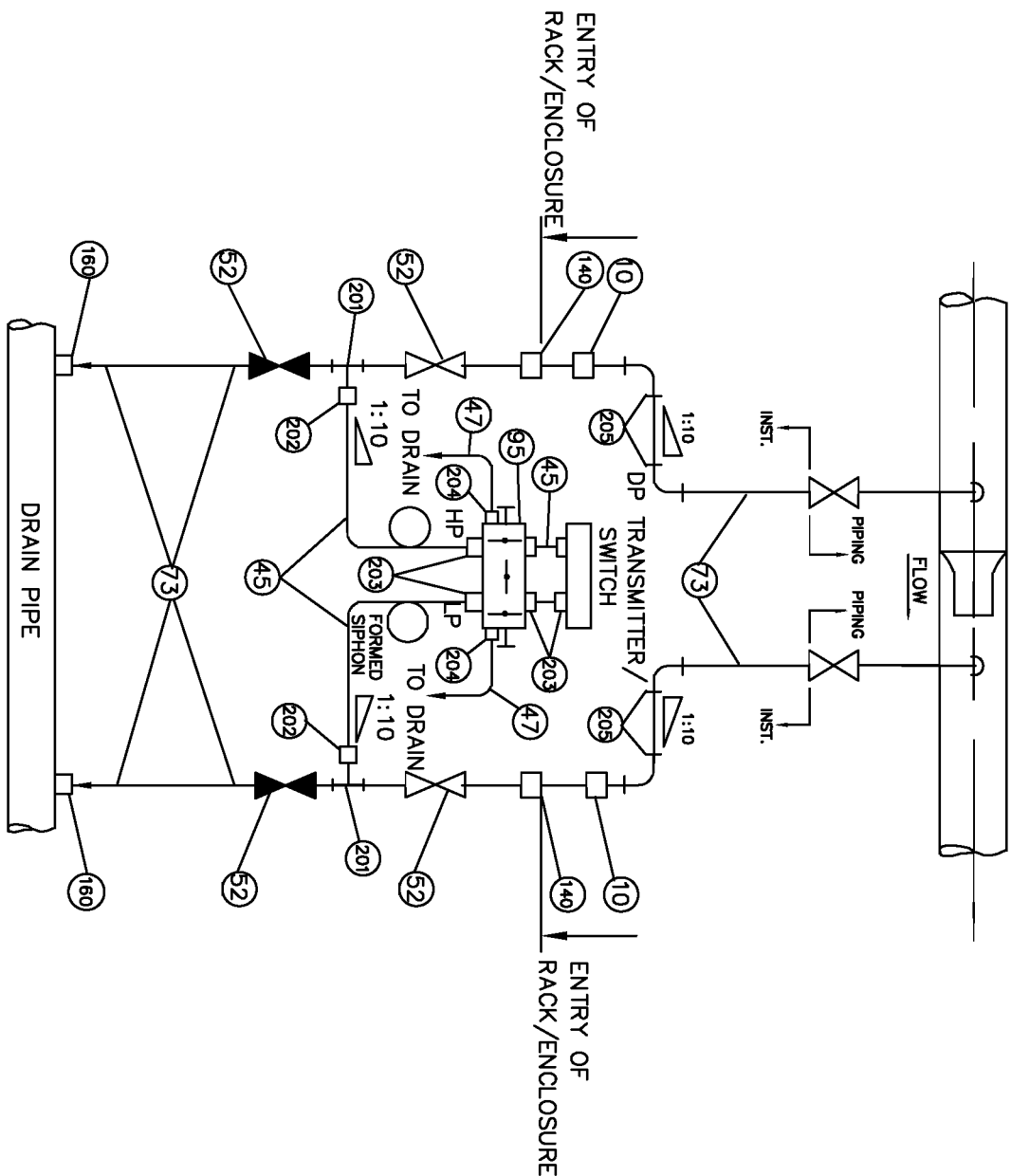
DESCRIPTION

RAWN

**CHECKED**

**APPROVED**

DIFF. PRESS. TRANSMITTER/DIFF. PRESS. SWITCH  
MOUNTED BELOW SOURCE POINT



| BILL OF MATERIAL |             |                                                                      |
|------------------|-------------|----------------------------------------------------------------------|
| ITEM NO.         | QTY./ INST. | DESCRIPTION                                                          |
| 201              | 2           | EQUAL TEE (FEMALE) 1/2" SW 6000lbs                                   |
| 202              | 2           | MALE CONNECTOR 1/2" PE X 1/2" OD 6000 lbs                            |
| 52               | 4           | GLOBE VALVES 1/2" SW 600lbs                                          |
| 45               | 6 Mtrs      | TUBE 1/2" OD 2.1 MM THICK                                            |
| 203              | 6           | MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 6000 lbs                        |
| 73               | 35mtrs      | IMPULSE PIPE 15 NB GR.B SCH 80                                       |
| 95               | 1           | 5 VALVE MANIFOLD 1/2" NPT(F)                                         |
| 10               | 2           | FULL COUPLING 1/2" SW 6000lbs                                        |
| 47               | 0.3mtrs     | TUBE 8 MM OD 1.0 MM THICK                                            |
| 204              | 2           | MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 6000 lbs                        |
| 205              | 4           | 90° ELBOW 1/2" SW 6000lbs                                            |
| 140              | 2           | BULK HEAD UNION/COUPLING CL: 6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11 |
| 160              | 2           | HAFT COUPLING CL: 6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11            |

SERVICE : CONDENSATE,FEED WATER ETC.

PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE

PRELIMINARY  
TENDER PURPOSE ONLY

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

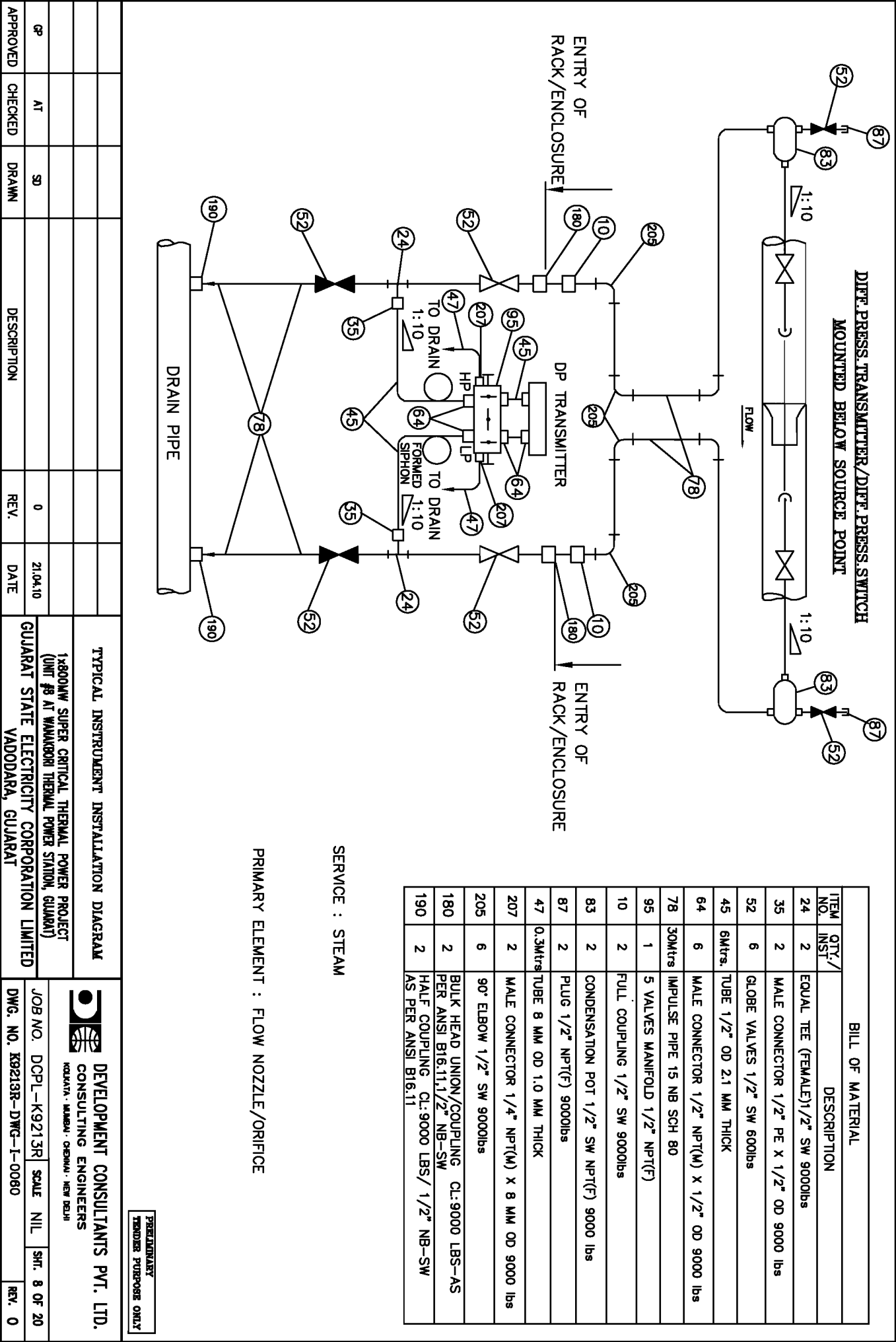


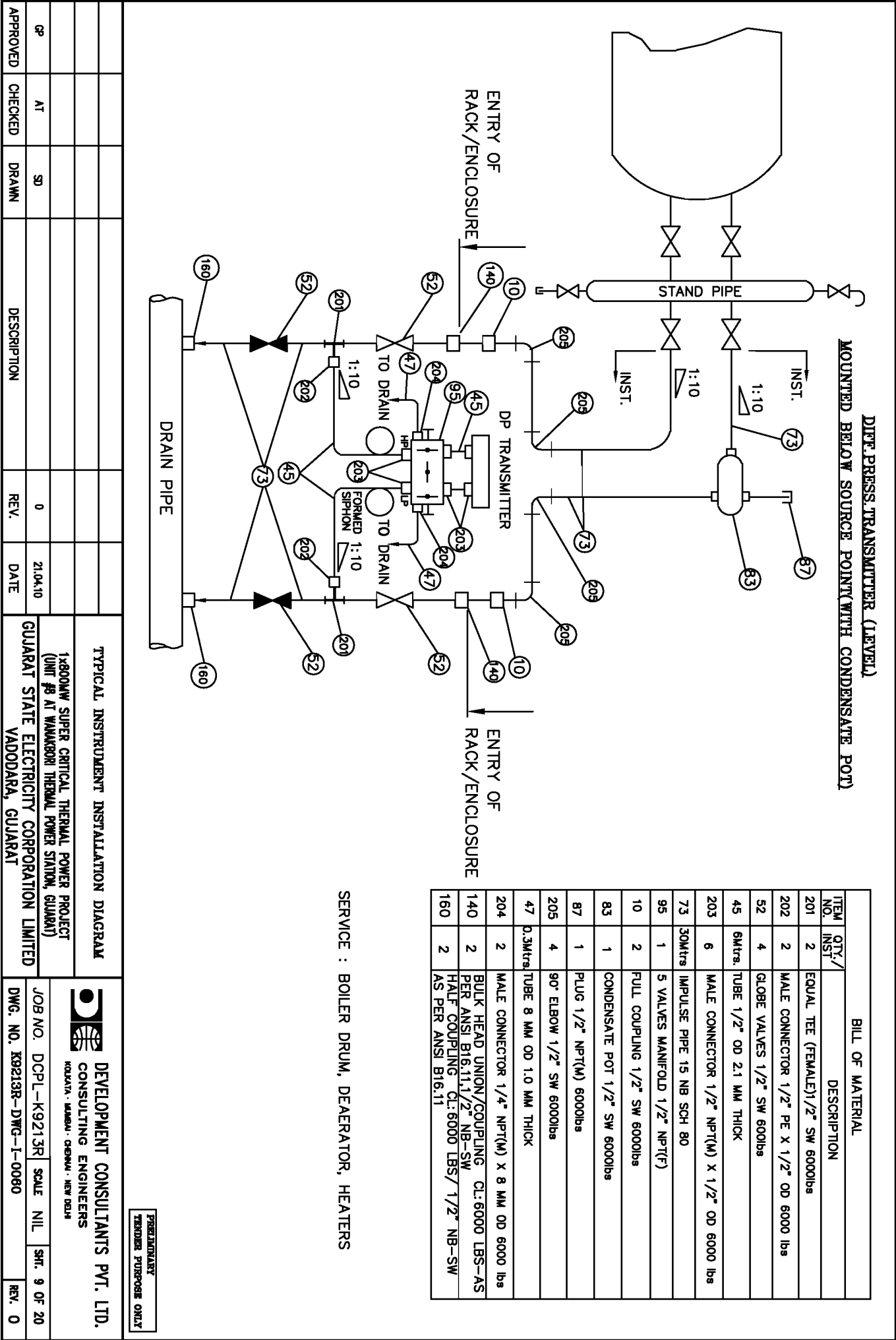
DEVELOPMENT CONSULTANTS PVT. LTD.  
CONSULTING ENGINEERS  
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

1x800W SUPER CRITICAL THERMAL POWER PROJECT  
(UNIT #8 AT WANDRABARI THERMAL POWER STATION, GUJARAT)  
GUJARAT STATE ELECTRICITY CORPORATION LIMITED  
VADODARA, GUJARAT

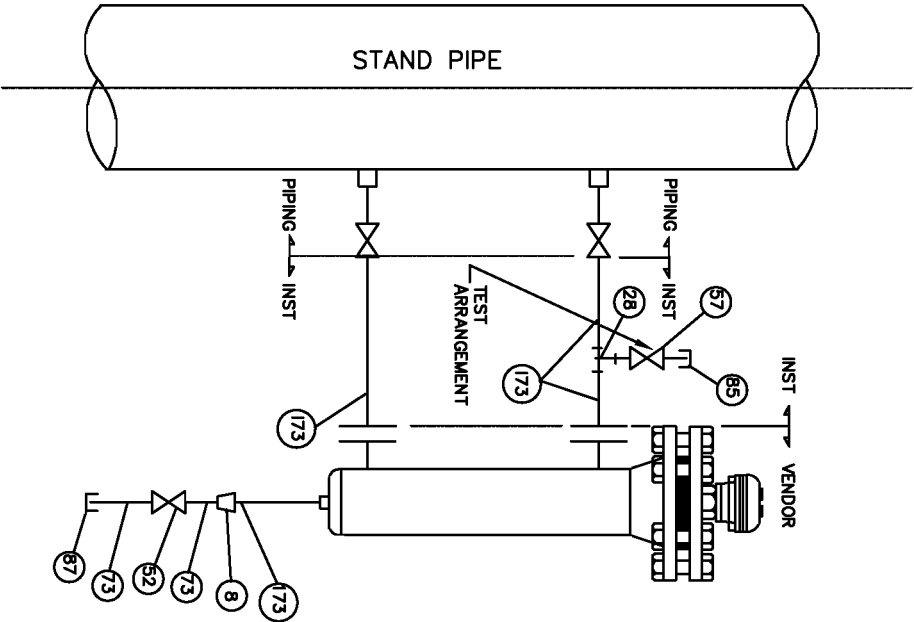
JOB NO. DCPL-K9213R SCALE NIL SHT. 7 OF 20  
DWG. NO. K9213R-DWG-I-0060 REV. 0

391





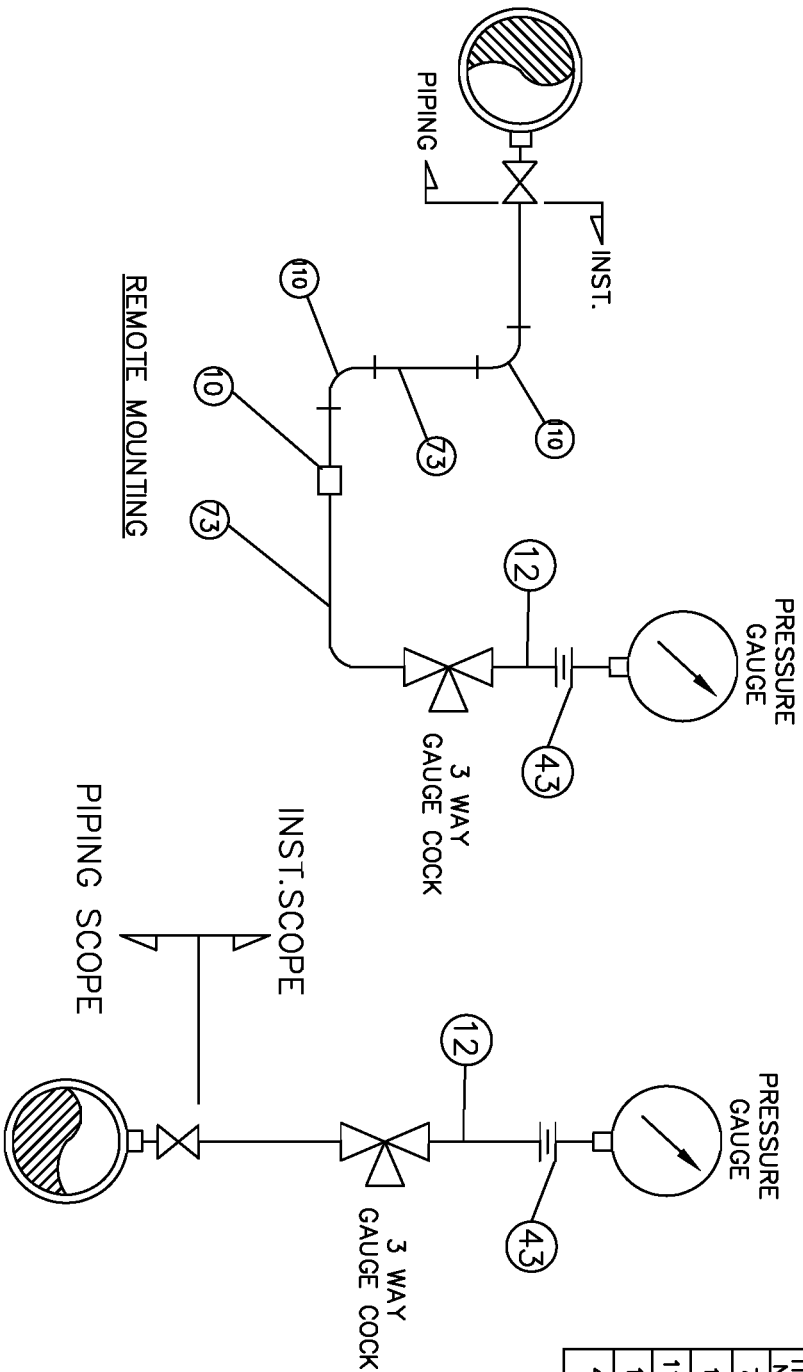
FLOAT OPERATED LEVEL SWITCH



| BILL OF MATERIALS |           |                                  |
|-------------------|-----------|----------------------------------|
| ITEM NO           | QTY/ INST | DESCRIPTION                      |
| 52                | 1         | GLOBE VALVE 1/2" SW 600lbs       |
| 73                | 0.5Mtrs   | IMPULSE PIPE 15 NB SCH.80        |
| 87                | 1         | PULG 1/2" NPT(M) 3000lbs         |
| 28                | 2         | EQUAL TEE (FEMALE) 1" SW 3000lbs |
| 173               | 1 Mtrs    | IMPULSE PIPE 25 NB SCH.80        |
| 8                 | 1         | REDUCER 1" SW X 1/2" SW 3000lbs  |
| 57                | 1         | GLOBE VALVE 1" SW 600 lbs        |
| 85                | 1         | PLUG 1" NPT(F) 3000 lbs          |

SERVICE : CONDENSATE

|          |         |       |             |      |          |                                                                    |  |                                                                                     |  |                                   |           |   |
|----------|---------|-------|-------------|------|----------|--------------------------------------------------------------------|--|-------------------------------------------------------------------------------------|--|-----------------------------------|-----------|---|
|          |         |       |             |      |          | TYPICAL INSTRUMENT INSTALLATION DIAGRAM                            |  |  |  | DEVELOPMENT CONSULTANTS PVT. LTD. |           |   |
|          |         |       |             |      |          |                                                                    |  | CONSULTING ENGINEERS                                                                |  |                                   |           |   |
|          |         |       |             |      |          |                                                                    |  | MUMBAI · CHENNAI · NEW DELHI                                                        |  |                                   |           |   |
| GP       | AT      | SD    |             | 0    | 21.04.10 |                                                                    |  | JOB NO.                                                                             |  | DCPL-K9213R                       | SCALE NIL |   |
|          |         |       |             |      |          |                                                                    |  | SHEET                                                                               |  | 10 OF                             | 20        |   |
| APPROVED | CHECKED | DRAWN | DESCRIPTION | REV. | DATE     | GUJARAT STATE ELECTRICITY CORPORATION LIMITED<br>VADODARA, GUJARAT |  | DWG. NO.                                                                            |  | KS9213R-DWG-I-0080                | REV.      | 0 |



| BILL OF MATERIAL |                                      |
|------------------|--------------------------------------|
| ITEM NO.         | DESCRIPTION                          |
| 73               | IMPULSE PIPE 15 NB SCH.80            |
| 10               | FULL COUPLING 1/2" SW 3000lbs        |
| 110              | 90° ELBOW 1/2" SW 3000lbs            |
| 12               | 1/2" NPT(M) X 1/2" PE 4" LONG NIPPLE |
| 43               | 1 1/2" NPT(F) X 1/2" PE              |

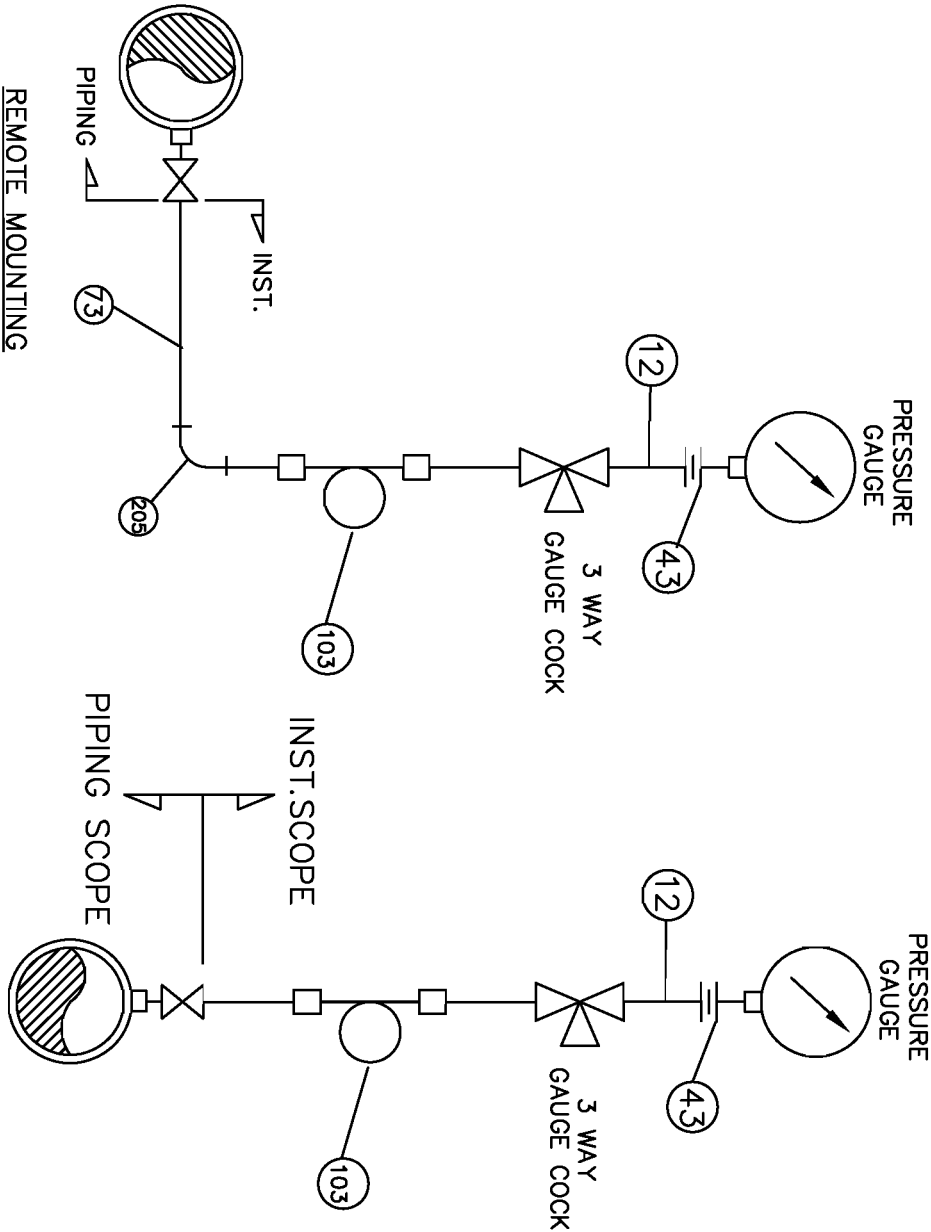
| TYPICAL INSTRUMENT INSTALLATION DIAGRAM                                                           |          |       |             |
|---------------------------------------------------------------------------------------------------|----------|-------|-------------|
| APPROVED                                                                                          | CHECKED  | DRAWN | DESCRIPTION |
| AT                                                                                                | SD       |       |             |
| 0                                                                                                 | 21.04.10 |       |             |
| GUJARAT STATE ELECTRICITY CORPORATION LIMITED                                                     |          |       |             |
| VADODARA, GUJARAT                                                                                 |          |       |             |
| 1:800W SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WAMANGORI THERMAL POWER STATION, GUJARAT) |          |       |             |
| JOB NO. DCP-1-K9213R SCALE NIL SHT. 11 OF 20                                                      |          |       |             |
| DWG. NO. K9213R-DWG-I-0060 REV. 0                                                                 |          |       |             |



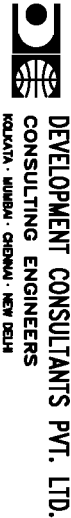
DEVELOPMENT CONSULTANTS PVT. LTD.  
CONSULTING ENGINEERS  
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

PRELIMINARY  
TENDER PURPOSE ONLY

|          |  |  |  |         |       |             |      |          |                                                                                                       |  |  |  |
|----------|--|--|--|---------|-------|-------------|------|----------|-------------------------------------------------------------------------------------------------------|--|--|--|
| APPROVED |  |  |  | CHECKED | DRAWN | DESCRIPTION | REV. | DATE     | TYPICAL INSTRUMENT INSTALLATION DIAGRAM                                                               |  |  |  |
| GP       |  |  |  | AT      | SD    |             | 0    | 21.04.10 | 1x800MW SUPER CRITICAL THERMAL POWER PROJECT<br>(UNIT #8 AT WANDARBON THERMAL POWER STATION, GUJARAT) |  |  |  |
|          |  |  |  |         |       |             |      |          | GUJARAT STATE ELECTRICITY CORPORATION LIMITED                                                         |  |  |  |
|          |  |  |  |         |       |             |      |          | VADODARA, GUJARAT                                                                                     |  |  |  |
|          |  |  |  |         |       |             |      |          | JOB NO. DGPL-K9213R SCALE NIL SFT. 12 OF 20                                                           |  |  |  |
|          |  |  |  |         |       |             |      |          | DWG. NO. K9213R-DWG-I-0060 REV. 0                                                                     |  |  |  |

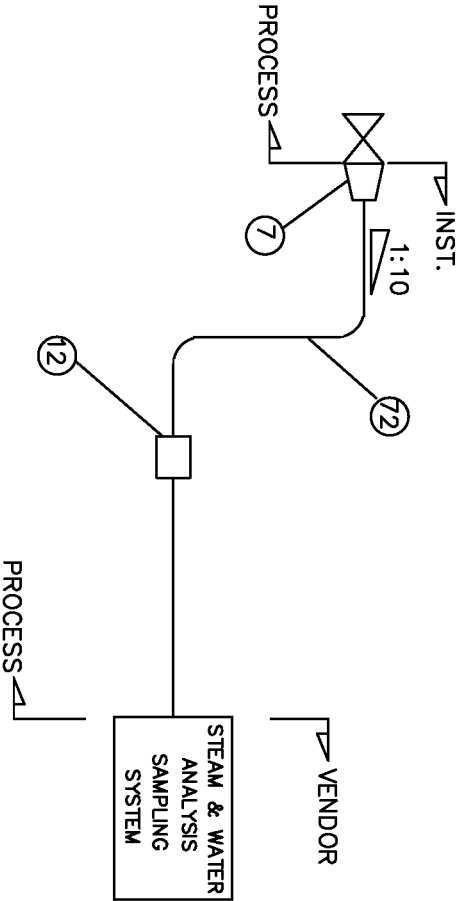


| BILL OF MATERIAL |            |                                                        |
|------------------|------------|--------------------------------------------------------|
| ITEM NO.         | QTY./INST. | DESCRIPTION                                            |
| 73               | 15Mtrs     | IMPULSE PIPE 15 NB SCH.80                              |
| 205              | 2          | 90° ELBOW 1/2" SW 6000lbs                              |
| 12               | 1          | 1/2" NPT(M) X 1/2" PE 4" LONG NIPPLE                   |
| 43               | 1          | NUT & TAIL FITTING WITH SS WASHER 1/2"NPT(F) X 1/2" PE |
| 103              | 1          | SYPHON 1/2" OD SCH.80                                  |



DEVELOPMENT CONSULTANTS PVT. LTD.  
CONSULTING ENGINEERS  
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

PRELIMINARY  
TENDER PURPOSE ONLY



| BILL OF MATERIAL |           |                                  |
|------------------|-----------|----------------------------------|
| ITEM NO.         | QTY./INST | DESCRIPTION                      |
| 12               | 1         | FULL COUPLING 1/2" SW 6000 lbs   |
| 7                | 1         | REDUCER 1" SW X 1/2" SW 6000 lbs |
| 72               | A/R       | IMPULSE PIPE 15 NB SCH 80        |

|                                                                                                    |         |       |      |
|----------------------------------------------------------------------------------------------------|---------|-------|------|
| TYPICAL INSTRUMENT INSTALLATION DIAGRAM                                                            |         |       |      |
| GP                                                                                                 | AT      | SD    | 0    |
| APPROVED                                                                                           | CHECKED | DRAWN | REV. |
| DATE                                                                                               |         |       |      |
| 21.04.10                                                                                           |         |       |      |
| GUJARAT STATE ELECTRICITY CORPORATION LIMITED                                                      |         |       |      |
| VADODARA, GUJARAT                                                                                  |         |       |      |
| 1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WAMKARBON THERMAL POWER STATION, GUJARAT) |         |       |      |
| JOB NO. DCPL-K9213R SCALE NIL SFT. 13 OF 20                                                        |         |       |      |
| DWG. NO. K9213R-DWG-I-0060 REV. 0                                                                  |         |       |      |

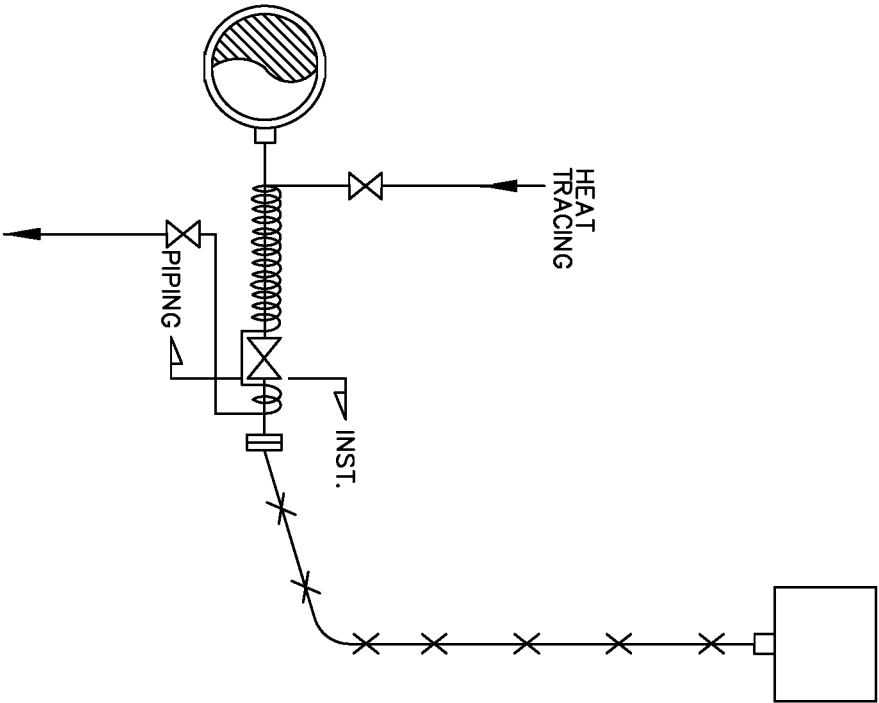


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CONSULTING ENGINEERS  
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

PRELIMINARY  
TENDER PURPOSE ONLY

PRESSURE TRANSMITTER/PRESSURE SWITCH  
IN HFO SERVICE

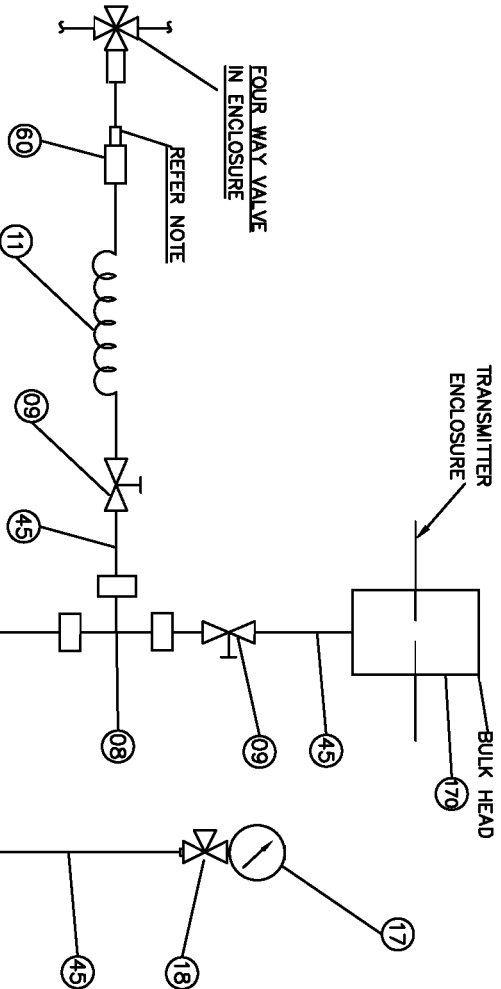
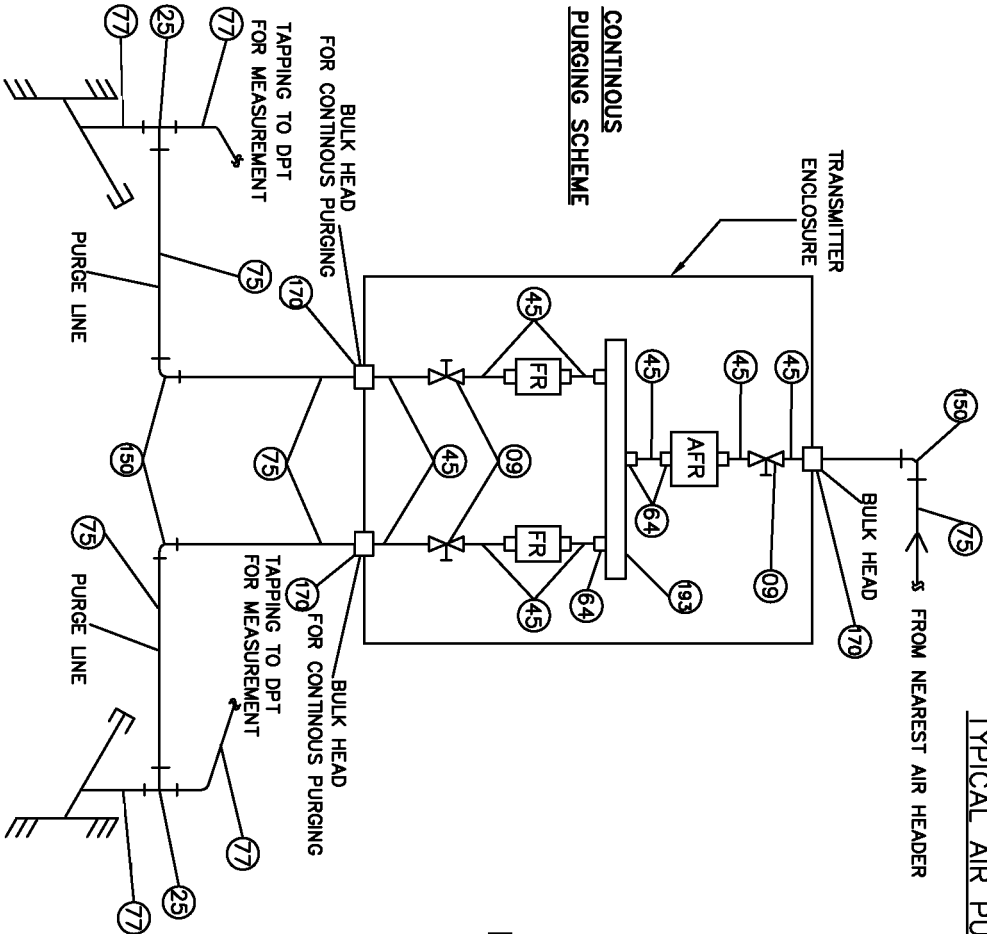
PRESSURE TRANSMITTER/  
SWITCH



|          |         |       |  |             |      |                                                                                                       |  |                                                                                                                                                                                            |  |  |  |  |  |
|----------|---------|-------|--|-------------|------|-------------------------------------------------------------------------------------------------------|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|
|          |         |       |  |             |      | TYPICAL INSTRUMENT INSTALLATION DIAGRAM                                                               |  | <br>DEVELOPMENT CONSULTANTS PVT. LTD.<br>CONSULTING ENGINEERS<br>KOLKATA · MUMBAI · CHENNAI · NEW DELHI |  |  |  |  |  |
|          |         |       |  |             |      | 1x800MW SUPER CRITICAL THERMAL POWER PROJECT<br>(UNIT #8 AT WANDIGORI THERMAL POWER STATION, GUJARAT) |  | JOB NO. DGPL-K9213R   SCALE NIL   SHT. 14 OF 20<br>DWG. NO. K9213R-DWG-I-0060                                                                                                              |  |  |  |  |  |
|          |         |       |  |             |      | GUJARAT STATE ELECTRICITY CORPORATION LIMITED<br>VADODARA, GUJARAT                                    |  |                                                                                                                                                                                            |  |  |  |  |  |
| GP       | AT      | SD    |  |             | 0    | 21.04.10                                                                                              |  |                                                                                                                                                                                            |  |  |  |  |  |
| APPROVED | CHECKED | DRAWN |  | DESCRIPTION | REV. | DATE                                                                                                  |  |                                                                                                                                                                                            |  |  |  |  |  |

PRELIMINARY  
TENDER PURPOSE ONLY

TYPICAL AIR PURGING SCHEMES



NOTE:

QUICK DISCONNECTING FITTING IS CONNECTED TO  
FOUR WAY VALVE WHERE INTERMITTENT PURGING  
IS CALLED IN SCHEME.  
FR-FLOW REGULATOR

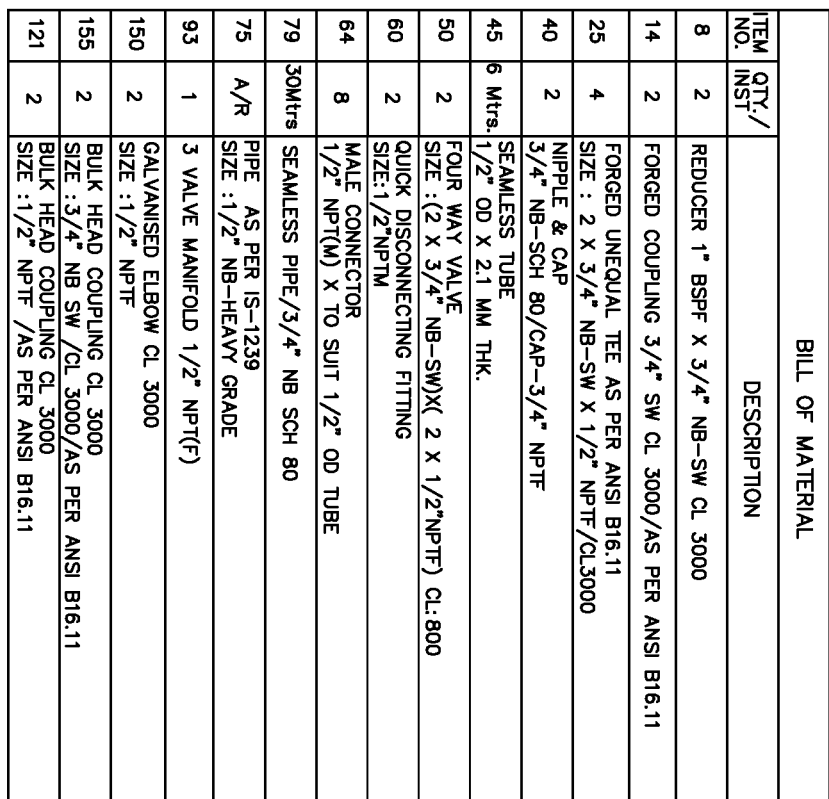
CONTINUE TO SHT. NO. 16/20

PRELIMINARY  
TENDER PURPOSE ONLY

|                                         |  |                                                                                                        |  |                                                                    |  |                                             |  |
|-----------------------------------------|--|--------------------------------------------------------------------------------------------------------|--|--------------------------------------------------------------------|--|---------------------------------------------|--|
| TYPICAL INSTRUMENT INSTALLATION DIAGRAM |  | 1x800MW SUPER CRITICAL THERMAL POWER PROJECT<br>(UNIT #9 AT VANDARBORI THERMAL POWER STATION, GUJARAT) |  | GUJARAT STATE ELECTRICITY CORPORATION LIMITED<br>VADODARA, GUJARAT |  | JOB NO. DCPL-K9213R SCALE NIL SHT. 15 OF 20 |  |
| APPROVED                                |  | CHECKED                                                                                                |  | DRAWN                                                              |  | DESCRIPTION                                 |  |
| AT                                      |  | SD                                                                                                     |  | 0                                                                  |  | 21.04.10                                    |  |
| REV.                                    |  | DATE                                                                                                   |  | 0                                                                  |  | 21.04.10                                    |  |
| TYPICAL INSTRUMENT INSTALLATION DIAGRAM |  | 1x800MW SUPER CRITICAL THERMAL POWER PROJECT<br>(UNIT #9 AT VANDARBORI THERMAL POWER STATION, GUJARAT) |  | GUJARAT STATE ELECTRICITY CORPORATION LIMITED<br>VADODARA, GUJARAT |  | JOB NO. DCPL-K9213R SCALE NIL SHT. 15 OF 20 |  |
| DWG. NO. K9213R-DWG-I-0060              |  | REV. 0                                                                                                 |  | DWG. NO. K9213R-DWG-I-0060                                         |  | REV. 0                                      |  |

| BILL OF MATERIAL |            |                                                                                 |
|------------------|------------|---------------------------------------------------------------------------------|
| ITEM NO.         | QTY./INST. | DESCRIPTION                                                                     |
| 77               | 15Mtrs     | IMPULSE PIPE 3/4" NB                                                            |
| 75               | A/R        | GI PIPE/1/2" NB                                                                 |
| 25               | 2          | FORGED UNEQUAL TEE/AS PER ANSI B16.11<br>SIZE: 2 X 3/4" NB SW X 1/2"NPT/CL 3000 |
| 150              | 3          | GALVANISED ELBOW CL 3000<br>SIZE: 1/2" NPTF                                     |
| 60               | 1          | QUICK DISCONNECTING FITTING.<br>MALE/END CONN. TO SUIT 1/2" OD CONN.            |
| 11               | A/R        | NYLON NOSE TO SUIT 1/2" END<br>CONN./Pr. TESTING 10 Kg/cm <sup>2</sup>          |
| 45               | A/R        | SEAMLESS TUBE 1/2" OD TUBE X 2.1 MM THK.                                        |
| 170              | 3          | BULK HEAD COUPLING TO SUIT 1/2" OD TUBE<br>& 1/2" NB PIPE                       |
| 09               | 5          | BALL VALVE TO SUIT 1/2" OD TUBE                                                 |
| 64               | 9          | MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 3000lbs                                    |
| 193              | 1          | INSTRUMENT AIR HEADER 1" NB PIPE                                                |
| 08               | 1          | EQUAL TEE/SS 316/TO SUIT 1/2" OD TUBE.                                          |
| 17               | 1          | Pr. GAUGE/4" DIAL SIZE/RANGE 0-10 Kg/cm <sup>2</sup><br>CONNECTION 1/2" NPTM    |
| 18               | 1          | 3 WAY GAUGE 1/2"NPTF X TO SUIT 1/2" TUBE.                                       |

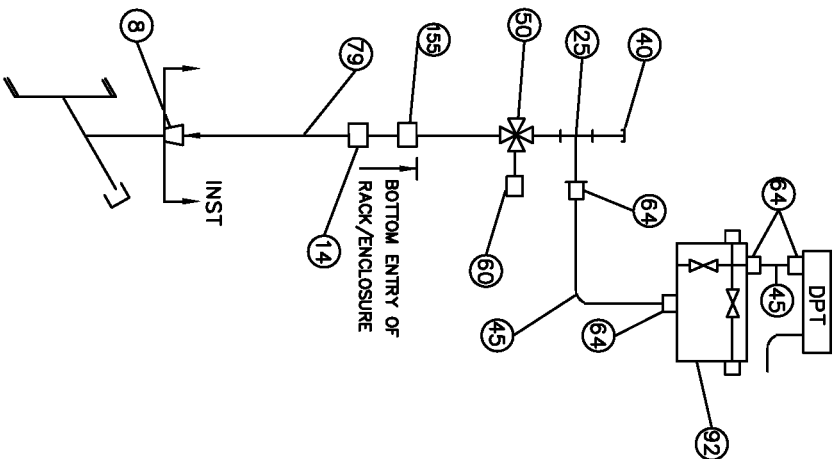
|          |         |       |      |      |                                                                                                        |                                                                                                                                                                                             |
|----------|---------|-------|------|------|--------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          |         |       |      |      | TYPICAL INSTRUMENT INSTALLATION DIAGRAM                                                                | DEVELOPMENT CONSULTANTS PVT. LTD.<br>CONSULTING ENGINEERS<br><br>KOLAKATA · MUMBAI · CHENNAI · NEW DELHI |
|          |         |       |      |      | 1x800MW SUPER CRITICAL THERMAL POWER PROJECT<br>(UNIT #B AT WANDAKHORI THERMAL POWER STATION, GUJARAT) |                                                                                                                                                                                             |
|          |         |       |      |      | GUJARAT STATE ELECTRICITY CORPORATION LIMITED                                                          |                                                                                                                                                                                             |
|          |         |       |      |      | VADODARA, GUJARAT                                                                                      |                                                                                                                                                                                             |
| APPROVED | CHECKED | DRAWN | REV. | DATE | JOB NO. DCP-L-K9213R SCALE NIL SHT. 16 OF 20                                                           |                                                                                                                                                                                             |
|          |         |       |      |      | DWG. NO. K9213R-DWG-I-0060 REV. 0                                                                      |                                                                                                                                                                                             |



**SERVICE : FLUE GAS, FURNACE ETC.**

**PRELIMINARY  
TENDER PURPOSE ONLY**

**DIFF. PRESSURE TRANSMITTER  
MOUNTED ABOVE SOURCE POINT**



| BILL OF MATERIAL |                                                                                   |
|------------------|-----------------------------------------------------------------------------------|
| ITEM NO.         | DESCRIPTION                                                                       |
| 8                | REDUCER 1" BSPF X 3/4" NB-SW CL 3000                                              |
| 14               | FORGED COUPLING 3/4" SW CL 3000/AS PER ANSI B16.11                                |
| 25               | FORGED UNEQUAL TEE AS PER ANSI B16.11<br>SIZE : 2 X 3/4" NB-SW X 1/2" NPTF/CL3000 |
| 40               | NIPPLE & CAP<br>3/4" NB-SCH 80/CAP-3/4" NPTF                                      |
| 45               | SEAMLESS TUBE<br>1/2" OD X 2.1 MM THK.                                            |
| 50               | FOUR WAY VALVE<br>SIZE : (2 X 3/4" NB-SW)X( 2 X 1/2"NPTF) CL:800                  |
| 60               | QUICK DISCONNECTING FITTING<br>SIZE:1/2"NPTM                                      |
| 64               | MALE CONNECTOR /SS 316<br>1/2" NPT(M) X TO SUIT 1/2" OD TUBE                      |
| 79               | 30Mtrs SEAMLESS PIPE/3/4" NB SCH 80                                               |
| 92               | 2 VALVE MANIFOLD 1/2" NPT(F)                                                      |
| 155              | BULK HEAD COUPLING CL 3000<br>SIZE : 3/4" SW /CL 3000/AS PER ANSI B16.11          |

SERVICE : FLUE GAS, PRIMARY AIR, SECONDARY AIR ETC.  
NOTE : AIR PURGING ARRANGEMENT SHALL BE INCLUDED.

|                                                                                                      |  |       |          |
|------------------------------------------------------------------------------------------------------|--|-------|----------|
| TYPICAL INSTRUMENT INSTALLATION DIAGRAM                                                              |  |       |          |
| 1:800MW SUPER CRITICAL THERMAL POWER PROJECT<br>(UNIT #8 AT WAMANGON THERMAL POWER STATION, GUJARAT) |  |       |          |
| GUJARAT STATE ELECTRICITY CORPORATION LIMITED<br>VADODARA, GUJARAT                                   |  |       |          |
| JOB NO. DCPL-K9213R                                                                                  |  | SCALE | NIL      |
| DWG. NO. K9213R-DWG-I-0060                                                                           |  | SHT.  | 18 OF 20 |
| REV. 0                                                                                               |  |       |          |



**DEVELOPMENT CONSULTANTS PVT. LTD.**  
CONSULTING ENGINEERS  
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

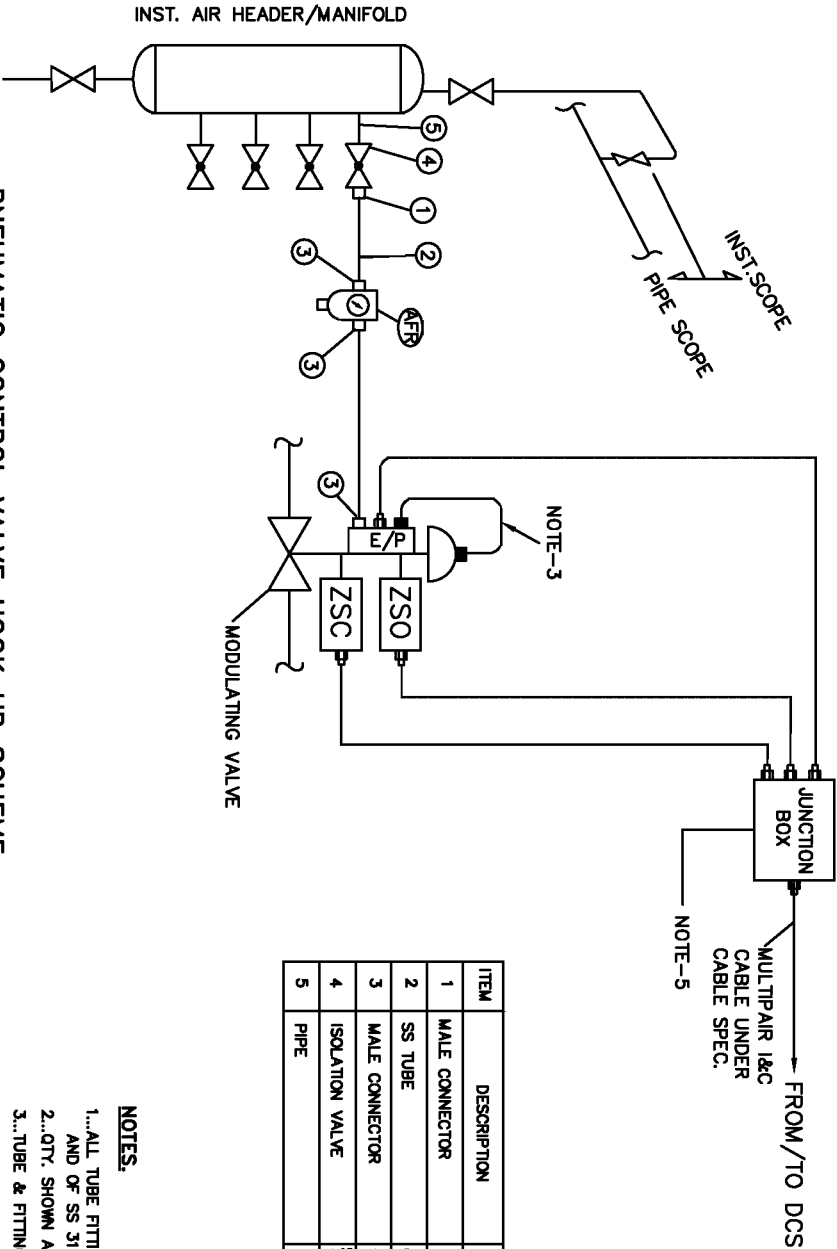
PRELIMINARY  
TENDER PURPOSE ONLY

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PRELIMINARY  
TENDER PURPOSE ONLY

PNEUMATIC CONTROL VALVE HOOK UP SCHEME

- NOTES.
- 1...ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.
  - 2...QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.
  - 3...TUBE & FITTINGS MARKED ■ ARE INTEGRAL TO THE VALVE.
  - 4...LIMIT SWITCHES WILL BE CONNECTED WHEREVER APPLICABLE.
  - 5...JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.
  - 6...ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.



| ITEM | DESCRIPTION     | SPECIFICATION                             | QTY.     | REMARKS |
|------|-----------------|-------------------------------------------|----------|---------|
| 1    | MALE CONNECTOR  | 1/2"NPT(M) X 6 mm OD COMPRL.              | 1        |         |
| 2    | SS TUBE         | 6 mm OD X 1 mm THK.                       | 10 MTRS. |         |
| 3    | MALE CONNECTOR  | 1/4"NPT(M) X 6 mm OD COMPRL.              | 3        |         |
| 4    | ISOLATION VALVE | SS BALL TYPE 600LBS 1/2" SW X 1/2" NPT(F) |          |         |
| 5    | PIPE            | 1/2" NB SCH 40S                           | A/R      |         |

|          |         |       |             |                                                                                                       |          |      |  |
|----------|---------|-------|-------------|-------------------------------------------------------------------------------------------------------|----------|------|--|
|          |         |       |             | TYPICAL INSTRUMENT INSTALLATION DIAGRAM                                                               |          |      |  |
|          |         |       |             | 1x800kW SUPER CRITICAL THERMAL POWER PROJECT<br>(UNIT #8 AT WAMANGORI THERMAL POWER STATION, GUJARAT) |          |      |  |
|          |         |       |             | GUJARAT STATE ELECTRICITY CORPORATION LIMITED                                                         |          |      |  |
|          |         |       |             | VADODARA, GUJARAT                                                                                     |          |      |  |
| GP       | AT      | SD    |             | 0                                                                                                     | 21.04.10 |      |  |
| APPROVED | CHECKED | DRAWN | DESCRIPTION |                                                                                                       | REV.     | DATE |  |

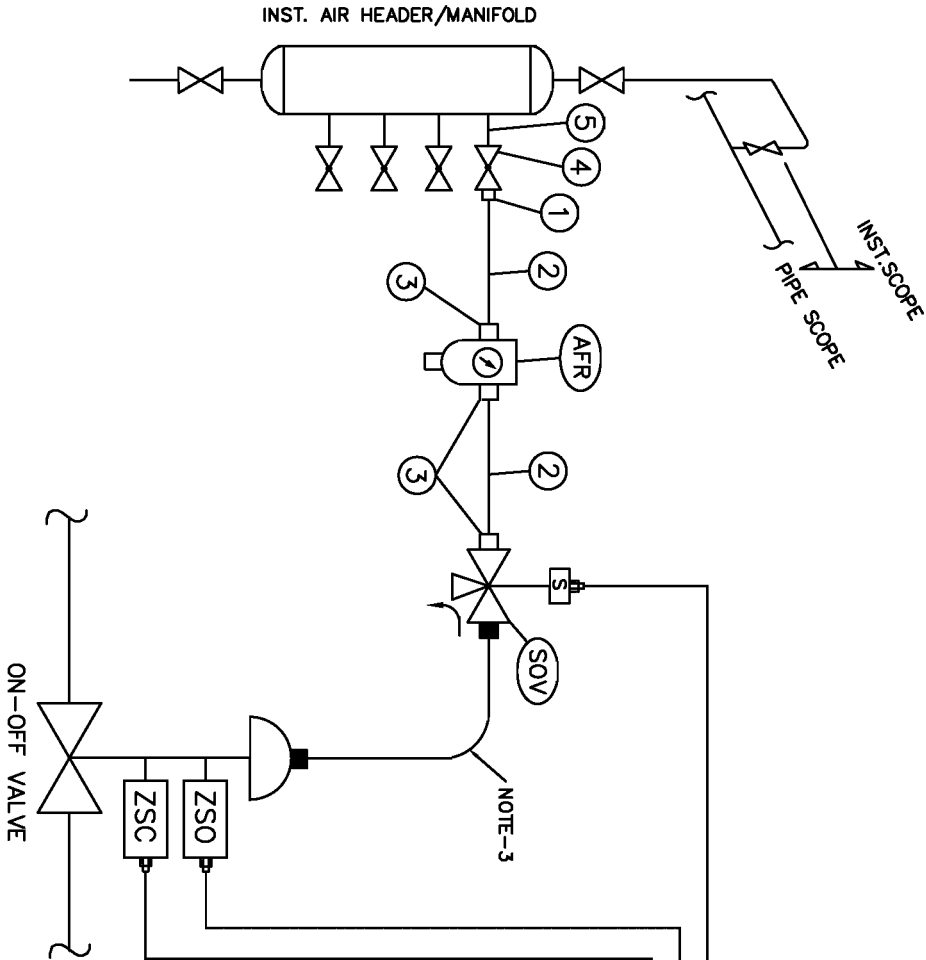


DEVELOPMENT CONSULTANTS PVT. LTD.  
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JOB NO. DCPL-K9213R SCALE NIL SHT. 20 OF 20  
DWG. NO. K9213R-DWG-I-0060 REV. 0

PRELIMINARY  
TENDER PURPOSE ONLY

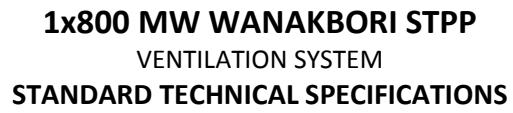
PNEUMATIC SOV HOOK UP SCHEME



| ITEM | DESCRIPTION     | SPECIFICATION                                | QTY.     | REMARKS |
|------|-----------------|----------------------------------------------|----------|---------|
| 1    | MALE CONNECTOR  | 1/2"NPT(M) X 6 mm OD COMPRN.                 | 1        |         |
| 2    | SS TUBE         | 6 mm OD X 1.0 mm THK.                        | 10 MTRS. |         |
| 3    | MALE CONNECTOR  | 1/4"NPT(M) X 6 mm OD COMPRN.                 | 3        |         |
| 4    | ISOLATION VALVE | SS BALL TYPE 800LBS<br>1/2" SW X 1/2" NPT(F) |          |         |
| 5    | PIPE            | 1/2" NB SCH 40S                              | A/R      |         |

NOTES.

- 1...ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.
- 2...QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.
- 3...TUBE & FITTINGS MARKED ■ ARE INTEGRAL TO THE VALVE.
- 4...JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.
- 5...ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.



REV. 00

## 404 of 533



**STANDARD TECHNICAL SPECIFICATION  
FOR  
AIR WASHER**

**SPECIFICATION NO.PES-554-01**

**VOLUME II B**

**SECTION D**

**REV. 00**

**DATE: NOV 2012**

**SHEET 1 OF 3**

**STANDARD TECHNICAL SPECIFICATION  
FOR  
AIR WASHER**

महेश्वर  
मुकुन्द रेड्डी  
S-4-162000 2011-07-13



## STANDARD TECHNICAL SPECIFICATION FOR AIR WASHER

SPECIFICATION NO.PES-554-01

VOLUME II B

SECTION D

REV. 00

DATE: NOV 2012

SHEET 2 OF 3

### 1. GENERAL

- 1.1.1 This specification covers the design, manufacture, construction features, installation, commissioning and conducting performance test at site.

### 2. CODES AND STANDARDS

The design/manufacture and performance of air washer shall comply with all currently applicable statutes, regulations and safety codes in the locality where the air washer is installed. The equipments shall also conform to the requirements of the latest editions of applicable Indian/British/US standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipments shall conform to the latest editions of the following standards:-

- 2.1.1 IS:277: Galvanised steel sheets  
2.1.2 IS:1239: Mild steel tubes  
2.1.3 IS: 2062:

### 3. DESIGN/CONSTRUCTION FEATURES

#### 3.1 GENERAL

- 3.1.1 The air washer shall be designed for max. air velocity of 2.8M/sec. Circulating water quantity shall be 1.0 CMH for every 1000 CMH of air flow, unless otherwise stated in data sheet A. The minimum saturating efficiency of air washer shall not be less than 90% Minimum length of air washer shall be 2500 mm.

#### 3.2 TANK (SUMP)

- 3.2.1 The air washer tank shall either be masonry or metallic construction as specified in data sheet A. Masonry tank shall be provided by purchaser whereas metallic tank shall be of welded construction, fabricated from not less than 6mm thick MS plates, and inside, outside surfaces shall be provided with anti corrosive paint (Zinc sprayed to coating thickness of 75 micron min.).
- 3.2.2 The air washer tank shall have a minimum depth of 600mm and tank construction shall be such that the suction screen can be replaced while the air washer is under operation. The inlet and outlet ends of tank shall be suitably constructed to accommodate distribution plates and eliminator plates.

#### 3.3 DISTRIBUTION PLATE

- 3.3.1 The distribution plate shall be fabricated from minimum 18 gauge thick GSS and shall have minimum 50% free area. The angles used for supports shall be galvanised.
- 3.3.2 The distribution plate shall be built up of number of sections for easy handling.

#### 3.4 HEADERS AND STAND PIPE

- 3.4.1 The air washer shall be of two bank construction (one cross flow and other unit flow). The piping up to and including 100mm dia meter shall be of galvanised steel and above 100mm dia shall be black steel (subsequently spray galvanized to coating thickness as per approved TDS). All piping shall be adequately supported.



## STANDARD TECHNICAL SPECIFICATION FOR AIR WASHER

SPECIFICATION NO. PES-554-01

VOLUME II B

SECTION D

REV. 00

DATE: NOV 2012

SHEET 3 OF 3

### 3.5 SPRAY NOZZLES

3.5.1 Spray nozzles shall be made of HDP (High density polyethylene) and shall be self cleaning type. The nozzles shall be designed to produce fine atomised spray and shall be spaced to give, uniform coverage of the air washer section. The pressure drop through the nozzle shall be in the range of 1.4 kg/cm<sup>2</sup> g to 2.4 Kg/cm<sup>2</sup>g

### 3.6 ELIMINATOR PLATE

3.6.1 Eliminator plate shall be fabricated from 22 gauge thick GSS (Zinc coating thickness as per approved TDS). The eliminator section shall have minimum 6 bends. Spacer bars, tie rods and supports shall be of galvanised steel construction. Eliminator box shall be complete with suitable drop tray and drain pipe.

### 3.7 SUCTION SCREENS

3.7.1 Suitable no. of suction screens shall be provided by vendor and one set of spare screens shall be furnished along with each air washer.

### 3.8 INSPECTION DOOR AND MARINE LIGHT

3.8.1 Air tight inspection door of 600x700mm, metallic construction shall be provided. The air washer shall be equipped with marine light as required.

### 3.9 MAKE UP, DRAIN AND QUICK FILL CONNECTION

3.9.1 The air washer shall be provided with quick fill and make up connection. The quick fill valve shall be a globe valve. Float valve for making connection shall be backed up by a gate valve. Drain connections complete with isolating valves shall be provided for both suction and main tank. Over-flow pipe shall be provided for main tank and shall be connected to drain pipe, before the isolating valve or drain. In case of masonry tanks suitable pipe pieces with stiffener plates shall be provided by Vendor for use during casting of masonry tank.

### 4. DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT

4.1.1 Performance curve for air washer

4.1.2 GA drg.

4.1.3 Foundation drag. weight, dynamic loading etc.

4.1.4 O&M manual



## AIR WASHER DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

DATE NOV 2012

SHEET 1 OF 2

**S.No. DESCRIPTION****DETAILS****GENERAL**

- |    |               |                                                   |
|----|---------------|---------------------------------------------------|
| 1. | Designation   | Air washers for power house building.             |
| 2. | Nos. required | Refer Section-C of Specific Technical Requirement |
| 3. | Service       | Evaporative Cooling of TG Hall & electrical bay   |
| 4. | Location      | As per section-C/ Tender Layout Drg.              |

**DESIGN DATA**

- |    |                                              |                                                          |
|----|----------------------------------------------|----------------------------------------------------------|
| 5. | Type                                         | Sheet metal type, as per schedule of Ventilation system. |
| 6. | Capacity M3/hr                               | Refer Section-C of Specific Technical Requirement        |
| 7. | Inlet air temperature                        | (Refer design data.)                                     |
| 8. | Saturation Efficiency (min).                 | To achieve saturation efficiency of 90%                  |
| 9. | Allowable Pressure drop through Spray nozzle | 2.4 Kg/cm <sup>2</sup> (g) max.                          |
| 9. | Pressure drop across Spray chamber           | 15 to 20 mm WG.                                          |

**MATERIALS**

- |     |                             |                                                                                                                          |
|-----|-----------------------------|--------------------------------------------------------------------------------------------------------------------------|
| 11. | Moisture Eliminators plates | 24 SWG Galvanized Sheet (Vertical and brake type). / 100% Virgin PVC of minimum finished thickness of 2 mm.              |
| 12. | Moisture Eliminators Frame  | 22 SWG G.I. Sheets.                                                                                                      |
| 13. | Distribution plates         | 18 G GSS to have 50% free area.                                                                                          |
| 14. | Tank                        | MS                                                                                                                       |
| 15. | Casing                      | Black M.S. (10 SWG min.)                                                                                                 |
| 16. | Louvers                     | 20 G GSS sheet & frame of 18 G galvanized steel angle. Louvers with Bird screen of galvanized wire mesh of 10 mm square. |
| 17. | Piping                      | MS Heavy Class Galvanized to IS: 1239 Part I, OR IS -3589 depending upon size.                                           |



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- |     |                      |                                                                                                                |
|-----|----------------------|----------------------------------------------------------------------------------------------------------------|
| 18. | Suction Screen Water | Brass (40 mesh size 2 nos for each air washer)                                                                 |
| 19. | Spray nozzles        | Brass/Bronze with chrome plating or suitable plastic material (Nylon/Polymer) and shall be self cleaning type. |
| 20. | Flooding Nozzles     | Nylon/Polymer.                                                                                                 |
| 21. | Banks                | Two spray banks each connected to individual header                                                            |

### EQUIPMENT SELECTION CRITERIA

- |     |                                              |                                    |
|-----|----------------------------------------------|------------------------------------|
| 22. | Face Velocity through louver.                | Not to exceed 2.5 m/s              |
| 23. | Max. Pressure drop                           | Not to exceed 6.5 mm Wg when clean |
| 24. | Saturation efficiency                        | Not less than 90%.                 |
| 25. | Face velocity of air through spray chamber.  | Not to exceed 2.5 m/s.             |
| 26. | Allowable pressure drop for washing chamber. | 15 to 20 mm Wg.                    |

### NOTE:

- 1) All parts coming in contact with moisture for air washer shall be spray galvanized/epoxy painted  
(2 coat of rust preventing epoxy primer & 2 coat of finished paint from both sides.)
- 2) Moisture eliminator shall have bends at 30 Degree with the direction of air flow & shall have effectively hooked edges for trapping the water.



**STANDARD TECHNICAL SPECIFICATION  
FOR  
VENTILATION FANS**

**SPECIFICATION NO.PES-554-03**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: NOV 2012**

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**STANDARD TECHNICAL SPECIFICATION  
FOR  
VENTILATION FANS**

महेश्वर  
मुकुन्द रेड्डी  
5-4-16/2012



## STANDARD TECHNICAL SPECIFICATION FOR VENTILATION FANS

SPECIFICATION NO.PES-554-03

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### 1. GENERAL

This specification covers the design, manufacture, testing of performance at manufacturer's/sub-contractors works, delivery at site, handling at site, erection and commissioning of ventilation fans.

### 2. CODE AND STANDARDS

The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where it is to be installed. The equipment shall conform to latest edition of applicable Indian Standards or their equivalent standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall conform to the latest editions of the Following standards.

- 2.1.1 IS:4894 -Centrifugal fans
- 2.1.2 IS:3588 -Electric Axial Flow fans
- 2.1.3 IS:2312 -Propeller type A.C. ventilation fans
- 2.1.4 IS-3963 -Roof extractor units
- 2.1.5 BS:848 -Method of performance test for fans.
- 2.1.6 AMCA publication 99 standards handbook
- 2.1.7 AMCA standard 210, Test code for air moving devices.

### 3. DESIGN AND CONSTRUCTION

**3.1 THE ENCLOSED DATA SHEET A GIVES THE NECESSARY DETAILS FOR CENTRIFUGAL/AXIAL/ROOF EXTRACTOR UNITS ETC.**

**3.2 WELDING PROCESS AND WELDERS EMPLOYED FOR FABRICATION SHALL BE QUALIFIED AS PER ASME SEC. IX**

#### 3.3 CASING

3.3.1 The centrifugal fans casing shall be of welded construction fabricated with heavy gauge material (min 3 mm) with flanges (min. 5 mm) on inlet and out let side for direct connection and shall be rigidly reinforced and supported by structural angles. The seams shall be permanently sealed airtight. Horizontal Split casings shall be provided on large size fans. Casing drain (at bottom) with threaded plug/ with valve shall be provided, as required. All mounting/ connecting holes shall be drilled off centre.

3.3.2 The axial flow casing for supply fans/roof extractors shall be of heavy gauge construction (min 3 mm) properly reinforced for rigidity and shall be complete with suitable supports. Access doors with suitable locking arrangement shall be provided in the casing for easy access to the motor and impeller. External junction box/ Terminal box on casing with IP-55 protection shall be provided, if required. Wiring for motor from external junction box/ Terminal box shall be through flexible conduit.

3.3.3 Suitable motor brackets designed for rigid mounting of motors, shall be provided for roof extractors and wall mounted exhaust/ supply fans.



## STANDARD TECHNICAL SPECIFICATION FOR VENTILATION FANS

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### 3.4 IMPELLER

3.4.1 Centrifugal fan impeller shall have die formed, aerofoil or laminar blades welded to the rim and back plate and shall have non-overloading, self cleaning characteristics. Rim shall be spun to have smooth contour. If required, intermediate stiffening rings shall be provided. Shaft sleeves shall be furnished, if specified. The impeller, pulley and shaft sleeve shall be secured to the shaft by key and/or nuts (threaded opposite to direction of rotation of impeller). The impeller shall be statically and dynamically balanced.

3.4.2 The axial fan impeller shall be of high efficiency aerofoil design. The blades shall be mounted on a streamlined hub and the impeller shall be mounted directly on the motor shaft. Impeller shall be in one piece however; fabricated blades will be acceptable up to 450 mm impeller diameter.

3.4.3 Roof ventilator impeller may either be centrifugal or axial type. Backward inclined blades shall be provided for centrifugal impellers. Blades may be die-formed or cast. Axial flow impeller shall be directly mounted to motor shaft whereas centrifugal impeller may either be direct-driven or belt-driven. The shaft of belt-driven centrifugal fan shall be solid cold rolled carbon steel, ground and polished. However, direct mounted impellers are preferred.

### 3.5 BEARINGS:

3.5.1 The centrifugal fan bearing may be ball, roller or sleeve bearings of self-aligning heavy duty type with adequate capacity and life. Make of Bearings to be specified. Bearings shall be oil/grease lubricated and provided with fittings for lubrication from outside and shall be located in easily accessible position to facilitate maintenance.

### 3.6 INLET CONES AND GUARDS

3.6.1 Centrifugal fans inlet shall be spun to have a smooth contour. Inlet screen, if provided, shall be galvanised wire mesh of 25 mm square with wire thickness of min. 1.5 mm.

3.6.2 Inlet cone, outlet bell and suitably designed guards shall be provided.

### 3.7 GUIDE VANES:

3.7.1 In case of vane axial fans guide vanes shall be provided on discharge side.

### 3.8 BASE PLATE AND VIBRATION ISOLATORS

3.8.1 Base plate and vibration isolators, which may be double deflection rubber in shear or rubber in compression type or spring type shall be provided. With each fan rubber bushes, washers wherever needed for vibration isolator in sufficient nos. shall be included, as required, to ensure isolation of foundation from vibration of equipment. For roof ventilators suitable mounting arrangement shall be provided such that there is no ingress of rain water into the building.

### 3.9 HOOD AND COWL

3.9.1 Roof exhaustors shall be provided with hinge type hood providing easy access to motor and impeller. Weather proof lockable type disconnect switch shall be provided such that hood can open only when the disconnect switch is in 'off'



## STANDARD TECHNICAL SPECIFICATION FOR VENTILATION FANS

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position. On larger size of roof ventilators hoods may be of split construction. 15 mm mesh galvanised bird screen shall be provided.

3.9.2 Rain protection cowls shall be designed to suit wall exhausters/supply fans for protecting fans from rain. The cowls shall be provided with bird screen of heavy gauge expanded metal netting.

### 3.10 SPEED

3.10.1 The speed of axial flow fans/roof ventilators shall not exceed 960 RPM for impeller dia exceeding 450 mm and shall not be greater than 1440 with impeller dia less than 450 mm.

## 4. MOTORS

Drive motors shall be of totally enclosed type, suitable for horizontal/vertical mounting as applicable and shall comply with the requirements of the specifications furnished elsewhere for motors.

## 5. ACCESSORIES

Accessories as specified in Data sheet-A and as required for satisfactory trouble free & safe operation of fans shall be provided.

### TESTING AND INSPECTION

List of TCs arranged as per Approved Quality Plan shall be furnished along with copy of TCs at the time of inspection by BHEL

- Visual inspection of sheets/plates, angles, channels etc. – Pitting, lamination in sheets/ plates, angles and channels shall be avoided.- visual inspection by main contractor of BHEL.
- Sheets/ Plates - Test certificate shall be furnished for physical and chemical properties for sheets / plates- for review by BHEL
- Shaft: Mechanical and chemical— review by BHEL
- Motors (of approved make): Routine TC ,FLP TC if applicable
- Workmanship and dimensional check as per manufacturing drg. and approved Drgs.- by main contractor of BHEL.- Shall be checked by BHEL/ Customer during final inspection.
- Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked/ welded to avoid loosening. - witness by manufacturer - TC to be furnished for review by BHEL(consisting of weight of impeller, radius of correction and balancing rpm). For spare impellers Dynamic Balancing shall be witnessed by BHEL.
- Performance test of one Centrifugal fan or Axial Fan /per type/per size as per applicable standard – by BHEL.

Centrifugal/ Axial fans 100% run tested by main contractor of BHEL. Run test by BHEL/Customer may be at random or 100%- Vibration shall be within satisfactory zone of VDI 2056 (group- G ) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient



**CENTRIFUGAL FAN  
DATA SHEET - A**

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**No. Particulars****Data****1 General Information**1.1 Fan Designation/application.  
system/Refer schedule of Ventilation  
Air washers & UAF Units.1.2 Nos. required/capacity  
TechnicalRefer Section-C of Specific  
Requirement

1.3 Location

Refer layout drg. Attached.

**2.0 Design Data**

2.1 Type

DIDW for Air Washer and SISW for  
UAF

2.2 Type of blades

backward curved

2.3 Arrangement

To suit application as per layout.

2.4 Discharge direction

To suit application as per layout.

2.5 Duty

Continuous

2.6 Capacity at site (Cubic Meter/hr) & static pressure.  
TechnicalRefer Section-C of Specific  
Requirement

2.7 Suction pressure (mm Wg)

As per system requirement.

2.8 Fluid

Atmospheric Air.

2.9 Suction Temperature

Refer weather data attached.

2.10 Suction humidity

Refer weather data attached.

**3.0 Materials**

3.1 Fan Scroll

Heavy Gauge Mild Steel to IS: 2062  
with galvanised

3.2 Fan Casing (side plates &amp; stiffeners)

Heavy Gauge Mild Steel to IS: 2062 /  
IS: 1079 / Eq. Minimum 3 mm thick  
casing.

3.3 Impeller

Mild Steel/plate to IS: 2062

3.4 Impeller hub

Mild Steel/plate to IS: 2062

3.5 Impeller back plate blade &amp; shroud

Mild Steel to IS: 2062 / IS: 1079 / Eq.



**CENTRIFUGAL FAN  
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SHEET 2 OF 3

- |      |                                                                                             |                                                                                              |
|------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| 3.6  | a) Shaft<br>b) Shaft sleeve                                                                 | EN-8 or eqv.<br>-do-                                                                         |
| 3.7  | Support frame and structure.                                                                | Mild Steel to IS: 2062                                                                       |
| 3.8  | Flexible connection at outlet<br>impregnated canvas with MS Flanges and cleats (3mm thick). | Fire resistant type plastic                                                                  |
| 3.9  | V Belt                                                                                      | ISI marked (Reinforced rubber section to<br>IS: 4776)                                        |
| 3.10 | V Pulley<br>per                                                                             | Cast Iron multi groove to grade FG 20 as<br><br>IS: 210. Having taper lock type<br>M.S./C.I. |
| 3.11 | Slide rails                                                                                 | G.I. according to supplier's design                                                          |
| 3.12 | Connection pieces                                                                           | M.S. Galvanized / Epoxy painted.                                                             |
| 3.13 | Bolts & nuts                                                                                | Hard synthetic rubber                                                                        |
| 3.14 | Vibration isolating pads, washers and spring<br>if any.                                     |                                                                                              |
| 4.0  | <b><u>ACCESSORIES</u></b>                                                                   |                                                                                              |
| 4.1  | Common base plate                                                                           | Required.                                                                                    |
| 4.2  | Anchor bolts                                                                                | -do-                                                                                         |
| 4.3  | Vibration Isolators                                                                         | Hard synthetic rubber                                                                        |
| 4.4  | V-belt pulleys                                                                              | -do-                                                                                         |
| 4.5  | V-belts                                                                                     | Reinforced rubber of appropriate<br>section                                                  |
| 4.6  | Belt guard                                                                                  | Required.                                                                                    |
| 4.7  | Outlet damper                                                                               | Required(M.S. Heavy Gauge)                                                                   |
| 4.8  | Inlet guard                                                                                 | Required.                                                                                    |
| 4.9  | Inlet Vane (variable)                                                                       | Not required.                                                                                |
| 4.10 | Drain valve                                                                                 | Required.                                                                                    |
| 4.11 | Acoustic silencers                                                                          | Not required.                                                                                |
| 5.0  | <b><u>Motor</u></b>                                                                         |                                                                                              |
| 5.1  | Motor by                                                                                    | Bidder                                                                                       |



**CENTRIFUGAL FAN  
DATA SHEET - A**

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SHEET 3 OF 3

5.2 Starter by

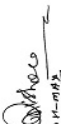
BHEL

6.0 Painting of fans including base frame

Galvanized / epoxy painting (as per  
Section-C & painting specifications)

**NOTE:**

- 1) Motors shall have 15 % margin on duty power point.
- 2) Fan shall be designed to operate with in 9% and 25% of system throttling line.
- 3) Opposed Multiple louvers damper shall be provided at fan outlet. Louvres shall be of 2 mm thick MS (galvanized). Casing shall be of 3.15 mm thick MS (galvanized).

Checked by:   
 N. K. Singh  
 5-11-2012



**VENTILATION FAN (R.E.UNIT)**  
**DATA SHEET - A**

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**General Information**

- |    |               |                                                                       |
|----|---------------|-----------------------------------------------------------------------|
| 1) | Designation   | Roof extractor Units for areas as per schedule of ventilation system. |
| 2) | Nos. required | As per schedule.                                                      |
| 3) | Service       | Continuous                                                            |
| 4) | Location      | Roof of respective areas.                                             |
| 5) | Area          | As per schedule                                                       |

**Design Data**

- |     |                               |                                                    |
|-----|-------------------------------|----------------------------------------------------|
| 6)  | Type                          | axial flow type.                                   |
| 7)  | Air delivery capacity system. | as per schedule of ventilation                     |
| 8)  | Fluid                         | Atmospheric Air.                                   |
| 9)  | Temperature                   | 50 Deg. C                                          |
| 10) | Static Pressure required      | As per Section 'C' schedule of ventilation system. |
| 11) | Outlet air velocity           | Not more than 12 m/sec.                            |

**Materials**

- |     |                                        |                                               |
|-----|----------------------------------------|-----------------------------------------------|
| 12) | Casing/cowl/hood                       | M.S. Sheet to IS: 2062 /IS: 1079/Eq.          |
| 13) | Impeller<br>617                        | Cast Aluminium alloy to A-6M IS-<br>Grade LM6 |
| 14) | Support frame and structure.<br>2062). | M.S. of adequate thickness (IS-               |

**ACCESSORIES**

- |     |                          |      |
|-----|--------------------------|------|
| 15) | Vibration isolating pads | Yes. |
| 16) | Base frame for mounting  | Yes. |
| 17) | Wire Guard at inlet.     | Yes. |
| 18) | Disconnect switch        | Yes. |

## VOLUME II-B

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**SHEET**            **2 OF 2**

- |                     |                                           |                                                    |
|---------------------|-------------------------------------------|----------------------------------------------------|
| 19)                 | Gravity damper at outlet                  | Yes                                                |
| <b><u>Motor</u></b> |                                           |                                                    |
| 20)                 | Motor by                                  | Bidder                                             |
| 21)                 | Starter by                                | Bidder                                             |
| 22)                 | Type of motor                             | Conforming to IS: 325 latest/as per specification. |
| 23)                 | Free delivery test                        | Yes.                                               |
| 24)                 | Performance test at specified duty point. | Yes                                                |
| 25)                 | Speed                                     | Not more than 1500 RPM                             |

NOTE:

1. Motors shall have 15% on duty power Point.

## VOLUME II-B

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## Ventilation Fan (Axial Flow Type)

### DATA SHEET - A

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SHEET 1 OF 2

#### No. Particulars

#### Data

#### General Information

- |    |                  |                                                                                      |
|----|------------------|--------------------------------------------------------------------------------------|
| 1) | Designation      | Supply/Exhaust Fans.                                                                 |
| 2) | Nos. required in | Refer schedule of Ventilation system section-C under specific technical requirement. |
| 3) | Service air.     | To exhaust warm air/to supply fresh                                                  |
| 4) | Location         | Wall mounted.                                                                        |
| 5) | Area             | Same as above in 2.                                                                  |

#### Design Data

- |     |                               |                                                    |
|-----|-------------------------------|----------------------------------------------------|
| 6)  | Type supply                   | Axial fans suitable for 415V/3 phase for Motor.    |
| 7)  | Air delivery capacity system. | As per schedule of ventilation                     |
| 8)  | Fluid                         | Atmospheric Air.                                   |
| 9)  | Temperature                   | Refer Section of specific technical requirement    |
| 10) | Static Pressure required      | As per Section 'C' schedule of ventilation system. |
| 11) | Outlet Air Velocity           | Not more than 12 m/sec.                            |

#### Materials

- |     |                                           |                                              |
|-----|-------------------------------------------|----------------------------------------------|
| 12) | Casing                                    | M.S. (IS-2062)                               |
| 13) | Impeller 617)                             | Cast Aluminium. (Alloy A-6M, IS-             |
| 14) | Hub                                       | Al Alloy.                                    |
| 15) | Support frame and structure. (Galvanized/ | M.S. of adequate thickness Painted) IS-2062. |
| 16) | Neoprene rubber pads                      | As required.                                 |



## Ventilation Fan (Axial Flow Type)

### DATA SHEET - A

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SHEET 2 OF 2

- |     |                                             |                                                            |
|-----|---------------------------------------------|------------------------------------------------------------|
| 17) | Coned inlet for wall exhausters/supply fans | MS (IS-2062)                                               |
| 18) | Supporting frame for mounting.              | Required.                                                  |
| 19) | Protective screen at inlet.                 | Yes (Min 14 SWG Galvanized wire knitted in 1" square mesh. |
| 20) | Rain Protection Cowl                        | Aluminum or hot dip Galvanized after fabrication from M.S. |

#### Motor

- |     |            |        |
|-----|------------|--------|
| 21) | Motor by   | Bidder |
| 22) | Starter by | BHEL   |

#### NOTE:

- 1) For Battery Room, motor for fan shall be of flame proof type & fan of spark proof construction with Epoxy painting.
- 2) Gravity type damper shall be provided at the outlet of axial fan for exhaust application.
- 3) Motor shall have 15% margin over Duty Point.



## Ventilation Fan (Axial Flow Type)

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महोदय  
मुख्य अभियंता  
डी एच डी एम  
स-4, लखनऊ-226001



**STANDARD TECHNICAL SPECIFICATION  
FOR  
LOW PRESSURE AIR DISTRIBUTION  
SYSTEM**

**SPECIFICATION NO. PES-554-02**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: NOV 2012**

**SHEET 1 OF 7**

**STANDARD TECHNICAL SPECIFICATION  
FOR  
LOW PRESSURE AIR DISTRIBUTION SYSTEM**



**TECHNICAL SPECIFICATION**  
**LOW PRESSURE AIR DISTRIBUTION**  
**SYSTEM**

SPECIFICATION NO.PES-554-02

VOLUME II B

SECTION D

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DATE: NOV 2012

SHEET 2 OF 7

**1. GENERAL**

This specification covers the design, manufacture, construction features, installation, inspection testing and air balancing of air distribution system upto a total pressure of 95mm w.g. The specification is intended to cover the air distribution for air conditioning system and ventilation system not involving localised exhaust.

**2. CODES AND STANDARDS**

2.1.1 The design, construction and performance of complete system shall conform to all currently applicable statutes, regulations, safety codes in the locality where the equipment are to be installed.

2.1.2 Unless specified otherwise the equipments shall generally conform to latest applicable Indian Standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall generally conform to latest editions by the following standards:-

- a) IS: 655 - Specifications for metal air ducts
- b) IS:277 - Specifications for galvanised steel sheets
- c) IS:737 - Specification for wrought aluminium and aluminium alloy sheet and strip.

**3. MATERIAL**

3.1.1 Metal air ducts shall be either of galvanised steel sheets or aluminium sheets, as indicated in data sheet-A.

3.1.2 The rolled steel sheets before galvanising shall be properly annealed or normalised so as to allow fabrication of ducts without developing cracks. Zinc coating on the steel shall be as per IS 277 Gr. 275 / as specified in Data Sheet A.

3.1.3 The aluminium sheets shall be of grade S1C or NS3 and shall be suitable for duct fabrication work as per IS-737 latest.

**4. CONSTRUCTION/FABRICATION**

The thickness of sheets, the type of bracing and other fabrication details shall generally conform to requirements given hereunder unless specified otherwise in data sheet A and/or indicated on drawings.

**4.1 RECTANGULAR DUCTS****4.1.1**

| S.No. | Max Side   | Sheet Thickness |            | Type of transverse Joint connections                           | Bracings      |
|-------|------------|-----------------|------------|----------------------------------------------------------------|---------------|
|       |            | (mm)<br>GI      | (mm)<br>Al |                                                                |               |
| a)    | Up to 600  | 0.63<br>(24G)   | 0.80       | S-drive, pocket or bar slips or flanged joints on 2.5m centres | None          |
| b)    | 601 to 750 | 0.63            | 0.80       | S-drive, 25mm pocket or                                        | 25x25x3 mm MS |



**TECHNICAL SPECIFICATION**  
**LOW PRESSURE AIR DISTRIBUTION**  
**SYSTEM**

**SPECIFICATION NO.PES-554-02**

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|    |                                                                                                                          |               |      |                                                                                                                           |                                                                   |
|----|--------------------------------------------------------------------------------------------------------------------------|---------------|------|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
|    |                                                                                                                          | (24G)         |      | 25mm bar slips or flanged joints on 2.5m centres                                                                          | angles, 1.2m from joints                                          |
| c) | 751 to 1000                                                                                                              | 0.80<br>(22G) | 1.00 | S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres                                                  | 25x25x3 mm MS angles, 1.2m from joints                            |
| d) | 1001 to1500                                                                                                              | 0.80<br>(22G) | 1.00 | 40x40x3mm MS angle, flanged connections or 40mm pocket or 40mm bar slips with 35x3mm bar reinforcing on 2.5m centres      | 40x40x3 mm MS angles, 1.2m from joints                            |
| e) | 1501 to2250                                                                                                              | 1.00<br>(20G) | 1.50 | 40x40x3mm MS angle, flanged connections or 40mm pocket or 40mm bar slips, 1M maximum centres, with 35x3mm bar reinforcing | 40x40x3 mm diagonal angles or 40x40x3mm angles, 600mm from joints |
| f) | 2251 & above                                                                                                             | 1.25<br>(18G) | 1.80 | 50x50x3mm MS angles,connections or 40mm pocket or 40 mm bar slips, 1M maximum centres with 35x3mm bar reinforcing.        | 50x50x3mm diagonal angles or 50x50x3mm angles 600 mm from joints. |
| g) | No bracing is required if transverse joints are less than 600mm apart                                                    |               |      |                                                                                                                           |                                                                   |
| h) | For ducts larger than 2250mm, special handling and supporting methods shall be provided as per the approval of Purchaser |               |      |                                                                                                                           |                                                                   |

- 4.1.2 All rectangular ducts having either dimension larger than 450mm shall be cross broken except these ducts which are insulated with sand cement plaster. Air outlet connections on ducts need not be cross broken.
- 4.1.3 The seams on duct cones shall be of Pittsburgh type. Longitudinal seams shall be smooth inside the ducts.
- 4.1.4 The flanges used for transverse joints shall be joined together with GI bolts (grade 4.6) and nuts spaced at 125mm centres as per following:
- Upto 1000mm - 6 mm dia GI bolts
  - 1001 to 1500 - 8 mm dia GI bolts
  - 1501 and above - 10mm dia GI bolts
- 4.1.5 The MS angle flanges shall be connected to ducts with rivets at approx. 100mm centres. The flanged joints shall have 6mm thick felt packing stuck to flanges with shellac varnish. The holes in the felt packing shall be burnt through. The ducts are to be tapped 6mm across the MS flanges.
- 4.1.6 MS angles used for bracings shall be tack welded to the ducts or rivetted at 125mm centres, as applicable.



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**4.2 ROUND DUCTS****4.2.1**

| S.No. | Duct dia-mm  | Sheet Thickness |            | Reinforcing                                    |
|-------|--------------|-----------------|------------|------------------------------------------------|
|       |              | (mm)<br>GI      | (mm)<br>Al |                                                |
| a)    | Up to 150    | 0.63<br>(24G)   | 0.80       | None                                           |
| b)    | 151 to 600   | 0.80<br>(22G)   | 1.00       | None                                           |
| c)    | 601 to 1000  | 1.00<br>(20G)   | 1.50       | 40x40x3mm girth MS                             |
| d)    | 1001 to 1250 | 1.00<br>(20G)   | 1.50       | 40x40x3mm girth MS angles at 2.0 meter centres |
| e)    | 1251 & above | 1.25<br>(18G)   | 1.80       | 40x40x3mm girth MS angles at 1.2m centres      |

**4.2.2** The seams on round ducts may be continuously welded or grooved longitudinal seam. In case of welding of GI sheet, zinc rich paint shall be applied on the welded zone.

**4.2.3** Round ducts shall either be joined by welding or the ducts shall be swedged 40mm from the ends such that larger end will butt against the swedge and is held in place with sheet metal screws.

**4.3 DUCT SUPPORTS**

Unless specified otherwise on drawings, rectangular ducts with larger side of 2250mm or above shall be supported by 15mm MS rods and 50x50x3mm and MS angles while those below 2250 mm shall be supported by 10mm MS rods and all angles shall be given a coat of primer paint. The duct supports shall be at a distance not exceeding 1800mm. The MS rods shall be fixed to MS angle cleats, which in turn are fixed to ceiling slab by suitable anchor fasteners. All anchor fasteners, MS angle cleats, coach screws, hooks and other supporting material required shall be provided by vendor.

However, If ducts are thermally insulated, the MS angles and supports shall not be in direct contact with ducts, for which purpose wooden pieces/ Resin bonded fibre glass sheets (50 mm thick) shall be used in between.

**4.4 FLEXIBLE CONNECTIONS**

Wherever the sheet metal ducts connects to intake or discharge of fan units a flexible connection of at least 150mm width made by closely woven double layer Fire resistant or canvas shall be provided. The same shall be attached to angle iron frames on equipment and to similar frame on duct or casing by means of a steel band or collar fitting over the end of the flexible connection and bolted through angle iron frame so as to clamp securely between the band and the angle frame.

**4.5 TRANSFORMATIONS AND BREACHES**

All curves, bends, offsets and other transformations shall be made for easy and

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noiseless flow of air. The throat of every branch duct shall be sized to have a velocity not exceeding that in the main duct to which the branch is connected.

**4.6 CAULKING**

Wherever duct passes through wall, the opening between masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to adjoin by space with a rated fire resistant material.

**4.7 EASEMENT**

Normally pipe hangers, light fitting rods etc. shall not be allowed to pass through the ducts. Wherever, It becomes absolutely essential to pass these hangers/rods etc. Through the ducts, prior approval of purchaser shall be taken and light streamlines easement around the same shall be provided to maintain smooth air flow.

**4.8 ACCESS DOORS**

Access doors shall be provided in ducts, plenums etc. on both sides to allow access and servicing of equipment viz. pipes, dampers, coils, valves, heaters etc.

All access doors shall be adequately sized and lined suitably with felt to prevent air leakage. The doors shall be of built-up construction, structurally strong and shall have at least two hinges each, and shall be with two rust proof window sash locks of approved type. All doors shall be so set as to flush with outer finish of duct insulation etc.

**4.9 DAMPERS AND SPLITTERS**

**4.9.1** Dampers and splitters shall be provided at suitable points for proportional volume control of the system. Splitters and dampers shall be made of minimum 18 gauge GSS of quadrant type with locking device mounted outside the duct at accessible location.

**4.9.2 Fire Dampers**

Fire dampers/fire doors shall be provided as specified in Data Sheet -A and shall be installed at locations indicated on drawings and/or as required/approved by purchaser, including all openings in passage of duct work through fire walls and floors etc. The fire damper shall be of electrical type with damper motor actuated by thermal sensor or fusible link type.

**4.9.3** Gravity operated back draft dampers shall be provided to ensure pressurisation of rooms as specified. These dampers shall be designed such as not to allow infiltration of outside air while forced exit of air shall be achieved through this damper. The louvres shall be freely mounted on spindles to allow the dampers to open with the pressure developed by the fan. The dampers shall be provided with flange at inlet.

**4.9.4 Vanes**

Unless otherwise shown in the drawings all elbows shall be such that the throat radius is 75% of the duct width. In case throat radius is smaller, suitable single thickness vanes of approved details shall be provided.

**4.9.5 Flashing**



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For the ducts penetrating roofs or outside walls, provision of flashing shall be made by the ducting vendor.

**4.10****DIFFUSERS AND GRILLS**

The type and quantity of diffusers and grills is indicated on enclosed drawings/data sheet A. The size/quantity of diffusers/ grills indicated in the drawing/data sheet is indicative and is for vendor's reference purpose only. Vendor shall ensure that the diffusers/grills offered are of requisite capacity, throw and terminal velocity. The pressure drop and noise levels shall be as per data sheet. A enclosed. The diffusers/grills shall be approved by purchaser.

Unless specified otherwise the diffusers/grills shall be of mild steel land painted with two coats of primer paint. Supply air grills shall be complete with volume control dampers. Supply air grills shall be double deflection type while Return Air grills can be single deflection type. Ceiling outlets/diffusers shall have volume control dampers, fixed grids and blanking baffles. All volume control dampers shall be operated by a key from the front of grills/diffusers.

Suitable vanes shall be provided in duct collars to have uniform air distribution. Blank-off baffles wherever required, shall also be provided.

**4.11****PLENUMS AND RA BOXING**

All plenum chambers and/or connections to fans, dampers etc. shall be constructed in 18 gauge GI sheet. supported on 40x40x6mm MS angle frames. All vertical angles shall be riveted at approx. 125mm. centres to the casing. Suitable caulking compound (Pecora or equivalent) shall be inserted between the base of the angle and all masonry construction to which angles are fastened.

Return air boxing requirements if any are indicated in data sheet-A and the same shall be provided by vendor. The return air box ~~shall be~~ fabricated out of GI sheets shall be insulated with 25mm thick fibre-glass.

**4.12****ACCOUSTIC LINING**

The ducts shall be lined acoustically from inside as given in data- sheet A and/or section C of the specification.

**4.13****PAINTING**

Wherever specified the ducts shall be painted or lined with suitable anti-corrosive paint/ lining as per approval of purchaser. In particular the ducts coming in contact with acid fumes shall be epoxy coated, inside and outside.

**4.14****THERMAL INSULATION**

Thermal insulation shall be as per data sheet - A and the insulation shall conform to enclosed spec. no. PES-553-08.

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| <div>5. INSPECTION AND TESTING</div> <div>5.1 INSPECTION &amp; TESTING DURING FABRICATION-BY MAIN VENDOR</div> <div>5.1.1 Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting , lamination in angles and channels shall be avoided.- visual inspection by Main Vendor.</div> <div>5.1.2 Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating –review of TC by BHEL/Customer</div> <div>5.1.3 Check for dimensions &amp; mass as per latest IS-277.</div> <div>5.1.4 Check for defect, twists, ungalvanised spots as per IS-2629.</div> <div>5.1.5 Bend test &amp; wrapping test as per IS-277.</div> <div>5.1.6 Zinc coating test on samples as per IS-6745.</div> <div>5.2 INSPECTION &amp; TESTING AT SITE.</div> <div>5.2.1 The duct branches, elbows etc. shall be inspected and the joints and connections etc, are to be checked before they are assembled in position.</div> <div>5.2.2 After completion, all duct systems shall be checked and tested for air leakage, tightness, velocity, pressure drop, vibration and noise etc.</div> <div>6. BALANCING</div> <div>6.1.1 The entire air distribution system shall be balanced by vendor to supply the air quantities as required in various rooms so as to maintain the requisite temperature and air flow in the conditioned spaces. The final balance of air quantities through each grill/diffuser etc. shall be recorded and submitted to purchaser for approval. Proper steps shall be taken to have a uniform temperature in all enclosures, with utmost care for noise level to be within tolerance limit</div> <div>6.1.2 All instruments required for testing/balancing etc. of the air distribution system shall be provided by vendor.</div> <div>7. DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT</div> <div>7.1 Fabrication drawings of ducts and grilles, louvers, dampers, etc, including typical details of grilles dampers etc.</div> <div>7.2 Test certificates in line with scope of inspection.</div> <div>7.3 Other dimensional drawings &amp; documents as may be required by purchaser for better understanding of the system &amp; for preparation of operation, maintenance &amp; instruction manual.</div> |                                                                                    |                             |                |



**LOW PRESSURE  
AIR DISTRIBUTION SYSTEM  
DATA SHEET - A**

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- |    |                                                                                                        |                                                                                          |
|----|--------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| 1) | General (List of areas)                                                                                | As per schedule/tender drgs of Ventilation system.                                       |
| 2) | i) GSS Duct Work                                                                                       |                                                                                          |
|    | a) Type                                                                                                | Zinc coating (Refer Section-C of Specific Technical Requirement)                         |
|    | b) 1.25 mm thk ducting                                                                                 | Bidder to estimate as per Drawings/sketch                                                |
|    | c) 1.0 mm thk ducting                                                                                  | Separately for Ventilation system.                                                       |
|    | d) Any other size                                                                                      | (area wise)                                                                              |
|    | e) Battery Room ducting. sides.                                                                        | MS with epoxy painting on both sides.                                                    |
| 3) | Special painting epoxy                                                                                 | MS Ducts in Battery Room to be painted. Both interior & exterior)                        |
| 4) | Thermal Insulation                                                                                     | Required in duct for vent. System exposed to Sun only (furnished by Cement sand plaster) |
| 5) | SA grilles (for each size) (SQ.M) schedule/tender                                                      | To suit airflow as per drgs.                                                             |
| 6) | Exhaust Gravity/Manual relief dampers (for each size & to maintain a slight positive pressure inside.) | -do-                                                                                     |
|    | a) Frame                                                                                               | 1.6mm M.S.                                                                               |
|    | b) Louver                                                                                              | 0.8mm Al.                                                                                |

**NOTE:**

- 1) Ducting shall be as per IS-655 standard.
- 2) Opposed blade type volume control damper (gang operated) shall be provided at each supply air grilles.
- 3) Bidder to provide suitable gasketing at each duct flange.(Asbestos shall not be used).
- 4) Supply Air Grills shall have 2 (two) set of adjustable louvres.
- 5) Bidder to indicate unit rates for variable items like ducting, grilles with & without volume control damper, gravity damper, thermal insulation, etc.
- 6) Grilles, frames & louvres shall be of at least 18 SWG sheet and 20 SWG MS respectively.



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DATA SHEET - A**

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- 6) Fire damper shall be solenoid operated in accordance with NFPA. The solenoid shall be charged during open condition and shall be de-energising to close.
- 7) Access door in ducting system shall be provided as required.
- 8) MS Angle (painted) shall be used only as duct supports.
- 9) Velocity thru duct shall not exceed 12 M/sec for Ventilation system.
- 10) All exhaust/return air grilles shall have one set of louvres in the front or thick rat-proof wire net guards.

Engineer-in-Charge  
 Health and Family Welfare  
 Government of India



# STANDARD TECHNICAL SPECIFICATION FOR CENTRIFUGAL PUMPS

SPECIFICATION NO. PES-554-05

VOLUME II-B

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## STANDARD TECHNICAL SPECIFICATION FOR CENTRIFUGAL PUMPS

महेश  
सहायक प्रमुख  
मुख्य अभियंता  
सहायक प्रमुख  
सहायक प्रमुख



## STANDARD TECHNICAL SPECIFICATION FOR CENTRIFUGAL PUMPS

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### 1.0 GENERAL

This specification covers the design, material, constructional features, manufacture, assembly, inspection and testing at manufacturer's of his subcontractor's works, suitable painting requirements of centrifugal pumps and drives complete with all accessories as specified hereinafter.

### 2.0 CODES AND STANDARDS

2.1 The design, manufacture, inspection, testing & performance of the pumps as specified hereinafter, shall comply with the requirements of the latest revision of the following standards as indicated below (as applicable):

- a) IS-1520 :Horizontal centrifugal pumps for clear, cold and fresh water
- b) IS-5120 :Technical requirements - Rotodynamic special purpose pump
- c) IS-1710 :Vertical turbine pumps for clear, cold and fresh water
- d) Hydraulic Institute Standards of USA
- e) BS - 599 :Method of testing Pumps
- f) PTC - '6' :Centrifugal Pumps Power test code
- g) API - 610

Wherever standards for certain aspects materials etc., not mentioned, the same shall be as per the applicable Indian or International standards.

2.2 In case of any conflict between the above codes/standards and this specification, the later shall prevail and in case of any further conflict in this matter, the decision of Purchaser's engineer shall be final and binding.

### 3.0 DESIGN REQUIREMENTS

3.1 The pumps shall be of heavy duty suitable for long periods of uninterrupted service and shall be standard product of the manufacturer thoroughly proven for satisfactory performance and reliability

3.2 The materials of construction of various components shall be as indicated under Data Sheet-A and where not specified to the applicable Indian/British/American standards.

3.3 All pressure containing components including the pump casing, nozzles and stuffing box housing shall be designed, fabricated and tested in accordance with applicable Indian standards if not specified otherwise.

3.4 The pump shall be suitable for handling the fluid as specified in Data Sheet-A

### 4.0 CONSTRUCTIONAL FEATURES

#### 4.1 Pump Casing

4.1.1 Pump casing may be axially or radially split or barrel type construction as specified in the pump data specification sheet. The casing shall be designed to withstand the maximum pressure developed by the pump at the pumping temperature.

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4.1.2 Pump casing shall be provided with adequate number of vent and priming connections with valves, unless the pump is made self venting & priming. Casing drain, as required, shall be provided complete with drain valves.

4.1.3 Pump shall preferably be of such construction that it is possible to service the internals of the pump without disturbing suction and discharge piping connections.

4.1.4 Under certain conditions, the pump casing nozzles will be subjected to reactions from external piping. Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610.

## 4.2 Impeller

Unless specifically indicated under Data Sheet-A enclosed, the pump impellers shall be of closed vane type. The impellers shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings. Impellers shall be statically and dynamically balanced individually. The assembled rotor shall be dynamically balanced and checked for eccentricity.

### 4.3 Wearing Ring

Renewable wearing rings for the casing and/or the impellers and renewable shaft sleeves, shall be provided for all pumps. Length of the shaft sleeves must extend beyond the outer faces of gland packing or seal and plate so as to distinguish between the leakage between shaft & shaft sleeve and that past the seals/gland.

#### 4.4 Shaft

Shaft size selected shall take into consideration the critical speed which shall be away from the operating speed as recommended in applicable Code/Standard. The critical speed shall also be at least 10% away from runaway speed.

#### 4.5 Bearings

Bearings and hydraulic devices (if provided for balancing axial thrust) of adequate design shall be furnished for taking the entire pump load arising from all probable conditions of continuous operation throughout its Range of Operation and also at the shut off condition. The bearing shall be designed on the basis of 20,000 working hrs minimum for the load corresponding to the duty point. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing-lubricating element does not contaminate the liquid being pumped. Where there is a possibility of liquid entering the bearing, suitable arrangement in the form of deflectors or otherwise shall be provided ahead of bearing assembly. Bearings shall be easily accessible without disturbing the pump assembly.

## 4.6 Stuffing Boxes

Packed type stuffing boxes of adequate depth with lantern rings shall be provided to minimize the leakage. In all cases where the pump suction is below atmospheric pressure, the shaft packing shall be sealed by the liquid pumped by tapping off from the pump discharge itself and all pipes, valves, fittings etc., required for this shall be furnished by the manufacturer.

## 4.7 Shaft Couplings



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The pumps shall be directly coupled to their drives through heavy duty flexible coupling. Suitable coupling guards shall be provided along with the coupling. The pump and its drive motor shall be mounted on a common base plate.

### 4.8 Base Plate and sole Plate

Unless otherwise stated the data specification sheet, a common base plate mounting both for the pump and drive shall be furnished. The base plate shall be of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust, etc. Suitable drain taps and drip lip shall be provided.

If required in the data specification sheet, steel sole plates shall be provided, below the base plate.

### 4.9 Prime Mover

The drive motor selected shall conform to the requirements of the enclosed motor specifications.

### 4.10 Lifting arrangement

Each pump and motor shall incorporate suitable lifting attachments e.g. lifting lugs or eye bolts etc., to facilitate erection and maintenance.

## 5.0 Performance Requirements

5.1 The pump shall be designed to have best efficiency at the specified duty point. The pump set shall be suitable for continuous operation at any point within the Range of Operation as stipulated in the data specification sheets.

5.2 Pump shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum being at shut off. Power capacity characteristic will be non-overloading type i.e. 110% of the design flow the power required to drive the pump will be practically the same as that at the design flow.

5.3 Wherever specified in data sheet, pumps of each category shall be suitable for parallel operation. The head vs capacity, input power vs. capacity characteristics, etc., shall match to ensure equal load sharing and trouble free operation throughout the range.

5.4 The pump motor set shall be designed in such a way that there is no damage due to the reverse flow through the pump which may occur due to any malfunction of the system.

## 6.0 Drive Rating

6.1 The power rating of the drive shall be selected such that a minimum margin of 15% is available over the pump input power required at the rated duty point. However, the drive rating shall not be less than the maximum power requirement at any point within the 'Range of Operation' specified.



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6.2 In cases where parallel operation of the pumps are specified the actual drive rating is to be selected by the bidder considering overloading of the pumps in the event of tripping of one of the operating pumps.

6.3 The bidder under this specification shall assume full responsibility in the operation of the pump and the drive as one unit.

### 7.0 SCOPE OF INSPECTION AND TESTING

#### 7.1 Castings

7.1.1 Witnessing pouring and thereafter physical testing of castings of 'Critical' nature such as casings, impellers, diffusers.

7.1.2 Identification and correlation with test reports for all tests as per the relevant material specifications for castings of 'Major' nature such as suction bell, discharge elbow, stuffing box, gland, wearing rings, shaft sleeves etc.

7.1.3 Foundry's conformity certificate for castings of 'Minor' nature such as base plates, covers etc.

7.1.4 Verification of heat treatment charts (as applicable)

Note: Casting defects shall not be filled by any method until an unless approved by BHEL/their customer

#### 7.2 Forgings and

7.2.1 Identification and correlation with mill test certificates for all tests as per the relevant specifications for important forgings like casings, stage bodies, diffusers, shaft material.

7.2.2 Verification of heat treatment charts (time temperature) (as applicable).

#### 7.3 Fabricated items

7.3.1 Identification and correlation with mill test certificates for material of items such as discharge bellows, column pipes etc.

7.3.2 Approval of welding procedure specifications and qualifications of weld procedures and personnel.

7.3.3 Dye penetrant tests of weldment as per ASTM E-165 and acceptance norm as per ASME Sec.VIII, Div.1, Appendix 8

7.3.4 Verification of heat treatment charts (time temperature), (as applicable)

7.3.5 Hydro test as per para 7.5.1 below.

Note: For para 7.1.2, 7.2.1 and 7.3.1 above; in case correlating test certificates are not available, material shall be identified by BHEL and physical tests conducted by the supplier in the presence of BHEL



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### 7.4 In process Inspection and Testing

7.4.1 Dye penetrant testing after machining for impellers including vanes, pump shaft, diffusers as per applicable code; in absence of which, as per ASTM E - 165. No defect shall be permitted on moving parts. On static parts acceptance norms are as per ASME Sec.III NB 2546.

7.4.2 Ultrasonic testing of dynamic duty component, i.e. pump shafts (50mm dia and above) and static duty forgings i.e. Barrel, casting (15mm and above wall thickness) as per applicable code, in absence of which as per ASTM E388 and acceptance norms as stipulated hereunder.

7.4.3 Acceptance norms for UT for dynamic duty components. the following defects are unacceptable :

- a) Cracks, flakes, seams and laps
- b) Defects giving indications longer than that from a 4mm equivalent flaw.
- c) Group of defects with maximum indications less than that from a 4mm equivalent flaw, which cannot be separated at testing sensitivity, if the back echo is reduced to less than 50%.
- d) Defects giving indications of 2 to 4mm dia. equivalent flaw separated by distance less than four times the size of the larger of the adjacent flaw.

7.4.4 For static duty components - as per NB 2542.2 of ASME Sec. III.

7.4.5 Hydro tests of all pressure parts such as casings, column pipes, discharge elbows etc., at two times duty point pressure or 1.5 time shut off pressure, whichever is higher for 30 min., without any leakage.

Note : In case the pump is required to boost certain pressure, the inlet pressure head shall also be taken into consideration to compute test pressures.

7.4.6 Static and dynamic balancing of individual impellers and also assembled rotors as per V.D.I. 2060 Q 6.3 or ISO 1940 G 6.3.

### 7.5 Performance Test

7.5.1 Pump testing with unit supply motor as per specifications and acceptance norms cited elsewhere, in absence of which as per IS 5120 latest edition. Performance shall be checked for minimum of 7 points (including shut off head and over load) following characteristics shall be checked:

Capacity V/s Head

Capacity V/s Power absorbed by pump

Capacity V/s pump efficiency

Note : For pump of fire protection system, performance test shall be conducted up to 150% of rated capacity

7.5.2 NPSH test in case specifically mentioned elsewhere



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7.5.3 Vibration and noise level measurement. Acceptance norms shall be as per manufacturers standards.

7.5.4 Overall dimensions as per GA drawings

7.5.5 Examination after selective opening up after running for pumps operating at speed over 1800 rpm and capacity exceeding 68M3/hr.

7.5.6 Painting and packing as per technical specification.

### 7.6 Test at site

The pumps will be tested at site by the purchaser to verify their performance. If the pumps fail to operate smoothly or within the required performance all such deficiencies shall be rectified by the manufacturer by making suitable alternatives in the pump set and additional tests required to show the effect of such alterations shall be performed by him.

### 7.7 Performance Guarantee

The vendor shall guarantee the material and workmanship of all components as well as the operation of the pump as per requirement of this specification.

The vendor shall also guarantee for each pump the total dynamic head at the specified rated capacity and also corresponding efficiency, brake horse power and shut off head.

### 8.0 CLEANING, PROTECTION & PAINTING

Before shipment of the equipment to be supplied under this specification the necessary cleaning, flushing etc., as per manufacturers standard shall be done to remove all dirts, scales etc. Shop coats of rust inhibiting paints, lacquers etc., shall be applied to various parts as necessary. Flanges, inlet and outlet pipe, etc shall be protected.

### 9.0 DRAWINGS, TECHNICAL DOCUMENTS AND OTHER INFORMATION REQUIRED WITH THE PROPOSAL

9.1 Fully dimensioned outline GA drawings of the pump motor assembly unit for each type and size offered. This drawing should include:-

- i) Foundation base plate and sole plate details as applicable
- ii) Civil foundation and anchor bolts details and loading data
- iii) Minimum submergence required for the pump (if applicable)

9.2 Cross sectional drawing of the equipment showing the details of assembly of components and their material of construction with standard applicable codes.

9.3 Performance characteristics (Discharge capacity vs head, BHP and efficiency of the pumps.



## STANDARD TECHNICAL SPECIFICATION FOR CENTRIFUGAL PUMPS

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- 9.4 Motor speed torque curve superimposed on pump speed torque curve. Required NPSH of pump.
- 9.5 Experience list about the supply and successful operation of similar pumps for similar application.
- 9.6 A comprehensive write up or brochure on the details of manufacturing and testing facilities in the shop of the manufacturer.
- 9.7 Quality plan for the equipment being offered, in BHEL format as practiced in the manufacturer's works and Field Quality Plan for receipt, storage erection, commissioning & testing at site.
- 9.8 Data sheet-B with all the particulars filled in.

### 10.0 DRAWINGS AND DATA AFTER AWARD OF CONTRACT

The vendor shall furnish the drawings and other technical documents as required in Data Sheet-C enclosed with this specification

### 10.1 MANUFACTURERS NAME AND TAG. PLATES

Each pump shall have a permanently attached brass/metal tag on the body indicating the following information both in Hindi and English.

- a) Manufacturer's name and trade mark
- b) Design Capacity and Head
- c) Design
- d) Purchaser's tag no. as furnished during the contract. The purchaser's tag no. will be indicated by the Purchaser on the drawing submitted for approval by the vendor.

### 11.0 DRAWINGS/DOCUMENTS TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT.

- 11.1 Certified GA drawings of pump motor assembly weights, crane
- 11.2 Detailed cross sectional drawings of the pump and motor assembly and all equipment & accessories supplied under the this specification along with details of material of construction with applicable standard codes
- 11.3 Foundation drawings with details of foundation pocket indicating static as well as dynamic load and other data with dimensions.
- 11.4 Certified characteristics curves (discharge capacity vs. head, BHP and efficiency) of each type of pump and motor.
- 11.5 Material and other test certificates as required by the application clauses of this specification.
- 11.6 Motor speed torque curves super imposed on pump speed torque curves.
- 11.7 Quality plan along with complete details of testing and inspection requirements of centrifugal pumps in BHEL format. Vendor shall also furnish Field Quality Plan.

## STANDARD TECHNICAL SPECIFICATION FOR CENTRIFUGAL PUMPS

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- 11.8 Installation , operation and maintenance manual.
- 11.9 Other drawings and data, if necessary.

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**CENTRIFUGAL PUMPS**  
**DATA SHEET - A**

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| <u>S.No.</u> | <u>DESCRIPTION</u>     | <u>DETAILS</u>                                 |
|--------------|------------------------|------------------------------------------------|
| 1)           | Designation            | Air washer Pumps.                              |
| 2)           | Type                   | Horizontal Centrifugal Type.                   |
| 3)           | Quantity               | As per section-C                               |
| 4)           | Installation           | On floating type foundation inside Air         |
| Washer       |                        | Room                                           |
| 5)           | Fluid to be handled    | Filtered Water.                                |
| 6)           | Temperature of Fluid   | To suit.                                       |
| 7)           | Capacity Cum/Hr TDH at | To suit system requirements however head shall |
|              |                        | Not be less than 35 MWC.                       |
| 8)           | Duty                   | -----Continuous (24Hr./day)-----               |
| 9)           | Suction condition      | -----Flooded-----                              |
| 10)          | Type of drive          | Direct (flexible coupling)                     |
| 11)          | Type of prime mover    | LV Ac Motor.                                   |
| 12)          | Maximum speed          | Not more than 1500 RPM                         |
| 13)          | Type of lubrication    | Grease Lubrication                             |

**MATERIALS OF CONSTRUCTION**

| <u>S.No.</u> | <u>DESCRIPTION</u> | <u>DETAILS</u>                                         |
|--------------|--------------------|--------------------------------------------------------|
| a)           | Impeller           | Bronze                                                 |
| b)           | Pump Shaft         | Carbon Steel C-45, IS-1570 or class-IV, IS-1875        |
| c)           | Casing             | Cast Iron, grade-20, IS- 210                           |
| d)           | Wearing ring       | Bronze                                                 |
| e)           | Shaft Sleeve       | Bronze                                                 |
| f)           | Base Plate/frame   | Cast Iron to Grade FG-200 IS-210/fabricated Mild steel |



## CENTRIFUGAL PUMPS

### DATA SHEET - A

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- |           |                     |                                                    |
|-----------|---------------------|----------------------------------------------------|
| g)        | Counter Flanges     | Mild Steel                                         |
| h)        | Stuffing box bush   | Deep Bronze packing to be renewable with Case.     |
| i)<br>not | Stuffing box gland  | Flexible graphite or PTFE (Asbestos shall be used) |
| j)        | Pump Motor Coupling | Pin & Bush type (Flexible)                         |
| k)        | Bolt and Nuts       | MS                                                 |

15) **ACCESSORIES REQUIRED**

The following accessories shall be provided by the bidder for each pump.

- |    |                                          |     |
|----|------------------------------------------|-----|
| a) | Priming funnel                           | Yes |
| b) | Drain piping upto<br>Common drain point. | Yes |
| c) | Vent                                     | Yes |
| d) | Suction & Discharge<br>Pressure gauges   | Yes |
| e) | Companion flanges                        | Yes |
| f) | Common base plate                        | Yes |
| g) | Suction strainer.                        | Yes |
| h) | Isolating valve.                         | Yes |
| i) | NRV at pump outlet at inlet/outlet       | Yes |
| j) | Any special requirements                 | Yes |
| k) | Inspection & Testing                     | Yes |



**STANDARD TECHNICAL  
SPECIFICATION  
FOR  
AIR FILTER**

**SPECIFICATION NO. PES-554-04**

**VOLUME II B**

**SECTION D**

**REV. 02**

**DATE: NOV 2012**

**SHEET 1 OF 3**

**STANDARD TECHNICAL SPECIFICATION  
FOR  
AIR FILTER**

महेश्वर  
मुकुन्द रेड्डी  
S.A. 16/10/12



## STANDARD TECHNICAL SPECIFICATION FOR AIR FILTER

SPECIFICATION NO. PES-554-04

VOLUME II B

SECTION D

REV. 02

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### 1. GENERAL

This specification covers the design, manufacture, inspection and testing at manufacturer's work or his sub-contractor's works of Air filters to be used for air-conditioning and ventilation system:

### 2. CODES AND STANDARDS

This design, manufacture and performance of AIR FILTERS shall comply with all currently applicable statutes, regulation and safety codes in the locality where the equipment will be installed. The equipment shall also conform to latest applicable Indian/British/USA standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. The following standards, in particular, shall be applicable for certified ratings of filters and for conducting performance test, if required.

a) BS EN - 779 -Methods of test for air filters used in air conditioning and general ventilation.

### 3. GENERAL

The enclosed Data sheet A gives the type and other particulars of filters required.

#### 3.1 POLY FIBRE AIR FILTERS

Filtering media shall consist of a suitable fibrous material (e.g. polyethylene extruded sections coir etc.) packed into a 20 gauges GSS framework, complete with handles etc. The filter element shall be supported by galvanised steel wire mesh of 10mm. sq. on either side, Velocity across the filters shall not exceed 2.5 M/sec. Average efficiency  $E_m$  (%) shall be  $\geq 80$  as per BS EN - 779..

#### 3.2 DRY FABRIC AIR FILTERS

Filter element shall be pressed felt filter fabric or suitable material recommended by the manufacturer, stitched on to galvanised wire gauge support and crimped to form deep folds. Suitable aluminium spacers shall be provided to ensure uniform distribution of air flow through filters. Filter casing shall be provided with neoprene sponge rubber sealing, The filter shall have Average efficiency  $E_m$  (%) of  $\geq 95$  as per BS EN - 779.

#### 3.3 PANEL TYPE METALLIC FILTERS (DRY/VISCOUS)

Filter shall consist of V-fold galvanised wire mesh interspaced with flat layers of galvanised wire mesh. The density of media shall increase in the direction of air flow. Edges of wire mesh shall be suitably hemmed to prevent abrasion during handling. The media shall be supported on either side by galvanised expanded metal casing. The framework shall be at least 18 gauge GSS. Filter shall be either dry or wetted type as per data sheet=A. The oil shall be mineral oil of approved quality and make. As a the filter frame made of Aluminium alloy conforming to IS:737 can be considered unless use of aluminium is prohibited otherwise due to site conditions being saline/corrosive.



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FOR  
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All filters shall be capable of being cleaned of their accumulated dust by tap water flushing. The dry metallic filter shall have Average arrestance Am (%) shall be  $\geq 90$ . However oil wetted air filters shall have Average Efficiency Em (%)  $\geq 90$  as per BS EN - 779..

**3.4 ABSOLUTE FILTERS (HEPA)**

Filters shall be constructed by pleating a continuous sheet of filter medium into closely spaced pleats separated by heavy corrugated aluminium spacers. They shall be individually tested and certified to have an efficiency of not less than 99.97% when tested with 0.3 micron dioctylphalate smoke as per IS:2831. The clean filter initial static pressure drop shall not be greater than 25mm WC at rated capacity. A neoprene sponge rubber sealing shall be provided on either face of filter frame.

**3.5 WATER REPELLANT NYLON FILTERS**

This shall be constructed of water repellent nylon fabric with continuous water spraying on it from a header for keeping it clean. Efficiency of this filter shall be 85% down to 10 microns. This filter shall be used for unitary air filtration system only.

**4. INSPECTION & TESTING**

The scope of inspection for air filters shall be as below:

List of TCs arranged as per Approved Quality Plan shall be furnished along with copy of TCs at the time of inspection by BHEL.

4.1.1 Dimensional inspection of frame & filter media – TC from Manufacturer- review by BHEL/Customer.

4.1.2 Witnessing by BHEL/Customer of type tests on one per type per size air filters for the following properties.

- a) Gravimetric efficiency.
- b) Pressure drop in clean & dirty (choked - %age to be specified ) condition.
- c) Efficiency as per BS EN - 779.

4.1.3 Verification of type test certificates for similar type & size of filters for sodium flame test as per BS-3928 (if applicable- refer data sheet) - by BHEL/Customer

**5. DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT**

5.1.1 GA Drawing

5.1.2 Drawing showing material/construction detail

5.1.3 Installation and\service manual

5.1.4 Rating curves/charts

5.1.5 Test certificates

Elect. diagrams (when automatic cleaning type)



## AIR FILTER DATA SHEET - A

VOLUME II-B

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DescriptionData**1) General**

|                              |                                                                                                                                                     |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.1 Service                  | Ventilation system .                                                                                                                                |
| 1.2 Location                 | Main power house bldg. & Blower room of both the unit.                                                                                              |
| 1.3 Nos.                     | Refer Section 'C' of Specification.                                                                                                                 |
| 1.4 Total air flow/type      | Refer Section 'C' of Specification.                                                                                                                 |
| 1.5 Temperature              | As per project information.                                                                                                                         |
| 1.6 Relative Humidity        | 100%                                                                                                                                                |
| 1.7 Gas Composition          | Atmospheric Air (Dusty) as prevalent in power station.                                                                                              |
| 1.8 Filter Media             | Synthetic non woven                                                                                                                                 |
| 1.9 Efficiency               | Average arrestance efficiency of 65-80 % for Dry panel filter (pre-filters) and average arrestance efficiency of 80-90 % for fine filters.          |
| 1.10 Allowable pressure drop | 2.5 mm & 6.5 mm in clean and dirty condition respectively for <b>dry panel filters</b> (pre filters).<br>12 mm in clean condition for fine filters. |
| 1.11 Frame Work              | 18 G, GSS.                                                                                                                                          |
| 1.12 Mounting                | Ladder Type M.S Angles (galvanised)                                                                                                                 |
| 1.13 Size                    | 600 x 600 mm                                                                                                                                        |

Note:-

- 1) Face velocity of air across the filters shall not exceed 2.5 m/sec.



**STANDARD TECHNICAL  
SPECIFICATION  
FOR  
THERMAL INSULATION FOR COLD  
SURFACES**

**SPECIFICATION NO.PES-554-06**

**VOLUME II B**

**SECTION D**

**REV. 01**

**DATE: NOV 2012**

**SHEET 1 OF 5**

**STANDARD TECHNICAL SPECIFICATION  
FOR  
THERMAL INSULATION FOR COLD SURFACES**

महेश्वर  
मुकुन्द राव  
5-11-2012



**TECHNICAL SPECIFICATION**  
**THERMAL INSULATION FOR COLD SURFACES**

**SPECIFICATION NO. PES-554-06**

**VOLUME II B**

**SECTION D**

**REV. 01**

**DATE: NOV 2012**

**SHEET 2 OF 5**

**1. SCOPE**

This specification covers design, manufacture, testing at manufacturers works, supply, application & finishing of insulation for cold piping, air conditioning ducting & equipment for low temperature service.

**2. CODES & STANDARDS**

The design, manufacture and performance of materials covered under this specification shall comply with all currently applicable statutes, regulations & safety codes in the locality where the equipment/material are to be installed. The material shall also conform to the latest applicable Indian/British/American codes & standards. Nothing in this specification shall be construed to relieve the vendor of his responsibility. In particular, the material shall conform to the latest editions of the following standards :-

- 2.1.1 IS:3069 : Glossary of terms & symbols & units relating to thermal insulation materials.
- 2.1.2 IS:4671 : Expanded polystyrene for thermal insulation purposes.
- 2.1.3 IS:3677 : Mineral wool for thermal insulation
- 2.1.4 IS:8183 : Resin bonded mineral wool
- 2.1.5 IS:702

**3. DESIGN REQUIREMENTS**

- 3.1.1 The insulating material as well as protective covering shall be new & unused, non-corrosive, vermin/rodent proof and shall be guaranteed to withstand continuously & without deterioration the maximum/minimum temperatures to which they may be subjected to, under specified site conditions.
- 3.1.2 The insulation material must be light weight, strong, free from shots & coarse fibre & shall provide high insulation efficiency at low weight & coat. It should be non-hygroscopic & should not rot. It shall not settle or shake down even when subjected to prolonged vibrations.
- 3.1.3 The insulation material, density and thickness etc. Shall be as specified in DATA SHEET A.

**4. APPLICATION DETAILS**

- 4.1.1 The surface to be insulated shall be thoroughly cleaned and allowed to dry. Pressure/hydrostatic tests, if any, shall be carried out before application of insulation.
- 4.1.2 A layer of solvent free, anticorrosive paint shall be applied & allowed to dry.
- 4.1.3 Hot industrial bitumen of grade 85/40 or 85/25 conforming to latest IS:702 shall be uniformly applied @ 1.5 kg/sq.m on the surface to be insulated. A similar layer shall also be applied on the inside surface & edges of the insulation. A suitable cold adhesive compound may also be used in place of bitumen.

|                                                                                                             |                                                                                    |                             |                |
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4.1.4

Insulation in the form of pipe sections/rolls slabs of specified density & thickness shall be stuck to the coated surface with joints staggered & well butted & secured. The adjoining sections shall be tightly pressed together. All the joints shall be sealed with bitumen/equivalent adhesive. Voids if any shall be packed with suitably cut pieces of insulation material.

4.1.5

In case of double layer application both circumferential & longitudinal joints shall be suitably staggered.

5.

VAPOR SEALING & INSULATION FINISH

The insulation shall be treated for vapor sealing & weather proofing & finished as specified in DATA SHEET A The acceptable types of finishes are outlined below:-

5.1

FINISHING SYSTEM I: EXTERNAL INSULATION WITH PLASTER FINISH

5.1.1

A thick vapor seal of hot bitumen @ 2.5 kg/Sqm shall be applied on the outer surface of insulation & allowed to dry.

5.1.2

The surface shall then be wrapped with 20mm (3/4"\_ hexagonal mesh of 24 SWG GI wire, butting all the joints & laced down with 22 SWG GI lacing wire.

5.1.3

12.5mm (1/2 inch) thick sand cement plaster in the ratio of (1:1) shall be applied in two layers, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application.

5.2

FINISH SYSTEM II: EXTERNAL INSULATION WITH PLASTER FINISH OVER POLYTHENE.

5.2.1

The insulation shall be covered with 500 g polythene/polythene bonded Hessians (PBH) with 50mm overlap on longitudinal & circumferential joints. Overlaps shall be sealed with synthetic adhesive in case o-f polythene & liberal coat of bitumen in case of PBH:

5.2.2

The surface shall then be wrapped with 20mm (3/4") mesh of 24 SWG GI wire butting all the joints & laced down with 22 SWG GI lacing wire.

5.2.3

12.5mm thick (1/2 inch) sand cement plaster in ratio of(4:1) shall be applied in two layers, the second layer being brought to a smooth & even finish similarly as described above.

5.3

FINISH III:EXTERNAL INSULATION WITH SHEET METAL FINISH

5.3.1

The insulation shall be covered with 500g polythene with 50mm overlaps at joints which shall be sealed with synthetic adhesive or equivalent compound.

5.3.2

The polythene shall be covered with 24 gauge GI/aluminum sheet

5.3.3

25mm wide x 22 SWG GI/aluminum peripheral straps shall be fixed over the GI/aluminum sheet at 300mm centres to secure.

5.4

FINISH IV: EXTERNAL INSULATION WITH PLASTER & WATER PROOFING COMPOUND

For ducts & piping exposed to atmosphere, the finish shall be as follows:

|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                             |                |
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|                                                                                   | <p>5.4.1 A thick vapor seal of hot bitumen at 2.05 kg/sq.m shall be applied on the outer surface of insulation &amp; allowed to dry.</p> <p>5.4.2 The surface shall then be wrapped with 20mm (3/4") hexagonal mesh of 24 SWG GI Wire butting all the joints &amp; laced down with 223 SWG GI lacing wire.</p> <p>5.4.3 12.5mm thick (1/2 inch) sand cement plaster in ratio of (4:1) shall be applied in two layers, the second layer being brought to a smooth finish with water proofing compound added to the cement.</p> <p>5.4.4 3mm (1/8") thick coat of water proofing compound shall be applied &amp; wrapped with fibre glass RP tissue. A final coat of 3mm thick water proofing compound shall then be applied over the fiberglass RP tissue &amp; allowed to dry. Alternatively, in place of water proofing as desired above, tar felt type 3 grade 1 of IS 1322 with joints overlapped by 75mm shall be fixed &amp; sealed with bitumen &amp; over this 24 SWG. 25mm hexagonal GI mesh shall be fixed with 22 swig. GI lacing wire &amp; finally bitumen paint shall be applied over wire netting.</p> |                             |                |
|   | <p><b>6. INSULATION OF PUMPS &amp; VALVES</b></p> <p>For all inspection covers &amp; hatches on equipment, pump casing &amp; valve bodies, flanges etc. the insulation shall be applied such as to facilitate removal with minimum damage to the insulation. This shall be achieved by encasing the insulation in 22 gauge aluminum sheet metal boxes, which shall be bolted together around the equipment to permit easy removal &amp; replacement. Proper care shall be taken to maintain continuity of vapor seal between the static &amp; removable partitions of the insulation.</p> <p>The tenderer may offer thickness of insulation &amp; finishes other than that specified in DATA SHEET A. However, calculations/reasons in support of alternative proposal shall be furnished for purchaser's approval.</p>                                                                                                                                                                                                                                                                                              |                             |                |
|                                                                                   | <p><b>7. INSPECTION &amp; TESTING (REFER SPEC. NO - PES-553.00)</b></p> <p>All necessary tests, as required to ensure that the material supplied conform to the requirements of applicable codes &amp; standards, shall be carried out at manufacturer's works &amp; test certificates including these for material/accessories shall be furnished for purchasers approval.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                             |                |
|                                                                                   | <p><b>8. PAINTING</b></p> <p>8.1.1 Pipe work having insulation &amp; cladding shall be provided with color identification for the fluids handled and for indicating direction of flow.</p> <p>8.1.2 Equipment surfaces having insulation and cladding shall also have identification numbers and any other relevant data provided on the insulated surface.</p> <p>8.1.3 All painting for insulated surfaces shall conform to the requirement specified elsewhere.</p> <p><b>9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT</b></p> <p>9.1.1 Final version of data sheet 'B' incorporating changes if any along with design data.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                             |                |

|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                              |                                    |                       |
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|                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                              | <b>SHEET 5 OF 5</b>                |                       |
| 9.1.2                                                                             | Test certificates/reports giving result of insulation to ensure conformance to applicable codes & standards & in particular the following :-<br><br>i) Thermal conductivity test<br>ii) Sound absorption coefficient test<br>iii) Corrosion test<br>iv) Sulphur content, moisture content, shot content, moisture absorption etc.<br>v) Compressive strength & cross breaking strength test. |                                    |                       |
| 9.1.3                                                                             | Sketches/technical literature/sectional drgs. indicating insulation materials finish and method of application etc.                                                                                                                                                                                                                                                                          |                                    |                       |
| 9.1.4                                                                             | Manual dealing with safety aspects & instructions for combating fire arising out of insulation work                                                                                                                                                                                                                                                                                          |                                    |                       |
| 9.1.5                                                                             | Instructions on maintenance of insulation work.                                                                                                                                                                                                                                                                                                                                              |                                    |                       |



**INSULATION**  
**DATA SHEET - A**

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**INSULATION MATERIAL :**

| Insulation                               | Code    | Thermal Conductivity<br>MW/cm °C | Density<br>Kg/m <sup>3</sup>                                                |
|------------------------------------------|---------|----------------------------------|-----------------------------------------------------------------------------|
| Resin bonded mineral wool / glass wool   | IS:8183 | 0.49 at 50 °C                    | At least 24<br>(For Thermal<br>Insulation)<br>48 for Acoustic<br>insulation |
| Mineral Wool Pipe Section<br>(min. Gr.2) | IS:9842 | 0.43 at 50 °C                    | At least 81                                                                 |
| Expanded Polystyrene                     | IS:4671 | 0.37 at 50°C                     | At least 15                                                                 |

**TYPE OF INSULATION :**

| S.No. | Surface                                              | Insulation Material                              | Insulation Form                              | Thickness (mm) |
|-------|------------------------------------------------------|--------------------------------------------------|----------------------------------------------|----------------|
| i)    | Supply & Return air duct for air-conditioning system | Resin bonded Glass Wool (IS:8183)                | Roll / Slab                                  | 50             |
| ii)   | Refrigerant Piping                                   | a) Expanded Polystyrene<br>or<br>b) Mineral Wool | Pipe Section<br><br>Pipe Section             | 75<br><br>75   |
| iii)  | AHU drain pipe<br>(Suction & Liquid line)            | a) Expanded Polystyrene<br>or<br>b) Mineral Wool | Pipe Section<br><br>Pipe Section             | 25<br><br>25   |
| iv)   | AHU casing and condensate pan                        | a) Expanded Polystyrene<br>or<br>b) Mineral Wool | Slabs<br><br>Slabs                           | 25<br><br>25   |
| v)    | Chilled water piping, valves & specialties           | a) Expanded Polystyrene<br>or<br>b) Mineral Wool | Pipe Section<br><br>Pipe Section             | 75<br><br>75   |
| vi)   | Chiller                                              | a) Expanded Polystyrene<br>or<br>b) Mineral Wool | Slabs<br><br>Slabs                           | 100<br><br>100 |
| vii)  | Chilled Water Pumps                                  | a) Expanded Polystyrene<br>or<br>b) Mineral Wool | Slabs<br><br>Slabs                           | 50<br><br>50   |
| viii) | Expansion tank with pipe                             | a) Expanded Polystyrene<br>or<br>b) Mineral Wool | Slabs/Pipe Section<br><br>Slabs/Pipe Section | 50<br><br>50   |



**INSULATION**  
**DATA SHEET - A**

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SHEET 2 OF 2

ix) Acoustic insulation of Duct

Glass Wool

Slab

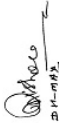
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|                                                                                   |                                                                                                            |                                      |  |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|--------------------------------------|--|
|  | 1X800 MW WANAKBORI STPP<br><b>VENTILATION SYSTEM</b><br><b>LIST OF MAKES OF SUB-VENDOR</b><br><b>ITEMS</b> | SPECIFICATION NO. PE-TS-408-554-A001 |  |
|                                                                                   |                                                                                                            | VOLUME : II B                        |  |
|                                                                                   |                                                                                                            | SECTION : E                          |  |
|                                                                                   |                                                                                                            | REV 00                               |  |
|                                                                                   |                                                                                                            | SHEET 1 OF 4                         |  |

## ANNEXURE-I

### LIST OF MAKES OF SUB-VENDOR ITEMS

  
 ENGINEER-IN-CHARGE  
 14/10/2019



1X800 MW WANAKBORI STPP  
**VENTILATION SYSTEM**  
**LIST OF MAKES OF SUB-VENDOR**  
**ITEMS**

**SPECIFICATION NO. PE-TS-408-554-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**SHEET 2 OF 4**

| S.No. | ITEM / EQUIPMENT                                            | SUB SUPPLIER                                                                                                                                                                                                                                                                                                                                  |
|-------|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.    | AIR WASHER & UAF*                                           | HYDERABAD POLLUTION CONTROL / SK SYSTEM / ADVANCE VENTILATION / DRAFT AIR / BLUE STAR / VOLTAS / STERLING WILSON & ROOTS COOLING SYSTEM / C.DOCTOR                                                                                                                                                                                            |
| 2.    | CENTRIFUGAL FAN (For Air washers and UAF)                   | FLAKT / KRUGGER / DRAFT AIR / HYDERABAD POLLUTION CONTROL / ADVANCE VENTILATION / PATEL AIR / NICOTRA/ SK SYSTEM / MARATHON / CB DOCTOR / SARLA                                                                                                                                                                                               |
| 3.    | AXIAL FLOW FANS/RE UNITS                                    | HYDERABAD POLLUTION/ SK SYSTEM / ADVANCE VENTILATION / KRUGER / NICOTRA / MARATHON / FLAKT / CB DOCTOR/ PATEL AIR /SITAL                                                                                                                                                                                                                      |
| 4.    | CENTRIFUGAL WATER PUMP                                      | BEST & CROMPTON / JYOTI / SAM TURBO / KBL / KSB / M&P / VOLTAS / BEACON-WEIR / WORTHINGTON / FLOWMORE / SULZER / BHARAT PUMPS & COMPRESSORS LTD / FLOWSERVE INDIA CONTROL PVT LTD / V-FLOW PUMPS & SYSTEMS CO/ KISHORE PUMP                                                                                                                   |
| 5.    | INDUCTION MOTORS (LT)                                       | SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF /JYOTI / LHP / BHARAT ELECTRIC                                                                                                                                                                                                                                                    |
| 6.    | AIR FILTER                                                  | PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER /SPECTRUM / AIR TECH / PUROMATIC                                                                                                                                                                                                                                                           |
| 7.    | INSULATION MATERIAL (Fibreglass / EPS/ PUF / Nitrile /EPDM) | BEARDSHELL / K-FLEX / PARAMONT / ARMAFLEX / SUPREME / LLOYDS / UP TWIGA                                                                                                                                                                                                                                                                       |
| 8.    | FIRE DAMPER                                                 | TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR )                                                                                                                                                                                                                                                                                                      |
| 9.    | BUTTERFLY VALVE                                             | ADVANCE / AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE / FLUIDLINE / INSTRUMENTATION LTD / R and D MULTIPLES (METAL CAST) PVT LTD / SURYA VALVES AND INSTRUMENTS MFG CO / PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED / UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED / VENUS PUMPS AND ENGG. WORKS |
| 10.   | NON RETURN VALVE(CI)                                        | LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA / SURYA VALVES AND INSTRUMENT MANUFACTURING / ATAM VALVES / GM DAULI & SONS / KBL / VENUS PUMPS AND ENGINEERING WORKS                                                                                                                        |
| 11.   | GATE/GLOBE VALVES (CI)                                      | CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / LEADER / H.SARKAR / FLUID LINE / HI -TECH / A V VALVES / BANKIM & COMPANY / SHIVADURGA / SURYA VALVES AND INSTRUMENT MANUFACTURING / ATAM VALVES / GM DAULI & SONS / KBL / VENUS PUMPS AND ENGINEERING WORKS.                                                    |
| 12.   | GUN METAL VALVES                                            | LEADER / A V VALVES / ATAM VALVES / VALTECH INDUSTRY / SANT VALVES                                                                                                                                                                                                                                                                            |

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1X800 MW WANAKBORI STPP  
**VENTILATION SYSTEM**  
**LIST OF MAKES OF SUB-VENDOR**  
**ITEMS**

**SPECIFICATION NO. PE-TS-408-554-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

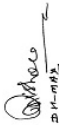
**SHEET 3 OF 4**

|     |                               |                                                                                                                                                                                                                                                                                                                                                                                          |
|-----|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13. | PIPING - ERW                  | SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA TUBES / BST / JINDAL / SAIL / PSL / LALIT PROFILE / SAMSHI PIPE INDUSTRIES / MUKUT PIPES / MANN INDUSTRIES/ SURENDRA ENGINEERING / PRATIBHA PIPES AND STRUCTURES PVT LTD / JCO GAS PIPES / NUKAT TANK AND VESSELS / GOODLUCK TUBES / ADVANCE STEEL TUBES / BIHAR TUBES / HITECH PIPES / RATNAMANI / MAHARASHTRA SEAMLESS |
| 14. | GI SHEETS FOR DUCTING         | TISCO / INDIAN IRON & STEEL CO LTD. / RASHITRYA ISPAT NIGAM LTD. / ESSAR/ ISPAT INDUSTRIES / JSW STEEL / LLOYDS STEEL / BHUSHAN / TATA / SAIL / JINDAL                                                                                                                                                                                                                                   |
| 15. | HUMID STAT                    | JHONSON CONTROL / HONEYWELL / PENN                                                                                                                                                                                                                                                                                                                                                       |
| 16. | PRESSURE GAUGE / DP GAUGE     | GENERAL INST CONSORTIUM / BELL / H.GURU INST/ H GURU / WAAREE INSTRUMENTS / FORBES MARSHALL / MANOMETER / A.N. INST / GAUGES BOURDON / GLUCK / WIKA / ASHCROFT / BAUMER TECHNOLOGIES                                                                                                                                                                                                     |
| 17. | TEMPERATURE GAUGE             | H.GURU IND/ H.GURU INST/ FORBES MARSHALL/DETRIVE INST & ELECTRONICS / PYRO ELECTRIC /TOSHNIWAL BROSS / WAREE INSTRUMENTS / A.N.INST / GOA INSTRUMENTS / WIKA/ ASHCROFT / H GURU (SI) / BUDENBERG GUAGE CO.LTD./ GOA THERMOSTATIC INSTRUMENTS PVT.LTD./ GAUGE BOURDON INDIA PVT. LTD/ Baumer Technologies India Pvt. Ltd                                                                  |
| 18. | LEVEL GAUGE                   | GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL / TECHNOMATIC / TELACO /LEVCON / D K INSTRUMENTS / PUNE TECHTROL / FLOW STAR                                                                                                                                                                                                                             |
| 19. | PRESSURE SWITCH / DP SWITCHES | BELLS / DANFOSS / DK INSTRUMENTS/ DRESSER / SOR INC / VASU / SWITZER / INDFOSS / TRAFAG / GIC / ASHCROFT / DELTA CONTROL                                                                                                                                                                                                                                                                 |
| 20. | LEVEL SWITCH                  | SBEM / BLISS ANAND / HI TECH / RAMAN INST / SIGMA / SOR INC / WAREE INST / LEVCON / DK INSTURMENT / V ATUOMATE /CHEMTROLS / SIMENS / FLOW STAR / TRAC                                                                                                                                                                                                                                    |
| 21. | LEVEL INDICATOR               | SBEM / SIGMA / LEVCON / DK INSTURMENT / V ATUOMATE / FLOW STAR / SCIENTIFIC DEVICES / GAUGES BOURDON / PNE TECHTROL                                                                                                                                                                                                                                                                      |
| 22. | TRANSMITTERS                  | EMERSON / LAXONS AUTOMATION / YIL / TAYLOR / ABB/BRISTOL BABCOCK / BIRLA KENT TAYLOR / BLISS ANAND /SBEM/ SMART INST / V AUTOMATION & INST / FISHER-ROSEMOUNT / SIEMENS/ HONEYWELL / YOKOGAWA / FUJI                                                                                                                                                                                     |
| 23. | Y / POT STRAINER              | MULTITEX / GREAVES COTTON / JAYPEE / SANT / OTOKLIN / GRAND PRIX / GUJARAT OTOLIFT / DS ENGG / SAROJINI ENTERPRISE / BHATIA ENGINEERING / FILTERATION ENGINEERS INDIA PVT LTD / SUNGOV ENGINEERING/ OTOKLIN GLOBAL BUSINESS LTD                                                                                                                                                          |
| 24. | CONTROL PANEL                 | INDUSTRIAL CONTROL & APPLIANCE/ PYROTECH /POSITRONICS / CONTROL & SWITCHGEAR /SIEMENS / L&T /GE POWER /RITTAL / HOFFMAN                                                                                                                                                                                                                                                                  |

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 1X800 MW WANAKBORI STPP  
 14-10-2019  
 14-10-2019

|                                                                                   |                                                                                                      |                                      |  |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|--------------------------------------|--|
|  | 1X800 MW WANAKBORI STPP<br><b>VENTILATION SYSTEM</b><br><b>LIST OF MAKES OF SUB-VENDOR<br/>ITEMS</b> | SPECIFICATION NO. PE-TS-408-554-A001 |  |
|                                                                                   |                                                                                                      | VOLUME : II B                        |  |
|                                                                                   |                                                                                                      | SECTION : E                          |  |
|                                                                                   |                                                                                                      | REV 00                               |  |
|                                                                                   |                                                                                                      | SHEET 4 OF 4                         |  |

|      |                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                            |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 25.  | INSTRUMENT FITTINGS                                                                                                                                                                                        | AURA INCORPORATED / Astec Valves & Fittings Pvt. Ltd., / Arya Crafts & Engineering Pvt. Ltd./ Comfit & Valve Pvt. Ltd./ FLUIDFIT ENGINEERS PVT. LTD / Fluid Controls Pvt. Ltd./ HP VALVES & FITTINGS INDIA PVT. LTD. / PRECISION ENGINEERING INDUSTRIES / Panam Engineers, / Perfect Instrumentation Control (India) Pvt. Ltd. / VIKAS INDUSTRIAL PRODUCTS |
| NOTE |                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                            |
|      | * Designed by C. Doctor / Blue Star / Voltas / Hyderabad Pollution Controls / SK System /Advance Ventilation / Draft Air / Sterling & Wilson / Roots cooling and fabricated by their approved fabricators. |                                                                                                                                                                                                                                                                                                                                                            |
|      | Above sub-vendor are also subjected to Customer approval during detailed engineering without any cost and time implication.                                                                                |                                                                                                                                                                                                                                                                                                                                                            |

  
R. S. Sharma  
S-4/10/04  
MUMBAI



**1x800 MW WANAKBORI STPP  
VENTILATION SYSTEM  
MANDATORY SPARE LIST**

**SPECIFICATION NO. PE-TS-408-554-A001**

**VOLUME : II B**

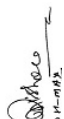
**SECTION : E**

**REV 00**

**SHEET 1 OF 7**

**ANNEXURE-II**

**MANDATORY SPARE LIST**

  
 ENGINEER-IN-CHARGE  
 14/10/2019



**1x800 MW WANAKBORI STPP  
VENTILATION SYSTEM  
MANDATORY SPARE LIST**

**SPECIFICATION NO. PE-TS-408-554-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**SHEET 2 OF 7**

| S.No.     | Equipment / Package name                          | Qty.                                         |
|-----------|---------------------------------------------------|----------------------------------------------|
|           | <b>VENTILATION SYSTEM</b>                         |                                              |
| <b>1.</b> | <b>Centrifugal Fans</b>                           |                                              |
| 1.1       | Set of bearings for Air washer fans               | 1Set for each Type of Fan                    |
| 1.2       | Set of bearings for U.A.F. fans                   | 1Set for each Type of Fan                    |
| 1.3       | Impeller for the Fan                              | 1Set for each Type of Fan                    |
| <b>2.</b> | <b>Centrifugal pumps</b>                          |                                              |
| 2.1       | Set of bearings for Air washer pumps              | 1Set for each Type and rating of Pump        |
| 2.2       | Set of bearings for U.A.F. pumps                  | 1Set for each Type and rating of Pump        |
| 2.3       | Gland packing, shaft sleeve & casing wearing ring | 1Set for each Type and rating of Pump        |
| 2.4       | Impeller for the Pump                             | 1Set for each Type and rating of Pump        |
| <b>3.</b> | <b>Spray Nozzles</b>                              |                                              |
| 3.1       | Spray nozzles for air washer unit                 | 5%                                           |
| 3.2       | Spray nozzles for U.A.F. unit                     | 5%                                           |
| <b>4.</b> | <b>SS Filters</b>                                 |                                              |
| 4.1       | SS Filters for Air washer                         | 10%                                          |
| 4.2       | SS Filter for Unitary air filtration unit         | 10%                                          |
| <b>5.</b> | <b>Flow Regulating Valve</b>                      |                                              |
| 5.1       | For Air Washer                                    | 10% or Minimum 1No. Whichever is higher      |
| 5.2       | For Unitary Air Filtration Unit                   | 10% or Minimum 1No. Whichever is higher      |
| <b>6.</b> | <b>moisture eliminators</b>                       |                                              |
| 6.1       | For Air Washer                                    | 1 no. for each type and rating of Air washer |
| 6.1       | For UAF                                           | 1 no. for each type and rating of UAF        |
| <b>7.</b> | <b>Basket for POT Strainer</b>                    |                                              |
| 7.1       | Strainer Basket for Air Washer                    | 1No. for each type and size                  |

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 Checked by: *[Signature]*  
 Date: 14/10/2014

|                                                                                   |                                                                                            |  |                                      |  |
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|  | <b>1x800 MW WANAKBORI STPP</b><br><b>VENTILATION SYSTEM</b><br><b>MANDATORY SPARE LIST</b> |  | SPECIFICATION NO. PE-TS-408-554-A001 |  |
|                                                                                   |                                                                                            |  | VOLUME : II B                        |  |
|                                                                                   |                                                                                            |  | SECTION : E                          |  |
|                                                                                   |                                                                                            |  | REV 00                               |  |
|                                                                                   |                                                                                            |  | SHEET 3 OF 7                         |  |

|            |                                                                                                     |                                                                               |
|------------|-----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| 7.2        | Strainer Basket for Unitary Air Filtration unit                                                     | 1No. for each type and size                                                   |
| <b>8.</b>  | <b>Valves</b>                                                                                       |                                                                               |
| 8.1        | Gate valve for Air washer                                                                           | 10% or Minimum 1No. Whichever is higher                                       |
| 8.2        | NR Valve for Air Washer                                                                             | 10% or Minimum 1No. Whichever is higher                                       |
| 8.3        | Gate valve for Unitary Air Filtration Unit                                                          | 10% or Minimum 1No. Whichever is higher                                       |
| 8.4        | NR valve for Unitary Air Filtration Unit                                                            | 10% or Minimum 1No. Whichever is higher                                       |
| 8.5        | Gate Valve for Make-up Drain of Air washer                                                          | 10% or Minimum 1No. Whichever is higher                                       |
| 8.6        | Gate valve for UAF                                                                                  | 20% or Minimum 2Nos. Whichever is higher                                      |
| <b>9.</b>  | <b>Electrical Spares as applicable as per the Electrical List</b>                                   | Item & Quantity applicable as per Electrical list                             |
| 9.1        | <b>415 V motor (above 30 KW rating up to 160 KW)</b>                                                |                                                                               |
| 9.1.1      | End shield cover Driving & Non – Driving End                                                        | 1 set for each type and rating of motor                                       |
| 9.1.2      | Driving & Non – Driving End bearing                                                                 | 1 set for each type and rating of motor                                       |
| 9.1.3      | Cooling Fan                                                                                         | 1 No. for each type and rating of motor                                       |
| 9.1.4      | Motor space heater                                                                                  | 1 No. for each type and rating of motor                                       |
| 9.1.5      | Motor terminal block                                                                                | 1 No. for each type and rating of motor                                       |
| 9.1.6      | Complete set of coupling                                                                            | 1 set for each application                                                    |
| 9.2        | <b>415 V motor (up to 30 KW rating)</b>                                                             |                                                                               |
| 9.2.1      | Driving & Non – Driving End bearing                                                                 | 3 set for each type and rating of motor                                       |
| 9.2.3      | Cooling Fan                                                                                         | 2 No. for each type and rating of motor                                       |
| 9.2.4      | Motor terminal block                                                                                | 5 No. for each type and rating of motor                                       |
| 9.2.5      | Complete set of coupling                                                                            | 1 set for each application                                                    |
| <b>10.</b> | <b>Field Instruments &amp; Others as applicable as per the C&amp;I List</b>                         |                                                                               |
| 10.1       | Field instruments (Transmitters/ temperature element ( TC / RTD) / gauge / Switches etc. along with | 10 (ten) percent of total of each type or at least one (whichever is higher ) |

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|            |                                                                                                                                             |                                                                                     |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|            | <b>relevant accessories)</b>                                                                                                                | of each type along with accessories                                                 |
| 10.2       | <b>Valves, actuators &amp; Accessories</b>                                                                                                  |                                                                                     |
| 10.2.1     | <b>Control valves</b>                                                                                                                       |                                                                                     |
| 10.2.1.1   | spare control valve stem packing                                                                                                            | 2 (two) sets for each of the control valves                                         |
| 10.2.1.2   | spare valve trim (including cage, plug, stem, seat rings, guide bushings etc.) for both the units for each of the control valves as offered | 1 (one) set                                                                         |
| 10.2.2     | <b>Control valve Actuators</b>                                                                                                              |                                                                                     |
| 10.2.2.1   | spare actuators with drive                                                                                                                  | 1 (one) set of each type and rating                                                 |
| 10.2.2.2   | valve positioners                                                                                                                           | 10 (ten) percent of each type                                                       |
| 10.2.2.3   | position transmitters                                                                                                                       | 10 (ten) percent of each type                                                       |
| 10.2.2.4   | limit switches                                                                                                                              | 10 (ten) percent of each type or 2 nos. of each type and rating whichever is higher |
| 10.2.2.5   | torque switches                                                                                                                             | 10 (ten) percent of each type or 2 nos. of each type and rating whichever is higher |
| 10.2.2.6   | Auxiliary contact                                                                                                                           | 1 no. of each type and rating                                                       |
| 10.2.2.7   | motor                                                                                                                                       | 1 no. of each type and rating                                                       |
| 10.2.2.8   | complete seal kit                                                                                                                           | 1 set for each type and rating                                                      |
| 10.2.2.9   | complete O ring set                                                                                                                         | 1 set for each type and rating                                                      |
| <b>11.</b> | <b>Fan-Filter Units</b>                                                                                                                     |                                                                                     |
| 11.1       | Filter                                                                                                                                      | 1 set for each FFU                                                                  |
| 11.2       | Fan-motor Bearing                                                                                                                           | 1 set for each rating of FFU                                                        |
| 11.3       | Vibration Isolators                                                                                                                         | 1 set for each FFU                                                                  |
| 11.4       | Back Draft Dampers                                                                                                                          | 1 no. of each size                                                                  |
| 11.4       | Any other spare parts recommended by the Manufacturer                                                                                       | As recommended by the Manufacturer                                                  |
| <b>12.</b> | <b>Wall mounted supply/ Exhaust fan</b>                                                                                                     |                                                                                     |
| 12.1       | Fan-motor Bearing                                                                                                                           | 1 set for each rating of fan                                                        |



**1x800 MW WANAKBORI STPP  
VENTILATION SYSTEM  
MANDATORY SPARE LIST**

**SPECIFICATION NO. PE-TS-408-554-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**SHEET 5 OF 7**

|            |                                                            |                                                                                 |
|------------|------------------------------------------------------------|---------------------------------------------------------------------------------|
| 12.2       | Vibration Isolators                                        | 1 set for each fan                                                              |
| 12.3       | Fan Motor                                                  | 1 set for each rating of fan                                                    |
| <b>13.</b> | <b>Electrical Spares for panels</b>                        |                                                                                 |
| 13.1       | Control Supply Transformer                                 | 2 Nos. of each type and rating                                                  |
| 13.2       | Contactor                                                  | 2 Nos. of each type and rating                                                  |
| 13.3       | Coils for contactor & aux. Contactor                       | 5 Nos. for each contactor                                                       |
| 13.4       | Main & Aux. Contacts sets for contactor and Aux. Contactor | 5 Sets. for each contactor                                                      |
| 13.5       | Air Break Switch                                           | 1 No. for each rating                                                           |
| 13.6       | Control ,Isolating and selector switches                   | 5% of each type and rating                                                      |
| 13.7       | Fuses                                                      | 6Nos,of each type and rating or 10% whichever is higher                         |
| 13.8       | Fuse Bases                                                 | 3Nos,of each type and rating or 5% whichever is higher                          |
| 13.9       | Circuit Breaker                                            | 1 No. for each rating                                                           |
| 13.10      | Indicating Lamps                                           | 10% of installed quantity                                                       |
| 13.11      | Indicating lamps cover of different colour and holders     | 5% of installed quantity                                                        |
| 13.12      | Push Buttons of various colours                            | 10 nos. of each type and colour                                                 |
| 13.13      | Terminal Blocks                                            | 5% of installed quantity                                                        |
| <b>14.</b> | <b>Electrical Spares for Motors</b>                        |                                                                                 |
| 14.1       | Terminal plates                                            | 10 Nos. each for small motors up to 30KW and 4 Nos. each for motors above 30 KW |
| 14.2       | Heaters                                                    | 1 Set for each motor of rating above 30 KW                                      |
| 14.3       | Greasing arrangements                                      | 4 sets for each type of motors                                                  |
| 14.4       | Motors below 0.75 KW                                       | 10% of the installed quantity or minimum 1 no. whichever is higher              |
| 14.5       | Bearings (DE & NDE)                                        | 4 sets of each type and rating                                                  |

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**1x800 MW WANAKBORI STPP  
VENTILATION SYSTEM  
MANDATORY SPARE LIST**

**SPECIFICATION NO. PE-TS-408-554-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**SHEET 6 OF 7**

|            |                                          |                                                                      |
|------------|------------------------------------------|----------------------------------------------------------------------|
| <b>15.</b> | <b>Control panel/ desk mounted items</b> |                                                                      |
| 15.1       | Push Button                              |                                                                      |
| 15.1.1     | Complete assembly                        | 5Nos for each colour                                                 |
| 15.1.2     | Contact Element (1NO + 1NC) Block        | 20Nos.                                                               |
| 15.2       | Selector Switch                          | 10Nos. for each type and rating                                      |
| 15.3       | Meter (Analog or Digital)                |                                                                      |
| 15.3.1     | Ammeter                                  | 10% for each type and range or minimum one (1) no. whichever is more |
| 15.3.2     | Voltmeter                                | 10% for each type and range or minimum one (1) no. whichever is more |
| 15.3.3     | Frequency                                | 10% for each type and range or minimum one (1) no. whichever is more |
| 15.3.4     | MW                                       | 10% for each type and range or minimum one (1) no. whichever is more |
| 15.3.5     | MVAR                                     | 10% for each type and range or minimum one (1) no. whichever is more |
| 15.3.6     | Power Factor                             | 10% for each type and range or minimum one (1) no. whichever is more |
| 15.3.7     | Synchroscope                             | 10% for each type and range or minimum one (1) no. whichever is more |
| 15.4       | Indicating Lamps complete assembly       | 10 Nos. for each Colour and type                                     |
| 15.5       | Mimic Lamps                              | 10 Nos. for each Colour and type                                     |
| 15.6       | MCB                                      | 2 Nos. for each type and rating                                      |
| 15.7       | Door Limit Switch                        | 2 Nos.                                                               |
| 15.8       | Annunciation system                      |                                                                      |
| 15.8.1     | Lamp Box with Facia & Lamps (LED type)   | 25Nos.                                                               |
| 15.8.2     | Hooter                                   | 1No.                                                                 |

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 Date: 14/10/2014



**SHEET 7 OF 7**

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**1x800 MW WANAKBORI STPP  
VENTILATION SYSTEM  
PAINTING & COLOUR SCHEME**

**SPECIFICATION No: PE-TS-408-554-A001**

**VOLUME : II B**

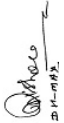
**SECTION : E**

**REV 00**

**SHEET 1 OF 8**

**ANNEXURE-III**

**PAINTING & COLOUR SCHEME**

  
 ENGINEER IN CHARGE  
 24/10/2024

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                           |                                                                                                                    |  |      |   |                                            |         |   |                                      |         |   |                                             |         |   |                                                                             |         |   |                                                                                 |        |   |                                                                                                   |         |   |                                                               |        |   |                                                   |          |   |                                                            |          |   |                                                     |         |   |                                                        |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p>TITLE</p> <p style="text-align: center;"><b>PAINTING SCHEDULE</b></p> <p style="text-align: center;"><b>1x800 MW WANAKBORI TPS</b></p> | <p>DOCUMENT NO. PE-DC-408-100-A999</p> <hr/> <p>REV.NO. 02      DATE 15/09/2015</p> <hr/> <p>SHEET 1      OF 3</p> |  |      |   |                                            |         |   |                                      |         |   |                                             |         |   |                                                                             |         |   |                                                                                 |        |   |                                                                                                   |         |   |                                                               |        |   |                                                   |          |   |                                                            |          |   |                                                     |         |   |                                                        |
| <p>1.0      <b><u>GENERAL PAINTING REQUIREMENTS</u></b></p> <p>1.1      Painting of equipment shall be carried out as per the specifications indicated below and attached annexures and shall conform to the relevant IS specification/ international standards for the material and workmanship.</p> <p>1.2      The following latest Indian Standards may be referred to for carrying out the painting job:</p> <table border="0" style="width: 100%;"> <tr> <td style="width: 15%;">IS:5</td> <td style="width: 5%;">:</td> <td style="width: 80%;">Colours for ready mixed paints and enamels</td> </tr> <tr> <td>IS:1303</td> <td>:</td> <td>Glossary of terms relating to paints</td> </tr> <tr> <td>IS:2379</td> <td>:</td> <td>Colour code for identification of pipelines</td> </tr> <tr> <td>IS:1477</td> <td>:</td> <td>Code of practice for painting of ferrous metals in Buildings (Parts I &amp; II)</td> </tr> <tr> <td>IS:2524</td> <td>:</td> <td>Code of practice for painting of non-ferrous metals in buildings (Parts I &amp; II)</td> </tr> <tr> <td>IS:158</td> <td>:</td> <td>Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting</td> </tr> <tr> <td>IS:2074</td> <td>:</td> <td>Ready mixed paint, air drying, red Oxide Zinc Chrome, priming</td> </tr> <tr> <td>IS:104</td> <td>:</td> <td>Ready mixed paint, brushing, Zinc Chrome, priming</td> </tr> <tr> <td>IS: 2932</td> <td>:</td> <td>Enamel, synthetic, exterior (a) undercoating (b) Finishing</td> </tr> <tr> <td>IS :2933</td> <td>:</td> <td>Specification for enamel synthetic exterior type II</td> </tr> <tr> <td>IS:2339</td> <td>:</td> <td>Specification for Aluminium paints for general purpose</td> </tr> </table> <p>1.3      <b>Preparation of Surfaces</b></p> <p>All surfaces to be painted shall be thoroughly cleaned of all grease, oil, loose mill scale, dust, rust and any other foreign matter. Mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out sand scrapping may be permitted with steel wire brushes and /or abrasive paper. Cleaning with solvents shall be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents shall be adopted only after written approval of the OWNER/OWNER REPRESENTATIVE.</p> |                                                                                                                                           |                                                                                                                    |  | IS:5 | : | Colours for ready mixed paints and enamels | IS:1303 | : | Glossary of terms relating to paints | IS:2379 | : | Colour code for identification of pipelines | IS:1477 | : | Code of practice for painting of ferrous metals in Buildings (Parts I & II) | IS:2524 | : | Code of practice for painting of non-ferrous metals in buildings (Parts I & II) | IS:158 | : | Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting | IS:2074 | : | Ready mixed paint, air drying, red Oxide Zinc Chrome, priming | IS:104 | : | Ready mixed paint, brushing, Zinc Chrome, priming | IS: 2932 | : | Enamel, synthetic, exterior (a) undercoating (b) Finishing | IS :2933 | : | Specification for enamel synthetic exterior type II | IS:2339 | : | Specification for Aluminium paints for general purpose |
| IS:5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | :                                                                                                                                         | Colours for ready mixed paints and enamels                                                                         |  |      |   |                                            |         |   |                                      |         |   |                                             |         |   |                                                                             |         |   |                                                                                 |        |   |                                                                                                   |         |   |                                                               |        |   |                                                   |          |   |                                                            |          |   |                                                     |         |   |                                                        |
| IS:1303                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | :                                                                                                                                         | Glossary of terms relating to paints                                                                               |  |      |   |                                            |         |   |                                      |         |   |                                             |         |   |                                                                             |         |   |                                                                                 |        |   |                                                                                                   |         |   |                                                               |        |   |                                                   |          |   |                                                            |          |   |                                                     |         |   |                                                        |
| IS:2379                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | :                                                                                                                                         | Colour code for identification of pipelines                                                                        |  |      |   |                                            |         |   |                                      |         |   |                                             |         |   |                                                                             |         |   |                                                                                 |        |   |                                                                                                   |         |   |                                                               |        |   |                                                   |          |   |                                                            |          |   |                                                     |         |   |                                                        |
| IS:1477                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | :                                                                                                                                         | Code of practice for painting of ferrous metals in Buildings (Parts I & II)                                        |  |      |   |                                            |         |   |                                      |         |   |                                             |         |   |                                                                             |         |   |                                                                                 |        |   |                                                                                                   |         |   |                                                               |        |   |                                                   |          |   |                                                            |          |   |                                                     |         |   |                                                        |
| IS:2524                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | :                                                                                                                                         | Code of practice for painting of non-ferrous metals in buildings (Parts I & II)                                    |  |      |   |                                            |         |   |                                      |         |   |                                             |         |   |                                                                             |         |   |                                                                                 |        |   |                                                                                                   |         |   |                                                               |        |   |                                                   |          |   |                                                            |          |   |                                                     |         |   |                                                        |
| IS:158                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | :                                                                                                                                         | Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting                  |  |      |   |                                            |         |   |                                      |         |   |                                             |         |   |                                                                             |         |   |                                                                                 |        |   |                                                                                                   |         |   |                                                               |        |   |                                                   |          |   |                                                            |          |   |                                                     |         |   |                                                        |
| IS:2074                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | :                                                                                                                                         | Ready mixed paint, air drying, red Oxide Zinc Chrome, priming                                                      |  |      |   |                                            |         |   |                                      |         |   |                                             |         |   |                                                                             |         |   |                                                                                 |        |   |                                                                                                   |         |   |                                                               |        |   |                                                   |          |   |                                                            |          |   |                                                     |         |   |                                                        |
| IS:104                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | :                                                                                                                                         | Ready mixed paint, brushing, Zinc Chrome, priming                                                                  |  |      |   |                                            |         |   |                                      |         |   |                                             |         |   |                                                                             |         |   |                                                                                 |        |   |                                                                                                   |         |   |                                                               |        |   |                                                   |          |   |                                                            |          |   |                                                     |         |   |                                                        |
| IS: 2932                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | :                                                                                                                                         | Enamel, synthetic, exterior (a) undercoating (b) Finishing                                                         |  |      |   |                                            |         |   |                                      |         |   |                                             |         |   |                                                                             |         |   |                                                                                 |        |   |                                                                                                   |         |   |                                                               |        |   |                                                   |          |   |                                                            |          |   |                                                     |         |   |                                                        |
| IS :2933                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | :                                                                                                                                         | Specification for enamel synthetic exterior type II                                                                |  |      |   |                                            |         |   |                                      |         |   |                                             |         |   |                                                                             |         |   |                                                                                 |        |   |                                                                                                   |         |   |                                                               |        |   |                                                   |          |   |                                                            |          |   |                                                     |         |   |                                                        |
| IS:2339                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | :                                                                                                                                         | Specification for Aluminium paints for general purpose                                                             |  |      |   |                                            |         |   |                                      |         |   |                                             |         |   |                                                                             |         |   |                                                                                 |        |   |                                                                                                   |         |   |                                                               |        |   |                                                   |          |   |                                                            |          |   |                                                     |         |   |                                                        |

466 of 533  
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                           |                                 |                 |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                           | SHEET 2 OF 3                    |                 |
| <p>The sheet steel of electrical and instrumentation panels shall be pre-treated through chemical cleaning (7 tank) process of rinsing, degreasing, rinsing, derusting, rinsing, phosphate and rinsing. However, in case mechanical cleaning is also required the Contractor shall carry out the same to get a smooth finish.</p> <p><b>1.4 Primer Paint</b></p> <p>After the surface is prepared one coat of Zinc Phosphate primer conforming to IS 2074 shall be applied.</p> <p><b>1.5 Tie Paint</b></p> <p>After the coat is dried up completely, second coat of Zinc Phosphate primer conforming to IS 2074 shall be applied by brushing, spray, roller as per manufacture recommendation to ensure a continuous film. The dry film thickness of each coat shall be as indicated in Ann-I &amp; II enclosed. Insulated surfaces will have only primer coating and no finish painting.</p> <p><b>1.6 Finish Paint</b></p> <p>Synthetic enamel paint conforming to IS 2932 shall be used for finish coats. The colour /shade shall be as approved by the OWNER. After cleaning the dust on the dried up primer, first coat of synthetic enamel shall be applied. After this first coat dries up hard, the surface is wet scrubbed cutting down to a smooth finish and ensuring that at no place the first coat is completely removed. After allowing the water to get evaporated completely, the second finish coat of synthetic enamel paint shall be applied.</p> <div style="display: flex; align-items: flex-start;"> <div style="margin-right: 10px;">  </div> <div> <p><b>Note</b></p> <p>For structural painting, customer's specification V II/G2/8 CI 3.03.11 shall be followed however DFT and coating system shall be followed in line with paint manufacturer's recommendation.</p> </div> </div> <p><b>1.7 Painting and Corrosion Protection for Pipes &amp; Fittings</b></p> <p><b>1.7.1</b> All uninsulated piping systems, hangers and supports shall have two coats of Zinc Phosphate Primer (conforming to IS 2074) (One primer coat and one tie coat) and finish paint using synthetic enamel paint to give a finish coat. Shades shall be as per IS 5 or as indicated by PURCHASER/OWNER. Service of the pipeline designations shall be painted on all pipes at visible locations.</p> <p><b>1.7.2</b> Before application of paint, Contractor shall clean the pipes of all mill scale, dirt dust, soot grease, rust etc.</p> <p><b>1.7.3</b> All pipe lines, piping components shall be adequately protected against corrosion during manufacture, fabrication, shipment and storage by appropriate protective paint.</p> |                                                                                                                                           |                                 |                 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                     |                                                                                                                    |  |                                                                                                                                                                             |                                                                                                                                                     |
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| <p>1.7.4 Shop fabricated equipment/items shall be dispatched with final paint. Necessary touch up shall be done at site. Site fabricated equipment/items shall be dispatched with primer painting only and final painting shall be applied at site.</p> <p>1.8 <b>Painting and Corrosion Protection for Valves &amp; Specialties</b></p> <div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;">  </div> <div> <p>Primer of thickness as indicated in Ann-II shall be applied to all steel and cast iron exposed surfaces as required to prevent corrosion before dispatch. The use of grease or oil, other than light grade mineral oil, for corrosion protection is prohibited. Bores of all vales shall be covered immediately after testing, draining and drying with suitable plastic end covers to avoid ingress of foreign materials.</p> </div> </div> <p>1.9 <b>Suggested Colour Codes for Painting</b></p> <p>Suggested colour codes shall be furnished by the successful bidder after award of contract. Colour codes for piping shall be as per IS 2379 with necessary modifications. Where band colour is specified for piping, same shall be provided at 30 metre intervals on long uninterrupted lines and also adjacent to valves and junctions.</p> <p>2.0 <b>Approved Paint Makes</b></p> <table border="0" style="width: 100%;"> <tr> <td style="vertical-align: top;">         i) Asian Paints (I) Ltd.<br/>         ii) Berger Paints India Ltd<br/>         iii) Goodlass Nerolac<br/>         iv) Jenson &amp; Nicholson (I) Ltd<br/>         v) CDC carboline (I) Ltd.<br/>         vi) Shalimar Paints Ltd.       </td> <td style="vertical-align: top;">         vii) Addison Paints Ltd<br/>         viii) Grand Polycoat<br/>         ix) Bombay Paints<br/>         x) Hemple Paints (Singapore)<br/>         xi) Jotun Paints<br/>         xii) Akzonobel coatings       </td> </tr> </table> <p>2.1 <b><u>PAINTING SCHEDULES</u></b></p> <p>2.1 Painting schedules for various systems/ items are furnished as per enclosed Annexures-I and II. Vendors of different packages/ items will furnish detailed painting schedule for customer approval during detail engineering as per this guide specification.</p> |                                                                                                                                                     |                                                                                                                    |  | i) Asian Paints (I) Ltd.<br>ii) Berger Paints India Ltd<br>iii) Goodlass Nerolac<br>iv) Jenson & Nicholson (I) Ltd<br>v) CDC carboline (I) Ltd.<br>vi) Shalimar Paints Ltd. | vii) Addison Paints Ltd<br>viii) Grand Polycoat<br>ix) Bombay Paints<br>x) Hemple Paints (Singapore)<br>xi) Jotun Paints<br>xii) Akzonobel coatings |
| i) Asian Paints (I) Ltd.<br>ii) Berger Paints India Ltd<br>iii) Goodlass Nerolac<br>iv) Jenson & Nicholson (I) Ltd<br>v) CDC carboline (I) Ltd.<br>vi) Shalimar Paints Ltd.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | vii) Addison Paints Ltd<br>viii) Grand Polycoat<br>ix) Bombay Paints<br>x) Hemple Paints (Singapore)<br>xi) Jotun Paints<br>xii) Akzonobel coatings |                                                                                                                    |  |                                                                                                                                                                             |                                                                                                                                                     |



TITLE

DOCUMENT NO. PE-DC-408-100-A999

# PAINTING SCHEDULE

## 1x800 MW WANAKBORI TPS

REV.NO. 02

DATE 15/09/2015

SHEET 1 OF 2

### Annexure-I

| Paint Reference Scheme                                                 | Surface Preparation Grade / Surface Profile                                            | Primer Coat                                        |              |                  | Intermediate Coat                                  |              |                  | Finish Coat                                              |              |                                     | Total DFT in microns |
|------------------------------------------------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------|--------------|------------------|----------------------------------------------------|--------------|------------------|----------------------------------------------------------|--------------|-------------------------------------|----------------------|
|                                                                        |                                                                                        | Premier Paint                                      | No. of Coats | DFT in Microns   | Intermediate Paint                                 | No. of Coats | DFT in Microns   | Finish Paint (See Note)                                  | No. of Coats | DFT in Microns                      |                      |
| Various type of equipment/vessel, etc. (Temp. upto 90°C)               | Degreasing and Mech. Cleaning with wire brushing/hand tool (Sa1/St2/St3 as applicable) | HB Zinc Phosphate (alkyd Medium) as per IS:2074    | 1            | 35-45 per coat   | HB Zinc Phosphate (alkyd Medium) as per IS:2074    | 1            | 35-45 per coat   | Synthetic enamel (alkyd med.) as per IS:2932             | 2            | 20 – 25 per coat                    | 110 - 140            |
| Structural                                                             | - do -                                                                                 | Epoxy resin based HB Zinc phosphate (alkyd medium) | 1            | 50 – 75 per coat | Epoxy based HB MIO pigmented polyamide cured paint | 1            | 110-125 per coat | Polyamide cured epoxy finish coating + Polyurethane coat | 1+1          | 50 – 60 per coat + 25 – 35 per coat | 235 - 295            |
| LP Piping/ Vessels, etc. (Temp. upto 90°)                              | - do -                                                                                 | HB Zinc Phosphate as per IS:2074 (alkyd medium)    | 1            | 35 – 45 per coat | HB Zinc Phosphate (alkyd Medium) as per IS:2074    | 1            | 35-45 per coat   | Synthetic enamel (alkyd med.) as per IS:2932             | 2            | 20 – 25 per coat                    | 110-140              |
| Equipment with (Temp. upto 250°)                                       | - do -                                                                                 | Heat resistant Al – paint                          | 2            | 20 per coat      | - NA                                               | -            | -                | NA                                                       | Insulated    | NA                                  | 40                   |
| Equipment in corrosive areas like CPU (regeneration) Dosing skid, etc. | Blast clean to Sa 2 1/2                                                                | HB Epoxy resin based zinc phosphate primer         | 1            | 50 per coat      | Epoxy based MIO pigmented paint                    | 1            | 50 per coat      | Polyamide cured Epoxy finish coat                        | 2            | 25 – 35 per coat                    | 150 - 170            |
| Elect. / Control Panels, etc.                                          | Seven tank process                                                                     | HB Zinc phosphate (alkyd Medium) as per IS:2074    | 2            | 35 – 45 per coat | HB Zinc Phosphate (alkyd Medium) as per IS:2074    | 1            | 35-45 per coat   | Synthetic enamel (alkyd med.) as per IS:2932             | 2            | 20 – 25 per coat                    | 110 – 140            |
| Large dia pipes                                                        | As per customer specification for Large diameter piping CI. No. 9.00.00 of VII-I/S-5   |                                                    |              |                  |                                                    |              |                  |                                                          |              |                                     |                      |



TITLE

**PAINTING SCHEDULE**  
**1x800 MW WANAKBORI TPS**

DOCUMENT NO. PE-DC-408-100-A999

REV.NO. 02 DATE 15/09/2015

SHEET 2 OF 2

## Notes:

1. Surface preparation shown above is as per Swedish Standards SIS 05-5900. Degreasing will be as per Standard SSPC-SP1.
2. In case of insulated surfaces, only primer coats shall be applied.
3. GM/SS items with piping and G.I. pipes will not be painted. Further SS/GI piping shall be given necessary colour banding for identification as per colour scheme.
4. All instruments shall be painted as per manufacturer standard practice.
5. All structural steel items shall be painted at site. Piping shall go with primer coating & finish Paint shall be applied at site. Equipment shall be finish painted at shop.
6. Method of painting application shall be as per paint manufacturer's recommendation.
7. **Based on above painting schedule, detailed painting schedule will be prepared by respective Package supplier and approved painting schedule shall be submitted to GSECL/DCPL under information category.**
8. **This painting schedule is applicable for bought out equipment/packages of PEM. Painting specification for various piping/ equipment in scope of various other BHEL units like Power cycle piping, CW piping, LP piping, R.E. joints, Butterfly valves, Power cycle valve etc., shall be furnished by unit separately.**

1



TITLE

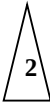
**PAINTING SCHEDULE**  
**1x800 MW WANAKBORI TPS**

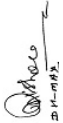
DOCUMENT NO. PE-DC-408-100-A999

REV.NO. 02 DATE 15/09/2015

SHEET 1 OF 1

**ANNEXURE -II****LDO/HFO Storage Tank**

|                                                                                          | Internal                                                                          | External                                                                                 | Underneath                                                                              |
|------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Surface preparation                                                                      | Wire bushing                                                                      | ST2 (Wire Brushing/<br>Hand tool cleaning)                                               | Blast clean to SA 2.5                                                                   |
| Primer                                                                                   | 2 coats of double boiled<br>linseed oil                                           | 2 coats of red oxide<br>zinc chromate primer<br>(IS 2074) of 30 - 35<br>microns DFT each | 1 coat of high build coal<br>tar epoxy suitably<br>pigmented, DFT : 80 –<br>100 microns |
| Finish  | 1 coats of synthetic enamel<br>(IS – 2932) paint of 20 – 25<br>microns (DFT) each | 2 coats of synthetic<br>enamel (IS – 2932) paint<br>of 20 – 25 microns<br>(DFT) each     | N.A                                                                                     |
| Total DFT                                                                                |                                                                                   | 100 – 120 microns                                                                        | 80 – 100 microns                                                                        |

  
 Engineer  
 15-09-2015



TITLE

## PAINTING SCHEDULE

1x800 MW WANAKBORI TPS

DOCUMENT NO. PE-DC-408-100-A999

REV.NO. 02 DATE 15/09/2015

SHEET 1 OF 3

ANNEXURE-III

SUGGESTED COLOUR CODES FOR PAINTING

| SL. NO. | ITEM/SERVICE                                                              | COLOUR              | IS-5                | COLOUR (BAND)   | IS-5 |
|---------|---------------------------------------------------------------------------|---------------------|---------------------|-----------------|------|
| 1.0     | Structures, platforms, galleries, ladders and handrails                   | Dark Admiralty Grey | 632                 | -               | -    |
| 2.0     | Fans, pumps, motors, compressors, Blowers                                 | Light Grey          | 631                 | -               | -    |
| 3.0     | Tanks (without insulation and cladding)                                   |                     |                     |                 |      |
| 3.1     | Outdoor, Stand pipes, vent pipes                                          | Aluminum            | -                   | -               | -    |
| 3.2     | Indoor                                                                    | Aluminum            | -                   | -               | -    |
| 4.0     | Vessels & all other proprietary equipment (without insulation & cladding) | Light grey          | 631                 | -               | -    |
| 5.0     | Switchgear                                                                | Light grey          | 631                 | -               | -    |
| 6.0     | Control & relay panels                                                    | Light grey          | 631/7078 of IS 1650 | -               | -    |
| 7.0     | Transformers                                                              | Dark Admiralty Grey | 632                 | -               | -    |
| 8.0     | Machinery guards                                                          | Signal red          | 537                 | -               | -    |
| 9.0     | Piping (without insulation and cladding)                                  |                     |                     |                 |      |
| 9.1     | Water System                                                              |                     |                     |                 |      |
| a)      | Boiler feed                                                               | Sea green           | 217                 | -               | -    |
| b)      | Condensate                                                                | Sea green           | 217                 | Light brown     | 410  |
| c)      | D M Water                                                                 | Sea Green           | 217                 | Light orange    | 557  |
| d)      | Soft water                                                                | Sea green           | 217                 | French blue     | 166  |
| e)      | Bearing cooling water                                                     | Sea green           | 217                 | French blue     | 166  |
| f)      | Potable & filtered water                                                  | Sea green           | 217                 | French blue     | 166  |
| g)      | Service & clarified water                                                 | Sea green           | 217                 | French blue     | 166  |
| h)      | Raw water                                                                 | Sea green           | 217                 | White           | -    |
| i)      | Cooling water                                                             | Sea green           | 217                 | French blue     | 166  |
| 9.2     | Compressed Air System                                                     |                     |                     |                 |      |
| a)      | Service air                                                               | Sky Blue            | 101                 | -               | -    |
| b)      | Instrument air                                                            | blue                | 101                 | White           | -    |
| 9.3     | Oil system                                                                |                     |                     |                 |      |
| a)      | Fuel oil                                                                  | Light brown         | 410                 | French Blue     | 166  |
| b)      | Light oil                                                                 | Dark Brown          | 412                 | Brilliant green | 221  |
| c)      | Lubricating oil                                                           | Light brown         | 410                 | Light grey      | 631  |



TITLE

DOCUMENT NO. PE-DC-408-100-A999

**PAINTING SCHEDULE****1x800 MW WANAKBORI TPS**

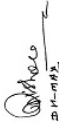
REV.NO. 02 DATE 15/09/2015

SHEET 2 OF 3

| SL. NO. | ITEM/SERVICE                   | COLOUR        | IS-5 | COLOUR (BAND) | IS-5 |
|---------|--------------------------------|---------------|------|---------------|------|
| d)      | Control oil                    | Light brown   | 410  | Light orange  | 557  |
| e)      | Transformer oil                | Light brown   | 410  | Light orange  | 557  |
| 9.4     | Gas system                     |               |      |               |      |
| a)      | Carbon dioxide                 | Canary yellow | 309  | Light grey    | 631  |
| 9.5     | Fire services                  | Fire red      | 536  | -             | -    |
| 9.6     | Drainage                       | Black         | -    | -             | -    |
| 9.7     | Stand pipes and all Vent pipes | Aluminum      | -    | -             | -    |

Notes:

1. This color code basically refers to IS:2379 for piping with necessary modifications.
2. Where band color is specified, same shall be provided at 10 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.

  
 Engineer in Charge  
 15/09/2015

|                                                                                   |                                                                                                   |  |                                      |  |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|--|--------------------------------------|--|
|  | <b>1x800 MW WANAKBORI STPP</b><br><b>VENTILATION SYSTEM</b><br><b>LIST OF TOOLS &amp; TACKLES</b> |  | SPECIFICATION No: PE-TS-408-554-A001 |  |
|                                                                                   |                                                                                                   |  | VOLUME : II B                        |  |
|                                                                                   |                                                                                                   |  | SECTION : E                          |  |
|                                                                                   |                                                                                                   |  | REV 00                               |  |
|                                                                                   |                                                                                                   |  | SHEET 1 OF 2                         |  |

## ANNEXURE-IV

### LIST OF TOOLS & TACKLES

DRAWN BY:                       
 CHECKED BY:                       
 DATE:



**1x800 MW WANAKBORI STPP  
VENTILATION SYSTEM  
LIST OF TOOLS & TACKLES**

**SPECIFICATION No: PE-TS-408-554-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**SHEET 2 OF 2**

| SL No | ITEM                                          | UNIT | QTY |
|-------|-----------------------------------------------|------|-----|
| 1     | FLAT D WRENCH - 6 MM TO 32 MM <b>(12 Pcs)</b> | SET  | 1   |
| 2     | BOX WRENCHES - 6 MM TO 22 MM <b>(14 Pcs)</b>  | SET  | 1   |
| 3     | RING SPANNER - 6 MM TO 32 MM <b>(12 Pcs)</b>  | SET  | 1   |
| 4     | ALLEN KEYS - 2 MM TO 10 MM                    | SET  | 1   |
| 5     | CRESCENT SCREW SPANNER                        | NO.  | 1   |
| 6     | SCREW DRIVER                                  | NO.  | 1   |
| 7     | OFFSET SCREW DRIVER                           | NO.  | 1   |
| 8     | INSULATED PLIER                               | NO.  | 1   |
| 9     | TORCH LIGHT FOR 2 CELL                        | NO.  | 1   |
| 10    | HAMMER 1 LB                                   | NO.  | 1   |
| 11    | OIL CAN                                       | NO.  | 1   |
| 12    | POCKET THERMOMETER - 0 TO 50 DEG. C)          | NO.  | 1   |
| 13    | INSULATION TAPE ROLL                          | NO.  | 1   |
| 14    | STEEL FOOT RULE - 12"                         | NO.  | 1   |
| 15    | FEELER GAUGE 9 BLADES                         | NO.  | 1   |
| 16    | PIPE WRENCH                                   | NO.  | 1   |
| 17    | PSYCHRO METER                                 | NO.  | 1   |
| 18    | LOCK WITH KEY FOR TOOL BOX                    | NO.  | 1   |
| 19    | RATCHET 1/4"                                  | NO.  | 1   |
| 20    | MS TOOL BOX                                   | NO.  | 1   |

Note – List furnished above are indicative & minimum requirement. Detailed list shall be finalized during detail engineering

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 14/06/2019  
 14/06/2019  
 14/06/2019



**1x800 MW WANAKBORI STPP  
VENTILATION SYSTEM  
CLARIFIED WATER ANALYSIS**

**SPECIFICATION No: PE-TS-408-554-A001**

**VOLUME : II B**

**SECTION : E**

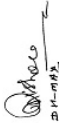
**REV 00**

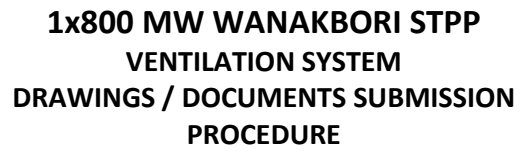
**SHEET 1 OF 1**

**ANNEXURE-V**

**CLARIFIED WATER ANALYSIS**

**PLEASE REFER PROJECT INFORMATION, SECTION-B**

  
 ENGINEER IN CHARGE  
 14/10/2019



**SHEET 1 OF 1**

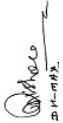
## DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE (COVERED UNDER SECTION C 2B)

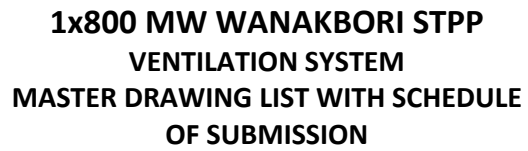
|                                                                                   |                                                                                  |  |                                      |  |
|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------|--|--------------------------------------|--|
|  | <b>1x800 MW WANAKBORI STPP<br/>VENTILATION SYSTEM<br/>INSPECTION AND TESTING</b> |  | SPECIFICATION No: PE-TS-408-554-A001 |  |
|                                                                                   |                                                                                  |  | VOLUME : II B                        |  |
|                                                                                   |                                                                                  |  | SECTION : E                          |  |
|                                                                                   |                                                                                  |  | REV 00                               |  |
|                                                                                   |                                                                                  |  | SHEET 1 OF 1                         |  |

## ANNEXURE-VII

### INSPECTION AND TESTING

**PLEASE REFER SECTION C2-B UNDER GTR**

  
 RAJESH K. S. SHARMA  
 RAJESH K. S. SHARMA  
 RAJESH K. S. SHARMA



**SHEET 1 OF 4**

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**1x800 MW WANAKBORI STPP  
VENTILATION SYSTEM  
MASTER DRAWING LIST WITH SCHEDULE  
OF SUBMISSION**

**SPECIFICATION No: PE-TS-408-554-A001**

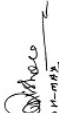
**VOLUME : II B**

**SECTION : E**

**REV 00**

**SHEET 2 OF 4**

| S. NO. | DRAWING NO         | DRG./ DOC. TITLE                                                                                                         | SCH. WEEK |
|--------|--------------------|--------------------------------------------------------------------------------------------------------------------------|-----------|
| 1*     | PE-V0-408-554-A001 | INSPECTION CATEGORISATION PLAN                                                                                           | 4         |
| 2*     | PE-V0-408-554-A002 | QUALITY PLAN OF AIR WASHER & UAF                                                                                         | 12        |
| 3*     | PE-V0-408-554-A003 | QUALITY PLAN OF CENTRIFUGAL PUMPS                                                                                        | 12        |
| 4*     | PE-V0-408-554-A004 | QUALITY PLAN OF CENTRIFUGAL FANS                                                                                         | 13        |
| 5*     | PE-V0-408-554-A005 | QUALITY PLAN OF AXIAL FLOW FANS & RE UNITS                                                                               | 14        |
| 6*     | PE-V0-408-554-A006 | QUALITY PLAN OF MOTOR                                                                                                    | 15        |
| 7*     | PE-V0-408-554-A101 | VENTILATION FAN SCHEDULE.                                                                                                | 22        |
| 8*     | PE-V0-408-554-A201 | DATA SHEET & GA FOR AIR WASHER ALONGWITH FAN AND PUMP WITH FOUNDATION DETAILS.                                           | 12        |
| 9*     | PE-V0-408-554-A202 | DATA SHEET & GA FOR UAF ALONGWITH FAN AND PUMP FOUNDATION DETAILS.                                                       | 10        |
| 10*    | PE-V0-408-554-A203 | DATA SHEET & GA FOR ROOF EXTRACTOR, AXIAL EXHAUST AND SUPPLY AIR FANS WITH FIXING ARRANGEMENT.                           | 12        |
| 11*    | PE-V0-408-554-A204 | DATA SHEET & GA FOR VALVES AND STRAINER.                                                                                 | 8         |
| 12*    | PE-V0-408-554-A205 | DATA SHEET FOR INSULATION.                                                                                               | 8         |
| 13*    | PE-V0-408-554-A206 | DATA SHEET & GA FIRE DAMPER.                                                                                             | 8         |
| 14*    | PE-V0-408-554-A207 | DATA SHEET FOR INSTRUMENTS (PRESSURE GAUGE, TEMP GAUGE, LEVEL GAUGE, PRESSURE SWITCH, LEVEL SWITCH).                     | 14        |
| 15*    | PE-V0-408-554-A208 | DATA SHEET OF PIPE.                                                                                                      | 5         |
| 16*    | PE-V0-408-554-A209 | DATA SHEET OF GI AND MS SHEET.                                                                                           | 5         |
| 17*    | PE-V0-408-554-A210 | DATA SHEET & GA FOR PRE AND FINE FILTERS.                                                                                | 8         |
| 18*    | PE-V0-408-554-A211 | DATA SHEET FOR MOTORS (A/W Fan, A/W pumps, UAF Fan, UAF Pump, RE units, Supply and Exhaust axial fans)                   | 15        |
| 19*    | PE-V0-408-554-A401 | TYPICAL Details DUCT FABRICATION DRAWING / SUPPORT / ERECTION. INSULATION OF DUCTING / PIPING & EQUIPMENTS PIPE ERECTION | 7         |
| 20*    | PE-V0-408-554-A403 | GA OF PROPELLER FAN.                                                                                                     | 9         |

  
 Engineer in Charge  
 E-410/0001 2011-08-23

|                                                                                   |                                                                                                                                 |                                             |  |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--|
|  | <b>1x800 MW WANAKBORI STPP</b><br><b>VENTILATION SYSTEM</b><br><b>MASTER DRAWING LIST WITH SCHEDULE</b><br><b>OF SUBMISSION</b> | <b>SPECIFICATION No: PE-TS-408-554-A001</b> |  |
|                                                                                   |                                                                                                                                 | <b>VOLUME : II B</b>                        |  |
|                                                                                   |                                                                                                                                 | <b>SECTION : E</b>                          |  |
|                                                                                   |                                                                                                                                 | <b>REV 00</b>                               |  |
|                                                                                   |                                                                                                                                 | <b>SHEET 3 OF 4</b>                         |  |

|     |                    |                                                                                   |    |
|-----|--------------------|-----------------------------------------------------------------------------------|----|
| 21* | PE-V0-408-554-A601 | SCHEME FOR AIR DISTRIBUTION IN TG BUILDING AND ESP BUILDING.                      | 5  |
| 22* | PE-V0-408-554-A602 | PID FOR AIRWASHER AND UAF UNIT.                                                   | 8  |
| 23* | PE-V0-408-554-A603 | AIR WASHER LAYOUT OUTSIDE "A ROW" SIDE ALONGWITH FOUNDATION DETAILS - TG BUILDING | 14 |
| 24* | PE-V0-408-554-A604 | AIR WASHER LAYOUT FOR "B-C BAY" SIDE ALONGWITH FOUNDATION DETAILS - TG BUILDING   | 14 |
| 25* | PE-V0-408-554-A605 | UAF LAYOUT ALONGWITH FOUNDATION DETAILS - ESP BUILDING.                           | 11 |
| 26* | PE-V0-408-554-A606 | VENTILATION DUCT LAYOUT FOR TG BUILDING - 'A' ROW SIDE (UNIT I & II).             | 12 |
| 27* | PE-V0-408-554-A607 | VENTILATION DUCT LAYOUT FOR TG BUILDING - 'BC BAY' SIDE (UNIT I & II).            | 12 |
| 28* | PE-V0-408-554-A608 | VENTILATION DUCT LAYOUT FOR ESP BUILDINGS.(UNIT I & II).                          | 12 |
| 29* | PE-V0-408-554-A609 | LOCATION OF ROOF EXTRACTOR UNIT IN TG BUILDING ALONGWITH FIXING DETAILS.          | 12 |
| 30* | PE-V0-408-554-A610 | VENT. ARRANGEMENT FOR BATTERY ROOM.                                               | 13 |
| 31* | PE-V0-408-554-A611 | VENT. ARRANGEMENT FOR VARIOUS AUXILIARY BUILDING.                                 | 18 |
| 32* | PE-V0-408-554-A701 | ELECTRICAL FEEDER LIST.                                                           | 18 |
| 33* | PE-V0-408-554-A702 | VENTILATION CABLE SCHEDULE                                                        | 18 |
| 34* | PE-V0-408-554-A901 | P.G. TEST PROCEDURE.                                                              | 12 |
| 35* | PE-V0-408-554-A902 | O & M MANUAL.                                                                     | 25 |

**Note:**

1. The above is indicative and may change during detail engineering.
2. The drawings/ documents submitted by vendor shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non- submission with delays attributable to vendor's account. For any clarification/discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL / Customer's place any number of time as per the requirement for across the table discussions/ finalizations/ submissions of drawings.  
All the documents shall be resubmitted within one week after receipt of comment.
3. Star marked (\*) documents and document listed in C&I specification shall be treated as basic Engineering documents linked with payment against engineering completion.
4. Drawing/ documents shall be submitted through wrench / DMS. Procedure for the same will be informed after award of contract.



**1x800 MW WANAKBORI STPP  
VENTILATION SYSTEM  
FORMAT FOR OPERATION AND  
MAINTENANCE MANUAL**

**SPECIFICATION No: PE-TS-408-554-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**SHEET 1 OF 4**

**ANNEXURE-IX**

**FORMAT FOR OPERATION AND MAINTENANCE  
MANUAL**

REVISION  
DATE  
BY  
CHECKED  
DATE  
BY  
APPROVED  
DATE  
BY



**1x800 MW WANAKBORI STPP  
VENTILATION SYSTEM  
FORMAT FOR OPERATION AND  
MAINTENANCE MANUAL**

**SPECIFICATION No: PE-TS-408-554-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**SHEET 2 OF 4**

Project name :  
Project number :  
Package Name :  
PO reference :  
Document number :  
Revision number :

| Sl.no. & Sections | Description                                                                                                                                                                                                     | Tick ( ✓ )if included in Manual |    |                | Remarks |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|----|----------------|---------|
|                   |                                                                                                                                                                                                                 | Yes                             | No | Not Applicable |         |
| <b>1.</b>         | <b>COVER PAGE</b>                                                                                                                                                                                               |                                 |    |                |         |
| <b>1.1</b>        | Project Name                                                                                                                                                                                                    |                                 |    |                |         |
| <b>1.2</b>        | Customer/consultant Name                                                                                                                                                                                        |                                 |    |                |         |
| <b>1.3</b>        | Name of Package                                                                                                                                                                                                 |                                 |    |                |         |
| <b>1.4</b>        | Supplier details with phone, FAX ,email address , Emergency Contact number                                                                                                                                      |                                 |    |                |         |
| <b>1.5</b>        | Name and sign of prepared by , checked by & approved by                                                                                                                                                         |                                 |    |                |         |
| <b>1.6</b>        | Revision history with approval Details                                                                                                                                                                          |                                 |    |                |         |
| <b>2.0</b>        | <b>INDEX</b>                                                                                                                                                                                                    |                                 |    |                |         |
| <b>2.1</b>        | showing the sections & related page nos<br>All the pages should be numbered section wise                                                                                                                        |                                 |    |                |         |
| <b>3.0</b>        | <b>DESCRIPTION OF PLANT/SYSTEM</b>                                                                                                                                                                              |                                 |    |                |         |
| <b>3.1</b>        | Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases |                                 |    |                |         |
| <b>3.2</b>        | Equipment list and basic parameter with Tag numbers                                                                                                                                                             |                                 |    |                |         |
| <b>3.3</b>        | Data sheets approved by Customer/for information and catalogues provided by original manufacturer                                                                                                               |                                 |    |                |         |
| <b>3.4</b>        | Associated other packages and Interface /terminal points                                                                                                                                                        |                                 |    |                |         |
| <b>3.5</b>        | P&ID & Process Diagrams                                                                                                                                                                                         |                                 |    |                |         |
| <b>3.6</b>        | GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)                                                                        |                                 |    |                |         |
| <b>3.7</b>        | Single line/wiring diagrams                                                                                                                                                                                     |                                 |    |                |         |

Prepared by: *[Signature]*  
 Checked by: *[Signature]*  
 Date: 14/08/2014



**1x800 MW WANAKBORI STPP  
VENTILATION SYSTEM  
FORMAT FOR OPERATION AND  
MAINTENANCE MANUAL**

**SPECIFICATION No: PE-TS-408-554-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**SHEET 3 OF 4**

| Sl.no. & Sections | Description                                                                                                                                                                                                                     | Tick ( √ )if included in Manual |    |                | Remarks |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|----|----------------|---------|
|                   |                                                                                                                                                                                                                                 | Yes                             | No | Not Applicable |         |
| 3.8               | Control philosophy /control write-ups                                                                                                                                                                                           |                                 |    |                |         |
| 4.0               | <b>COMMISSIONING ACTIVITIES (IF NOT COVERED IN SEPARATE DOCUMENT I.E. ERECTION MANUAL, COMMISSIONING MANUAL)</b>                                                                                                                |                                 |    |                |         |
| 4.1               | Pre-Commissioning Checks                                                                                                                                                                                                        |                                 |    |                |         |
| 4.2               | handling of items at site                                                                                                                                                                                                       |                                 |    |                |         |
| 4.3               | Storage at site                                                                                                                                                                                                                 |                                 |    |                |         |
| 4.4               | Unpacking & Installation procedure                                                                                                                                                                                              |                                 |    |                |         |
| 5.0               | <b>OPERATION GUIDELINES FOR PLANT PERSONAL/USER/OPERATOR</b>                                                                                                                                                                    |                                 |    |                |         |
| 5.1               | Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.                                                |                                 |    |                |         |
| 5.2               | Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned. |                                 |    |                |         |
| 5.3               | Do's & Don't of the equipments.                                                                                                                                                                                                 |                                 |    |                |         |
| 5.4               | Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition                                                         |                                 |    |                |         |
| 5.5               | Parameters to be monitored with normal values and limiting values                                                                                                                                                               |                                 |    |                |         |
| 5.6               | Trouble shooting with causes and remedial measures                                                                                                                                                                              |                                 |    |                |         |
| 5.7               | Routine operational checks, recommended logs & records                                                                                                                                                                          |                                 |    |                |         |
| 5.8               | Changeover schedule if more than one auxiliary for the same purpose is given                                                                                                                                                    |                                 |    |                |         |
| 5.9               | Painting requirement and schedule                                                                                                                                                                                               |                                 |    |                |         |
| 5.10              | Inspection, repair , Testing and calibration procedures                                                                                                                                                                         |                                 |    |                |         |
| 6.0               | <b>MAINTENANCE GUIDELINES FOR PLANT</b>                                                                                                                                                                                         |                                 |    |                |         |

Drawn:   
 Checked:   
 Date: 14/10/2014



**1x800 MW WANAKBORI STPP  
VENTILATION SYSTEM  
FORMAT FOR OPERATION AND  
MAINTENANCE MANUAL**

**SPECIFICATION No: PE-TS-408-554-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**SHEET 4 OF 4**

| Sl.no. & Sections | Description                                                                                                                                                                                                                     | Tick ( √ )if included in Manual |    |                | Remarks |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|----|----------------|---------|
|                   |                                                                                                                                                                                                                                 | Yes                             | No | Not Applicable |         |
|                   | <b>PERSONAL</b>                                                                                                                                                                                                                 |                                 |    |                |         |
| <b>6.1</b>        | List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.                                                                                      |                                 |    |                |         |
| <b>6.2</b>        | Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given. |                                 |    |                |         |
| <b>6.3</b>        | Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given                                                                                                          |                                 |    |                |         |
| <b>6.4</b>        | Long term maintenance schedules especially for structural, foundations etc.                                                                                                                                                     |                                 |    |                |         |
| <b>6.5</b>        | Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.        |                                 |    |                |         |
| <b>6.6</b>        | List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given                                                                             |                                 |    |                |         |
| <b>6.7</b>        | List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.                                                                                              |                                 |    |                |         |
| <b>6.8</b>        | List of mandatory and recommended spare parts list                                                                                                                                                                              |                                 |    |                |         |
| <b>6.9</b>        | Tentative Lead time required for ordering of spares from the equipment supplier                                                                                                                                                 |                                 |    |                |         |
| <b>6.10</b>       | Guarantee and warranty clauses                                                                                                                                                                                                  |                                 |    |                |         |
| <b>7.0</b>        | <b>Statutory and other specific requirements considerations.</b>                                                                                                                                                                |                                 |    |                |         |
| <b>8.0</b>        | <b>List of reference documents</b>                                                                                                                                                                                              |                                 |    |                |         |
| <b>9.0</b>        | <b>Binding as per requirement</b>                                                                                                                                                                                               |                                 |    |                |         |

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 14/06/2019



**1x800 MW WANAKBORI STPP  
VENTILATION SYSTEM  
SITE STORAGE AND PRESERVATION**

**SPECIFICATION No: PE-TS-408-554-A001**

**VOLUME : II B**

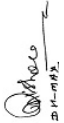
**SECTION : E**

**REV 00**

**SHEET 1 OF 16**

## **ANNEXURE-X**

### **SITE STORAGE AND PRESERVATION**

  
 ENGINEER IN CHARGE  
 E-4/10/2019

# SITE STORAGE AND PRESERVATION GUIDELINES

## FOR

## MECHANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)



PROJECT ENGINEERING MANAGEMENT, POWER SECTOR  
BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

## CONTENT

- 1 SCOPE OF THE DOCUMENT
- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
  - a) GENERAL STORAGE REQUIREMENTS
  - b) GENERAL PRESERVATION REQUIREMENTS
  - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

APPROVED  
S. A. KHAN  
2011-01-12

## 1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

## 2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

## 3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

### a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

## b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
  - a. Rust preventive fluid (RPF)
  - b. Rust protective paints
  - c. Tarpaulin covers, in case of outdoor storage
  - d. De-oxy aluminate for weld-ments

### c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
  - Ingress of moisture and corrosion damages.
  - Damage to protective coating.
  - Open ends in pipes, vessels and equipment -
    - In case any open ends are noticed, same shall be capped.
2. Any damages to equipment / materials.
  - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
  - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

#### 4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

##### i **Closed storage with dry and dust free atmosphere. (C )**

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



##### ii **Semi-closed storage. (S)**

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





### iii Open storage (O )

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.



The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

| Sl. No.                                                                            | Description of the equipment        | Type of Storage | Check for                                        | Remarks         |
|------------------------------------------------------------------------------------|-------------------------------------|-----------------|--------------------------------------------------|-----------------|
| <b>Raw material /mechanical items like pipes, plates, structure sections etc.)</b> |                                     |                 |                                                  |                 |
| 1.                                                                                 | Steel pipes ( lined/unlined)        | S               | Damage , paint, corrosion, rubber lining peeling | Provide end cap |
| 2.                                                                                 | MS Plates                           | S               | Damage, paint, corrosion                         |                 |
| 3.                                                                                 | SS Plates                           | S               | Damage                                           |                 |
| 4.                                                                                 | Non-metallic pipes                  | S               | Damage, cracks                                   | Provide end cap |
| 5.                                                                                 | Stainless steel pipes               | S               | Damage ,                                         | Provide end cap |
| 6.                                                                                 | MS sections, beams                  | S               | Damage, paint, corrosion                         |                 |
| 7.                                                                                 | Cable trays                         | S               | Damage, condition of preservations               |                 |
| 8.                                                                                 | Insulation sheets                   | S               | Damage                                           |                 |
| 9.                                                                                 | Insulation                          | C               | Damage, packing                                  |                 |
| 10.                                                                                | Hangers Rods                        | S               | Damage, paint, packing                           |                 |
| 11.                                                                                | Tubes                               | S               | Damage, paint , packing                          | Provide end cap |
| 12.                                                                                | Hume pipes                          | O               | Damage                                           |                 |
| 13.                                                                                | Castings                            | O               | Damage, paint, corrosion                         |                 |
| <b>Fabricated mechanical items (pressure vessels, tanks etc.)</b>                  |                                     |                 |                                                  |                 |
| 14.                                                                                | Pressure vessels (unlined)          | O               | Damage, paint, corrosion,                        | Covered nozzles |
| 15.                                                                                | Atmospheric storage tanks (unlined) | O               | Damage, paint, corrosion                         | Covered nozzles |

| Sl. No.                                                                         | Description of the equipment         | Type of Storage | Check for                               | Remarks         |
|---------------------------------------------------------------------------------|--------------------------------------|-----------------|-----------------------------------------|-----------------|
| 16.                                                                             | Pressure vessels (lined)             | S               | Damage, paint, corrosion, rubber lining |                 |
| 17.                                                                             | Atmospheric storage tanks(lined)     | S               | Damage, paint, corrosion, rubber lining |                 |
| 18.                                                                             | Support structures                   | O               | Damage , paint, corrosion               |                 |
| 19.                                                                             | Flanges                              | C               | Damage , paint, corrosion               |                 |
| 20.                                                                             | Fabricated pipes                     | S               | Damage , paint, corrosion               | Provide end cap |
| 21.                                                                             | Vessels internals                    | C               | Damage , paint, corrosion ,packing      |                 |
| 22.                                                                             | Grills                               | S               | Damage , paint, corrosion               |                 |
| 23.                                                                             | Angles                               | S               | Damage , paint, corrosion               |                 |
| 24.                                                                             | Bridge mechanism/clarifier mechanism | O               | Damage , paint, corrosion               |                 |
| 25.                                                                             | Cranes, rails                        | S               | Damage , paint, corrosion               |                 |
| 26.                                                                             | Stair cases                          | O               | Damage , paint, corrosion               |                 |
| 27.                                                                             | Ladders/handrails                    | O               | Damage , paint, corrosion               |                 |
| 28.                                                                             | Fabricated ducts                     | S               | Damage , paint, corrosion               |                 |
| 29.                                                                             | Isolation Gates                      | O               | Damage , paint, corrosion               |                 |
| 30.                                                                             | Fabricated boxes/panels              | S               | Damage , paint, corrosion               |                 |
| <b>Mechanical components like valves, fittings, cables glands, spares etc.)</b> |                                      |                 |                                         |                 |
| 31.                                                                             | Valves                               | S               | Damage , packing                        |                 |

| Sl. No.                                                                       | Description of the equipment         | Type of Storage | Check for                   | Remarks         |
|-------------------------------------------------------------------------------|--------------------------------------|-----------------|-----------------------------|-----------------|
| 32.                                                                           | Fittings                             | S               | Damage , packing            | Provide end cap |
| 33.                                                                           | Cable glands                         | C               | Damage , packing            |                 |
| 34.                                                                           | Tools & tackles                      | C               | Damage , packing            |                 |
| 35.                                                                           | Nut , bolts, washers,                | C               | Damage , packing            |                 |
| 36.                                                                           | Gasket & Packings                    | C               | Damage , packing            |                 |
| 37.                                                                           | Copper tubes                         | C               | Damage , packing, corrosion | Provide end cap |
| 38.                                                                           | SS tubing                            | C               | Damage , packing            | Provide end cap |
| <b>Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)</b> |                                      |                 |                             |                 |
| 39.                                                                           | Pumps                                | S               | Damage , packing, corrosion | Shaft rotation  |
| 40.                                                                           | Blowers/Compressors                  | S               | Damage , packing, corrosion | Shaft rotation  |
| 41.                                                                           | Agitators/stirrers/radial launders   | C               | Damage , packing, corrosion | Shaft rotation  |
| 42.                                                                           | Rollers for chlorine tonner mounting | C               | Damage , packing, corrosion |                 |
| 43.                                                                           | Centrifuge                           | S               | Damage , packing,           |                 |
| 44.                                                                           | Gear box                             | C               | Damage , packing, corrosion |                 |
| 45.                                                                           | Bearings                             | C               | Damage , packing, corrosion |                 |
| 46.                                                                           | Fans                                 | S               | Damage , packing, corrosion |                 |
| 47.                                                                           | Dosing skids                         | S               | Damage , packing, corrosion |                 |
| 48.                                                                           | Pump assemblies                      | S               | Damage , packing, corrosion |                 |
| 49.                                                                           | Air washers( INTERNALS)              | S               | Damage , packing            |                 |
| 50.                                                                           | Air conditioners ( split)            | C               | Damage , packing            |                 |

| Sl. No.                                                                                        | Description of the equipment                     | Type of Storage                              | Check for                            | Remarks            |
|------------------------------------------------------------------------------------------------|--------------------------------------------------|----------------------------------------------|--------------------------------------|--------------------|
| 51.                                                                                            | Elevators( CONTAINERIZED)                        | O                                            | Damage , packing, corrosion          |                    |
| 52.                                                                                            | Chillers/VA machines                             | S                                            | Damage , packing                     |                    |
| 53.                                                                                            | Air handling Unit/Package unit                   | S                                            | Damage , packing                     |                    |
| 54.                                                                                            | Chlorinators & Evaporators                       | C                                            | Damage , packing                     |                    |
| 55.                                                                                            | Ejectors                                         | C                                            | Damage , packing                     |                    |
| 56.                                                                                            | Electrolyser                                     | C                                            | Damage , packing                     |                    |
| <b>Miscellaneous items like chain pulley blocks, hoists etc.</b>                               |                                                  |                                              |                                      |                    |
| 57.                                                                                            | Chain pulley blocks                              | S                                            | Damage, Packing                      |                    |
| 58.                                                                                            | Electric hoists                                  | S                                            | Damage, Packing                      |                    |
| 59.                                                                                            | Fire extinguishers                               | C                                            | Damage, expiry date                  |                    |
| 60.                                                                                            | Fork Lift Truck                                  | S                                            | Damage, Packing                      |                    |
| 61.                                                                                            | Hydraulic Mobile Crane                           | O                                            | Damage, Packing                      |                    |
| 62.                                                                                            | Mobile Pick Up & Carry Crane                     | O                                            | Damage, Packing                      |                    |
| 63.                                                                                            | Motor boats                                      | O                                            | Damage, Packing                      |                    |
| 64.                                                                                            | Safety showers                                   | S                                            | Damage, Packing                      |                    |
| 65.                                                                                            | Diffusers/dampers                                | S                                            | Damage, Packing                      |                    |
| <b>Chemicals and consumables ( acid, alkali, paints, oils, reagents and special chemicals)</b> |                                                  |                                              |                                      |                    |
| 66.                                                                                            | Hydro Chloric Acid (HCl)                         | Store in canes/<br>storage tank in dyke area | Date of production/<br>leakage/fumes | hazardous chemical |
| 67.                                                                                            | Sulphuric acid (H <sub>2</sub> SO <sub>4</sub> ) | Store in canes/<br>storage tank in dyke area | Date of production/<br>leakage/fumes | hazardous chemical |

| Sl. No. | Description of the equipment  | Type of Storage                           | Check for                                    | Remarks                                                                                   |
|---------|-------------------------------|-------------------------------------------|----------------------------------------------|-------------------------------------------------------------------------------------------|
| 68.     | Sodium hydroxide (NaOH)       | Store in canes/ storage tank in dyke area | Date of production/ leakage/ fumes/ breather | hazardous chemical ,breather to be checked for air ingress                                |
| 69.     | Sodium hypo chlorite          | To be stored under shed                   | Date of production/ leakage/ fumes           | hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays |
| 70.     | Ammonia                       | S                                         | Date of production/ leakage/ fumes           | Store in closed storage tanks, hazardous chemical                                         |
| 71.     | CW treatment chemicals        | S                                         | Date of production , Self-life               | Store in closed canes                                                                     |
| 72.     | RO/UF cleaning chemicals      | S                                         | Date of production , Self-life               | Store in closed canes                                                                     |
| 73.     | Lime                          | C                                         | Damage to packing , seepage                  | Prevent moisture, rain                                                                    |
| 74.     | Alum bricks                   | C                                         | Damage to packing                            | Prevent moisture, rain                                                                    |
| 75.     | Poly electrolyte              | S                                         |                                              | Store in closed storage tanks                                                             |
| 76.     | Laboratory chemicals( powder) | C                                         | Damage, Packing self-life                    |                                                                                           |
| 77.     | Laboratory chemicals( liquid) | C                                         | Damage, Packing self-life                    |                                                                                           |
| 78.     | Lubrication oils              | C                                         | Leakage                                      |                                                                                           |
| 79.     | Paints                        | S                                         | Leakage ,air tightness                       |                                                                                           |
| 80.     | Sand                          | O                                         | Damage of packing                            | No hooks                                                                                  |
| 81.     | Salt (NaCl)                   | C                                         | Damage of packing, water ingress             | Prevent moisture, rain                                                                    |
| 82.     | Anthracite                    | S                                         | Damage of packing                            |                                                                                           |
| 83.     | Activated carbon              | S                                         | Damage of packing                            |                                                                                           |

| Sl. No.                                                     | Description of the equipment         | Type of Storage                                                                                           | Check for         | Remarks                       |
|-------------------------------------------------------------|--------------------------------------|-----------------------------------------------------------------------------------------------------------|-------------------|-------------------------------|
| 84.                                                         | Thermal insulation                   | S                                                                                                         | Damage of packing |                               |
| 85.                                                         | Cement                               | C                                                                                                         | Damage of packing | Prevent moisture, rain        |
| 86.                                                         | Gravels                              | O                                                                                                         | Damage of packing |                               |
| 87.                                                         | ION exchange resins                  | C                                                                                                         | Damage , packing  | Refer manufacturer guidelines |
| 88.                                                         | RO membranes                         | C                                                                                                         | Damage , packing  | Refer manufacturer guidelines |
| 89.                                                         | UF membranes                         | C                                                                                                         | Damage , packing  | Refer manufacturer guidelines |
| 90.                                                         | Cleaning chemicals                   | C                                                                                                         | Damage , packing  | Refer manufacturer guidelines |
| 91.                                                         | Chemicals for analysers/calibration  | C                                                                                                         | Damage , packing  | Refer manufacturer guidelines |
| <b>Electrical and C &amp; I items (motors, cables etc.)</b> |                                      |                                                                                                           |                   |                               |
| 92.                                                         | Motors                               | C                                                                                                         | Damage , packing  |                               |
| 93.                                                         | Cable drums                          | O                                                                                                         | Damage            |                               |
| 94.                                                         | Control Panel /control desk, UPS ,JB | S                                                                                                         | Damage, Packing   |                               |
| 95.                                                         | Instruments( gauges/analysers)       | C                                                                                                         | Damage            |                               |
| <b>Special items</b>                                        |                                      | As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc. |                   |                               |

## 5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

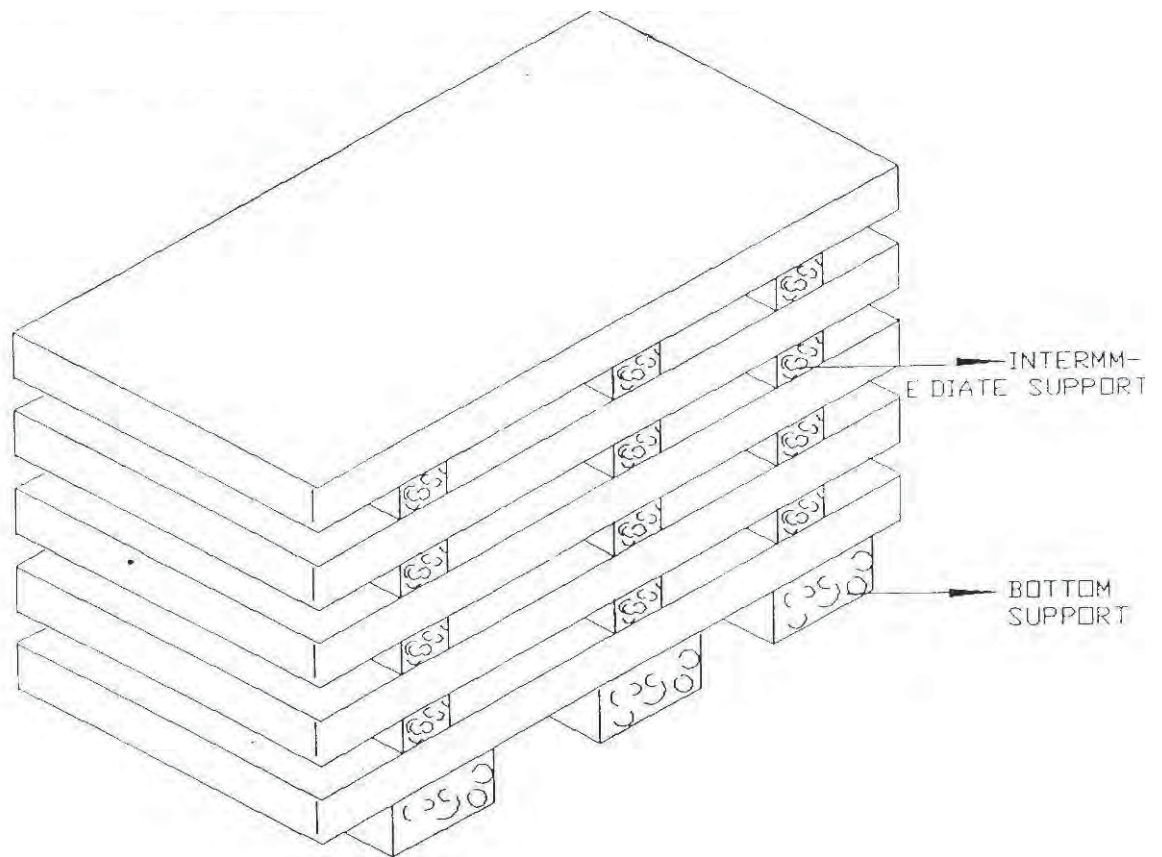


Figure – 1 – PLATE STACKING ARRANGEMENT

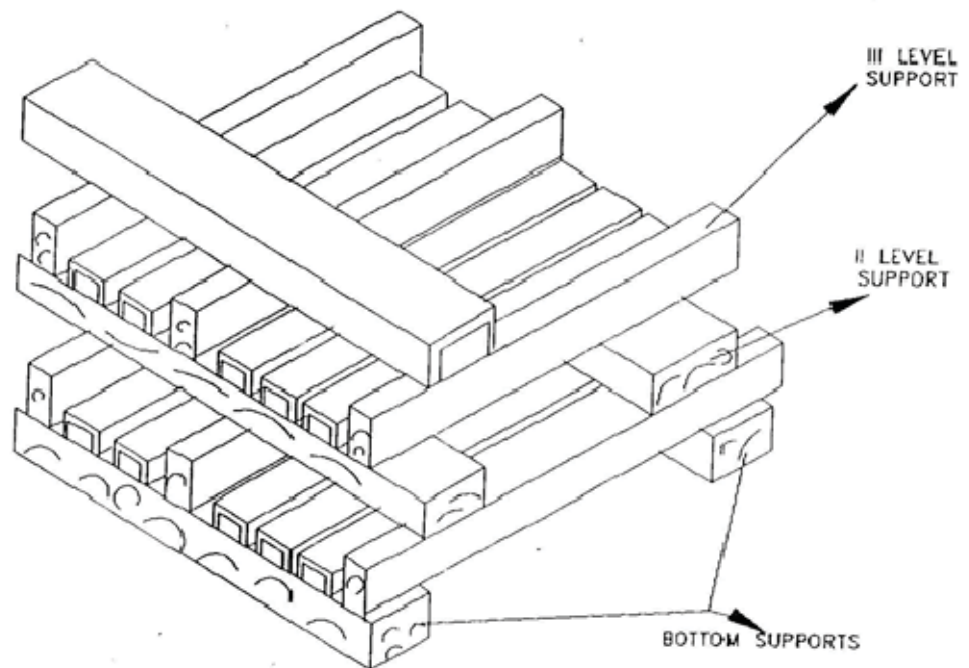


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



**1x800 MW WANAKBORI STPP  
VENTILATION SYSTEM  
PACKING PROCEDURE**

**SPECIFICATION No: PE-TS-408-554-A001**

**VOLUME : II B**

**SECTION : E**

**REV 00**

**SHEET 1 OF 1**

**ANNEXURE-XI**

**PACKING PROCEDURE**  
**(COVERED UNDER SECTION C 2B, GTR)**

REVISION  
DATE  
BY  
CHECKED  
DATE  
BY  
APPROVED  
DATE  
BY



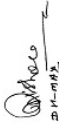
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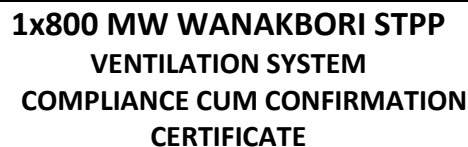
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|                                                                                   |                                                                                                                            |  |                                      |  |
|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|--|--------------------------------------|--|
|  | <b>1x800 MW WANAKBORI STPP</b><br><b>VENTILATION SYSTEM</b><br><b>LIST OF DOCUMENTS TO BE SUBMITTED WITH</b><br><b>BID</b> |  | SPECIFICATION No: PE-TS-408-554-A001 |  |
|                                                                                   |                                                                                                                            |  | VOLUME : III                         |  |
|                                                                                   |                                                                                                                            |  | SECTION : 1                          |  |
|                                                                                   |                                                                                                                            |  | REV: 00                              |  |
|                                                                                   |                                                                                                                            |  | SHEET 1 OF 1                         |  |

**BIDDER SHOULD SUBMIT THE SIGNED AND STAMPED COPY OF THE FOLLOWING DOCUMENTS:**

1. Compliance cum confirmation certificate
2. Guaranteed power consumption
3. Un priced format for main package
4. Un priced format for mandatory spare
5. Complete set of technical specification
6. No deviation certificate
7. Pre bid clarification schedule

  
 NAVEEN K. SHARMA  
 S-4, KIRAN, B-1, M-13



**SHEET: 1 OF 2**



**1x800 MW WANAKBORI STPP  
VENTILATION SYSTEM  
COMPLIANCE CUM CONFIRMATION  
CERTIFICATE**

**SPECIFICATION No: PE-TS-408-554-A001**

**VOLUME: III**

**SECTION: 2**

**REV. NO. 00**

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commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account

- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's / Customer's / Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.
- k) As built drawings shall be submitted as and when required during the project execution.
- l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.
- m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.
- n) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.

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**1x800 MW WANAKBORI STPP  
VENTILATION SYSTEM  
PRE-BID CLARIFICATION SCHEDULE**

SPECIFICATION No: PE-TS-408-554-A001

VOLUME: III

SECTION: 3

REV. NO. 00

SHEET: 1 OF 1

**PRE-BID CLARIFICATION SCHEDULE**

| S. NO. | SECTION/CLAUSE/PAGE NO. | STATEMENT OF THE REFERRED CLAUSE | CLARIFICATION REQUIRED |
|--------|-------------------------|----------------------------------|------------------------|
|        |                         |                                  |                        |
|        |                         |                                  |                        |
|        |                         |                                  |                        |
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|        |                         |                                  |                        |
|        |                         |                                  |                        |
|        |                         |                                  |                        |

The bidder hereby clarifies that above mentioned are the only clarifications required on the technical specification for the subject package.

Signature: \_\_\_\_\_

Name: \_\_\_\_\_

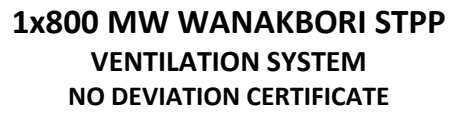
Designation: \_\_\_\_\_

Company: \_\_\_\_\_

Date: \_\_\_\_\_

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**SHEET 1 OF 2**

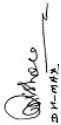
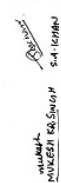
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|  | <b>1x800 MW WANAKBORI STPP<br/>VENTILATION SYSTEM<br/>GAURANTEE POWE CONSUMPTION</b>                                                                                                                                                                                                                                                                                                                                                                      |                 |         | SPECIFICATION No: PE-TS-408-554-A001                                             |                        |             |          |
|----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------|----------------------------------------------------------------------------------|------------------------|-------------|----------|
|                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |         | VOLUME: III                                                                      |                        |             |          |
|                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |         | SECTION: 5                                                                       |                        |             |          |
|                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |         | REV. NO. 00                                                                      |                        |             |          |
|                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |         | SHEET: 1 OF 2                                                                    |                        |             |          |
| S.NO.                                                                            | DESCRIPTION OF EQUIPMENT                                                                                                                                                                                                                                                                                                                                                                                                                                  | NO OF EQUIPMENT |         | TOTAL POWER FOR EACH EQUIPMENT AT MOTOR INPUT TERMINAL AND CONTROL PANEL (IN KW) | GUARANTEED CONSUMPTION | DUTY FACTOR | TOTAL KW |
|                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                           | WORKING         | STANDBY |                                                                                  |                        |             |          |
|                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 3A              | 3B      | 4                                                                                |                        | 5           | 6=3Ax4x5 |
| 1.                                                                               | Centrifugal Fan of cap. 1,00,000 CMH at 75 mmwc static pr. for Air Washers.                                                                                                                                                                                                                                                                                                                                                                               | 12              | 0       |                                                                                  |                        | 1           |          |
| 2.                                                                               | Pumps for above Air Washer.                                                                                                                                                                                                                                                                                                                                                                                                                               | 12              | 12      |                                                                                  |                        | 1           |          |
| 3.                                                                               | Centrifugal Fan of cap. 90,000 CMH at 60 mmwc static pr. for UAF.                                                                                                                                                                                                                                                                                                                                                                                         | 1               | 0       |                                                                                  |                        | 1           |          |
| 4.                                                                               | Pumps for above UAF.                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1               | 1       |                                                                                  |                        | 1           |          |
| 5.                                                                               | RE unit fan of capacity 50,000 CMH at 15 mmwc static pr.                                                                                                                                                                                                                                                                                                                                                                                                  | 16              | 0       |                                                                                  |                        | 1           |          |
|                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |         | TOTAL (KW)                                                                       |                        |             | 670      |
| NOTES:                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                 |         |                                                                                  |                        |             |          |
| 1                                                                                | Estimated power consumption (EPC) figure for the system (for working drives only) has been considered as 670 KW. So long bidder's quoted guaranteed power consumption (GPC) above remains within this EPC, there will be no technical loading of bid on power consumption for evaluation. However, if bidder's quoted GPC exceeds EPC, there shall be technical loading of bid for evaluation @ <b>Rs 2,00,000/-</b> per KW of additional power over EPC. |                 |         |                                                                                  |                        |             |          |
| 2                                                                                | Bidder's guaranteed power consumption at motor input terminals (not shaft power) as furnished in relevant schedule shall be demonstrated by the successful bidder during performance testing at works/ site. In case power consumption is noted higher than EPC / bidder's quoted GPC whichever is higher, during inspection/ PG test, penalty @ <b>Rs 2,00,000/-</b> per KW shall be levied on vendor.                                                   |                 |         |                                                                                  |                        |             |          |

|                                                                                   |                                                                                   |                                             |  |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------------------------------------|--|
|  | <b>1x800 MW WANAKBORI STPP<br/>VENTILATION SYSTEM<br/>SUGGESTIVE PRICE FORMAT</b> | <b>SPECIFICATION No: PE-TS-408-554-A001</b> |  |
|                                                                                   |                                                                                   | <b>VOLUME : III</b>                         |  |
|                                                                                   |                                                                                   | <b>SECTION : 6</b>                          |  |
|                                                                                   |                                                                                   | <b>REV 00</b>                               |  |
|                                                                                   |                                                                                   |                                             |  |

**SUGGESTIVE PRICE FORMAT**

REVIEWED BY:   
DATE: 14/10/2024  
BY: 

| PROJECT :1X800 MW WANAKBORI STTP                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |        |      |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------|-----------------|---------------------------|--------------------|----------------|-----------------------------------------------------|----------------------------------|----------------------------|------------------|------------------|---------------------------------------------------|----------------------------------------------------------------|
| PACKAGE : VENTILATION SYSTEM --- SUGGESTIVE PRICE FORMAT |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |        |      |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| SL NO                                                    | DESCRIPTION OF EQUIPMENT/ ITEM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | SUPPLY |      | SUPPLY          |                           |                    |                |                                                     |                                  | ERECTION AND COMMISSIONING |                  |                  |                                                   | TOTAL                                                          |
|                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Qty    | UNIT | Unit Price (Rs) | Total ex-works price (Rs) | ED (Inc CESS) (Rs) | CST / VAT (Rs) | Freight (Including service tax, if applicable) (Rs) | TOTAL FOR site price SUPPLY (Rs) | Unit Price (Rs)            | Total price (Rs) | Service Tax (Rs) | TOTAL PRICE (Erection and commissioning including | Total Price Supply FOR site and E&C including service tax (Rs) |
| 1.0                                                      | Total lumpsum firm prices for equipment & Services as specified, Comprising Engineering, design, manufacture, inspection & Testing at manufacturer's/subvendor's works, Painting at manufactures works, duly packed for transportation, delivery to site, unloading, storage & handling at site, fabrication, erection and commissioning, performance and guarantee testing, submission of as built drawing, O&M Manual, carrying out acceptance tests at site, and final painting of complete Ventilation system on turnkey basis as per specification <b>PE-TS-408-554-A001</b> including mandatory spares, special tool & tackels for maintenance, commissioning spares, all taxes, duties etc. |        |      |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.0                                                      | Break up prices for items covered in clause 1.0 above.In case, price indicated above does not match with item wise break-up given at 2.0, the highest price so calculated shall be considered for evaluation but in case of order, the same shall be placed at the lowest price.                                                                                                                                                                                                                                                                                                                                                                                                                   |        |      |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.1                                                      | Sheet metal containrised type type air washer unit with centrifugal fan (DIDW) with motor, , pumps with motors, air washer internals, inlet air louvers, filters, piping, valves, nozzles, instruments, back wash arrangement, drain piping, casing, insulation etc as per specification of capacity <b>1,00,000 CMH</b> . Each Air washer has 1 no centrifugal fan ( 1 x 100% duty) of capacity <b>1,00,000 CMH</b> each at min. <b>75 mm SP</b> .                                                                                                                                                                                                                                                | 12     | NO   |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.2                                                      | Unitary air filtration unit with centrifugal fan (SISW) with motor, pumps with motors, filters, UAF internals, piping, valves for auto start of standby equipment, nozzles, instruments, back wash arrangement, drain piping, casing, insulation etc. as per spec. of capacity <b>90,000 CMH</b> . Each UAF has 1 no centrifugal fan ( 1 x 100% duty) of capacity <b>90,000 CMH at min. 60 mm SP</b>                                                                                                                                                                                                                                                                                               | 1      | NO   |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.3*                                                     | Supply air ducting (finished) for above area complete with dampers, grills (with VCD & without VCD), supports (painted) and all accessories as specified.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |        |      |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.3.1*                                                   | Finished ductwork fabricated from GSS sheet having zinc coating of 180 gms/ m2 complete with hangers/ supports, and all other accessories to make the duct complete in all respect.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |      |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| a)*                                                      | 18 G                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 3000   | SQM* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| b)*                                                      | 20 G                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 3000   | SQM* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| c)*                                                      | 22 G                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 2000   | SQM* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| d)*                                                      | 24 G                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 2000   | SQM* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.3.2*                                                   | MS Duct With Epoxy paint for battery room.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 200    | SQM* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.3.3*                                                   | MS Grilles with VCD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 125    | SQM* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.3.4*                                                   | MS Grilles without VCD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 5      | SQM* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.3.5*                                                   | Volume control damper as per specification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 8      | SQM* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.3.6*                                                   | Exposed duct insulation as per specifications.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 500    | SQM* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.3.7*                                                   | Wall mounted dampers (gravity operated) for different areas.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 15     | SQM* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |

| PROJECT :1X800 MW WANAKBORI STTP                         |                                                                                                                                                                                                                                                                                                                                    |        |       |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
|----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------|-----------------|---------------------------|--------------------|----------------|-----------------------------------------------------|----------------------------------|----------------------------|------------------|------------------|---------------------------------------------------|----------------------------------------------------------------|
| PACKAGE : VENTILATION SYSTEM --- SUGGESTIVE PRICE FORMAT |                                                                                                                                                                                                                                                                                                                                    |        |       |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| SL NO                                                    | DESCRIPTION OF EQUIPMENT/ ITEM                                                                                                                                                                                                                                                                                                     | SUPPLY |       | SUPPLY          |                           |                    |                |                                                     |                                  | ERECTION AND COMMISSIONING |                  |                  |                                                   | TOTAL                                                          |
|                                                          |                                                                                                                                                                                                                                                                                                                                    | Qty    | UNIT  | Unit Price (Rs) | Total ex-works price (Rs) | ED (Inc CESS) (Rs) | CST / VAT (Rs) | Freight (Including service tax, if applicable) (Rs) | TOTAL FOR site price SUPPLY (Rs) | Unit Price (Rs)            | Total price (Rs) | Service Tax (Rs) | TOTAL PRICE (Erection and commissioning including | Total Price Supply FOR site and E&C including service tax (Rs) |
| 2.3.8*                                                   | Inlet Louvres                                                                                                                                                                                                                                                                                                                      | 15     | SQM*  |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.4*                                                     | FIRE DAMPER                                                                                                                                                                                                                                                                                                                        |        |       |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| a)*                                                      | Fire damper                                                                                                                                                                                                                                                                                                                        | 10     | SQM*  |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| b)*                                                      | Motorized Actuator with single phase power supply for the above Fire damper with auto resetting, limit switches, indication lamps etc                                                                                                                                                                                              | 15     | Nos*  |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| c)*                                                      | Fusible Link type Fire Damper                                                                                                                                                                                                                                                                                                      | 2      | SQM*  |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.5*                                                     | Roof extractor units (axial flow type) with hood, disconnect switch and all accessories as specified. <b>Following fan shall have 15 mmwc static pressure.</b>                                                                                                                                                                     |        |       |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| a)*                                                      | Capacity 50,000 CMH with Motor rating 5.5 KW                                                                                                                                                                                                                                                                                       | 22     | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| b)*                                                      | Capacity 40,000 CMH with Motor rating 5.5 KW                                                                                                                                                                                                                                                                                       | 1      | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| c)*                                                      | Capacity 20,000 CMH with Motor rating 2.2 KW                                                                                                                                                                                                                                                                                       | 1      | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.6*                                                     | Axial flow supply fans with pre and fine filter (wall mounted) complete with casing, TEFC sq cage induction motors & mounting frame, MS rain protection cowl, bird screen and all other accessories (suitable for 415V/3-phase supply). <b>Following fan shall have 30 mmwc static pressure.</b>                                   |        |       |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| a)*                                                      | Capacity 10,000 CMH with Motor rating 2.2 KW                                                                                                                                                                                                                                                                                       | 10     | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| b)*                                                      | Capacity 7,500 CMH with Motor rating 1.5 KW                                                                                                                                                                                                                                                                                        | 4      | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| c)*                                                      | Capacity 6,000 CMH with Motor rating 1.1 KW                                                                                                                                                                                                                                                                                        | 5      | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| d)*                                                      | Capacity 4,000 CMH with Motor rating 0.75 KW                                                                                                                                                                                                                                                                                       | 2      | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.7*                                                     | Axial flow supply fans with pre filter (wall mounted) complete with casing, TEFC sq cage induction motors & mounting frame, MS rain protection cowl, bird screen and all other accessories (suitable for 415V/3-phase supply) as specified. <b>Following fan shall have 20 mmwc static pressure.</b>                               |        |       |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| a)*                                                      | Capacity 10,000 CMH with Motor rating 1.5 KW                                                                                                                                                                                                                                                                                       | 10     | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| b)*                                                      | Capacity 7,500 CMH with Motor rating 1.1 KW                                                                                                                                                                                                                                                                                        | 3      | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| c)*                                                      | Capacity 6,000 CMH with Motor rating 1.1 KW                                                                                                                                                                                                                                                                                        | 2      | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| d)*                                                      | Capacity 4,000 CMH with Motor rating 0.75 KW                                                                                                                                                                                                                                                                                       | 3      | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.8*                                                     | Axial flow exhaust fans (Bifurcated type, spark proof construction, wall mounted) complete with casing, flame proof motor & mounting frame, MS rain protection cowl, bird screen and all other accessories epoxy painted (suitable for 415V/3-phase supply) as specified. <b>Following fan shall have 15 mmwc static pressure.</b> |        |       |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| a)*                                                      | Capacity 15,000 CMH with Motor rating 2.2 KW                                                                                                                                                                                                                                                                                       | 8      | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| b)*                                                      | Capacity 10,000 CMH with Motor rating 1.5 KW                                                                                                                                                                                                                                                                                       | 8      | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |

MUKESH K.R. SINGH

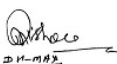
S.A. ICHAN

D.H. MAH

| PROJECT :1X800 MW WANAKBORI STTP                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                   |        |       |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-------|-----------------|---------------------------|--------------------|----------------|-----------------------------------------------------|----------------------------------|----------------------------|------------------|------------------|---------------------------------------------------|----------------------------------------------------------------|
| PACKAGE : VENTILATION SYSTEM --- SUGGESTIVE PRICE FORMAT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                   |        |       |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| SL NO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | DESCRIPTION OF EQUIPMENT/ ITEM                                                                                                                                                                                                                                                                    | SUPPLY |       | SUPPLY          |                           |                    |                |                                                     |                                  | ERECTION AND COMMISSIONING |                  |                  |                                                   | TOTAL                                                          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                   | Qty    | UNIT  | Unit Price (Rs) | Total ex-works price (Rs) | ED (Inc CESS) (Rs) | CST / VAT (Rs) | Freight (Including service tax, if applicable) (Rs) | TOTAL FOR site price SUPPLY (Rs) | Unit Price (Rs)            | Total price (Rs) | Service Tax (Rs) | TOTAL PRICE (Erection and commissioning including | Total Price Supply FOR site and E&C including service tax (Rs) |
| c)*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Capacity 7,500 CMH with Motor rating 1.1 KW                                                                                                                                                                                                                                                       | 5      | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| d)*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Capacity 2,000 CMH with Motor rating 0.55 KW                                                                                                                                                                                                                                                      | 5      | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.9*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Axial flow exhaust fans (Wall mounted) complete with casing,TEFC sq cage induction motor & mounting frame, MS rain protection cowl, bird screen and all other accessories epoxy painted (suitable for 415V/3-phase supply) as specified. <b>Following fan shall have 10 mmwc static pressure.</b> |        |       |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| a)*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Capacity 15,000 CMH with Motor rating 1.1 KW                                                                                                                                                                                                                                                      | 10     | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| b)*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Capacity 10,000 CMH with Motor rating 0.75 KW                                                                                                                                                                                                                                                     | 5      | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| c)*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Capacity 7,500 CMH with Motor rating 0.55 KW                                                                                                                                                                                                                                                      | 5      | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| d)*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Capacity 6,000 CMH with Motor rating 0.55 KW                                                                                                                                                                                                                                                      | 7      | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| e)*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Capacity 2,000 CMH with Motor rating 0.37 KW                                                                                                                                                                                                                                                      | 7      | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.10*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Exhaust fan (propeller type) completes with induction motor & mounting frame MS rain protection cowl, bird screen and all other accessories as specified (suitable for 240V/ 1 phase). <b>Following fan shall have 5 mmwc static pressure.</b>                                                    |        |       |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| a)*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Capacity 1200 CMH with Motor rating 100 watts                                                                                                                                                                                                                                                     | 50     | Nos.* |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.11                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Total lumpsum price for special tools & tackles for maintenance inclusive of packing forwarding, transportation up to site, etc. (Bidder shall submit item-wise price break-up).                                                                                                                  | 1      | LOT   |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Total lumpsum price for commissioning spares inclusive of packing forwarding, transportation up to site, etc. (Bidder shall submit item-wise price break-up).                                                                                                                                     | 1      | LOT   |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.14                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>FIELD INSTRUMENTS</b> like pressure gauge, temperature gauge, pressure switch, differential pressure switch, flow switch and other instrument required for Ventilation System etc.                                                                                                             | 1      | LOT   |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Any other item not indicated above, but required to make the system complete in all respects.                                                                                                                                                                                                     | 1      | LOT   |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| 2.16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Total lumpsum price for Mandatory Spare inclusive of packing forwarding, transportation up to site, etc. (Bidder to submit item-wise price break-up seperately).                                                                                                                                  | 1      | LOT   |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |
| <p>1 The bidder shall furnish unit rates for variable item (marked *) for necessary adjustment (plus or minus) variation during detailed engg. stage. The unit rates quoted above shall be considered and no separate unit rates shall be quoted. Unit rates shall be valid throughout the contract.</p> <p>2 Bidder must submit prices in the Pro Forma duly filled in signed and stamped on every page without any ambiguity. The price shall be written against each item. Term such as "refer covering letter" etc. are not acceptable. Extra sheet may be attached if the space provided is not sufficient</p> <p>3 Price format shall not be changed by the bidder as the bidder may get disqualified by doing so.</p> <p>4 For limitation on payment, percentages of individual items/equipments, as specified in the <b>Appendix-A</b> shall be applicable</p> |                                                                                                                                                                                                                                                                                                   |        |       |                 |                           |                    |                |                                                     |                                  |                            |                  |                  |                                                   |                                                                |

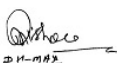
| SUGGESTIVE PRICE FORMAT        |                                                   |                                              |      |                 |                           |                        |                |                                                   |                                     |
|--------------------------------|---------------------------------------------------|----------------------------------------------|------|-----------------|---------------------------|------------------------|----------------|---------------------------------------------------|-------------------------------------|
| PROJECT : 1 x 800 MW WANAKBORI |                                                   |                                              |      |                 |                           |                        |                |                                                   |                                     |
| PACKAGE : VENTILATION SYSTEM   |                                                   |                                              |      |                 |                           |                        |                |                                                   |                                     |
| MANDATORY SPARE LIST           |                                                   |                                              |      |                 |                           |                        |                |                                                   |                                     |
| SL No                          | DESCRIPTION OF EQUIPMENT/ ITEM                    | QUANTITY                                     | UNIT | SUPPLY          |                           |                        |                |                                                   |                                     |
|                                |                                                   |                                              |      | Unit Price (Rs) | Total ex-works price (Rs) | ED including CESS (Rs) | CST / VAT (Rs) | FREIGHT including Service Tax, If applicable (Rs) | TOTAL F.O.R. Site Price Supply (Rs) |
| <b>1</b>                       | <b>Centrifugal Fans</b>                           |                                              |      |                 |                           |                        |                |                                                   |                                     |
| 1.1                            | Set of bearings for Air washer fans               | 1Set for each Type of Fan                    |      |                 |                           |                        |                |                                                   |                                     |
| 1.2                            | Set of bearings for U.A.F. fans                   | 1Set for each Type of Fan                    |      |                 |                           |                        |                |                                                   |                                     |
| 1.3                            | Impeller for the Fan                              | 1Set for each Type of Fan                    |      |                 |                           |                        |                |                                                   |                                     |
| <b>2</b>                       | <b>Centrifugal pumps</b>                          |                                              |      |                 |                           |                        |                |                                                   |                                     |
| 2.1                            | Set of bearings for Air washer pumps              | 1Set for each Type and rating of Pump        |      |                 |                           |                        |                |                                                   |                                     |
| 2.2                            | Set of bearings for U.A.F. pumps                  | 1Set for each Type and rating of Pump        |      |                 |                           |                        |                |                                                   |                                     |
| 2.3                            | Gland packing, shaft sleeve & casing wearing ring | 1Set for each Type and rating of Pump        |      |                 |                           |                        |                |                                                   |                                     |
| 2.4                            | Impeller for the Pump                             | 1Set for each Type and rating of Pump        |      |                 |                           |                        |                |                                                   |                                     |
| <b>3</b>                       | <b>Spray Nozzles</b>                              |                                              |      |                 |                           |                        |                |                                                   |                                     |
| 3.1                            | Spray nozzles for air washer unit                 | 5%                                           |      |                 |                           |                        |                |                                                   |                                     |
| 3.2                            | Spray nozzles for U.A.F. unit                     | 5%                                           |      |                 |                           |                        |                |                                                   |                                     |
| <b>4</b>                       | <b>SS Filters</b>                                 |                                              |      |                 |                           |                        |                |                                                   |                                     |
| 4.1                            | SS Filters for Air washer                         | 10%                                          |      |                 |                           |                        |                |                                                   |                                     |
| 4.2                            | SS Filter for Unitary air filtration unit         | 10%                                          |      |                 |                           |                        |                |                                                   |                                     |
| <b>5.</b>                      | <b>Flow Regulating Valve</b>                      |                                              |      |                 |                           |                        |                |                                                   |                                     |
| 5.1                            | For Air Washer                                    | 10% or Minimum 1 No. Whichever is higher     |      |                 |                           |                        |                |                                                   |                                     |
| 5.2                            | For Unitary Air Filtration Unit                   | 10% or Minimum 1 No. Whichever is higher     |      |                 |                           |                        |                |                                                   |                                     |
| <b>6.</b>                      | <b>moisture eliminators</b>                       |                                              |      |                 |                           |                        |                |                                                   |                                     |
| 6.1                            | For Air Washer                                    | 1 no. for each type and rating of Air washer |      |                 |                           |                        |                |                                                   |                                     |
| 6.2                            | For UAF                                           | 1 no. for each type and rating of UAF        |      |                 |                           |                        |                |                                                   |                                     |
| <b>7.</b>                      | <b>Basket for POT Strainer</b>                    |                                              |      |                 |                           |                        |                |                                                   |                                     |
| 7.1                            | Strainer Basket for Air Washer                    | 1No. for each type and size                  |      |                 |                           |                        |                |                                                   |                                     |
| 7.2                            | Strainer Basket for Unitary Air Filtration unit   | 1No. for each type and size                  |      |                 |                           |                        |                |                                                   |                                     |
| <b>8.</b>                      | <b>Valves</b>                                     |                                              |      |                 |                           |                        |                |                                                   |                                     |




  
 MUKESH RA. SINGH      S.A. KISHOR      D. H. MISHRA

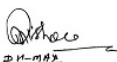
| SUGGESTIVE PRICE FORMAT        |                                                              |                                                   |      |                 |                           |                        |                |                                                   |                                     |
|--------------------------------|--------------------------------------------------------------|---------------------------------------------------|------|-----------------|---------------------------|------------------------|----------------|---------------------------------------------------|-------------------------------------|
| PROJECT : 1 x 800 MW WANAKBORI |                                                              |                                                   |      |                 |                           |                        |                |                                                   |                                     |
| PACKAGE : VENTILATION SYSTEM   |                                                              |                                                   |      |                 |                           |                        |                |                                                   |                                     |
| MANDATORY SPARE LIST           |                                                              |                                                   |      |                 |                           |                        |                |                                                   |                                     |
| SL No                          | DESCRIPTION OF EQUIPMENT/ ITEM                               | QUANTITY                                          | UNIT | SUPPLY          |                           |                        |                |                                                   |                                     |
|                                |                                                              |                                                   |      | Unit Price (Rs) | Total ex-works price (Rs) | ED including CESS (Rs) | CST / VAT (Rs) | FREIGHT including Service Tax, If applicable (Rs) | TOTAL F.O.R. Site Price Supply (Rs) |
| 8.1                            | Gate valve for Air washer                                    | 10% or Minimum 1No. Whichever is higher           |      |                 |                           |                        |                |                                                   |                                     |
| 8.2                            | NR Valve for Air Washer                                      | 10% or Minimum 1No. Whichever is higher           |      |                 |                           |                        |                |                                                   |                                     |
| 8.3                            | Gate valve for Unitary Air Filtration Unit                   | 10% or Minimum 1No. Whichever is higher           |      |                 |                           |                        |                |                                                   |                                     |
| 8.4                            | NR valve for Unitary Air Filtration Unit                     | 10% or Minimum 1No. Whichever is higher           |      |                 |                           |                        |                |                                                   |                                     |
| 8.5                            | Gate Valve for Make-up Drain of Air washer                   | 10% or Minimum 1No. Whichever is higher           |      |                 |                           |                        |                |                                                   |                                     |
| 8.6                            | Gate valve for UAF                                           | 20% or Minimum 2Nos. Whichever is higher          |      |                 |                           |                        |                |                                                   |                                     |
| 9.                             | Electrical Spares as applicable as per the Electrical List   | Item & Quantity applicable as per Electrical list |      |                 |                           |                        |                |                                                   |                                     |
| 9.1                            | 415 V motor (above 30 KW rating up to 160 KW)                |                                                   |      |                 |                           |                        |                |                                                   |                                     |
| 9.1.1                          | End shield cover Driving & Non – Driving End                 | 1 set for each type and rating of motor           |      |                 |                           |                        |                |                                                   |                                     |
| 9.1.2                          | Driving & Non – Driving End bearing                          | 1 set for each type and rating of motor           |      |                 |                           |                        |                |                                                   |                                     |
| 9.1.3                          | Cooling Fan                                                  | 1 No. for each type and rating of motor           |      |                 |                           |                        |                |                                                   |                                     |
| 9.1.4                          | Motor space heater                                           | 1 No. for each type and rating of motor           |      |                 |                           |                        |                |                                                   |                                     |
| 9.1.5                          | Motor terminal block                                         | 1 No. for each type and rating of motor           |      |                 |                           |                        |                |                                                   |                                     |
| 9.1.6                          | Complete set of coupling                                     | 1 set for each application                        |      |                 |                           |                        |                |                                                   |                                     |
| 9.2                            | 415 V motor (up to 30 KW rating)                             |                                                   |      |                 |                           |                        |                |                                                   |                                     |
| 9.2.1                          | Driving & Non – Driving End bearing                          | 3 set for each type and rating of motor           |      |                 |                           |                        |                |                                                   |                                     |
| 9.2.3                          | Cooling Fan                                                  | 2 No. for each type and rating of motor           |      |                 |                           |                        |                |                                                   |                                     |
| 9.2.4                          | Motor terminal block                                         | 5 No. for each type and rating of motor           |      |                 |                           |                        |                |                                                   |                                     |
| 9.2.5                          | Complete set of coupling                                     | 1 set for each application                        |      |                 |                           |                        |                |                                                   |                                     |
| 10.                            | Field Instruments & Others as applicable as per the C&I List |                                                   |      |                 |                           |                        |                |                                                   |                                     |




  
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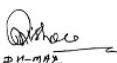
| SUGGESTIVE PRICE FORMAT        |                                                                                                                                             |                                                                                                                   |      |                 |                           |                        |                |                                                   |                                     |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|------|-----------------|---------------------------|------------------------|----------------|---------------------------------------------------|-------------------------------------|
| PROJECT : 1 x 800 MW WANAKBORI |                                                                                                                                             |                                                                                                                   |      |                 |                           |                        |                |                                                   |                                     |
| PACKAGE : VENTILATION SYSTEM   |                                                                                                                                             |                                                                                                                   |      |                 |                           |                        |                |                                                   |                                     |
| MANDATORY SPARE LIST           |                                                                                                                                             |                                                                                                                   |      |                 |                           |                        |                |                                                   |                                     |
| SL No                          | DESCRIPTION OF EQUIPMENT/ ITEM                                                                                                              | QUANTITY                                                                                                          | UNIT | SUPPLY          |                           |                        |                |                                                   |                                     |
|                                |                                                                                                                                             |                                                                                                                   |      | Unit Price (Rs) | Total ex-works price (Rs) | ED including CESS (Rs) | CST / VAT (Rs) | FREIGHT including Service Tax, If applicable (Rs) | TOTAL F.O.R. Site Price Supply (Rs) |
| 10.1                           | Field instruments (Transmitters/ temperature element ( TC / RTD) / gauge / Switches etc. along with relevant accessories)                   | 10 (ten) percent of total of each type or at least one (whichever is higher ) of each type along with accessories |      |                 |                           |                        |                |                                                   |                                     |
| 10.2                           | Valves, actuators & Accessories                                                                                                             |                                                                                                                   |      |                 |                           |                        |                |                                                   |                                     |
| 10.2.1                         | Control valves                                                                                                                              |                                                                                                                   |      |                 |                           |                        |                |                                                   |                                     |
| 10.2.1.1                       | spare control valve stem packing                                                                                                            | 2 (two) sets for each of the control valves                                                                       |      |                 |                           |                        |                |                                                   |                                     |
| 10.2.1.2                       | spare valve trim (including cage, plug, stem, seat rings, guide bushings etc.) for both the units for each of the control valves as offered | 1 (one) set                                                                                                       |      |                 |                           |                        |                |                                                   |                                     |
| 10.2.2                         | Control valve Actuators                                                                                                                     |                                                                                                                   |      |                 |                           |                        |                |                                                   |                                     |
| 10.2.2.1                       | spare actuators with drive                                                                                                                  | 1 (one) set of each type and rating                                                                               |      |                 |                           |                        |                |                                                   |                                     |
| 10.2.2.2                       | valve positioners                                                                                                                           | 10 (ten) percent of each type                                                                                     |      |                 |                           |                        |                |                                                   |                                     |
| 10.2.2.3                       | position transmitters                                                                                                                       | 10 (ten) percent of each type                                                                                     |      |                 |                           |                        |                |                                                   |                                     |
| 10.2.2.4                       | limit switches                                                                                                                              | 10 (ten) percent of each type or 2 nos. of each type and rating whichever is higher                               |      |                 |                           |                        |                |                                                   |                                     |
| 10.2.2.5                       | torque switches                                                                                                                             | 10 (ten) percent of each type or 2 nos. of each type and rating whichever is higher                               |      |                 |                           |                        |                |                                                   |                                     |
| 10.2.2.6                       | Auxiliary contact                                                                                                                           | 1 no. of each type and rating                                                                                     |      |                 |                           |                        |                |                                                   |                                     |
| 10.2.2.7                       | motor                                                                                                                                       | 1 no. of each type and rating                                                                                     |      |                 |                           |                        |                |                                                   |                                     |
| 10.2.2.8                       | complete seal kit                                                                                                                           | 1 set for each type and rating                                                                                    |      |                 |                           |                        |                |                                                   |                                     |
| 10.2.2.9                       | complete O ring set                                                                                                                         | 1 set for each type and rating                                                                                    |      |                 |                           |                        |                |                                                   |                                     |
| 11.                            | Fan-Filter Units                                                                                                                            |                                                                                                                   |      |                 |                           |                        |                |                                                   |                                     |
| 11.1                           | Filter                                                                                                                                      | 1 set for each FFU                                                                                                |      |                 |                           |                        |                |                                                   |                                     |




  
 MUKESH K. SINGH S.A. KISHORE D.K. MISHRA

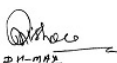
| SUGGESTIVE PRICE FORMAT        |                                                            |                                                                                 |      |                 |                           |                        |                |                                                   |                                     |
|--------------------------------|------------------------------------------------------------|---------------------------------------------------------------------------------|------|-----------------|---------------------------|------------------------|----------------|---------------------------------------------------|-------------------------------------|
| PROJECT : 1 x 800 MW WANAKBORI |                                                            |                                                                                 |      |                 |                           |                        |                |                                                   |                                     |
| PACKAGE : VENTILATION SYSTEM   |                                                            |                                                                                 |      |                 |                           |                        |                |                                                   |                                     |
| MANDATORY SPARE LIST           |                                                            |                                                                                 |      |                 |                           |                        |                |                                                   |                                     |
| SL No                          | DESCRIPTION OF EQUIPMENT/ ITEM                             | QUANTITY                                                                        | UNIT | SUPPLY          |                           |                        |                |                                                   |                                     |
|                                |                                                            |                                                                                 |      | Unit Price (Rs) | Total ex-works price (Rs) | ED including CESS (Rs) | CST / VAT (Rs) | FREIGHT including Service Tax, If applicable (Rs) | TOTAL F.O.R. Site Price Supply (Rs) |
| 11.2                           | Fan-motor Bearing                                          | 1 set for each rating of FFU                                                    |      |                 |                           |                        |                |                                                   |                                     |
| 11.3                           | Vibration Isolators                                        | 1 set for each FFU                                                              |      |                 |                           |                        |                |                                                   |                                     |
| 11.4                           | Back Draft Dampers                                         | 1 no. of each size                                                              |      |                 |                           |                        |                |                                                   |                                     |
| 11.5                           | Any other spare parts recommended by the Manufacturer      | As recommended by the Manufacturer                                              |      |                 |                           |                        |                |                                                   |                                     |
| 12.                            | Wall mounted supply/ Exhaust fan                           |                                                                                 |      |                 |                           |                        |                |                                                   |                                     |
| 12.1                           | Fan-motor Bearing                                          | 1 set for each rating of fan                                                    |      |                 |                           |                        |                |                                                   |                                     |
| 12.2                           | Vibration Isolators                                        | 1 set for each fan                                                              |      |                 |                           |                        |                |                                                   |                                     |
| 12.3                           | Fan Motor                                                  | 1 set for each rating of fan                                                    |      |                 |                           |                        |                |                                                   |                                     |
| 13.                            | Electrical Spares for panels                               |                                                                                 |      |                 |                           |                        |                |                                                   |                                     |
| 13.1                           | Control Supply Transformer                                 | 2 Nos. of each type and rating                                                  |      |                 |                           |                        |                |                                                   |                                     |
| 13.2                           | Contactor                                                  | 2 Nos. of each type and rating                                                  |      |                 |                           |                        |                |                                                   |                                     |
| 13.3                           | Coils for contactor & aux. Contactor                       | 5 Nos. for each contactor                                                       |      |                 |                           |                        |                |                                                   |                                     |
| 13.4                           | Main & Aux. Contacts sets for contactor and Aux. Contactor | 5 Sets. for each contactor                                                      |      |                 |                           |                        |                |                                                   |                                     |
| 13.5                           | Air Break Switch                                           | 1 No. for each rating                                                           |      |                 |                           |                        |                |                                                   |                                     |
| 13.6                           | Control ,Isolating and selector switches                   | 5% of each type and rating                                                      |      |                 |                           |                        |                |                                                   |                                     |
| 13.7                           | Fuses                                                      | 6 Nos,of each type and rating or 10% whichever is higher                        |      |                 |                           |                        |                |                                                   |                                     |
| 13.8                           | Fuse Bases                                                 | 3 Nos,of each type and rating or 5% whichever is higher                         |      |                 |                           |                        |                |                                                   |                                     |
| 13.9                           | Circuit Breaker                                            | 1 No. for each rating                                                           |      |                 |                           |                        |                |                                                   |                                     |
| 13.10                          | Indicating Lamps                                           | 10% of installed quantity                                                       |      |                 |                           |                        |                |                                                   |                                     |
| 13.11                          | Indicating lamps cover of different colour and holders     | 5% of installed quantity                                                        |      |                 |                           |                        |                |                                                   |                                     |
| 13.12                          | Push Buttons of various colours                            | 10 nos. of each type and colour                                                 |      |                 |                           |                        |                |                                                   |                                     |
| 13.13                          | Terminal Blocks                                            | 5% of installed quantity                                                        |      |                 |                           |                        |                |                                                   |                                     |
| 14.                            | Electrical Spares for Motors                               |                                                                                 |      |                 |                           |                        |                |                                                   |                                     |
| 14.1                           | Terminal plates                                            | 10 Nos. each for small motors up to 30KW and 4 Nos. each for motors above 30 KW |      |                 |                           |                        |                |                                                   |                                     |



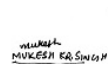


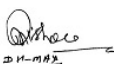
| SUGGESTIVE PRICE FORMAT        |                                          |                                                                      |      |                 |                           |                        |                |                                                   |                                     |
|--------------------------------|------------------------------------------|----------------------------------------------------------------------|------|-----------------|---------------------------|------------------------|----------------|---------------------------------------------------|-------------------------------------|
| PROJECT : 1 x 800 MW WANAKBORI |                                          |                                                                      |      |                 |                           |                        |                |                                                   |                                     |
| PACKAGE : VENTILATION SYSTEM   |                                          |                                                                      |      |                 |                           |                        |                |                                                   |                                     |
| MANDATORY SPARE LIST           |                                          |                                                                      |      |                 |                           |                        |                |                                                   |                                     |
| SL No                          | DESCRIPTION OF EQUIPMENT/ ITEM           | QUANTITY                                                             | UNIT | SUPPLY          |                           |                        |                |                                                   |                                     |
|                                |                                          |                                                                      |      | Unit Price (Rs) | Total ex-works price (Rs) | ED including CESS (Rs) | CST / VAT (Rs) | FREIGHT including Service Tax, If applicable (Rs) | TOTAL F.O.R. Site Price Supply (Rs) |
| 14.2                           | Heaters                                  | 1 Set for each motor of rating above 30 KW                           |      |                 |                           |                        |                |                                                   |                                     |
| 14.3                           | Greasing arrangements                    | 4 sets for each type of motors                                       |      |                 |                           |                        |                |                                                   |                                     |
| 14.4                           | Motors below 0.75 KW                     | 10% of the installed quantity or minimum 1 no. whichever is higher   |      |                 |                           |                        |                |                                                   |                                     |
| 14.5                           | Bearings (DE & NDE)                      | 4 sets of each type and rating                                       |      |                 |                           |                        |                |                                                   |                                     |
| <b>15</b>                      | <b>Control panel/ desk mounted items</b> |                                                                      |      |                 |                           |                        |                |                                                   |                                     |
| 15.1                           | Push Button                              |                                                                      |      |                 |                           |                        |                |                                                   |                                     |
| 15.1.1                         | Complete assembly                        | 5 Nos for each colour                                                |      |                 |                           |                        |                |                                                   |                                     |
| 15.1.2                         | Contact Element (1NO + 1NC) Block        | 20 Nos.                                                              |      |                 |                           |                        |                |                                                   |                                     |
| 15.2                           | Selector Switch                          | 10Nos. for each type and rating                                      |      |                 |                           |                        |                |                                                   |                                     |
| 15.3                           | Meter (Analog or Digital)                |                                                                      |      |                 |                           |                        |                |                                                   |                                     |
| 15.3.1                         | Ammeter                                  | 10% for each type and range or minimum one (1) no. whichever is more |      |                 |                           |                        |                |                                                   |                                     |
| 15.3.2                         | Voltmeter                                | 10% for each type and range or minimum one (1) no. whichever is more |      |                 |                           |                        |                |                                                   |                                     |
| 15.3.3                         | Frequency                                | 10% for each type and range or minimum one (1) no. whichever is more |      |                 |                           |                        |                |                                                   |                                     |
| 15.3.4                         | MW                                       | 10% for each type and range or minimum one (1) no. whichever is more |      |                 |                           |                        |                |                                                   |                                     |
| 15.3.5                         | MVAR                                     | 10% for each type and range or minimum one (1) no. whichever is more |      |                 |                           |                        |                |                                                   |                                     |
| 15.3.6                         | Power Factor                             | 10% for each type and range or minimum one (1) no. whichever is more |      |                 |                           |                        |                |                                                   |                                     |
| 15.3.7                         | Synchroscope                             | 10% for each type and range or minimum one (1) no. whichever is more |      |                 |                           |                        |                |                                                   |                                     |



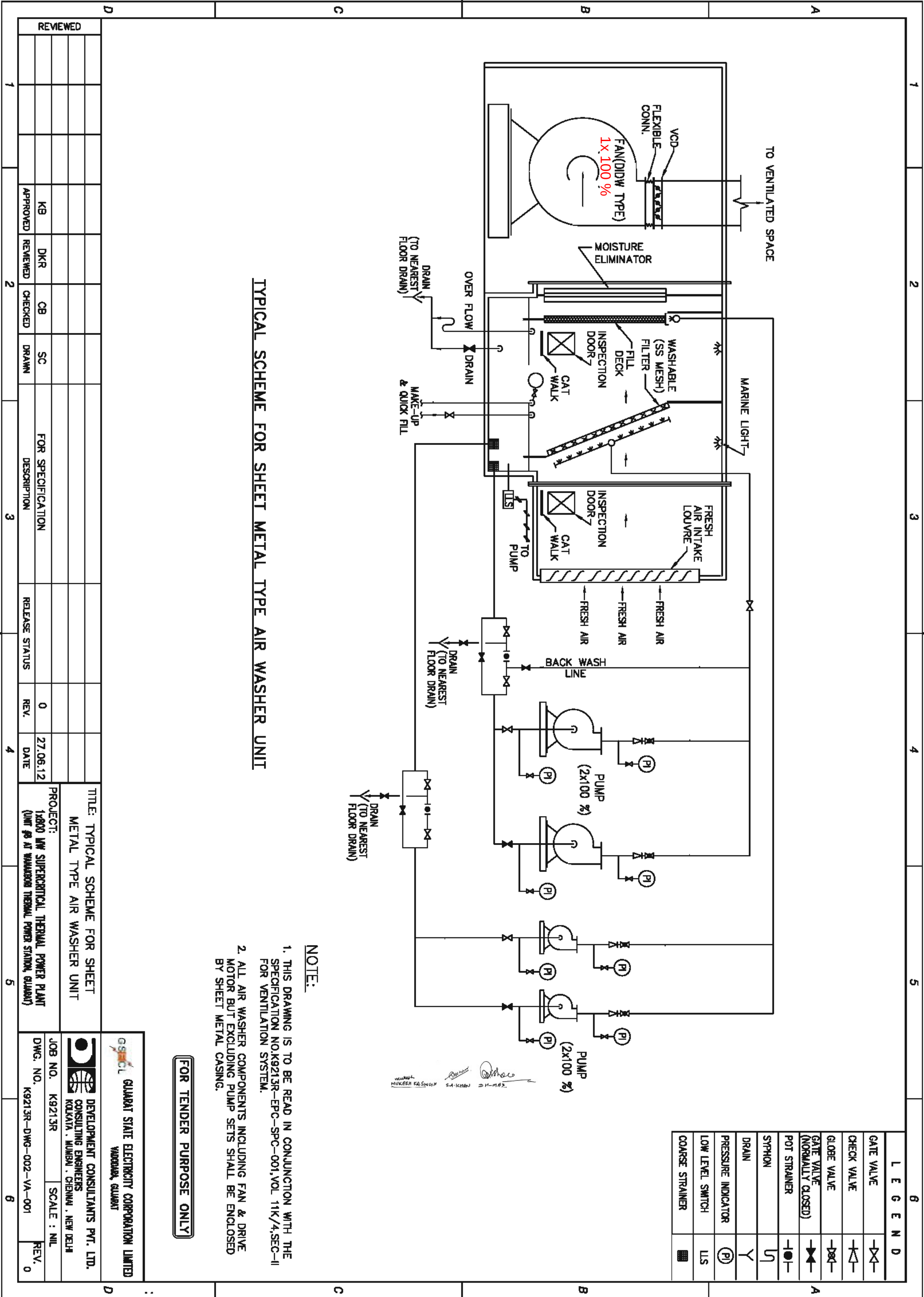

  
 MUKESH K. SINGH      S.A. SINGH      D.H. SINGH

| SUGGESTIVE PRICE FORMAT        |                                        |                                  |      |                 |                           |                        |                |                                                   |                                     |
|--------------------------------|----------------------------------------|----------------------------------|------|-----------------|---------------------------|------------------------|----------------|---------------------------------------------------|-------------------------------------|
| PROJECT : 1 x 800 MW WANAKBORI |                                        |                                  |      |                 |                           |                        |                |                                                   |                                     |
| PACKAGE : VENTILATION SYSTEM   |                                        |                                  |      |                 |                           |                        |                |                                                   |                                     |
| MANDATORY SPARE LIST           |                                        |                                  |      |                 |                           |                        |                |                                                   |                                     |
| SL No                          | DESCRIPTION OF EQUIPMENT/ ITEM         | QUANTITY                         | UNIT | SUPPLY          |                           |                        |                |                                                   |                                     |
|                                |                                        |                                  |      | Unit Price (Rs) | Total ex-works price (Rs) | ED including CESS (Rs) | CST / VAT (Rs) | FREIGHT including Service Tax, If applicable (Rs) | TOTAL F.O.R. Site Price Supply (Rs) |
| 15.4                           | Indicating Lamps complete assembly     | 10 Nos. for each Colour and type |      |                 |                           |                        |                |                                                   |                                     |
| 15.5                           | Mimic Lamps                            | 10 Nos. for each Colour and type |      |                 |                           |                        |                |                                                   |                                     |
| 15.6                           | MCB                                    | 2 Nos. for each type and rating  |      |                 |                           |                        |                |                                                   |                                     |
| 15.7                           | Door Limit Switch                      | 2 Nos.                           |      |                 |                           |                        |                |                                                   |                                     |
| 15.8                           | Annunciation system                    |                                  |      |                 |                           |                        |                |                                                   |                                     |
| 15.8.1                         | Lamp Box with Facia & Lamps (LED type) | 25Nos.                           |      |                 |                           |                        |                |                                                   |                                     |
| 15.8.2                         | Hooter                                 | 1No.                             |      |                 |                           |                        |                |                                                   |                                     |
| 15.8.3                         | Each type of PCB                       | 1(one) no.                       |      |                 |                           |                        |                |                                                   |                                     |




  
 MUKESH R. S. SINGH      S. A. K. SINGH      D. H. SINGH

| PROJECT : 1X800 MW WANAKBORI |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                              |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| PACKAGE : VENTILATION SYSTEM |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                              |
| APPENDIX - A                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                              |
| SL NO                        | DESCRIPTION OF EQUIPMENT/ ITEM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Percentage of total price                    |
| 1                            | Total lumpsum firm prices for equipment & Services as specified, Comprising Engineering, design, manufacture, inspection & Testing at manufacturer's/subvendor's works, Painting at manufactures works, duly packed for transportation, delivery to site, unloading, storage & handling at site, fabrication, erection and commissioning, performance and guarantee testing, submission of as built drawing, carrying out acceptance tests at site, and final painting of complete Ventilation system on turnkey basis as per specification PE-TS-408-554-A001 including special tool & tackels for maintenance, commissioning spares, all taxes, duties etc. (Without mandatory spare - Sr. No. 2.16 of suggestive price format) | 100%                                         |
| 2.0                          | <b>BREAK-UP OF PRICES GIVEN IN 1.0 ABOVE (To be used during contract execution for payment)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                              |
| 2.1                          | Total lump sum firm price for <b>EQUIPMENT (SUPPLY)</b> for Engineering, design, manufacture, inspection & Testing at manufacturers works/subvendor's work, Painting at manufactures works, duly packed for transportation, delivery to site, unloading storage & handling at site, for the complete scope of supply of Ventilation system and as defined in the technical specification ( PE-TS-408-554-A001).                                                                                                                                                                                                                                                                                                                   | 80%                                          |
| 2.2                          | <b>Erection &amp; commissioning</b> , carrying out acceptance tests at site, final painting and handing over to customer the complete ventilation system on turnkey basis as per specification PE-TS-408-554-A001 including special tool & tackels for maintenance, commissioning spares, all taxes, duties etc.                                                                                                                                                                                                                                                                                                                                                                                                                  | 20%                                          |
| 3.0                          | <b>Break-up (%) of prices given at SI No-2.1 above (To be used during contract execution for payment)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Percentage of total price of SL No 2.1 above |
| 3.1                          | Air washer - (Item no 2.1 of Suggestive price format)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 35%                                          |
| 3.2                          | UAF - (Item no 2.2 of Suggestive price format)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 5%                                           |
| 3.3                          | GSS Duct work - (Item no 2.3.1 of Suggestive price format)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 18%                                          |
| 3.4                          | MS duct and grills (Item no 2.3.2, 2.3.3, 2.3.4 & 2.3.5 of Suggestive price format)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 2%                                           |
| 3.5                          | Thermal Insulation (Item no 2.3.6 of Suggestive price format)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1%                                           |
| 3.6                          | Gravity damper, Inlet louver, Fire damper, VCD, (Item no 2.3.7, 2.3.8 & 2.4 of Suggestive price format)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1%                                           |
| 3.7                          | RE units (Item no 2.5 of Suggestive price format)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 5%                                           |
| 3.8                          | Supply air fans (Item no 2.6 and 2.7 of Suggestive price format)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 14%                                          |
| 3.9                          | Exhaust fans (Item no 2.8 to 2.10 of Suggestive price format)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 16%                                          |
| 3.10                         | Tools and tackels & Commissioning Spares (Item no 2.11 to 2.12 of Suggestive price format)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1%                                           |
| 3.11                         | Field Instruments and any other accessories/item (Item no 2.14 to 2.15 of Suggestive price format)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 2%                                           |





**NOTE:**  
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE SPECIFICATION NO.K9213R-EPC-SPC-001, VOL. 11K/4, SEC-II FOR VENTILATION SYSTEM.

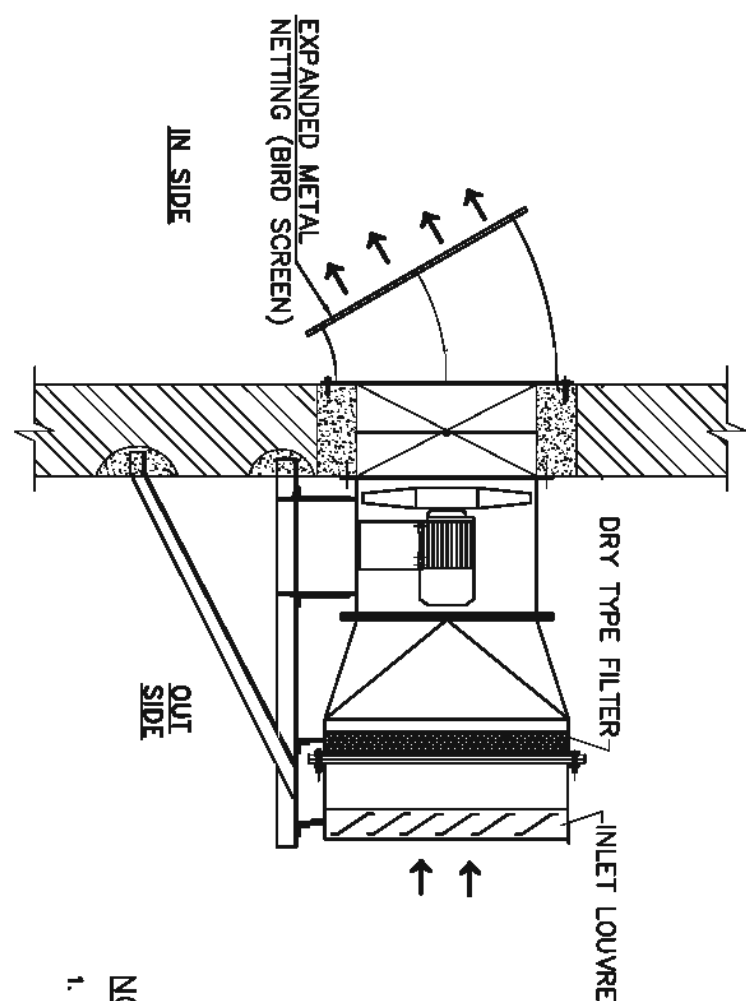
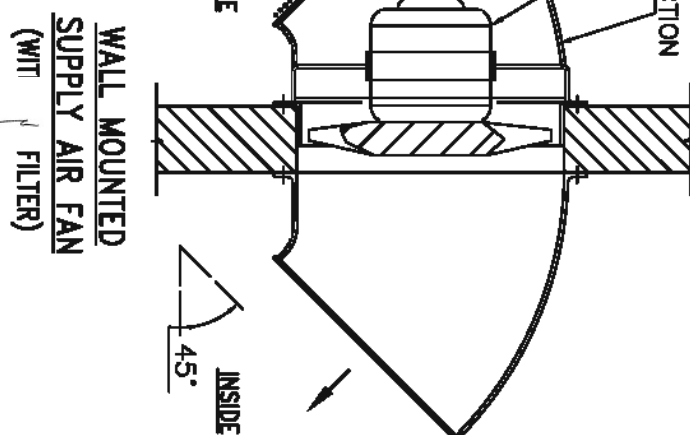
11

**A**

7

4

G



1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE SPECIFICATION NO.K9213R-EPC-SPC-001,VOL 11K/4,SEC-II FOR VENTILATION SYSTEM.

**(ALTERNATIVE-1)**

**(ALTERNATIVE-2)**

**FOR TENDER PURPOSE ONLY**

|                                                                                                                                                                                                    |             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
|  <b>DEVELOPMENT CONSULTANTS PVT. LTD.</b><br><b>CONSULTING ENGINEERS</b><br>KOLKATA, MUMBAI, CHENNAI, NEW DELHI |             |
| JOB NO. K9213R                                                                                                                                                                                     | SCALE : NIL |
| DWG. NO. K9213R-DWG-002-VA-003                                                                                                                                                                     | REV. 0      |

 **GUJARAT STATE ELECTRICITY CORPORATION LIMITED**  
VADODRA, GUJARAT



**DEVELOPMENT CONSULTANTS PVT. LTD.**  
**CONSULTING ENGINEERS**  
 KOLKATA, MUMBAI, CHENNAI, NEW DELHI

|          |                       |         |     |
|----------|-----------------------|---------|-----|
| JOB NO.  | K9213R                | SCALE : | NIL |
| DWG. NO. | K9213R-DWG-002-YA-003 |         | RI  |

|                       |      |
|-----------------------|------|
| DWG. NO.              | REV. |
| K0213B-DWG 002-YA-003 |      |



LEGENDS

|  |                                      |
|--|--------------------------------------|
|  | CENTRIFUGAL FAN                      |
|  | EXHAUST FAN                          |
|  | FAN FILTER UNIT<br>(AXIAL FLOW TYPE) |
|  | SA FAN WITHOUT<br>FILTER UNIT        |
|  | BACK DRAFT<br>DAMPER                 |
|  | INLET<br>LOUVRE                      |
|  | EXHAUST<br>LOUVRE                    |
|  | FIRE DAMPER                          |
|  | SA GRILLE WITH<br>VCD                |

NOTE:  
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE SPECIFICATION NO.K9213R-EP-C-001.VOL. 11/K/4/SEC-II FOR VENTILATION SYSTEM.  
2. THE AREA SHOWN IN THE BLOCK DIAGRAM ARE TENTATIVE & SHOULD CONTRIN IN ACCORDANCE WITH THE LATEST FLOOR PLAN/BUILDING PLAN.

FOR TENDER PURPOSE ONLY

TITLE :  
SCHEME OF VENTILATION SYSTEM  
FOR DIFFERENT AUXILIARY BUILDINGS  
1x800 MW SUPERCRITICAL THERMAL POWER PLANT  
(UNIT #8 AT WANKAGORI THERMAL POWER STATION, GUJARAT)

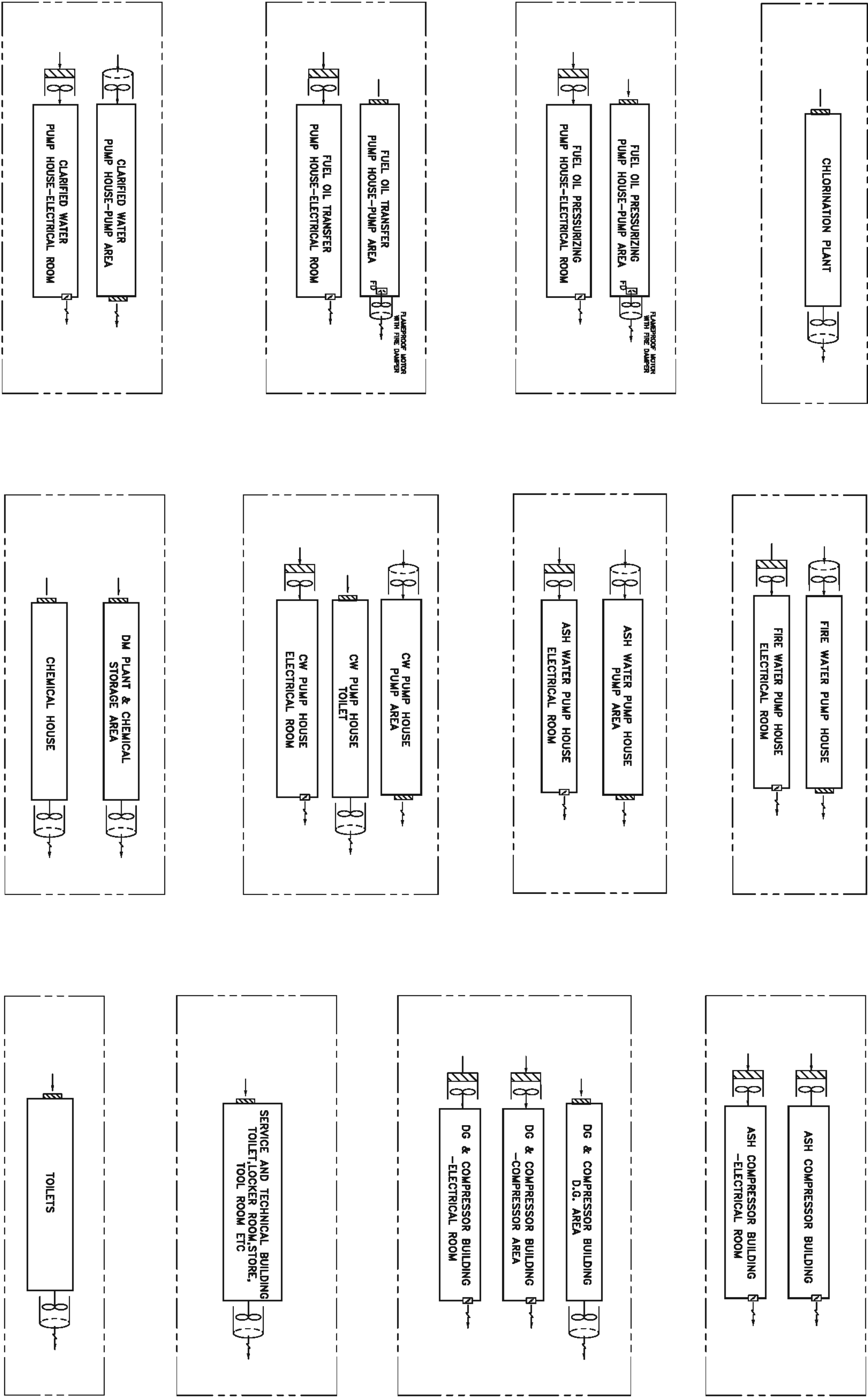
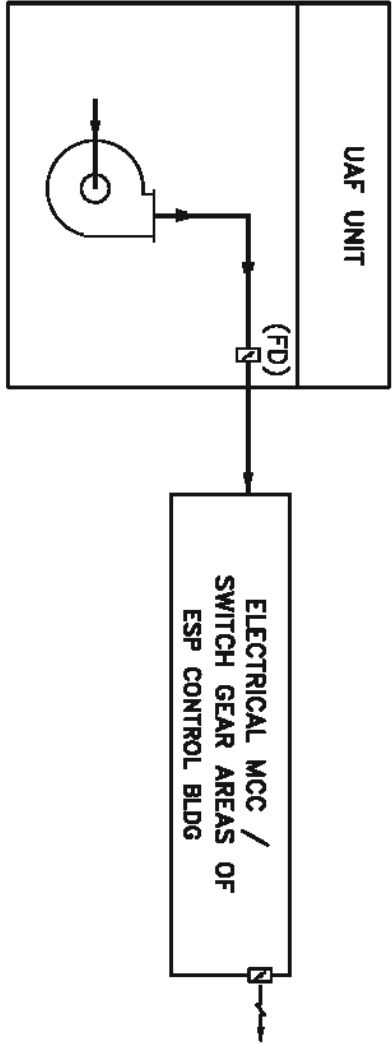
GS ECL GUARAT STATE ELECTRICITY CORPORATION LIMITED  
VADODARA, GUJARAT

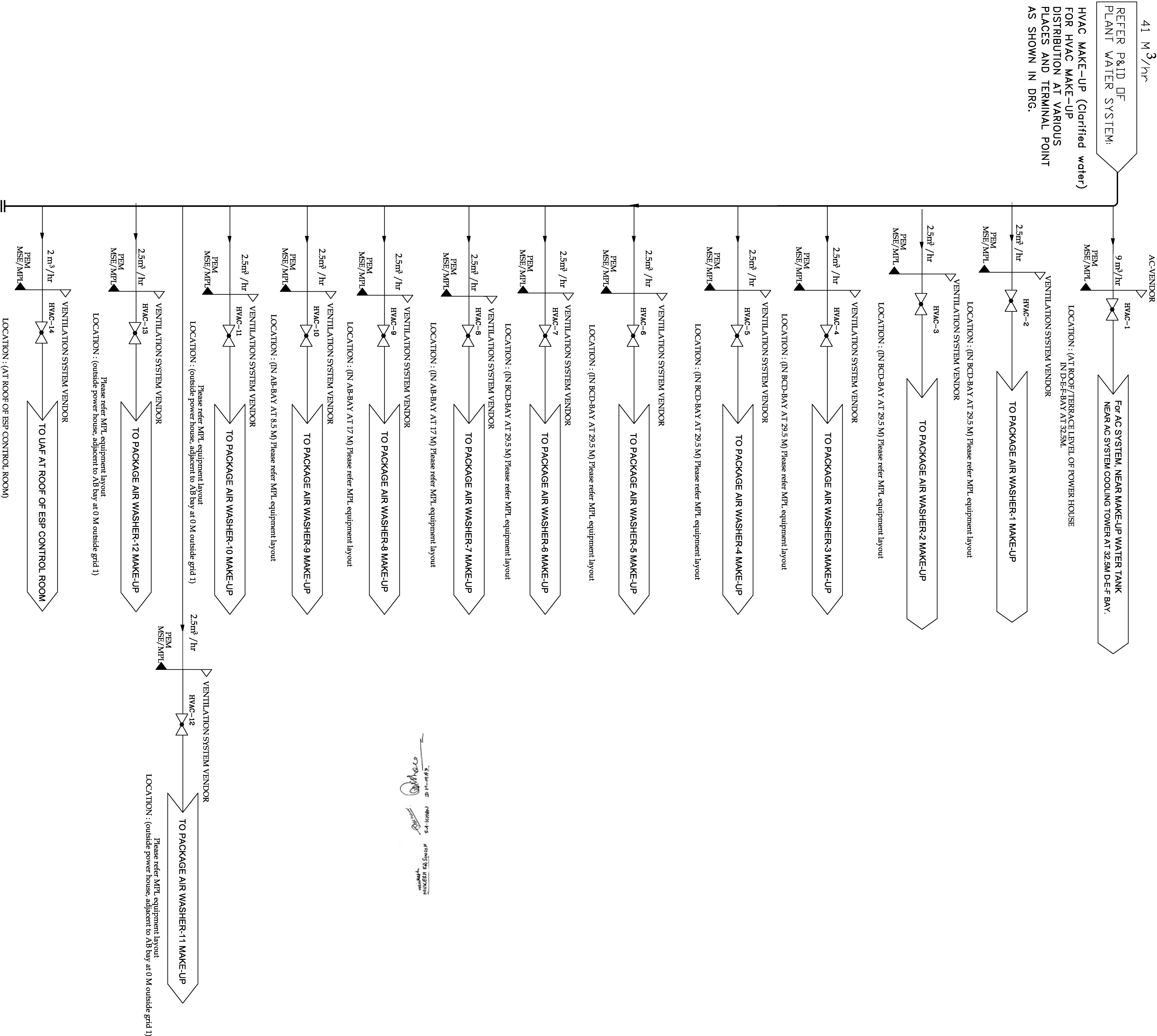
CONSULTING ENGINEERS  
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

|                |                  |                |
|----------------|------------------|----------------|
| DESIGNED : SC  | CHECKED : CB     | SCALE : N.T.S. |
| REVIEWED : DKR | DATE : 07/07/12  |                |
| APPROVED : KBR | JOB NO. : K9213R | REV. : 0       |

FOR SPECIFICATION  
NATURE OF REVISION & DESCRIPTION

|         |      |       |       |       |        |       |          |      |      |         |      |          |                    |      |           |
|---------|------|-------|-------|-------|--------|-------|----------|------|------|---------|------|----------|--------------------|------|-----------|
| APPROV. | HVAC | MECH. | INST. | ELEC. | STRUC. | ARCH. | DATE     | REV. | DRWN | CHECKED | DATE | REVIEWED | RELEASE STATUS     | DATE | SIGNATURE |
| CB      | DKR  |       |       |       |        |       | 27.06.12 | 0    | SC   | CB      |      |          | FOR TENDER ONLY    |      |           |
|         |      |       |       |       |        |       |          |      |      |         |      |          | FOR CONSTRUCTION   |      |           |
|         |      |       |       |       |        |       |          |      |      |         |      |          | ARCHITECTURAL      |      |           |
|         |      |       |       |       |        |       |          |      |      |         |      |          | CIVIL & STRUCTURAL |      |           |
|         |      |       |       |       |        |       |          |      |      |         |      |          | ELECTRICAL         |      |           |
|         |      |       |       |       |        |       |          |      |      |         |      |          | INSTRUMENTATION    |      |           |
|         |      |       |       |       |        |       |          |      |      |         |      |          | MECHANICAL         |      |           |

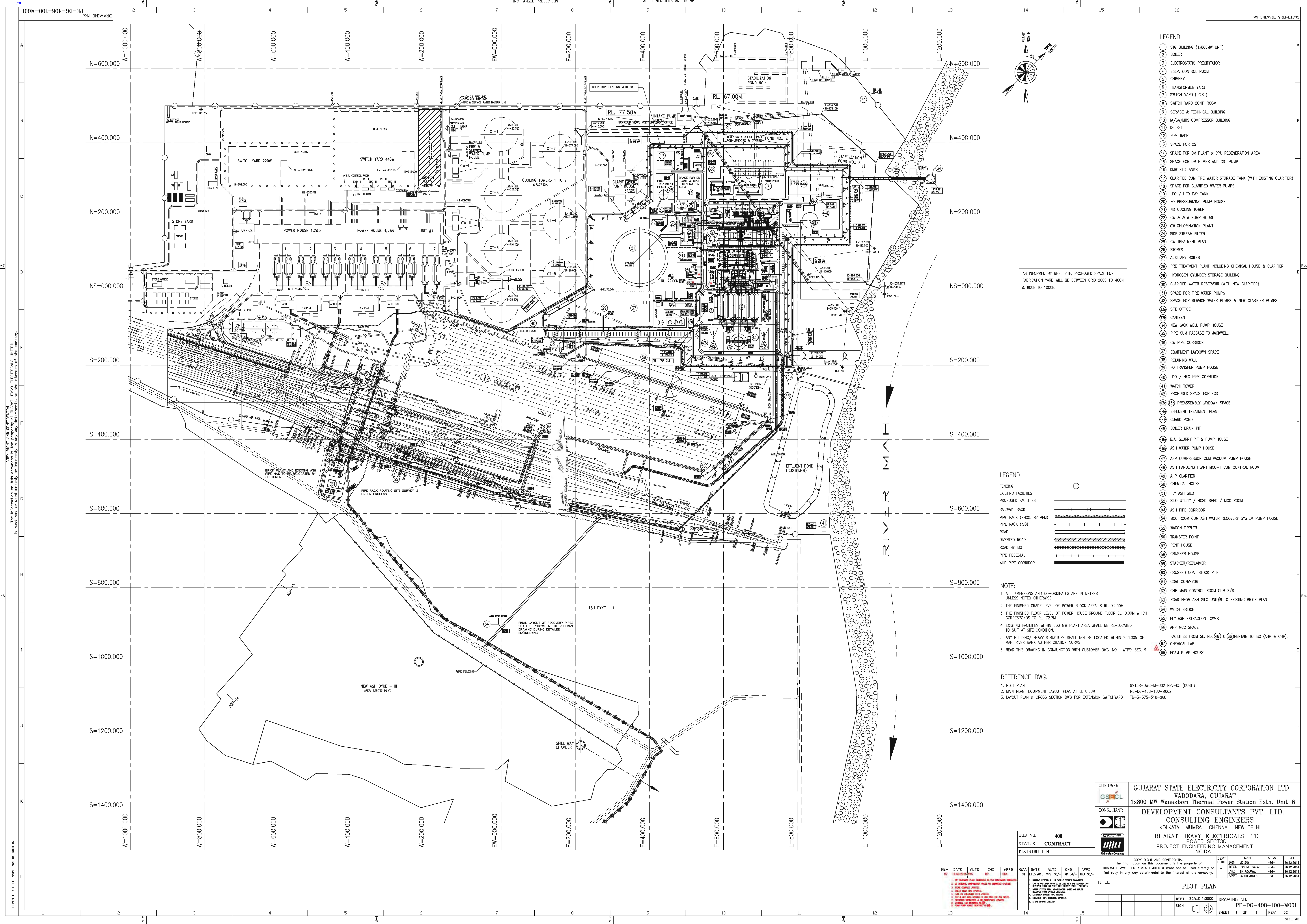




NOTE:-

1. MPL TO PROVIDE HVAC MAKE-UP WATER PIPING/FITTINGS UP TO THE TERMINAL POINT AS SHOWN IN DRG.
2. HVAC MAKE-UP WATER PIPING INCLUDING FITTINGS SHALL BE TERMINATED WITHIN THE RANGE OF 5 METER DISTANCE FROM MAKE-UP WATER TANK / AIR-WASHER BY MPL (UP PIPING VENDORS SCOPE) FURTHER PIPING SHALL BE DONE BY RESPECTIVE PLANT SUPPLIER AS MARKED IN THIS DRG.
3. FOR HVAC MAKE-UP WATER ISOLATING VALVES ENGINEERING & PROCUREMENT ETC. IN THE SCOPE OF MSE/MPL.
4. HVAC MAKE-UP WATER PRESSURE AT EACH TERMINAL POINT SHALL BE MAINTAINED 0.5 kg/ cm2.
5. HVAC.-SYSTEM MAKE-UP WATER PIPING FROM TERMINAL POINT TO MAKE-UP WATER TANK, COOLING TOWER, EXPANSION TANK & PAN HUMIDIFIER ETC. SHALL BE IN BIDDERS SCOPE.
6. MAKE-UP WATER REQUIREMENT IS CONTINUOUS.

|                 |  |                                           |  |
|-----------------|--|-------------------------------------------|--|
| CUSTOMER :      |  | GSCIL                                     |  |
| JOB No. : 408   |  | 1 X 800 MW W ANAKBORI                     |  |
| STATUS CONTRACT |  | BHARAT HEAVY ELECTRICALS LTD              |  |
| DISTRIBUTION    |  | POWER SECTOR                              |  |
| NOT             |  | PROJECT ENGINEERING MANAGEMENT            |  |
|                 |  | PHEI BLDG. PLOT NO. 25, SECTOR-46A, NOIDA |  |
|                 |  | TITLE SCHEMATIC DIAGRAM FOR HVAC MAKE UP  |  |
|                 |  | SHEET 1 OF 1                              |  |
|                 |  | REV 1                                     |  |
|                 |  | DATE 2024                                 |  |



- LEGEND**
- 1. STG. BUILDING (1x800MW UNIT)
  - 2. BOILER
  - 3. ELECTROSTATIC PRECIPITATOR
  - 4. E.S.P. CONTROL ROOM
  - 5. CHIMNEY
  - 6. TRANSFORMER YARD
  - 7. SWITCH YARD (GIS)
  - 8. SWITCH YARD CONT. ROOM
  - 9. SERVICE & TECHNICAL BUILDING
  - 10. IA/SA/MRS COMPRESSOR BUILDING
  - 11. DG SET
  - 12. PIPE RACK
  - 13. SPACE FOR CST
  - 14. SPACE FOR DM PLANT & CPU REGENERATION AREA
  - 15. SPACE FOR DM PUMPS AND CST PUMP
  - 16. DMW STG. TANKS
  - 17. CLARIFIED CUM FIRE WATER STORAGE TANK (WITH EXISTING CLARIFIER)
  - 18. SPACE FOR CLARIFIED WATER PUMPS
  - 19. LFO / HFO DAY TANK
  - 20. FO PRESSURIZING PUMP HOUSE
  - 21. NO COOLING TOWER
  - 22. CW & ACW PUMP HOUSE
  - 23. CW CHLORINATION PLANT
  - 24. SDE STREAM FILTER
  - 25. CW TREATMENT PLANT
  - 26. STORES
  - 27. AUXILIARY BOILER
  - 28. PRE TREATMENT PLANT INCLUDING CHEMICAL HOUSE & CLARIFIER
  - 29. HYDROGEN CYLINDER STORAGE BUILDING
  - 30. CLARIFIED WATER RESERVOIR (WITH NEW CLARIFIER)
  - 31. SPACE FOR FIRE WATER PUMPS
  - 32. SPACE FOR SERVICE WATER PUMPS & NEW CLARIFIER PUMPS
  - 33. SITE OFFICE
  - 34. CANTEN
  - 35. NEW JACK WELL PUMP HOUSE
  - 36. PIPE CUM PASSAGE TO JACKWELL
  - 37. CW PIPE CORRIDOR
  - 38. EQUIPMENT LAYDOWN SPACE
  - 39. RETAINING WALL
  - 40. FO TRANSFER PUMP HOUSE
  - 41. LDO / HFO PIPE CORRIDOR
  - 42. WATCH TOWER
  - 43. PROPOSED SPACE FOR FGD
  - 44. PREASSEMBLY LAYDOWN SPACE
  - 45. EFFLUENT TREATMENT PLANT
  - 46. GUARD POND
  - 47. BOILER DRAIN PIT
  - 48. B.A. SLURRY PIT & PUMP HOUSE
  - 49. ASH WATER PUMP HOUSE
  - 50. AHP COMPRESSOR CUM VACUUM PUMP HOUSE
  - 51. AHP HANDLING PLANT MCC-1 CUM CONTROL ROOM
  - 52. AHP CLARIFIER
  - 53. CHEMICAL HOUSE
  - 54. FLY ASH SILO
  - 55. SILO UTILITY / H/CSD SHED / MCC ROOM
  - 56. ASH PIPE CORRIDOR
  - 57. MCC ROOM CUM ASH WATER RECOVERY SYSTEM PUMP HOUSE
  - 58. WAGON TIPLER
  - 59. TRANSFER POINT
  - 60. PENT HOUSE
  - 61. CRUSHER HOUSE
  - 62. STACKER/RECLAIMER
  - 63. CRUSHED COAL STOCK PILE
  - 64. COAL CONVEYOR
  - 65. CHP MAIN CONTROL ROOM CUM S/S
  - 66. ROAD FROM ASH SILO UNIT#8 TO EXISTING BRICK PLANT
  - 67. WEIGH BRIDGE
  - 68. FLY ASH EXTRACTION TOWER
  - 69. AHP MCC SPACE
  - 70. FACILITIES FROM SL. No. 46 TO 66 PERTAIN TO ISC (AHP & CHP).
  - 71. CHEMICAL LAB
  - 72. FOAM PUMP HOUSE

- LEGEND**
- FENCING
- EXISTING FACILITIES
- PROPOSED FACILITIES
- RAILWAY TRACK
- PIPE RACK (ENGG. BY PEM)
- PIPE RACK (ISC)
- ROAD
- DIVERTED ROAD
- ROAD BY ISC
- PIPE PEDESTAL
- AHP PIPE CORRIDOR

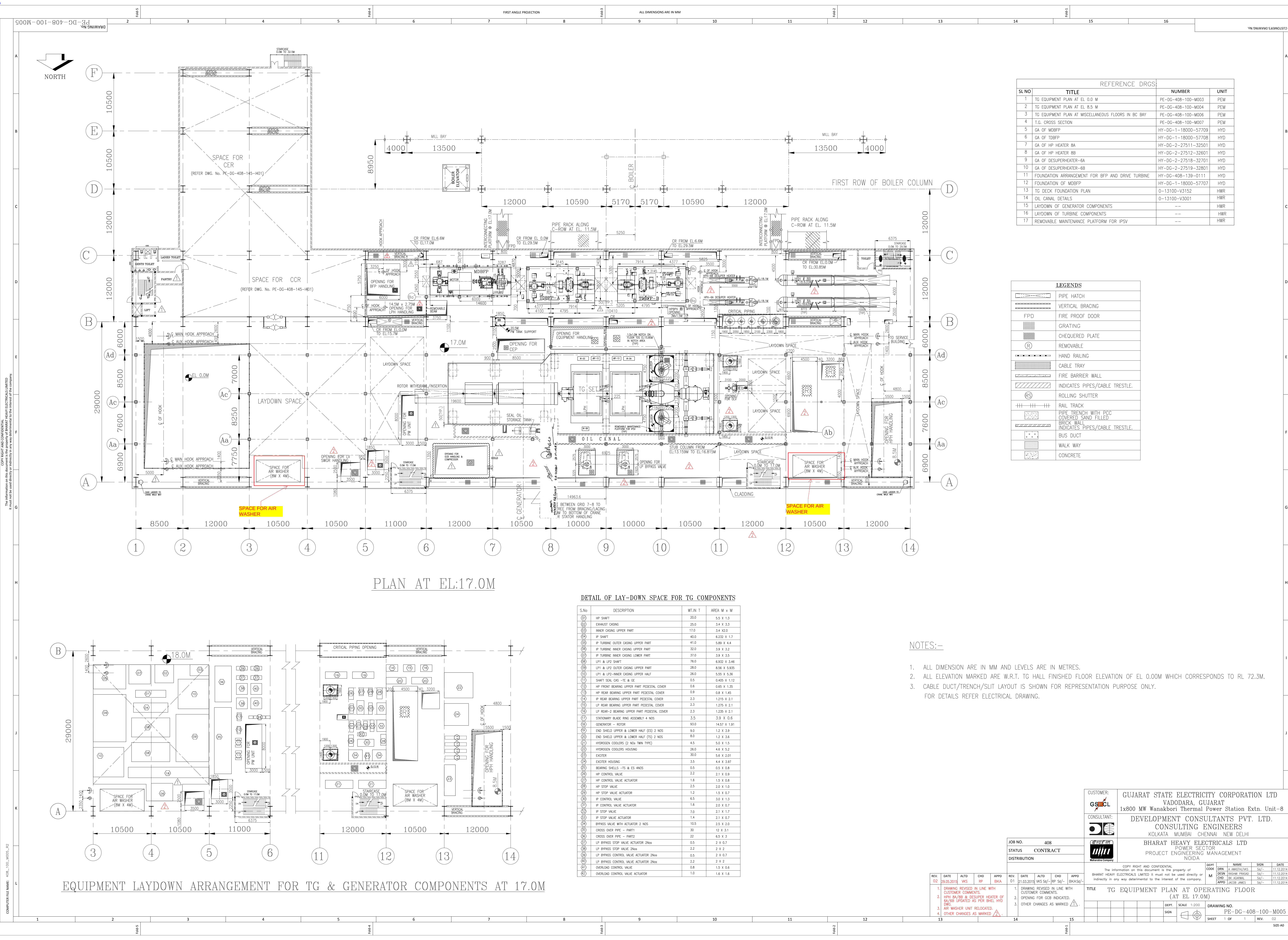
- NOTE:-**
1. ALL DIMENSIONS AND CO-ORDINATES ARE IN METRES UNLESS NOTED OTHERWISE.
  2. THE FINISHED GRADE LEVEL OF POWER BLOCK AREA IS RL. 72.00M.
  3. THE FINISHED FLOOR LEVEL OF POWER HOUSE GROUND FLOOR EL. 0.00M WHICH CORRESPONDS TO RL. 72.30M
  4. EXISTING FACILITIES WITHIN 800 MM PLANT AREA SHALL BE RE-LOCATED TO SUIT AT SITE CONDITION.
  5. ANY BUILDING/ HEAVY STRUCTURE SHALL NOT BE LOCATED WITHIN 200.00M OF MAHI RIVER BANK AS PER CITATION NORMS.
  6. READ THIS DRAWING IN CONJUNCTION WITH CUSTOMER DWG. NO. - WTPS: SEC.19.

- REFERENCE DWG.**
1. PLOT PLAN
  2. MAIN PLANT EQUIPMENT LAYOUT PLAN AT EL. 0.00M
  3. LAYOUT PLAN & CROSS SECTION DWG FOR EXTENSION SWITCHYARD

9213R-DWG-M-002 REV-05 (CUST.)  
PE-DG-408-100-M002  
TB-3-375-510-060

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                               |      |     |      |      |            |      |     |      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|------|-----|------|------|------------|------|-----|------|
| CUSTOMER:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | GUJARAT STATE ELECTRICITY CORPORATION LTD<br>VADODARA, GUJARAT                                |      |     |      |      |            |      |     |      |
| CONSULTANT:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | DEVELOPMENT CONSULTANTS PVT. LTD.<br>CONSULTING ENGINEERS<br>KOLKATA MUMBAI CHENNAI NEW DELHI |      |     |      |      |            |      |     |      |
| JOB NO.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 408                                                                                           |      |     |      |      |            |      |     |      |
| STATUS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | CONTRACT                                                                                      |      |     |      |      |            |      |     |      |
| DISTRIBUTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                               |      |     |      |      |            |      |     |      |
| REV.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | DATE                                                                                          | ALTD | CHD | APPD | REV. | DATE       | ALTD | CHD | APPD |
| 02                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 16.03.2015                                                                                    | YES  | NO  | NO   | 01   | 13.03.2015 | YES  | NO  | NO   |
| 1. BY PLANT PLAN RELEASED BY THE CUSTOMER COMPANY.<br>2. BY PLANT PLAN RELEASED BY THE CUSTOMER COMPANY.<br>3. BY PLANT PLAN RELEASED BY THE CUSTOMER COMPANY.<br>4. BY PLANT PLAN RELEASED BY THE CUSTOMER COMPANY.<br>5. BY PLANT PLAN RELEASED BY THE CUSTOMER COMPANY.<br>6. BY PLANT PLAN RELEASED BY THE CUSTOMER COMPANY.<br>7. BY PLANT PLAN RELEASED BY THE CUSTOMER COMPANY.<br>8. BY PLANT PLAN RELEASED BY THE CUSTOMER COMPANY.<br>9. BY PLANT PLAN RELEASED BY THE CUSTOMER COMPANY.<br>10. BY PLANT PLAN RELEASED BY THE CUSTOMER COMPANY.                                                                                                                                                                                                  |                                                                                               |      |     |      |      |            |      |     |      |
| 1. DRAWING NUMBER IS THE ONLY IDENTIFYING NUMBER.<br>2. THIS DRAWING IS THE PROPERTY OF THE CUSTOMER COMPANY.<br>3. NO PART OF THIS DRAWING IS TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM.<br>4. NO PART OF THIS DRAWING IS TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM.<br>5. NO PART OF THIS DRAWING IS TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM. |                                                                                               |      |     |      |      |            |      |     |      |
| TITLE: PLOT PLAN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                               |      |     |      |      |            |      |     |      |
| DEPT. SCALE 1:3000 DRAWING NO. PE-DG-408-100-M001                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                               |      |     |      |      |            |      |     |      |
| SHEET 1 OF 1 REV. 02                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                               |      |     |      |      |            |      |     |      |

COMPUTER FILE NAME: AGL0000002.DWG



| REFERENCE DRGS |                                                     |                     |      |
|----------------|-----------------------------------------------------|---------------------|------|
| SL NO          | TITLE                                               | NUMBER              | UNIT |
| 1              | TG EQUIPMENT PLAN AT EL. 0.0 M                      | PE-DG-408-100-M003  | PEM  |
| 2              | TG EQUIPMENT PLAN AT EL. 8.5 M                      | PE-DG-408-100-M004  | PEM  |
| 3              | TG EQUIPMENT PLAN AT MISCELLANEOUS FLOORS IN BC BAY | PE-DG-408-100-M006  | PEM  |
| 4              | T.G. CROSS SECTION                                  | PE-DG-408-100-M007  | PEM  |
| 5              | GA OF MDBFP                                         | HY-DG-1-18000-57709 | HYD  |
| 6              | GA OF HP HEATER 8A                                  | HY-DG-2-27511-32501 | HYD  |
| 7              | GA OF HP HEATER 8B                                  | HY-DG-2-27512-32601 | HYD  |
| 8              | GA OF DESUPERHEATER-8A                              | HY-DG-2-27518-32701 | HYD  |
| 9              | GA OF DESUPERHEATER-8B                              | HY-DG-2-27519-32801 | HYD  |
| 10             | FOUNDATION ARRANGEMENT FOR BFP AND DRIVE TURBINE    | HY-DG-408-139-0111  | HYD  |
| 11             | FOUNDATION OF MDBFP                                 | HY-DG-1-18000-57707 | HYD  |
| 12             | TG DECK FOUNDATION PLAN                             | O-13100-V3152       | HWR  |
| 13             | OIL CANAL DETAILS                                   | O-13100-V3001       | HWR  |
| 14             | LAYDOWN OF GENERATOR COMPONENTS                     | ---                 | HWR  |
| 15             | LAYDOWN OF TURBINE COMPONENTS                       | ---                 | HWR  |
| 16             | REMOVABLE MAINTENANCE PLATFORM FOR IPSV             | ---                 | HWR  |

| LEGENDS |                                          |
|---------|------------------------------------------|
|         | PIPE HATCH                               |
|         | VERTICAL BRACING                         |
|         | FIRE PROOF DOOR                          |
|         | GRATING                                  |
|         | CHEQUERED PLATE                          |
|         | REMOVABLE                                |
|         | HAND RAILING                             |
|         | CABLE TRAY                               |
|         | FIRE BARRIER WALL                        |
|         | INDICATES PIPES/CABLE TRESTLE            |
|         | ROLLING SHUTTER                          |
|         | RAIL TRACK                               |
|         | PIPE TRENCH WITH PCC COVERED SAND FILLED |
|         | BRICK WALL                               |
|         | BUS DUCT                                 |
|         | WALK WAY                                 |
|         | CONCRETE                                 |

DETAIL OF LAY-DOWN SPACE FOR TG COMPONENTS

| S.No | DESCRIPTION                                 | WT. IN T | AREA M x M    |
|------|---------------------------------------------|----------|---------------|
| 01   | HP SHFT                                     | 20.0     | 5.5 X 1.3     |
| 02   | EXHAUST CASING                              | 25.0     | 3.4 X 3.3     |
| 03   | INNER CASING UPPER PART                     | 17.0     | 3.4 X 2.0     |
| 04   | IP SHFT                                     | 40.0     | 6.232 X 1.7   |
| 05   | IP TURBINE OUTER CASING UPPER PART          | 41.0     | 5.89 X 4.4    |
| 06   | IP TURBINE INNER CASING UPPER PART          | 32.0     | 3.9 X 3.2     |
| 07   | IP TURBINE INNER CASING LOWER PART          | 37.0     | 3.9 X 3.5     |
| 08   | LP1 & LP2 SHFT                              | 76.0     | 6.332 X 3.46  |
| 09   | LP1 & LP2 OUTER CASING UPPER PART           | 28.0     | 8.56 X 5.935  |
| 10   | LP1 & LP2 INNER CASING UPPER HALF           | 26.0     | 5.95 X 5.36   |
| 11   | SHFT SEAL CAS - TE & GE                     | 0.5      | 0.405 X 1.132 |
| 12   | HP FRONT BEARING UPPER PART PEDESTAL COVER  | 0.8      | 0.65 X 1.35   |
| 13   | HP REAR BEARING UPPER PART PEDESTAL COVER   | 0.9      | 0.8 X 1.45    |
| 14   | IP REAR BEARING UPPER PART PEDESTAL COVER   | 2.3      | 1.215 X 2.1   |
| 15   | LP REAR BEARING UPPER PART PEDESTAL COVER   | 2.3      | 1.275 X 2.1   |
| 16   | LP REAR-2 BEARING UPPER PART PEDESTAL COVER | 2.3      | 1.235 X 2.1   |
| 17   | STATIONARY BLADE RING ASSEMBLY 4 NOS        | 3.5      | 3.9 X 0.5     |
| 18   | GENERATOR - ROTOR                           | 93.0     | 14.57 X 1.91  |
| 19   | END SHIELD UPPER & LOWER HALF (ES) 2 NOS    | 9.0      | 1.2 X 3.9     |
| 20   | END SHIELD UPPER & LOWER HALF (TS) 2 NOS    | 8.0      | 1.2 X 3.6     |
| 21   | HYDROGEN COOLERS (2 NOS TWIN TYPE)          | 4.5      | 5.0 X 1.5     |
| 22   | HYDROGEN COOLERS HOUSING                    | 26.0     | 4.6 X 5.2     |
| 23   | EXCITER                                     | 30.0     | 5.6 X 2.01    |
| 24   | EXCITER HOUSING                             | 3.5      | 4.4 X 3.97    |
| 25   | BEARING SHELLS - TS & ES 4NOS               | 0.5      | 0.5 X 0.8     |
| 26   | HP CONTROL VALVE                            | 2.2      | 2.1 X 0.8     |
| 27   | HP CONTROL VALVE ACTUATOR                   | 1.6      | 1.5 X 0.8     |
| 28   | HP STOP VALVE                               | 2.5      | 2.0 X 1.0     |
| 29   | HP STOP VALVE ACTUATOR                      | 1.2      | 1.5 X 0.7     |
| 30   | IP CONTROL VALVE                            | 6.5      | 3.0 X 1.5     |
| 31   | IP CONTROL VALVE ACTUATOR                   | 1.6      | 2.0 X 0.7     |
| 32   | IP STOP VALVE                               | 7.0      | 2.1 X 1.7     |
| 33   | IP STOP VALVE ACTUATOR                      | 1.4      | 2.1 X 0.7     |
| 34   | BIYPASS VALVE WITH ACTUATOR 2 NOS           | 10.5     | 2.5 X 2.0     |
| 35   | CROSS OVER PIPE - PART1                     | 30       | 12 X 3.1      |
| 36   | CROSS OVER PIPE - PART2                     | 22       | 6.5 X 3       |
| 37   | LP BIYPASS STOP VALVE ACTUATOR 2nos         | 0.5      | 2 X 0.7       |
| 38   | LP BIYPASS STOP VALVE 2nos                  | 2.2      | 2 X 2         |
| 39   | LP BIYPASS CONTROL VALVE ACTUATOR 2nos      | 0.5      | 2 X 0.7       |
| 40   | LP BIYPASS CONTROL VALVE ACTUATOR 2nos      | 2.2      | 2 X 2         |
| 41   | OVERLOAD CONTROL VALVE                      | 0.8      | 1.5 X 0.6     |
| 42   | OVERLOAD CONTROL VALVE ACTUATOR             | 1.0      | 1.6 X 1.6     |

NOTES:-

- ALL DIMENSION ARE IN MM AND LEVELS ARE IN METRES.
- ALL ELEVATION MARKED ARE W.R.T. TG HALL FINISHED FLOOR ELEVATION OF EL.0.00M WHICH CORRESPONDS TO RL 72.3M.
- CABLE DUCT/TRENCH/SLOT LAYOUT IS SHOWN FOR REPRESENTATION PURPOSE ONLY. FOR DETAILS REFER ELECTRICAL DRAWING.

| REV. | DATE       | ALTD | CHD  | APPD |
|------|------------|------|------|------|
| 02   | 26.05.2015 | W/S  | RP   | BKA  |
| 01   | 21.03.2015 | W/S  | SA/- | RP   |

| REV. | DATE       | ALTD | CHD  | APPD |
|------|------------|------|------|------|
| 01   | 21.03.2015 | W/S  | SA/- | RP   |
| 02   | 26.05.2015 | W/S  | RP   | BKA  |

CUSTOMER:

GUJARAT STATE ELECTRICITY CORPORATION LTD

VADODARA, GUJARAT

1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

CONSULTANT:

DEVELOPMENT CONSULTANTS PVT. LTD.

CONSULTING ENGINEERS

KOLKATA MUMBAI CHENNAI NEW DELHI

BHARAT HEAVY ELECTRICALS LTD

POWER SECTOR

PROJECT ENGINEERING MANAGEMENT

NODA

JOB NO.

408

STATUS

CONTRACT

DISTRIBUTION

DEPT

CHD

NAME

SIGN

DATE

DEPT

CHD

NAME

SIGN

DATE

DEPT

CHD

NAME

SIGN

DATE

TITLE

TG EQUIPMENT PLAN AT OPERATING FLOOR

(AT EL. 17.0M)

DEPT.

SCALE

1:200

DRAWING NO.

PE-DG-408-100-M005

SHEET

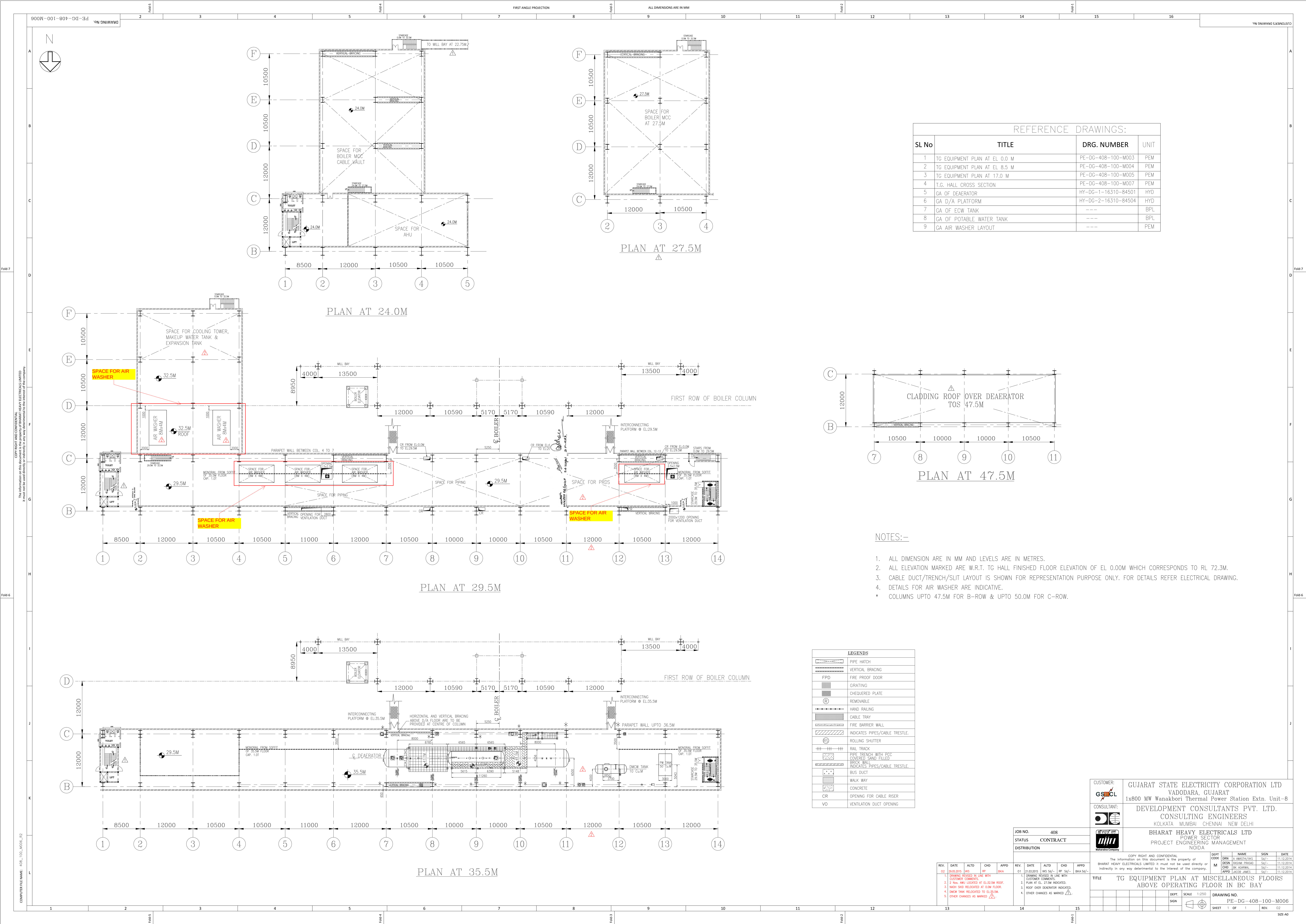
1 OF 1

REV.

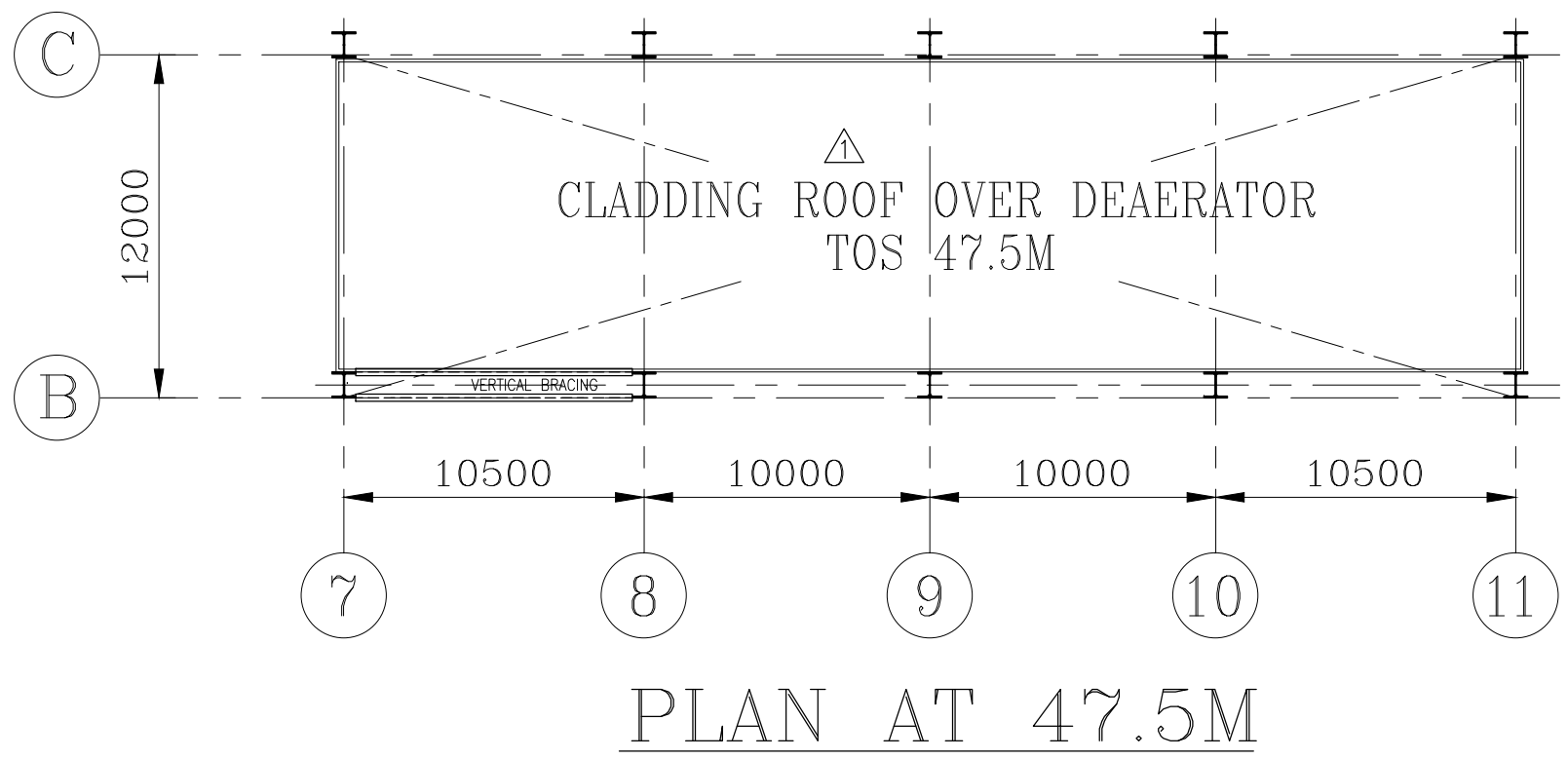
02

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COMPUTER FILE NAME: 408\_100\_M005\_02



| REFERENCE DRAWINGS: |                                 |                     |      |
|---------------------|---------------------------------|---------------------|------|
| SL No               | TITLE                           | DRG. NUMBER         | UNIT |
| 1                   | TG EQUIPMENT PLAN AT EL. 0.0 M  | PE-DG-408-100-M003  | PEM  |
| 2                   | TG EQUIPMENT PLAN AT EL. 8.5 M  | PE-DG-408-100-M004  | PEM  |
| 3                   | TG EQUIPMENT PLAN AT EL. 17.0 M | PE-DG-408-100-M005  | PEM  |
| 4                   | T.G. HALL CROSS SECTION         | PE-DG-408-100-M007  | PEM  |
| 5                   | GA OF DEAERATOR                 | HY-DG-1-16310-84501 | HYD  |
| 6                   | GA D/A PLATFORM                 | HY-DG-2-16310-84504 | HYD  |
| 7                   | GA OF ECW TANK                  | ----                | BPL  |
| 8                   | GA OF POTABLE WATER TANK        | ----                | BPL  |
| 9                   | GA AIR WASHER LAYOUT            | ----                | PEM  |



- NOTES:-
1. ALL DIMENSION ARE IN MM AND LEVELS ARE IN METRES.
  2. ALL ELEVATION MARKED ARE W.R.T. TG HALL FINISHED FLOOR ELEVATION OF EL. 0.00M WHICH CORRESPONDS TO RL 72.3M.
  3. CABLE DUCT/TRENCH/SLOT LAYOUT IS SHOWN FOR REPRESENTATION PURPOSE ONLY. FOR DETAILS REFER ELECTRICAL DRAWING.
  4. DETAILS FOR AIR WASHER ARE INDICATIVE.
- \* COLUMNS UPTO 47.5M FOR B-ROW & UPTO 50.0M FOR C-ROW.

| LEGENDS |                                          |
|---------|------------------------------------------|
|         | PIPE HATCH                               |
|         | VERTICAL BRACING                         |
|         | FIRE PROOF DOOR                          |
|         | GRATING                                  |
|         | CHECKERED PLATE                          |
|         | REMOVABLE                                |
|         | HAND RAILING                             |
|         | CABLE TRAY                               |
|         | FIRE BARRIER WALL                        |
|         | INDICATES PIPES/CABLE TRESTLE            |
|         | ROLLING SHUTTER                          |
|         | RAIL TRACK                               |
|         | PIPE TRENCH WITH PCC COVERED SAND FILLED |
|         | BRICK WALL                               |
|         | INDICATES PIPES/CABLE TRESTLE            |
|         | BUS DUCT                                 |
|         | WALK WAY                                 |
|         | CONCRETE                                 |
|         | OPENING FOR CABLE RISER                  |
|         | VENTILATION DUCT OPENING                 |

|             |                                                       |  |  |
|-------------|-------------------------------------------------------|--|--|
| CUSTOMER:   | GUJARAT STATE ELECTRICITY CORPORATION LTD             |  |  |
|             | VADODARA, GUJARAT                                     |  |  |
| CONSULTANT: | 1x800 MW Wanakbori Thermal Power Station Extn. Unit-8 |  |  |
|             | DEVELOPMENT CONSULTANTS PVT. LTD.                     |  |  |
|             | CONSULTING ENGINEERS                                  |  |  |
|             | KOLKATA MUMBAI CHENNAI NEW DELHI                      |  |  |
|             | BHARAT HEAVY ELECTRICALS LTD                          |  |  |
|             | POWER SECTOR                                          |  |  |
|             | PROJECT ENGINEERING MANAGEMENT                        |  |  |
|             | NOIDA                                                 |  |  |

| REV.                                                | DATE       | ALTD | CHD | APPD | REV. | DATE       | ALTD    | CHD     | APPD     | DEPT. NAME SIGN DATE |            |            |            |
|-----------------------------------------------------|------------|------|-----|------|------|------------|---------|---------|----------|----------------------|------------|------------|------------|
| 02                                                  | 28.05.2015 | WS   | RP  | BSA  | 01   | 21.03.2015 | WS Sd/- | RP Sd/- | BSA Sd/- | DEPT. NAME SIGN DATE | 11.12.2014 | 11.12.2014 | 11.12.2014 |
| 1. DRAWING REVISION IN LINE WITH CUSTOMER COMMENTS. |            |      |     |      |      |            |         |         |          | DEPT. NAME SIGN DATE | 11.12.2014 | 11.12.2014 | 11.12.2014 |
| 2. 2 Nos. ANY LOCATED AT EL.32.5M ROOF.             |            |      |     |      |      |            |         |         |          | DEPT. NAME SIGN DATE | 11.12.2014 | 11.12.2014 | 11.12.2014 |
| 3. INCH DUCT RELOCATED AT 6.0M FLOOR.               |            |      |     |      |      |            |         |         |          | DEPT. NAME SIGN DATE | 11.12.2014 | 11.12.2014 | 11.12.2014 |
| 4. DMCW TANK RELOCATED TO EL.35.5M.                 |            |      |     |      |      |            |         |         |          | DEPT. NAME SIGN DATE | 11.12.2014 | 11.12.2014 | 11.12.2014 |
| 5. OTHER CHANGES AS MARKED.                         |            |      |     |      |      |            |         |         |          | DEPT. NAME SIGN DATE | 11.12.2014 | 11.12.2014 | 11.12.2014 |

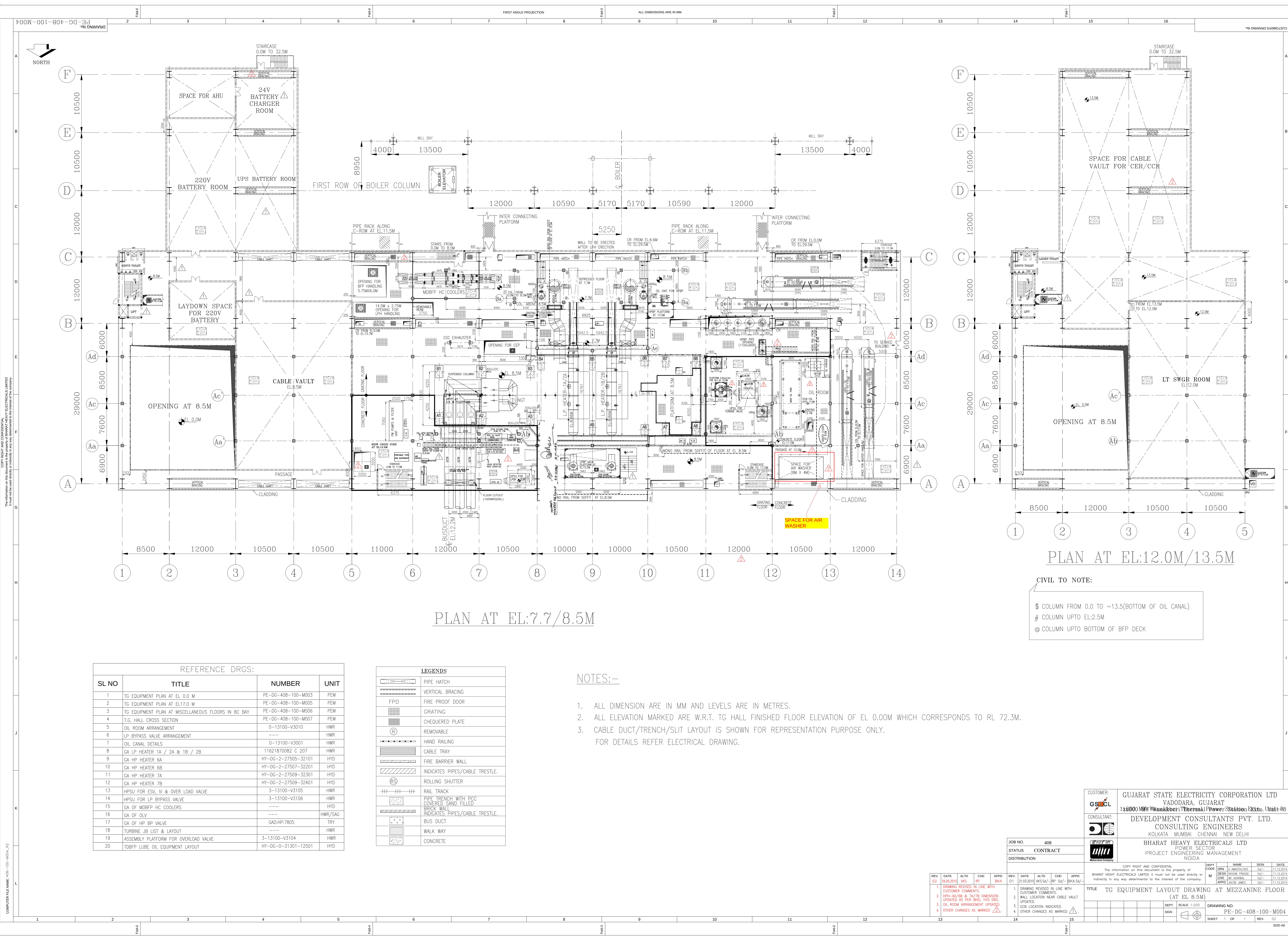
|                   |  |  |  |                                                                           |  |  |  |
|-------------------|--|--|--|---------------------------------------------------------------------------|--|--|--|
| TITLE             |  |  |  | TG EQUIPMENT PLAN AT MISCELLANEOUS FLOORS ABOVE OPERATING FLOOR IN BC BAY |  |  |  |
| DEPT. SCALE 1:250 |  |  |  | DRAWING NO. PE-DG-408-100-M006                                            |  |  |  |
| SIGN              |  |  |  | SHEET 1 OF 1 REV. 02                                                      |  |  |  |

531

PE-DG-408-100-M004-R2

COMPUTER FILE NAME: 408-100-M004-R2

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| REFERENCE DRGS: |                                                     |                     |         |
|-----------------|-----------------------------------------------------|---------------------|---------|
| SL NO           | TITLE                                               | NUMBER              | UNIT    |
| 1               | TG EQUIPMENT PLAN AT EL 0.0 M                       | PE-DG-408-100-M003  | PEM     |
| 2               | TG EQUIPMENT PLAN AT EL17.0 M                       | PE-DG-408-100-M005  | PEM     |
| 3               | TG EQUIPMENT PLAN AT MISCELLANEOUS FLOORS IN BC BAY | PE-DG-408-100-M006  | PEM     |
| 4               | T.G. HALL CROSS SECTION                             | PE-DG-408-100-M007  | PEM     |
| 5               | OIL ROOM ARRANGEMENT                                | 0-13100-V3010       | HWR     |
| 6               | LP BYPASS VALVE ARRANGEMENT                         | ---                 | HWR     |
| 7               | OIL CANAL DETAILS                                   | 0-13100-V3001       | HWR     |
| 8               | GA LP HEATER 1A / 2A & 1B / 2B                      | 11621870082 C 207   | HWR     |
| 9               | GA HP HEATER 6A                                     | HY-DG-2-27505-32101 | HYD     |
| 10              | GA HP HEATER 6B                                     | HY-DG-2-27507-32201 | HYD     |
| 11              | GA HP HEATER 7A                                     | HY-DG-2-27509-32301 | HYD     |
| 12              | GA HP HEATER 7B                                     | HY-DG-2-27509-32401 | HYD     |
| 13              | HPSU FOR ESV, IV & OVER LOAD VALVE                  | 3-13100-V3105       | HWR     |
| 14              | HPSU FOR LP BYPASS VALVE                            | 3-13100-V3106       | HWR     |
| 15              | GA OF MDBFP HC COOLERS                              | ---                 | HYD     |
| 16              | GA OF OLV                                           | ---                 | HWR/SAG |
| 17              | GA OF HP BP VALVE                                   | GAD:HP:7805         | TRY     |
| 18              | TURBINE JB LIST & LAYOUT                            | ---                 | HWR     |
| 19              | ASSEMBLY PLATFORM FOR OVERLOAD VALVE                | 3-13100-V3104       | HWR     |
| 20              | TDBFP LUBE OIL EQUIPMENT LAYOUT                     | HY-DG-0-31301-12501 | HYD     |

| LEGENDS |                                          |
|---------|------------------------------------------|
|         | PIPE HATCH                               |
|         | VERTICAL BRACING                         |
|         | FIRE PROOF DOOR                          |
|         | GRATING                                  |
|         | CHEQUERED PLATE                          |
|         | REMOVABLE                                |
|         | HAND RAILING                             |
|         | CABLE TRAY                               |
|         | FIRE BARRIER WALL                        |
|         | INDICATES PIPES/CABLE TRESTLE            |
|         | ROLLING SHUTTER                          |
|         | RAIL TRACK                               |
|         | PIPE TRENCH WITH RCC COVERED SAND FILLED |
|         | BRICK WALL                               |
|         | INDICATES PIPES/CABLE TRESTLE            |
|         | BUS DUCT                                 |
|         | WALK WAY                                 |
|         | CONCRETE                                 |

NOTES:-

- ALL DIMENSION ARE IN MM AND LEVELS ARE IN METRES.
- ALL ELEVATION MARKED ARE W.R.T. TG HALL FINISHED FLOOR ELEVATION OF EL 0.00M WHICH CORRESPONDS TO RL 72.3M.
- CABLE DUCT/TRENCH/SLOT LAYOUT IS SHOWN FOR REPRESENTATION PURPOSE ONLY.  
FOR DETAILS REFER ELECTRICAL DRAWING.

CIVIL TO NOTE:

- \$ COLUMN FROM 0.0 TO ~13.5(BOTTOM OF OIL CANAL)
- # COLUMN UPTO EL:2.5M
- @ COLUMN UPTO BOTTOM OF BFP DECK

|              |          |
|--------------|----------|
| JOB NO.      | 408      |
| STATUS       | CONTRACT |
| DISTRIBUTION |          |

| REV                                                                                                                                                                                  | DATE       | ALTD | CHD | APPD | REV | DATE       | ALTD | CHD | APPD |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------|-----|------|-----|------------|------|-----|------|
| 02                                                                                                                                                                                   | 28.05.2015 | WS   | RP  | BKA  | 01  | 21.03.2015 | WS   | RP  | BKA  |
| 1. DRAWING REVISED IN LINE WITH CUSTOMER COMMENTS.<br>2. HPH-6A/6B & 7A/7B DIMENSION UPDATED AS PER BHEL WTD DRG.<br>3. OIL ROOM ARRANGEMENT UPDATED.<br>4. OTHER CHANGES AS MARKED. |            |      |     |      |     |            |      |     |      |

|             |  |                                                                                                                         |  |  |  |
|-------------|--|-------------------------------------------------------------------------------------------------------------------------|--|--|--|
| CUSTOMER:   |  | GUJARAT STATE ELECTRICITY CORPORATION LTD<br>VADODARA, GUJARAT<br>18000 MW Wankhori Thermal Power Station Pktn. Unit-08 |  |  |  |
| CONSULTANT: |  | DEVELOPMENT CONSULTANTS PVT. LTD.<br>CONSULTING ENGINEERS<br>KOLKATA MUMBAI CHENNAI NEW DELHI                           |  |  |  |
|             |  | BHARAT HEAVY ELECTRICALS LTD<br>POWER SECTOR<br>PROJECT ENGINEERING MANAGEMENT<br>NOIDA                                 |  |  |  |

|                                                                                                                                                                                                                          |     |               |             |            |            |
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| DEPT                                                                                                                                                                                                                     | DRN | NAME          | SIGN        | DATE       |            |
| M                                                                                                                                                                                                                        | M   | RASHMI PRASAD | SA/-        | 11.12.2014 |            |
|                                                                                                                                                                                                                          |     | CHD           | BR. AGARWAL | SA/-       | 11.12.2014 |
|                                                                                                                                                                                                                          |     | APPD          | JACOB JAMES | SA/-       | 11.12.2014 |

|       |  |  |  |                                                                |  |  |  |
|-------|--|--|--|----------------------------------------------------------------|--|--|--|
| TITLE |  |  |  | TG EQUIPMENT LAYOUT DRAWING AT MEZZANINE FLOOR<br>(AT EL 8.5M) |  |  |  |
|       |  |  |  | DEPT. SCALE 1:200                                              |  |  |  |
|       |  |  |  | SIGN                                                           |  |  |  |
|       |  |  |  | DRAWING NO.                                                    |  |  |  |
|       |  |  |  | PE-DG-408-100-M004                                             |  |  |  |
|       |  |  |  | SHEET 1 OF 1                                                   |  |  |  |
|       |  |  |  | REV. 02                                                        |  |  |  |
|       |  |  |  | SIZE-A0                                                        |  |  |  |



