

- 6.05.06 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.
- 6.05.07 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.
- 6.05.08 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.
- 6.05.09 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.
- 6.06.00 **Noise & Vibration**
- 6.06.01 The noise level shall not exceed 85db (A) at 1.5 meters from the motor.
- 6.06.02 The peak amplitude of the vibration shall be within IS/IEC specified limits.
- 6.07.00 **Motor Terminal Box**
- 6.07.01 Motor terminal box shall be phase segregated (PSTB) type and located in accordance with Indian Standards clearing the motor base- plate/ foundation
- 6.07.02 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors and 90 Deg. for LT motors unless otherwise approved.
- 6.07.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.
- 6.07.04 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.
- 6.07.05 Motor main terminal box shall be located right hand side of motor body looking from driving end.
- 6.07.06 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.
- 6.07.07 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
- 6.07.08 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.

6.07.09 For 11000V, 6600V and 3300V motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.

6.07.10 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.

6.07.11 The gland plate for single core cable shall be non-magnetic type.

6.08.00 **Grounding**

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

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

HT Motor (11kV, 6.6kV & 3.3 kV) : 75 X 10 mm GS Flat

LT Motor above 90 KW : 50 x 6 mm GS Flat

Motor above 30 KW up to 90 KW : 35 x 6 mm GS Flat

Motor above 5 KW up to 30 KW : 25 x 3 mm GS Flat

Motor up to 5 KW : 8 SWG GI Wire

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

6.09.00 **Rating Plate**

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

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

7.00.00 **ACCESSORIES**

7.01.00 **General**

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

7.02.00 **Space Heater**

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

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

7.03.00 **Temperature Detectors**

7.03.01 All 11000V, 6600V and 3300V motors shall be provided with twelve (12) nos. simplex type winding temperature detectors, four (4) nos. per phase.

7.03.02 11000V, 6600V and 3300V motor bearing shall be provided with duplex type temperature detectors.

7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.

7.03.04 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DCS connectivity.

7.03.05 Five numbers of Temperature detectors / thermisters shall be provided for L.T. motors above 90 KW (3 nos. winding temperatures & 2 nos. bearing temperatures)

7.04.00 **Indicator/Switch**

7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:

- a) 11000 V, 6600V and 3300V motor bearing temperature.
- b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.

7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used.

7.04.03 Alarm switch contact rating shall be minimum 0.5 A at 220V D.C. and 5A at 240V A.C.

7.05.00 **Current Transformer for Differential Protection**

7.05.01 Motor 1000 KW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure. Loose 3 nos. CT for mounting on switchgear side shall be in bidder's scope.

7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.

7.06.00 **Accessory Terminal Box**

7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.

7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit cable connections.

7.07.00 **Drain Plug**

Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 **Lifting Provisions**

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

7.09.00 **Dowel Pins**

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

7.10.00 **Painting**

Motor including fan shall be painted with corrosion proof paints of colour battle ship grey shade 632 of IS-5.

8.00.00 **TESTS**

Routine and Type Tests are to be conducted in presence of customer's representative as per IS:325 and required copies of test certificates are to be furnished for approval. In addition, following tests shall have to be carried out on the motors in presence of OWNER's representative on 3.3kV/6.6kV/11kV motors.

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

Voltage rating of motor	Impulse Test Voltage
3.3 kV	18 kV peak
6.6 kV	31 kV peak
11 kV	49 kV peak

- b. Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test.

- c. Polarization Index Test as per IS:7816 as routine test

- d. Test for suitability of IPW– 55(Weather proof) as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test, provided the test motor is identical to motor being supplied.

Second numeral test shall be carried out on one motor of each type and rating.

- e. Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box.
- f. Test for noise level as routine test.
- g. Test for vibration as routine test.
- h. Tan delta measurement on coils.
- i. Surge withstand test for inter turn insulation.
- j. Test to diagnose rotor bar failure during manufacture.

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

9.00.00 **DRAWINGS, DATA & MANUALS**

Drawings, data & manuals for the motors shall be submitted as indicated below:

9.01.00 **Along with the bid**

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

9.02.00 **After Award of the Contract**

- a) Dimensional General Arrangement drawing
- b) Foundation Plan & Loading
- c) Cable end box details
- d) Space requirement for rotor removal
- e) Thermal withstand curves hot & cold
- f) Starting and speed torque characteristics at 80% & 100% voltage
- g) Complete motor data
- h) Erection & Maintenance Manual
- i) Test reports

j) Data sheets to be enclosed


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**ANNEXURE-A
DESIGN DATA**

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.T. Supply	11000 V, 3Ø, 3W, 50 Hz, non-effectively earthed Fault level 40 KA symm.	Motors above 2000 KW & all mill motors
	3300 V, 3Ø, 3W, 50 Hz, non-effectively earthed	Motors above 160 KW upto and including 2000KW
	6600 V, 3Ø, 3W, 50 Hz, non-effectively earthed Fault level 40 KA symm.	All Motors of CHP system and Water System
L.T. Supply	415V, 3Ø, 3W, 50 Hz effectively earthed Fault level 50 KA symm.	Motors upto and including 160KW
	240V, 1Ø, 2W, 50 Hz effectively earthed	Lighting, space heating, A.C. control & protective devices
D.C. Supply	220V, 2W, unearthed Fault level 25* KA.	D.C. alarm, control & protective devices

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

2.0 RANGE OF VARIATION

A.C. Supply :

Voltage : $\pm 10\%$ Frequency : $\pm 5\%$ Combined Volt : 10% (absolute sum)
+ frequency

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

D.C. Supply :

Voltage : 187 to 242 Volt


S.D. KHAN
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MUKESH K. SINGH

VOLUME : IIF/1

SECTION-III

**TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS**

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	STANDARDS
3.00.00	SERVICE CONDITIONS
4.00.00	RATING
5.00.00	PERFORMANCE
6.00.00	SPECIFIC REQUIREMENT
7.00.00	TEST
8.00.00	DRAWINGS, DATA & MANUALS


S.A. KHAN
MUKESH K. SINGH

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

8.00.00 TEST

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

9.00.00 DRAWINGS, DATA & MANUALS

9.01.01 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.



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

Signature
S.A. KHAN
MUKESH K.S. SINGH



TITLE :
GENERAL TECHNICAL REQUIREMENTS
FOR
LV MOTORS

SPECIFICATION NO.
PE-SS-999-506-E101
VOLUME NO. : **II-B**
SECTION : **D**
REV NO. : **00** DATE : 29/08/2005
SHEET : 1 OF 4

1.0 INTENT OF SPECIFICATION

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

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

2.0 CODES AND STANDARDS

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

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

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

3.0 DESIGN REQUIREMENTS

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

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

3.3 Starting Requirements

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

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



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.
PE-SS-999-506-E101
VOLUME NO. : **II-B**
SECTION : **D**
REV NO. : **00** DATE : 29/08/2005
SHEET : 2 OF 4

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

- i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.
- ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)
- iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 **Stress During bus Transfer**

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 **CONSTRUCTIONAL FEATURES**

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

Signature
S.A. KHAN
S.A. KHAN
MUKESH K.S. SINGH



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.
PE-SS-999-506-E101
VOLUME NO. : **II-B**
SECTION : **D**
REV NO. : **00** DATE : 29/08/2005
SHEET : 3 OF 4

- 4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.
- 4.5. Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.
- 4.6. In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.
- 4.7. **Terminals and Terminal Boxes**
- 4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".
- 4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.
- 4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.
- 4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.
- 4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.
- 4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.
- 4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.
- 4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.
- 4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.
- 4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.9 **General**



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.
PE-SS-999-506-E101
VOLUME NO. : **II-B**
SECTION : **D**
REV NO. : **00** DATE : 29/08/2005
SHEET : 4 OF 4

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

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

LT MOTORS

A. GENERAL

1. Manufacturer & Country of origin.
(Shall be as per approved QA make)

2. Equipment driven by motor

3. Motor type

4. Quantity

B. DESIGN AND PERFORMANCE DATA

1. Frame size

2. Type of duty

3. Type of enclosure /Method of cooling/Degree of protection

4. Applicable standard to which motor generally conforms

5. Efficiency class as per IS 12615

6. (a) Whether motor is flame proof Yes/No

(b) If yes, the gas group to which it conforms as per IS:2148

7. Type of mounting

8. Direction of rotation as viewed from DE END__

9. Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW)

10. Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)

11. Maximum continuous load demand of driven equipment in KW

12. Rated Voltage (volts)

13. Permissible variation of :

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

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

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

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 20-11-2010

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

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

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

C. CONSTRUCTIONAL FEATURES

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

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

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

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

4. Insulation of bearing (Yes/No)

5. Noise reducer(Yes/No)

6. Grounding pads

i) No and size on motor body

ii) Nos on terminal Box

7. Vibration pads

i) Nos and size

ii) Location

8. Any other fitments

E. **List of curves.**

1. Torque speed characteristic of the motor

2. Thermal withstand characteristic

3. Starting. current Vs. Time

4. Starting. current Vs speed

5. P.F. and Effi. Vs Load

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

1. Rated armature voltage (Volt)

2. Rated field excitation (Amp)

3. Permissible % variation in voltage

4. Minimum Permissible Starting voltage (volt)

5. At rated voltage

i) Full load Armature current.(Amp)

ii) Full load Field current (Amp)

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

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

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

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

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

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


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 20-11-2010

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			



MUKESH K. SINGH **S.A. KHAN** **20-MAY-20**

		QUALITY PLAN		CUSTOMER/ GSECL		PROJECT TITLE		1 X 800 MW WANAKBORI TPS		SPECIFICATION : NUMBER :	
COMPONENT/OPERATION		SHEET 1 OF 9		BIDDER/ VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SPECIFICATION : TITLE	
SL. NO.	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION		VOLUME III	
								P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10		11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL										
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	MA	VISUAL	100%	-		FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-
		MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC		MANFR'S DRG./SPEC	-DO-	3	-	-
		MA	MECH. TEST	-DO-	-DO-		INSPEC. REPORT		3	-	2
1.2	HARDWARES	MA	VISUAL	100%			FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-
		MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK		RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2
		MA	VISUAL	100%			FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2
1.3	CASTING	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC		RELEVANT IS/	SUPPLIER'S TC	3	-	2
		MA	MEASUREMENT	100%	MANUFR'S DRG.		MANUFR'S DRG.	LOG BOOK	3	-	2
1.4	PAINT & VARNISH	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC		MANFR'S DRG./SPEC	LOG BOOK	3	-	2
											HEAT NO. SHALL BE VERIFIED
BHEL											
PARTICULARS											
NAME											
SIGNATURE											
DATE											
BIDDER/VENDOR											
BIDDER'S/VENDORS COMPANY SEAL											




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		CUSTOMER: GSECL		PROJECT TITLE		1 X 800 MW WANAKBORI TPS		SPECIFICATION : NUMBER :	
QUALITY PLAN		BIDDER/ VENDOR		QUALITY PLAN		NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE	
SHEET 2 OF 9		SYSTEM		EXTENT OF CHECK		REFERENCE DOCUMENT		ACCEPTANCE NORM	
COMPONENT/OPERATION		CHARACTERISTIC CHECK		TYPE/ METHOD OF CHECK		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		FORMAT OF RECORD	
SL. NO.		CAT.		4		5		6	
1		2		3		4		5	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.		MA	VISUAL	100%	-	7	8
		2. CHEM. & PHYSICAL PROPERTIES		MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	9	10
		3. DIMENSIONS		MA	MEASUREMENT	100%	-DO-	11	
		4.INTERNAL FLAWS		CR	UT	-DO-	ASTM-A388		
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING		MA	VISUAL	-DO-	MANUF'R'S DRG. SPEC.	3	2
		2. PHYSICAL COND.		MA	-DO-	-DO-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	3	2
		3.DIMENSIONS (WHEREVER APPLICABLE)		MA	MEASUREMENT	SAMPLE	MANUF'R'S DRG./ SPEC.	3	2
		4.PERFORMANCE/ CALIBRATION		MA	TEST	100%	-DO-	INSP. REPORT	3
BHEL		PARTICULARS		BIDDER/VENDOR					
		NAME							
		SIGNATURE							
		DATE							




MUKESH K. SINGH **S.A. KHAN** **20-MAY-20**

		QUALITY PLAN		CUSTOMER/	GSECL	PROJECT		SPECIFICATION :	
						1 X 800 MW WANAKBORI TPS		NUMBER :	
						TITLE		SPECIFICATION :	
						QUALITY PLAN		TITLE	
						NUMBER PED-506-00-Q-007, REV-03		SECTION	
						ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		VOLUME III	
						REFERENCE DOCUMENT		AGENCY	
						ACCEPTANCE NORM		P	
						FORMAT OF RECORD		W	
								V	




MUKESH K. SINGH **S.A. KHAN** **20-MAY-20**

		QUALITY PLAN		CUSTOMER/ GSECL		PROJECT TITLE		1 X 800 MW WANAKBORI TPS		SPECIFICATION : NUMBER :			
COMPONENT/OPERATION		SHEET 4 OF 9		BIDDER/ VENDOR SYSTEM		QUALITY PLAN		NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE			
		CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY	VOLUME III REMARKS			
SL. NO.													
1	2	3	4	5	6	7	8	9	10	11			
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2		
		1.MAKE & TYPE	MA	VISUAL	100%	MANUF'S DRG./ APPROVED DATASHEET	MANUF'S DRG./ APPROVED DATASHEET	-DO-	3	-	2		
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2		
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2		
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-		
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-		
		3.TEMP WITH- STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2		
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2		
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-		
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-		
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-		
BHEL		PARTICULARS		BIDDER/VENDOR									
		NAME											
		SIGNATURE											
		DATE											
										BIDDER'S/VENDORS COMPANY SEAL			

10

MURKIN KQ. SINGH H

3.4-12192

1-800-4-A-FLY

			QUALITY PLAN		CUSTOMER/ GSECL		PROJECT TITLE		1 X 800 MW WANAKBORI TPS		SPECIFICATION : NUMBER :	
SHEET 5 OF 9			BIDDER/ VENDOR		QUALITY PLAN		SPECIFICATION : TITLE		SPECIFICATION : TITLE		SPECIFICATION : TITLE	
			SYSTEM CAT.		EXTENT OF CHECK		REFERENCE DOCUMENT		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	TYPE/ METHOD OF CHECK	5	6	7	8	9	10		11	
1	2	3	4	5	6	7	8	9	10		11	
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ ASTM-E165	MANUF'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANF'S SPEC/BHEL SPEC./ SAME AS RELEVANT STAND	BHEL SPEC. SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE									
					BIDDER/VENDORS COMPANY SEAL							



MUKESH K. SINGH

Signature

S.A. KHAN

20-MAY-20

QUALITY PLAN SHEET 6 OF 9		CUSTOMER/	GSECL	PROJECT		SPECIFICATION :					
		BIDDER/ VENDOR		TITLE		NUMBER :					
COMPONENT/OPERATION		SYSTEM		QUALITY PLAN		TITLE					
SL. NO.	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION	VOLUME III		
									AGENCY	REMARKS	
1	2	3	4	5	6	7	8	9	10	11	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUF'R'S SPEC.	MANUF'R'S SPEC.	Log Book	2	-	-
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-
		3.CORE LOSS & HOT/SPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUF'R'S SPEC./BHEL SPEC.	MANUF'R'S SPEC./BHEL SPEC.	Log Book	2	-	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1
2.6	IMPREGNATION	4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1
		1.VISCOSCTY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-
		2.TEMP. PRESSURE VACUUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1
BHEL		PARTICULARS		BIDDER/VENDOR							
		NAME									
		SIGNATURE									
		DATE									




MUKESH K. SINGH **S.A. KHAN** **20-MAY-20**

			CUSTOMER/ VENDOR		GSECL		PROJECT TITLE		1 X 800 MW WANAKBORI TPS		SPECIFICATION : NUMBER :	
QUALITY PLAN			BIDDER/ VENDOR				QUALITY PLAN				SPECIFICATION : TITLE	
			SYSTEM				NUMBER PED-506-00-Q-007, REV-03				VOLUME III	
SHEET 7 OF 9			CAT.		TYPE/ METHOD OF CHECK		EXTENT OF CHECK		REFERENCE DOCUMENT		SECTION AGENCY	
CHARACTERISTIC CHECK									ACCEPTANCE NORM		FORMAT OF RECORD	
REMARKS												
SL. NO.			COMPONENT/OPERATION									
1			2		3		4		5		6	




MUKESH K. SINGH **S.A. KHAN** **20-11-2022**

		CUSTOMER: GSECL		PROJECT TITLE		1 X 800 MW WANAKBORI TPS		SPECIFICATION : NUMBER :		
QUALITY PLAN		BIDDER/ VENDOR		QUALITY PLAN		NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION :		
SHEET 8 OF 9		SYSTEM		EXTENT OF CHECK		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		TITLE		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY	VOLUME III REMARKS
1	2	3	4	5	6	7	8	9	10	11
3.0	TESTS	1. TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC. 2. ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC. 3. VIBRATION & NOISE LEVEL 4. OVERALL DIMENSIONS AND ORIENTATION 5. DEGREE OF PROTECTION 6. MEASUREMENT OF RESISTANCE OF RTD & BTD 7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER 8. NAMEPLATE DETAILS 9. EXPLOSION FLAME PROOF NESS (IF SPECIFIED) 10. PAINT SHADE, THICKNESS & FINISH	MA	ELECT. TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2 1* 1	* NOTE - 1
			MA	-DO-	100%	-DO-	-DO-	-DO-	2 1\$ 1	\$ NOTE - 2
			MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2 1\$ 1	\$ NOTE - 2
			MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2 1 -	
			MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2 - 1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
			MA	-DO-	100%	-DO-	-DO-	-DO-	2 1\$ 1	\$ NOTE - 2
			MA	-DO-	100%	-DO-	-DO-	-DO-	2 1\$ 1	\$ NOTE - 2
			MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2 1\$ 1	\$ NOTE - 2
			MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2 - 1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
			MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2 1\$ 1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY \$ NOTE - 2
BHEL		PARTICULARS		BIDDER/VENDOR						
		NAME								
		SIGNATURE								
		DATE								
		BIDDER'S/VENDORS COMPANY SEAL								

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S.A. KHAN
20-11-2020

		CUSTOMER : GSECL		PROJECT TITLE : 1 X 800 MW WANAKBORI TPS		SPECIFICATION : NUMBER :				
QUALITY PLAN		BIDDER/ VENDOR :		QUALITY PLAN		SPECIFICATION : TITLE				
		SYSTEM		NUMBER PED-506-00-Q-007, REV-03		SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	REMARKS
									P W V	
1	2	3	4	5	6	7	8	9	10	11
NOTES: 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED. 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON. 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED. 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY										
BHEL		PARTICULARS		BIDDER/VENDOR						
		NAME								
		SIGNATURE								
		DATE								
						BIDDER'S/VENDORS COMPANY SEAL				


MUKESH K. SINGH
Signature
S.A. KHAN
Signature

QUALITY PLAN		BIDDER/ VENDOR		SYSTEM		QUALITY PLAN		SPECIFICATION :			
SHEET 1 OF 2		VENDOR		CAT.		NUMBER PED-506-00-Q-006, REV-01		NUMBER :			
SL. NO.	COMPONENT/OPERATION CHARACTERISTICS CHECK	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY	VOLUME III	REMARKS		
1	2	3	4	5	6	7	8	9	10		
1.0	ASSEMBLY	1.WORKMANSHIP 2.DIMENSIONS 3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL -DO- VISUAL	100% -DO- 100%	MANUF'S SPEC MFG. DRG./ MFG. SPEC. MFG.SPEC./ RELEVANT IS	MANUF'S SPEC MFG. DRG./ MFG. SPEC. MFG.SPEC. RELEVANT IS	-DO- -DO- -DO-	2 2 2	- - -	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUF'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC. 2.OVERALL DIMENSIONS & ORIENTATION	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1	NOTE -1 & NOTE-3
			MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	NOTE -1 & NOTE-3
BHEL		PARTICULARS		BIDDER/VENDOR							
		NAME									
		SIGNATURE									

Signature
SHRI K. SINGH
 CUSTOMER GSECL
 PROJECT 1 X 800 MW WANAKBORI TPS
 S.A. - KANAK
Signature

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

ANNEXURE-I

SUB-VENDOR LIST

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

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

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


S.A. KHAN

MUKESH K.S. SINGH

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ANNEXURE-II

ANNEXURE III

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5.4-1618N
5.4-1618N

11/11/2011
 11/11/2011

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

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

One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).

The cables shall be described as per the scheme listed below:

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

(A) SYSTEM VOLTAGE CODES:

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

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

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

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

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

(C) CABLE CODES

PVC Copper

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

PVC Aluminium

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

XLPE Copper

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

XLPE Aluminium

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

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



**1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
TECHNICAL SPECIFICATION
(C&I PORTION)**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME: II B

SECTION : C-4

REV. 00

**SECTION: C-4
TECHNICAL SPECIFICATION (C&I PORTION)**

Signature
S.A. KHAN
MUKESH K.S. SINGH

Signature
S.A. KHAN
20.11.15

Signature
S.A. KHAN
20.11.15

Signature
S.A. KHAN
20.11.15

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I												
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)													
CONTROL AND INSTRUMENTATION SPECIFICATION FOR AC SYSTEM <table border="1"><tr><td>DESIGN</td><td>VKV</td></tr><tr><td>CHECKED</td><td>SCS</td></tr><tr><td>APPROVED</td><td>SCS</td></tr><tr><td>DATE</td><td>12.10.15</td></tr><tr><td>REV.</td><td>00</td></tr><tr><td></td><td></td></tr></table>			DESIGN	VKV	CHECKED	SCS	APPROVED	SCS	DATE	12.10.15	REV.	00		
DESIGN	VKV													
CHECKED	SCS													
APPROVED	SCS													
DATE	12.10.15													
REV.	00													

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

TABLE OF CONTENTS

- A. General & Specific Technical requirement
- B. C&I deliverables list
- C. Specification for Motorized valve actuator
- D. Specification for field instruments
- E. PLC specification
- F. Control panels specification
- G. Drive control philosophy
- H. Applicable codes and standards
- I. Specification for Quality assurance & Testing
- J. Mandatory spares
- K. Drawings

MUKESH K. SINGH
 S.A. KHAN
 S. A. KHAN

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
GENERAL & SPECIFIC TECHNICAL REQUIREMENT		

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

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

GENERAL REQUIREMENT

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

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

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

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

5.0 In case of any contradiction most stringent clause/condition shall prevail.

MUKESH K. SINGH
 S.A. - ICHN
 20-11-2018

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

Specific Technical Requirements (C&I):

The control of Air Conditioning System plant shall be through PLC based control system having hot redundant Central Processing Unit. The control of Ventilation system shall also be through the above PLC. The operation and control philosophy of AC and Ventilation has been elaborated in separate section in the specification. The PLC for the AC & Ventilation system shall be located in control room in AC plant.. One (1) nos. OWS (Operator Works Station) and one(1) no. OEWS (Operator cum Engineering Work Station) with 24" colour TFT monitor ,one (01) no. A3 size color laser printer, keyboard, mouse etc. shall be provided by the bidder. OWS/EWS shall be provided with anti-glare coating. AC plant of service building and equipments of AHU room of ESP VFD building shall be controlled from the above PLC through Remote I/O panel, located in the respective areas. Bidder to include necessary PLC hardware & software for Ventilation system also in his scope. Equipments of Ventilation system such as Air Washers Unit in Power house building, UAF of ESP control rooms etc. shall be controlled from the above PLC. Bidder to also include in his scope the supply of local control panels for operation & control of each AHUs and each Air washers. Microprocessor based systems of screw chilling machines shall be interfaced with PLC system through soft link in addition to hardwired connectivity so that all parameters of the machine are available in PLC. The Remote I/O panel shall be suitable for working in Non-AC environment. In addition to OWS operation, 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 system. The Complete PLC based control system with OWS, Laptop, Remote I/Os, Printer, desk along with furniture shall be in Bidder's scope. PC for OWS shall be of workstation grade. Additional laptop loaded with engineering software shall be provided.

2) The communication between PLC and Main plant DCS shall be OPC compliant (Data Access 2.0) TCP/IP on Fibre Optic link. The communication link between PLC and Main plant DCS shall be redundant. The necessary hardware/software including LIU (Light Interface unit) at PLC end shall be in Bidder's scope. Repeaters, if required for interfacing shall also be provided by the bidder. For communication between main plant DCS and PLC, the PLC end shall be considered as server and DCS shall be considered as client.

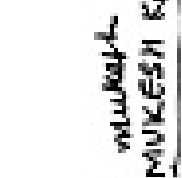
3) PLC control system shall be time synchronized with the Master clock system of the main plant to ensure uniform time indication throughout the Plant. The required provision (IRIG-B) shall be made by the bidder at the PLC end to achieve the same.

4) The software and hardware for offered PLC system shall be of latest version and shall be upgradable. Bidder to ensure the availability of spares and

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 20-11-2018

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
service support for the offered PLC system for minimum 20 years after guarantee period. The software tool shall have facility to interface with third party software packages. Easy up gradation and future expansion facility shall be available. All softwares used shall be licensed versions only. All software user licenses shall be valid for entire life of power plant and shall be in the name of customer. User shall not have to pay any recurring license fee during the usage period of the system. It shall be possible to upgrade the installed system with the latest available version of the software model during the plant life. 5) All electrical actuators shall be non-integral type. 6) The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with. 7) The solenoid valves shall have limit switches for open/close feedback. 8) Interface of MCC, HT SWGR, Actuators etc. with PLC based control system shall be as per Drive Control Philosophy attached in the specification. The attached philosophy is for DCS based control system. However, the same is applicable for PLC as well. 9) All the instruments/drives shall be terminated on JBs/Panels in field. JBs/Panels shall be in Bidder's scope. RTD's shall be of duplex type. 10) Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification. Any cable in Bidder's scope shall be as per specification. 11) Redundant 230 VAC UPS feeders shall be provided by BHEL at a single point. Further distribution to various instruments/PLC/RIO/OWS/ etc. shall be in Bidder's scope. Bidder to include necessary power distribution board (ACDB) (as per details attached elsewhere in this specification) in his scope. Any power supply other than the above, if required by any instrument/device, has to be derived by the Bidder from the above supply and all necessary hardware for the same shall be in bidder's scope. Bidder to furnish UPS power requirement along with the bid. 12) Bidder shall provide Customer training on the proper application		


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	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

and maintenance of PLC Hardware & Software at Vendor's work or at Wanakbori site.

13) Following documents to be furnished by the bidder along with the bid:

- Proposed PLC system configuration drawing with write-up
- Duly stamped and signed copy of Quality Plan.
- Product catalogues and specifications for PLC as well as HMI application.
- Requirement of electronic earthing, if any, for PLC based control system

14) Ergonomically & aesthetically designed furniture viz. control desks & Chairs shall be provided for workstations, programming stations, PCs and various peripherals at control room/computer room/equipment room. Furniture shall include documentation racks, tables for laydown etc. Control Desk profile shall be in line with drawing K9213R-DWG-I-0161.

15) Bidder to comply with codes and standards as mentioned in the specification.

16) All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible.

17) Bidder to delegate /depute their persons/experts as per owner/consultants' requirement.

18) Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system.

19) The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.


 S.A. KHAN
 S.A. KHAN
 MUKESH K. SINGH

1.00.00 GENERAL

1.01.00 In conformity with the guidelines provided in the specification, the scope of works shall completely cover all Instrumentation & Control equipment, functions, activities and documentation specified under the accompanying Technical Specifications and shall not be limited to the following:

- a) Detailed design and engineering of the manufactured equipment; system integration and system engineering.
- b) Complete manufacture including shop testing before shipment.
- c) Specifying, procurement, quality inspection of bought-out items from sub-suppliers. Design co-ordination for and integration with bought-out items.
- d) Coordination, integration and interface between various BOP control systems such as Water Pretreatment plant, Demineralized Water plant, Coal Handling Plant, Ash Handling Plant, ETP etc. and the station DCS for centralized monitoring & selective operation.
- e) Providing engineering drawings, documents, licensed copy of software and developmental tools, data, instruction, operation and maintenance manual etc. for Owner's review / approval / record.
- f) Arranging for Owner's inspection and testing of manufactured as well as bought-out items at the respective works.
- g) Packaging and transportation of instruments, equipments, accessories and erection hardware from the manufacturer's works to the site, including transit insurance.
- h) Pre-assembly (if any), erection, testing and commissioning of all equipments and instruments supplied, in totality.
- i) Performing availability tests, Performance and Guarantee tests.
- j) Prepare and submit approved & as-built drawings and documents in hard and soft copies.
- k) Furnishing of spares, tools and tackle and test instruments.
- l) Fulfilling post-commissioning liabilities.
- m) Arranging for the training of Owner's personnel of different categories at manufacturer's works as well as plant site.
- n) Other activities detailed in subsequent sections of the Specification.
- o) Any other activity, not mentioned explicitly, but felt essential by Bidder for successful completion of work.

1.02.00 Requirements enumerated in this specification are qualitative in nature and are based on typical configuration of various BOP plants for the purpose of bidding. It shall be the responsibility of Bidder to offer Instrumentation &

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;

- e) Turbine Oil Purification system;
- f) ETP Plant;
- g) Ash Handling Plant;
- h) Fire sensing and protection system;
- i) Compressed air system;
- j) AC & Ventilation System.

1.05.03 Off Site Plants shall be operated from their local control stations located in the respective plant local control rooms. Some of the Plants shall have limited operational facility from Central Control Room as well.

1.05.04 All PLC based based control systems for plant auxiliaries and other offsite plants shall be powered from separate redundant UPS. Local control panels for such systems shall be kept in air condition environment.

~~1.05.05 Control matrix for the Auxiliary system & off-site systems shall be in general as below:~~

SL. NO.	AUX.SYSTEM / PLANT	CONTROL SYSTEM	CONTROL LOCATION	DCS INTERFACE
A.	Plant Auxiliaries System			
a)	~~DM Cooling Water System (Turbine)~~	~~DCS~~	~~DCS Monitoring & Operation from Central Control Room~~	
b)	~~DM Cooling Water System (Boiler)~~	~~DCS~~	~~DCS Monitoring & Operation from Central Control Room~~	
c)	~~CW system~~	~~Through Remote I/O Cabinet to DCS~~	~~DCS Monitoring & Operation from Central Control Room~~	
d)	~~ACW system~~	~~Through Remote I/O Cabinet to DCS~~	~~DCS Monitoring & Operation from Central Control Room~~	
e)	~~Condenser tube cleaning system~~	~~PLC~~	~~Local operating panel.~~	~~Hardware connectivity for alarm and monitoring.~~
f)	~~Mill Reject Handling~~	~~Redundant PLC~~	~~Operator stations in local~~	~~MODBUS Soft link for remote~~

SL. NO.	AUX. SYSTEM / PLANT	CONTROL SYSTEM	CONTROL LOCATION	DCS INTERFACE
			~~Control Room~~	~~monitoring~~
f)	~~Instrument Air & Service Air Compressors & air drying plant~~	~~Microprocessor based control for each compressor with master controller~~	~~Individual unit with operator interface & PC based master Operating Staion with 24" TFT monitor in Compressor Room.~~	~~MODBUS Soft link for remote monitoring~~
g)	~~Fire sensing and protection system for Entire Plant.~~	~~Microprocessor based Intelligent Detectors & PLC based Fire Water Pump control System~~	~~Microprocessor based Main Fire Alarm Panel in Control Room & Local panel in Fire Water Pump House. One repeater Fire Alarm Panel in existing Fire Station and depending on distance cabling interface shall be decided by Bidder.~~	~~Hard wired interface to DCS for monitoring and status indication.~~
h)	~~Pretreatment Plant~~	~~Redundant PLC~~	~~Within the boundary limit of PTPlant~~	~~MODBUS Soft link for remote monitoring~~

~~NOTE: As per concept of integration of control system Bidder may consider propriatary control systems as integrated part of DCS.~~

1.05.06 Considering the high ambient noise and electromagnetic interference prevailing in power plant, communication links between off-site controls and plant DCS shall be based on Optical Fiber Communication (OFC) alog with necessary hardware at both ends.

2.00.00 DESIGN PHILOSOPHY

2.01.00 General design philosophy outlined in Vol IIE Section 1 of the specification shall apply to plant auxiliaries as well.

2.02.00 PLC systems shall be time synchronized with the GPS Master Clock. Bidder shall arrange for the necessary ports ans cable for the purpose as well.

3.00.00 INSTRUMENT & SYSTEM PHILOSOPHY

3.01.00 Fuel Oil Pressurising & Heating System

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 8 of 17
	TECHNICAL REQUIREMENTS (C&I)	
C&I DELIVERABLES LIST		

MUKESH K. SINGH
S.A. KHAN
2011-01-12



 MUKESH K. SINGH S.A. - KPMG 2011-11-11

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT						
1X800 MW WANAKBORI TPP						
DOCUMENT NUMBER PE-GL-408-145-1100						
SI.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY	CUSTOMER	FROM	REMARKS
INSTRUMENTATION						
1	PE-V9-408-XXX-1901	INSTRUMENT DATA SHEETS	A	-	VENDOR	C&I
2	PE-V9-408-XXX-1902	INSTRUMENT SCHEDULE	I	-	VENDOR	C&I
3	PE-V9-408-XXX-1903	INSTRUMENT INSTALLATION/HOOK UP DIAGRAMS	A	-	VENDOR	C&I
4	PE-V9-408-XXX-1904	FIELD JB TERMINATIONS /GROUPING DOCUMENT	I	-	VENDOR	C&I
5	PE-V9-408-XXX-1905	QUALITY PLANS (CV,FE, Tx and Analyser)	A	-	VENDOR	C&I
PLC PANEL						
1	PE-V9-408-XXX-1906	PLC CONFIGURATION DRAWING	A	A	VENDOR	C&I
2	PE-V9-408-XXX-1907	PLC PANEL GA (INTERNAL & EXTERNAL) DRAWING	A	-	VENDOR	C&I
3	PE-V9-408-XXX-1908	CONTROL SCHEMES (BLOCK LOGIC)	A	-	VENDOR	C&I
4	PE-V9-408-XXX-1909	PLC INPUT / OUTPUT SIGNAL LIST	I	-	VENDOR	C&I
5	PE-V9-408-XXX-1910	UPS BATTERY CHARGER/ BATTERY DATASHEET & SLD	I	\$\$	VENDOR	C&I
6	PE-V9-408-XXX-1911	UPS SIZING CALCULATIONS	I	-	VENDOR	C&I
7	PE-V9-408-XXX-1912	BATTERY SIZING CALCULATIONS	I	-	VENDOR	C&I
8	PE-V9-408-XXX-1913	CONTROL DESK LAYOUT / GA DRAWING	A	-	VENDOR	C&I
9	PE-V9-408-XXX-1914	PLC-OWS/PRINTER FURNITURE BOM	A	-	VENDOR	C&I
10	PE-V9-408-XXX-1915	PLC CONTROL ROOM LAYOUT DRAWING	A	-	VENDOR	C&I
11	PE-V9-408-XXX-1916	PLC CATALOGUE	I	-	VENDOR	C&I
12	PE-V9-408-XXX-1917	PLC QUALITY PLAN & FAT PROCEDURE	A	-	VENDOR	C&I
13	PE-V9-408-XXX-1918	LIST OF SIGNAL EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE IN BHEL FORMAT)	A	-	VENDOR	C&I
14	PE-V9-408-XXX-1919	PROCESS GRAPHIC MANUSCRIPTS PLC	I	-	VENDOR	C&I
15	PE-V9-408-XXX-1920	PROCESS GRAPHIC MANUSCRIPTS FOR DDCMIS	I	-	VENDOR	C&I
16	PE-V9-408-XXX-1921	CABLE SCHEDULE (IN BHEL EXCEL FORMAT) & CABLE INTERCONNECTION DETAILS	I	-	VENDOR	C&I
17	PE-V9-408-XXX-1923	PANEL & ELECTRONIC EARTHING REQUIREMENT	I	-	VENDOR	C&I
18	PE-V9-408-XXX-1924	PANEL HEAT DISSIPATION DATA	I	-	VENDOR	C&I
19	PE-V9-408-XXX-1925	MANDATORY SPARES BILL OF MATERIAL	A	A	VENDOR	C&I
20	PE-V9-408-XXX-1926	PLC O & M MANUAL	I	-	VENDOR	C&I
21	PE-V9-408-XXX-1927	PLC EARTHING SCHEME	I	-	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						

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 9 of 18
	TECHNICAL REQUIREMENTS (C&I)	

SPECIFICATION FOR MOTORISED VALVE ACTUATOR

SPECIFICATION FOR MOTORISED VALVE ACTUATOR

MUKESH K. SINGH
S.A. ILMAN
D. M. M. A. S.



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 1

OF 3

Data Sheet A & B

DATA SHEET-A
(TO BE FILLED BY PURCHASER)

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

408

GENERAL*	* PROJECT		
	OFFER REFERENCE		
	* TAG NO. SERVICE		
	* DUTY	☐ ON / OFF	☐ INCHING
	* LINE SIZE (inlet/outlet): MATERIAL		
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY	
	* OPENING / CLOSING TIME		
	* WORKING PRESSURE		
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%	
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY	
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY	
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY	
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, 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 FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.	
HANDWHEEL	* REQUIRED	☒ YES ☐ NO	
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED	
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.		
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY	
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY	
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT- INCLUSIVE OF I.S. TOLERANCE	
	ACTUATOR APPLICABLE WIRING DIAGRAM	☒ ENCLOSED (BIDDER TO CONFIRM) A: ☐ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ☐ DRG. NO. 3-V-MISC-24283 R00 D: ☒ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram	
	COLOUR SHADE	☐ BLUE (RAL 5012) ☐ (TO BE DECIDED BY BHEL DURING DETAIL ENGG.)	
	PAINT TYPE (## Refer Notes)	☐ ENAMEL ☐ EPOXY ☐ (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)

408

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



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 3

OF 3

Data Sheet A & B

DATA SHEET-A
(TO BE FILLED BY PURCHASER)

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

408

LIMIT SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY					
	OPEN : INT : CLOSE	☐ 1 No ☒ 2 Nos.	2 Nos. (ADJ.)	☐ 1 No. ☒ 2 Nos.			
	CONTACT TYPE	2 NO + 2 NC					
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC					

POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	☒ REQUIRED ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☒ ELECTRONIC (2 WIRE) R/I CONVERTER ☐ ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	☒ 24V DC ☐	
	OUTPUT	☒ 4-20mA	
	ACCURACY	$\pm 1\%$ FS	
SPACE HEATER	@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	
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ ☐ IP 68 @ ☐	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET(9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	☐ REQUIRED ☐ NOT REQUIRED ☐ 2 NOS. ☐	
CABLE GLANDS	@ 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	☐ 1No. for BFV of CW PUMP(Cable size 2Px1.5mm2)	
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE :	



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 4

OF 3

Data Sheet A & B

DATA SHEET-A
(TO BE FILLED BY PURCHASER)

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

408

WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.

NOTES:

1. **SCOPE:** DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
2. **CODES & STANDARDS:** DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722
3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
5. 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.
6. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
7. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.
8. CANOPY FOR OUTDOOR SERVICES SHALL BE PROVIDED.

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

EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.

	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

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

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 SUB SECTION : C&I SHEET 10 of 18
	TECHNICAL REQUIREMENTS (C&I)	
SPECIFICATION FOR FIELD INSTRUMENTS		

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2011-01-12

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/
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 /
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.
 - b) High tensile carbon steel U-bolts.
 - c) Siphon for steam and hot water services.
 - d) Companion flange with nuts, bolts and gaskets.
 - 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 : ± 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° 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 ± 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.
 - b) Stainless steel Diaphragm seals for viscous fluids.
 - c) 3-Way SS316 Gauge cock for pressure gauges.
 - d) 5-valve SS316 manifold from barstock for differential pressure gauge.
 - 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 : $\pm 1\%$ 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).
Material of construction of Thermowell:
 - SS 316: In general
 - Inconel: For flue gas application
 - 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]
b) Duplex
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.
b) < 10 seconds for control.
 06. Accuracy : $\pm 1.1^{\circ}\text{C}$ up to 300°C & 0.4% of measured temperature range above 300°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 $\pm 1.0\%$
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.
b) Siphons for steam and hot water services.
c) Retention ring and screws for surface mounting.
d) 1/2" NPT 2 Valve SS-316 barstock manifold
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
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 $\pm 1.0\%$
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.
 - b) Syphons for steam and hot water services.
 - c) Retention ring and screws for surface mounting.
 - d) 1/2" NPT 3-Valve SS-316 manifold constructed from barstock
 - 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.
 - b) SS armoured capillary at least 3 meters each.
 - 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 Tappings	:	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. (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). 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 ² .
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
b) Hand wheel.
c) Air filter regulator with gauge.
d) Volume Booster.
e) Limit Switches.
f) Positioner with Input and Output pressure gauges, local keypad & display.
g) Solenoid Valve
h) Integral non contact type position Transmitter (4-20 mA DC linear output).
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~~

- ~~01. Type : In-situ infra-red~~
- ~~02. Principle of measurement : Transmission & absorption (Dual beam type)~~
- ~~03. Light source : Modulated high intensity LED~~
- ~~04. Display : Back Lit LCD~~
- ~~05. Measurement range : 0-999 mg/m³, 0-999 mg/Nm³, 0-100% opacity~~
- ~~06. Measurement averaging : Selectable 10 sec to 60 minutes~~
- ~~07. Accuracy : 0.2% opacity~~
- ~~08. Resolution : 0.1% opacity~~
- ~~09. Linearity : 0.1% opacity~~
- ~~10. Repeatability : 0.1% opacity~~
- ~~11. Flue gas temperature : 350 °C (max 600 °C)~~
- ~~12. Ambient temperature : 0-60 °C~~
- ~~13. Operating temperature : Transmitter & receiver 0-90 °C, Electronic unit -70 °C~~
- ~~14. Mounting : Transceiver on opposite side of the duct~~
- ~~15. Analog output : 4-20mA DC (in 500 ohm resistance) to~~
- ~~16. Alarm output : 2 SPCO potential free rated at 230 VAC, 5A~~
- ~~17. Power Supply : 240V AC, 50 Hz, 1 Phase~~
- ~~18. Automatic misalignment detection : Required~~

22. Accessories : a) ~~Blower unit, tubes & fittings for calibration and purging, purge fail alarm in CCR~~
b) ~~Calibration gas cylinders for NO_x 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 ~~H2 + CO2 + Air Analyzer~~
01. Type : ~~Thermal Conductivity~~
02. Range Selection : ~~3 ranges (H₂ in CO₂, H₂ in air and CO₂ 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.(Appox.)~~
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
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
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.
b) Case compensation
- 16. Performance :
 - i) Scale Accuracy : ± 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 ² (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	:	1/4" NPT

15.	Stability	:	Less than 0.25% of Span / Zero for six months.
16.	Cable connection	:	¾" 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	:	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	:	¾" 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 : ¾" 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.
±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 attemperator 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 attemperation control and Reheat attemperation control as a minimum for high availability. For other application, if the availability criteria for the plant cannot be met even with the best established product, redundant control valves shall be provided.
- 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 attemperation 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

- 4.01.06 Valve end to end dimension and connection shall be according to ANSI standard, straight through pattern. However, Bidder may offer angle body valve for high pressure drop applications. For high pressure drop applications, construction of the valve shall be such that the gland is not exposed to inlet pressure.
- 4.01.07 Control valves of 40 mm. size and above with line pressure up to 50 Kg / Sq. cm may have flanged or welded end connections.
- 4.01.08 Control valves, used in high pressure services shall have butt welded end connections for size 65mm and above and socket weld end connection for size 50 mm or below.
- 4.01.09 Control valve body shall be selected as per the ISA guideline. Generally control valve body shall be cast and machined for pressure rating up to 1500 lbs. Above 1500 lbs, valve body shall be of forged steel. For Demineralized Water application, valve body shall be Stainless Steel.
- 4.01.10 The direction of flow shall be clearly engraved on the body .
- 4.02.00 Valve Body Material (material shall match the process condition for super critical boiler)

SR. NO.	SERVICE	MATERIAL
1.	Non corrosive, non-flashing and non cavitating service for fluid temperature up to 275°C	Cast carbon steel ASTM A216 Gr. WCB
2.	Non corrosive, non-flashing and non cavitating service for fluid temperature above 275°C	Cast alloy steel ASTM A217 Gr. WC9
3.	Severe flashing / cavitating services	Cast alloy steel ASTM A217 Gr. WC9
4.	Low flashing / cavitating services	Cast alloy steel ASTM A217 Gr. WC6
5.	DM water application (condenser hotwell normal, emergency make up etc.)	Cast type 316 stainless steel ASTM A351 Gr. CF8M

- 4.03.00 Valve Size
- The control valve sizing (Cv / Kv) shall be based on following guidelines :
- The valves shall pass normal flow (MCR condition) with 60 to 70 percent opening for linear characterised valves and between 70 to 80 percent opening for equal percentage characterised valves.
 - The valves shall have adequate rangeability to pass the minimum and maximum flows at 10% and 85% of the valve opening respectively. Valve stem travel range from minimum to maximum flow condition shall not be less than 50% of the total valve stem travel.

- c) Valve Cv shall be selected in such a way that the valve shall be capable of handling at least 120% of required maximum flow.
- d) The valve selection shall be based on the highest size dictated by the above considerations unless noise, flashing or other factors dictate the final selection.
- e) Trim outlet velocity for the control valves shall be no more than 7 m/sec for water service and Mach number less than 1/3 for steam and air service application.
- f) The sizing procedure followed shall be as per latest edition of ANSI/ISA or equivalent standard.

- 4.04.00 Valve Top work
- 4.04.01 Top work shall be sized so that the valve shall operate properly when upstream pressure is 10 percent above maximum inlet pressure and downstream pressure is atmospheric.
- 4.04.02 Extended bonnet/Finned bonnet and high temperature packing shall be used for high temperature application.
- 4.04.03 The gland material shall be chosen to suit the operating temperature. PTFE may be chosen for lower temperature application (232°C maximum) and for high temperature application graphited asbestos glands are to be provided. For vacuum services, the glands shall be of dry seal type.
- 4.05.00 Valve Trim
- 4.05.01 Valve trim for applications up to leakage class-V shall be stainless steel 316 SS for pressure drop up to 7 Kg/ Sq. cm. For pressure drops above 7 Kg/Sq. cm hard trim (stelliting or equivalent) shall be used. Other alloys or treatment such as nitride shall be used if severe erosion is expected.
- 4.05.02 Balanced trim valves shall be offered for high shut-off pressure or high pressure drop condition to reduce the size of the actuators.
- 4.05.03 For flashing services and two stage mixtures, the trim material shall be 17-4 PH SS or equivalent.
- 4.05.04 If cavitating condition is foreseen, Bidder shall offer multistage or labyrinth trims valves. Trim of severe service valves shall be of multistage and multipath design with number of discrete pressure drop stages to eliminate the chances of erosion, cavitation, noise and vibration throughout the control range of the valve.
- 4.05.05 Quick replacement type trim shall be considered for easy maintenance.
- 4.05.06 Trim Material

SR. No.	SERVICE	MATERIAL
1.	Non corrosive, non-flashing and non cavitating service for fluid temperature up to 275°C.	: SS 316 stellited
2.	Non corrosive, non-flashing and non cavitating service for fluid temperature above 275°C.	: SS 316 stellited

SR. No.	SERVICE	MATERIAL
3.	Severe flashing /cavitating services	: 440 C
4.	Low flashing /cavitating services	: 17-4 PH SS
5.	DM water application (condenser hotwell normal, emergency make up etc.)	: 17-4 PH SS

4.06.00 Noise Level

The equivalent sound level measured at 1.5M above nearest floor level in elevation and 1 M horizontally from the control valve expressed in decibels to a reference of 0.0002 microbar shall not exceed 85 dBA. If the calculated noise is more than the above limit, even with low noise trim design, diffusers shall be included. Diffusers shall be made of stainless steel and shall be integrally connected to the control valve with spool piece. The spool piece shall be in conformity with the main line piping specification.

4.07.00 Valve Actuators

Spring-diaphragm type actuators shall generally be used. Piston type actuators shall be offered in case of high shut-off pressure & quick response requirement.

4.07.01 The actuator shall be designed for 150% thrust required for the valve (at shut-off pressure) at an air line supply pressure of 5.5 Kg/Sq. cm.

4.07.02 Diaphragms shall be designed for 200% maximum operating pressure.

4.07.03 Nylon reinforced neoprene is preferred as diaphragm material.

4.07.04 Valve actuators shall be capable of operating at 800 C ambient, continuously.

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

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

4.07.07 Bidder shall indicate the stroking time of the valve assemblies with positioner and ensure that the stroke time shall meet the process and equipment dynamics and shall be better than 20 seconds.

4.07.08 All actuators shall be of fail safe design signifying that the spring direction will tend to move the valve (open or close) in a direction safe for the process. "Failure to Open" or "Failure to Close" shall be marked on the actuator.

4.08.00 Valve Positioners

4.08.01 Regulating duty valves shall be offered with Electro Pneumatic Positioners to ensure accuracy and repeatability of response.

4.08.02 Positioners shall have integral non contact (LVDT) type position transmitter, input and output gauges, local keypad & display.

4.08.03 Positioners shall be capable of functioning under hot, humid and vibrating conditions.

4.08.04 Positioner casings shall be dust tight, corrosion resistant and weatherproof.

4.08.05 In general, positioner shall operate at signal range 4 - 20 mA DC for the full travel of the valve.

- 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
- Nameplate shall be provided for instrument or device mounted on the panel.
 - 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~~

14. Indication : Processor status and fault display
15. Features : Power fail hold, Automatic restoration on power

7.03.07 Operator's & Engineering Station:

The specification shall be as below or the latest available at the market at the time of contract:

- a) Operator's Station / Engineering Station (PC Based)
1. Intel Pentium Core 2 Duo processor with latest available speed;
 2. Windows XP Professional preloaded with CD media;
 3. 2 GB RAM;
 4. 320 GB HDD;
 5. 64 MB SVGA graphics card;
 6. 2 MB L2 Cache;
 7. 1 DVD Read / write;
 8. Antivirus protection software with license;
 9. 1 PCI Express x 1 slot 3 PCI 2.2 slot (5v, 32 bit) on Mini Tower, one PCI Express x 16 graphics slot;
 10. 4 x USB ports, 1 Serial Port, 1 Parallel Port, PS/2 Port for Mouse & Keyboard;
 11. 1 x 104 keyboard;
 12. Integrated sound Blaster Compatible Audio Controller 16-bit along with internal speaker;
 13. 10 / 100 / 1000 Mbps embedded Network Interface Card. Additional NIC with 2 nos. Intel Pro / 100S PCI Network Adapter Card;
 14. Minitower Chassis;
 15. 240 VAC 50 Hz power supply
- b) Client Server
- In case of Client Server Architecture this shall be of the latest model / version and shall have the following minimum requirements:
1. Two Intel Xeon up to 3.4 GHz Processors, 800 MHz FSB;
 2. Windows 2008 Server 10 user license preloaded with CD media;
 3. Interaction with at least 10 Clients;
 4. 2 GB ECC DDR (1GB Installed in two slots and two slots free) SDRAM;
 5. Dual 73 GB Ultra 320 SCSI internal storage; HDD partitioning C: 36 & D: 36;
 6. 64 MB SVGA graphics card;
 7. 2 MB L2 Cache;

8. DVD Read/Write;
9. Antivirus protection software with license;
10. 20 / 40 GB Internal DAT Drive;
11. 4 x 64 bit and 2 x 32 bit PCI slots;
12. 4 x USB ports, 1 Serial Port, 1 Parallel Port, PS/2 Port for Mouse & Keyboard;
13. 1 x 104 keyboard;
14. Integrated sound Blaster Compatible Audio Controller 16-bit along with internal speaker;
15. 10 / 100 / 1000 Mbps embedded Network Interface Card. Additional NIC with 2 nos. Intel Pro / 100S PCI Network Adapter Card;
16. 240 VAC 50 Hz power supply;
17. Tower Chassis;
18. 1 x 24" SVGA High Resolution TFT Monitor.

c) Monitor

1. Type : TFT monitor
2. Screen diagonal : 24" flat
3. Display : XGA or better
4. Resolution : 1680x1050 or better
5. Degree of protection : IP-30
6. External Controls : Brightness, contrast, Horizontal / Vertical amplification & shift
7. Power supply : 240 V, 50 Hz, 1 phase
8. Ambient temperature : 0-50 ° C
9. Humidity : 95% non-condensing
10. Version : To suit industrial application

d) Key Board

1. Type : Flat spill proof membrane type or Positive depression type
2. Different keys
 - a) Soft and user defined function keys for software/ programming including text correction, scan rate alteration, zooming/ flashing color selection etc.
 - b) Panel select keys for alarm summary, control loop display, overview, trend,

graphic, operator guide message etc.

- c) Standard Alphanumeric keys
- d) Alarm acknowledge keys
- e) Cursor keys
- f) Mode/loop status switching keys
- g) Setting change keys
- h) Print-out command keys
- i) Other keys as required to operate the system

3. Key lock : Lockable type push button mounted on keyboard

4. Life Expectancy 50 million cycles per key

5. Version : To suit industrial application

e) Laser Printer

1. Type : Electro-photographic laser, tabletop

2. Printer Memory : 256 MB (min.)

3. Speed : Monochrome 24 ppm - A4, Color 6 ppm - A4

4. Resolution : 1200 x 1200 DPI in color

5. No. of color (Basic) : 4 (four) minimum

6. Duty cycle : Monochrome 75000 pages / month

7. Power supply : 240 V, 50 Hz, 1 phase

8. Ambient temperature : 0-50 Deg C

9. Humidity : 95% non-condensing

10. Size of paper : Letter, A4, Legal, Ledger, A3

11. Print media : Plain paper, transparencies, thick stock, glossy stock, envelopes

12. Accessories : Adapters, Connector Cable, Multiplexer switch (4 point)

7.03.08 Stackable Managed Switch

Data highway shall be of high speed Ethernet and full duplex configuration. Network 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 process or equipment. Failure reporting shall be available at HMI. MTBF of the switch shall be more than 20 Years. Configuration shall be automatic.

7.03.09 Furniture

Bidder shall include a complete set of furniture for the Control Room and computer Room of ergonomic design from reputed manufacturer especially designed for computer peripherals. The set of furniture shall include but not be limited to control desk, chair, printer table, computer tables etc, all necessary furniture for Computer Room peripherals, cabinets for storage of manuals / booklets/recorder charts, storage racks for special tools/ diskettes and Shift Charge Engineer's desk/chair/side rack etc.

~~7.04.00 Software Specification~~

~~7.04.01 General~~

~~The system shall utilize a readily upgradeable, public domain software platform proven for real time operation environment at the control and monitoring level overlaid with a relational database program. The desirable features are enumerated below:~~

- ~~a) The operating system shall be suitable for real time operation both at process as well as HMI end.~~
- ~~b) The software system shall be fully modular.~~
- ~~c) The software shall meet the following general requirements:~~
 - ~~i) Simple, easy to learn language for editing and on-line operation.~~
 - ~~ii) Wide range of peripheral support.~~
 - ~~iii) Effective task scheduling and support of multiple priority structure including event based interrupt etc.~~
 - ~~iv) Effective debugging.~~
 - ~~v) Provision for on-line editing and program development without interrupting on-line functions.~~
 - ~~vi) Self diagnostic routines.~~
 - ~~vii) Efficient memory management and effective utilization of system time.~~
 - ~~viii) Quick start-up and loading.~~
 - ~~ix) Support of multiprogramming and multi user operation.~~

7.05.00 Memory Management / Operating System

- ~~a) The main memory capacity shall be adequate to minimize swapping.~~
- ~~b) Individual task shall reside in partitions, which can be split into sub-partition for parallel task handling.~~
- ~~c) The operating system shall automatically perform housekeeping functions including file management.~~
- ~~d) Task swapping shall be dynamic.~~

~~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) 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 μ m (min.) for individual pair screen and 60 μ m (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) 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. 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) HR PVC Type ST2 of IS-5831,1984 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 termite & moisture resistant properties) HR PVC Type ST2 of IS-5831,1984 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 b) ANSI MC 96.1 c) IS-8784-1987
21.	Tests	:	a) Oxygen Index: Min.29 at room temp. (ASTM-D-2863) b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I c) Temp Index : Min 250 DEG C at 21Oxy. Ind. (ASTM-D-2863) d) Smoke Density Rating : Max.60% (ASTM-D-2843). e) Flammability Test : as per IEC 332 Part-I /IEEE-383 Swedish Chimney Test - SS-424- 1475 F3 f) High voltage test Core to core- 1.5 KV for 1 min. Core to screen- 1.0 KV for 1 min. g) Insulation Resistance 100 M Ohm / 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)
HR PVC Type ST2 of IS-5831,1984
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)
HR PVC Type ST2 of IS-5831,1984
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
b) BS 5308
c) IEC 332-1
d) ASTM-B-33
e) IS-8130-1984
f) IS 1554 Part-1
g) IS 10810
21. Sheath colour : Inner- Black and Outer- Gray
22. Tests : a) Oxygen Index: Min.29 at room temp. (ASTM-D-2863)
b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I
c) Temp Index : Min 250 ° C at 21Oxy. Ind. (ASTM-D-2863)
d) Smoke Density Rating : Max.60% (ASTM-D-2843).
e) Flammability Test : as per IEC 332 Part-I
f) Swedish Chimney Test-SS-424-1475 F3
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 1st. unit, double band for 2nd. unit and so on, shall be provided on each conductor for identification of unit. Band marking on individual core shall be provided at regular intervals not exceeding 50 mm.

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 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 : ± 0.13 mm for outside diameter
: ± 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.

~~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/cm²~~
- Differential Pressure : ~~mm of H₂O column / Kg/cm²~~
- ii) Draught : ~~mm of H₂O column~~
- iii) Vacuum : ~~Kg/cm² (abs)/mm of Hg column~~
- iv) Temperature : ~~Degree Celsius (°C)~~
- v) Flow (Steam, Water) : ~~Tonnes / hr, M³/Hr~~
- vi) Flow (Oil) : ~~M³ / Hr, Litter/Hr~~
- vii) Flow Air : ~~Tonnes / hr / M³ / 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
Level Instruments		
Internal Displacer	4" - Flanged	4" - Flanged
External Displacer	2" - Flanged	2" - Flanged
Level gauge	¾" -Flanged	¾" - Flanged
DP Type	½" (min.)-welded 1" – welded for vessel like HP heaters, LP heaters, De-aerator etc. application	½"- NPT
External cage Level switch	1"- welded	1"- welded
Flow Instruments		
DP Type	½" - welded in general 1" – welded for high pressure / temperature main steam, feed water, PRDS etc. application	½" - NPT
Pressure Instruments		
Conventional	½" (min.)-welded 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
Temperature Instruments		
Thermowell	Generally - M 33 X2 (M); 1½" Flanged- For air/FG path application	½" NPT
Analyzer		
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.

- 5.05.00 Cooling : Natural convection or forced cooling using redundant fans.
- 5.06.00 Design Ambient Temperature : 50 Deg.C
- 5.07.00 A.C. input :
- a) Supply : 415V, 3-phase, 50 Hz
 - b) Voltage variation : $\pm 10\%$
 - c) Frequency variation : $\pm 5\%$
 - d) Combined volt frequency variation : 10% (absolute sum)
 - e) Short-circuit level : 50 KA
 - f) System earthing : Solidly grounded
- 5.08.00 D.C. output : 100% UPS load plus restoring fully discharged battery to full charge condition in 8 hours.
- 5.09.00 Blocking Diode, Peak inverse voltage : 800 V (minimum)
- 5.10.00 Performance Requirement
- a) The output voltage of the charger shall be regulated within $\pm 1\%$ 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
 - b) The ripple content in charger D.C. output shall be limited to less than $\pm 1\%$ with battery and less than $\pm 2\%$ without battery.
- 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
(can be attended from both front & back)

QUALITY PLAN
FOR
CONTROL VALVE (PNEUMATIC)

AN NO.: PE-QP-408-145-I 006

VOLUME

SECTION

REV. NO. 02 DATE: 10.06.15

SHEET 2 OF 8

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency s				Remarks
									P	W	V		

1.0	MATERIAL													
1.1	Body & Bonnet casting / forgings, plug, valve stem, seat ring/cage.	1. Physical, Chemical properties	MA	Physical, Chemical tests	One/ Heat(HT Batch)	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Test Certificate	3	---	2,1			
		2. Heat Treatment	MA	Review of H.T. Chart	Each H.T.	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Test Certificate	3/2	2	1	IBR Certification (if applicable) to be verified by BHEL		
		3. Internal quality of castings	MA	RT for Body & UT for Bonnet(NDT)	100%	ASME B 16.34	ASME B 16.34	Test Report / FILM	3/2	2	1.4 01	Only for rating ANSI 900 and above. Applicable for Body and Bonnet only. For Lower rating only if called for in specification.		
		4. Surface Quality	MA	1. Visual	100%	MSS-SP-55	MSS-SP-55	Test Certificate	3/2	---	2,1			
				2. MT/PT	100%	ASME B 16.34	ASME B 16.34	Test Certificate	3	2	1	After Machining on machined surface only		

LEGEND:	* CR	- Critical characteristics	RT- Radiographic Test	PT - Dye penetrant Test	\$ P - Agency Performing the Test.	1 - BHEL	4 - Customer/
	MA	- Major characteristics	UT - Ultrasonic Test	MT- Magnetic Test	W - Agency Witnessing the Test.	2 - Vendor	Consultant
	MI	- Minor characteristics			V - Agency Verifying the Test.	3 - Sub-vendor	01

QUALITY PLAN

FOR

CONTROL VALVE (PNEUMATIC)

425425/694

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s				Remarks
									P	W	V		
3.1	Actuator Chamber	Leakage & Strength	MA	Pneumatic test	100%	Mfr. Standard	No Leakage	Test Certificate	2	1	1,4	01	Refer Note-4
3.2	Body	Leakage and Pressure test (Body Mount Leakage)	MA	Hydro test	100%	ISA - S-75.19	No Leakage	Test Certificate	2	1,4	1	01	Refer Note-4
3.3	Seat leakage test for completed valve	Seat Leakage	MA	Pneumatic Test	100%	FCI-70.2	FCI-70.2	Test Certificate	2	1,4	1	01	Refer Note-4
4.0	OPERATION TEST ON COMPLETED VALVE (Final inspection)	1. Valve Travel	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1,4	1,4	01	Refer Note-4
		2. Opening/Closing time	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1,4	1,4	01	Refer Note-4
		3. Linearity/cam characteristic	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1,4	1,4	01	Refer Note-4
		4. Repeatability	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1,4	1,4	01	Refer Note-4
		5. Hysteresis	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1,4	1,4	01	Refer Note-4
		6. Sensitivity	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1,4	1,4	01	Refer Note-4
		7. Accuracy (Overall)	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1,4	1,4	01	Refer Note-4
		8. Control Valve characteristics / CV Test	MA	♦ Measurement (Press. vs. discharge and discharge vs. opening 0-100% in steps of 10%)	One per type	As per specs/ Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Test Certificate	2	1,4	1,4	01	♦ Size = Body & port size Or Body size & CV for non std port. Refer Note 1.

QUALITY PLAN
FOR
CONTROL VALVE (PNEUMATIC)

AN NO.: PE-QP-408-145-I 006

VOLUME

SECTION

REV. NO. 02 DATE: 10.06.15

SHEET 7 OF 8

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency s				Remarks
									P	W	V		
5.4	Electronic position transmitter(not applicable if provided integral to smart positioner)	1. Accuracy	MA	Operation	100%	Approved data sheet /	Approved data sheet /	Test Certificate	2	1	1,4	01	
5.5	Current to Pneumatic converter(not applicable for smart positioner)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	2,1, 4		
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	2,1, 4	01	
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1,4		
		4. Hysteresis	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1,4	01	
5.6	Smart Positioner (As Applicable)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	2,1, 4		
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	2,1, 4		
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1,4	01	
		4. Hysteresis	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1,4		
		5. Calibration with Hand Held Communicator	MA	Measurement	Each type	Approved data sheet / Mfr. Standard	Approved data sheet / Mfr. Standard	Test Certificate	2	1	1,4		

LEGEND:

* CR - Critical characteristics

MA - Major characteristics

MI - Minor characteristics

RT- Radiographic Test

UT - Ultrasonic Test

PT - Dye penetrant Test

MT- Magnetic Test

\$ P - Agency Performing the Test.

W - Agency Witnessing the Test.

V - Agency Verifying the Test.

1 - BHEL

2 - Vendor

3 - Sub-vendor

4 - Customer/ Consultant

QUALITY PLAN
FOR
CONTROL VALVE (PNEUMATIC)

AN NO.: PE-QP-408-145-I 006

REV. NO. 02 DATE: 10.06.15

SHEET 8 OF 8

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency s			Remarks
									P	W	V	
6.0	PAINTING	Soundness of Painting	MA	Visual and Measurement	100%	BHEL specn. / Mfr. Standard	BHEL specn. / Mfr. Standard	Inspection Report	2	---	1,4 01	Refer Note-2
7.0	PACKING	Soundness of Packing against transit damage	MA	Visual	100%	Mfr. Standard	Mfr. Standard	Inspection Report	2	---	---	Refer Note-3

NOTES:

- In case valid Cv test certificate for a similar control valve (Same type, Same size, Same Cv) is not submitted to BHEL by the vendor, Cv test shall be conducted at FCRI/ Any govt. approved laboratory/ BHEL approved Laboratory. Validity of the Cv test certificate shall not be more than 3 years.
- In the absence of BHEL spec. for painting, vendor to obtain BHEL's approval on their painting specification / procedure.
- Sea worthy packing shall be provided, if applicable.
- The quantum of check shall be 100% for manufacturer and 10% for BHEL/BHEL nominated inspection agency and Customer.
- IBR certificates in Form III-C shall be submitted if called for in the specification/datasheet.
- Copies of all TC's (Test Certificates) for materials duly correlated with Heat Nos., TC's for electrical items and mechanical tests (Leak/Operation) shall be submitted to BHEL for verification and acceptance.
- Calibrator used for calibration shall be approved by government agency & its calibration certificate shall be submitted.

LEGEND:	* CR	- Critical characteristics	RT- Radiographic Test	PT - Dye penetrant Test	\$ P - Agency Performing the Test.	1 - BHEL	4 - Customer/
	MA	- Major characteristics	UT - Ultrasonic Test	MT- Magnetic Test	W - Agency Witnessing the Test.	2 - Vendor	Consultant
	MI	- Minor characteristics			V - Agency Verifying the Test.	3 - Sub-vendor	01



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	

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

Note :

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



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

CHECK LIST FOR TRANSMITTER

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

Legend :

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

Note :

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



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

CHECK LIST FOR PRESSURE & DP GAUGE

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

Legend :

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

Note :

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



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

CHECK LIST FOR LEVEL GAUGE

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

Legend :

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

Note :

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



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

CHECK LIST FOR 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 :

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

Note :

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

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 11 of 18
	TECHNICAL REQUIREMENTS (C&I)	
PLC SPECIFICATION		

MUKESH K. SINGH

S.A. KHAN

2011-01-12

- 3.12.07 ~~Individual gauge board (as per manufacturer's standard) shall be provided near each Air Drying plant for local indication of all important parameters such as pressure, temperature, flow related to the driers.~~
- 3.12.08 ~~Bidder shall provide all measuring instruments with required accessories for control, monitoring, protection and interlock of the compressors and driers. Electronic analog signal transmission from field transmitters to area control rooms shall be 4-20 mA DC. All process switches, limit switches and drive feed back signals shall be provided with potential free contact. Temperature detector will be provided at each stage of the compressed air system and cooling water system of compressors for monitoring in the local control panel.~~
- a) ~~The control system shall meet the requirement of monitoring, sequential starting/stopping of drives, interlock and protection, individual/sequential control metering, annunciation and on-line and all other routine functions with minimum operator's intervention.~~
- b) ~~In-line flow gauge & flow switch shall be provided on the cooling water line of the compressed air system.~~
- 3.12.09 ~~Dew point measurement shall be provided for each Air drying plant of compressed air system. The output of the instrument shall be 4-20 mA DC to be connected to the master controller panel.~~
- 3.13.00 ~~Fuel Oil Unloading System~~
- 3.13.01 ~~The Fuel Oil Unloading System shall be controlled from PLC based local control system or relay based system. No operator work station has been envisaged for this system. The system shall be operated from Lamp / Pushbuttons, selector switches etc located on the panel. Integral type hardware annunciation system shall be provided at the top of the panel for alarm monitoring. Important parameters i.e. tank levels, oil flow, oil temperature etc. from this panel shall be monitored in the station DCS via RIO considered for Fuel Oil Pressurising & Heating System. Facility shall be provided in the PLC for connecting laptop for programming.~~
- 3.13.02 ~~Level signals from HFO/LDO day tank shall be connected to DCS via hardwired link for control of HFO/LDO transfer pumps. Bidder shall keep these signals terminated in suitable terminal blocks of the local panel.~~
- 3.14.00 ~~Ventilation And AC System~~
- 3.14.01 ~~For detail Instrumentation systems, operation & control philosophy refer Vol IIB.~~
- 4.00.00 **TECHNICAL SPECIFICATION – CONTROL SYSTEM**
- 4.01.00 Brief technical specification of the PLC based control systems are delineated below.
- 4.01.01 Programmable Logic Controller (PLC) based control system shall have 1:1 hot redundant configuration. Central Processing Units (CPUs) shall have word length of 32 bits minimum.

- 4.01.02 Following components shall be redundant as well : communication processors, memory modules, rack power supply units, bulk IO power supply units, IO communication modules, data highway and high speed (100Mbps) data network connecting the operator stations.
- 4.01.03 Two CPUs shall operate on fault tolerant mode with continuous self and cross-monitoring. Failure of the active CPU shall not affect the operation of the plant. In the event of failure of active CPU, tasks shall be transferred to the standby CPU within fastest possible transfer time (< 5m sec.) without causing any relays to drop out during the transfer.
- 4.01.04 CPUs shall not be loaded to over 60% of their capacity even under worst data loading conditions. It shall be possible to make a manual transfer from the active to the back-up CPU from engineering station and as well as from the front panel of CPU module.
- 4.01.05 Modules shall have adequate status and diagnostic indication on the front panel.
- 4.01.06 System shall be of modular construction and expandable by adding hardware modules. Bidder shall provide at least 20% or a minimum of one off, spare channels as hot-on-rail spares in each configured cards / modules. In addition to this, 10% or minimum of one off, extra assigned complete spare modules mounted on rails in racks for each type of I / O modules shall also to be provided. The spare channel and cards shall be fully wired and terminated.
- 4.01.07 Memory unit of the CPU shall be field expandable at least by 25%. Operating system / application program / sequence logic etc. shall be stored in nonvolatile memory for automatic re-booting. Dynamic memories shall be provided with battery back up at least for 360 hours.
- 4.01.08 Number of input / output points per card shall not exceed 16 (sixteen) for digital and 8 (eight) for analog / thermocouple / RTD signals. Individual input and Output channels shall have galvanic / optical isolation. Merely fusing of individual or a group of channels is not acceptable.
- 4.01.09 Data communication system of the PLC shall not be limited to the following:
- Internal bus and external data network loading shall in no case be more than 60% of its capacity.
 - Disrupted message shall be automatically retransmitted when the system is restored.
 - Failure or physical removal of any module connected on the system bus shall not lead to any loss of communication.
 - Diagnostics message shall be issued on fault detection.
 - Bus change over from active bus to stand by bus, during failure of active bus, shall be performed automatically and bumplessly. Such event shall be suitably logged or alarmed.

- f) Noise immunized and reliable highspeed dual fault tolerant optic fiber cable communication with standard communication protocol shall be provided between PLC s and remote or extended I/O modules.
- g) Main data network shall comply with the International Standard IEEE-802.3 (Ethernet) for data exchange and communication.
- 4.02.00 Operator workstation shall be complete with latest user friendly operating system, 24" colour LCD monitor, membrane KB, mouse, colour laser printer and dot matrix printer. In addition, a laptop unit loaded with engineering software shall be furnished.
- 4.02.01 The functions performed from the HMIs shall not be limited to the following:
- a) Selection of auto/Manual, open/close, sequence auto, start/stop operation.
 - b) Dynamic Mimic display depicting the process.
 - c) Alarm monitoring, report & log generation, printing of trends etc.
 - d) On line / historical trending, historical storage and retrieval of data.
- 4.03.00 Software
- a) Necessary software for implementation of the control logics, operational displays & logs, data storage, retrieval and other functional requirements, shall be provided.
 - b) Licensed version of required software including operating system, configuration and HMI software shall be provided.
 - c) Detail documentation on the programming softwares as part of the O&M manual.
- 4.04.00 Power Supply
- a) Power supply to the PLC system shall be provided from solid-state 240V AC $\pm$ 1% packaged UPS (Uninterruptible Power Supply) units to be placed local to the control systems. UPS system shall be complete Ni-Cd type battery & battery chargers. UPS shall have adequate capacity to cater 100% load without overloading. UPS system shall be adequate to provide back up power for not less than 30 minutes.
 - b) UPS shall be complete with AC Distribution board. Two feeders shall be extended from ACDB to PLC.
 - c) Bulk power supply units for interrogation, relay and solenoid voltage shall be separate from system power supply units and shall be redundant.
- 4.05.00 System shall have MTBF better than 99.7% and shall be hot maintainable. System hardware shall be designed to be 'fault avoidant' by selecting high-grade components of proven quality and properly thermally de-rated design. The network shall have extensive fault monitoring, self-surveillance & on-line self-diagnostic capability so that failure is immediately detected.

- 4.06.00 System shall automatically check & correct gain & drift for ADCs on-line.
- 4.07.00 Data exchange in a bus shall be fully monitored and checked for validity.
- 4.08.00 Response time consisting of IO scan time, data communication time, processing time etc. shall be equal to or less than the following :
- a) OLCS & sequence control inputs : 100 ms.
 - b) CLCS inputs : 250 ms.
 - c) Monitoring analog parameters : 500 ms.
 - d) Monitoring digital parameters : 100 ms.
- 4.09.00 Following operations will be performed on I/Os, as required:
- a) Square root extraction
 - b) Pressure & temperature compensation
 - c) Reasonability check of all inputs, validation and quality tagging like good, bad, suspect etc.
 - d) Channel wise engineering unit conversion
 - e) Contact bounce filtering with adjustable time constant.
- 4.10.00 The controllers shall be time synchronized to GPS master clock via IRIG-B or Ethernet port. Software capability shall be provided to implement closed loop control functions as follows:
- a) PID control and their variations.
 - b) On-off control
 - c) Cascade control
 - d) Ratio and bias control
- 4.11.00 Features for Open Loop Control shall not be limited to following:
- a) Logic functions like AND/OR/NOT gates, timers (on-delay, off-delay), shift registers, counters, latches, flip-flops, mono-shots etc.
 - b) Automatic sequence control for start up and shutdown of auxiliaries / equipment in functional groups initiated by command from operator's console. A sequence shall be made of steps executed in predetermined order according to logic criteria. For each step there shall be a provision for 'waiting time' and 'monitoring time'. System shall have the capability to bypass a step, if desired, from the operator's station. Such action however shall be registered as an exception.
 - c) Inputs for protection system shall be of high priority. In the event of either loss of control power or control signal input to the drive, the drive shall remain in its last position unless specifically required otherwise. The

system shall be designed such that no upset occurs either to process or to the drive when the power is restored.

- 4.12.00 Interface of the system with M.C.C / Switchgears shall be in the form of potential free contacts via interposing relay modules mounted in the respective switchgear or MCC unit. Other interfacing relays shall be mounted in a cabinet separate from the system cabinet. 10% wired additional interposing relay modules shall be provided as installed spare. Freewheeling diodes shall be provided across the coil of DC solenoid and contactors / relays. For AC solenoids and contactors directly driven from output cards, arc suppressors shall be provided across the coil.

Each I / O rack shall have 10% spare rack space for future upgradation.

- 4.13.00 Single programming instruction / command shall be sufficient to delete a program rung from memory. Similarly, any rung can be inserted into the existing program. The active and the stand-by CPU programs shall equalize automatically, once the new program is permitted to 'RUN'.

- 4.14.00 Updating time and reaction time shall be as follows:

- a) Calling up a mimic : 2 sec or better
- b) Updating status signal in mimic : 1 sec or better
- c) Updating variables in a mimic : 1 sec. or better
- d) Issuance of command to output : 1 sec. or better

(without considering process lag)

- 4.15.00 Displays shall be classified into overview display, group display, point display and trend display.

- 4.16.00 Printing of logs shall be initiated automatically at prescribed time intervals, or initiated on demand by the occurrence of predefined events.

System shall permit the operator to specify minimum of 5 summary logs each with minimum of 25 points to be printed on demand.

- 4.17.00 Salient features of the PLC system for I/O handling shall be as follows:

- a) Input filters to attenuate noise.
- b) Isolation of 1500V AC for the input & output module.
- c) Comm. Mode Noise rejection for analog inputs of 120 db at 50 Hz.
- d) Normal mode noise rejection for analog inputs of 60 db at 50 Hz.
- e) LED indicators on each card to show status of input.
- f) All the outputs shall be with individual fuse.
- g) J/K type thermocouple mV input where applicable.

- h) Pt-100 three / four wire resistance thermometer input where applicable.
- i) 24 V DC power supply to field mounted two wires transmitters.

4.18.00 Salient hardware/ software features of the CPUs shall be as follows:

- a) Watch dog timer : Periodical reset. Alarm and interruption, if not reset within stipulated time.
- b) Max. scan time for inputs: 1 sec. max.
- c) Maximum Scan Rate : 1 ms (Per K Word) or better
- d) Memory capacity : 25% spare capacity after full utilization. Expandable in multiples of 16 K.
- e) Comm. processor : Separate
- f) Battery back up for RAM : 360 hrs continuous operations.
- g) Diagnostic feature : Periodic, automatic self- diagnostic.

4.19.00 Salient features of the Input / Output modules are as follows:

- a) All modules
 - 1. Surge withstand capability : IEC-255.4
- b) Digital General
 - 1. No. of channels / module : 16
 - 2. Interrogation voltage : 24V DC or 48 V DC
 - 3. Status indicator : LED type.
 - 4. Isolation : Optical
- c) Digital Input Module
 - 1. Contact bounce filtering : Adjustable time constant of 15 m. sec.
 - 2. Diagnostic : Module fault
- d) Digital Output Module
 - 1. Output protection : Short ckt. Proof & Individual fuse
 - 2. Diagnostic : Module fault
- e) Analog General
 - 1. No. of channels / module : 8
 - 2. Isolation : Galvanic/Optical

f) Hi-level Analog Input Module

1. Type of input : 4-20 mA DC / 1-5V DC
2. A/D Converter : 11 bits + Sign (or better)
3. Accuracy : 0.1% or better
4. Diagnostic : Module fault
5. Powering of transmitter : 24 V DC 2 W type

g) Low Level Analog Input Module

1. Type of input : PT-100; T/C(As required)
2. C-J-C : On Module
3. Accuracy : 0.1% or better
4. A/D converter : 15 bits + Sign (or better)
5. Diagnostic : Module fault

h) Analog Output Module

1. Type of output : 4-20 mA DC
2. Accuracy : + 0.1% or better
4. A/D Converter : 11 bits + Sign (or better)
5. Load : 600 OHM
6. Diagnostic : Module fault

5.00.00 **OPTICAL FIBRE CABLE**

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

5.02.00 Fiber Optic Cables shall be installed on cable tray, duct bank, cable trench, as necessary. For outdoor applications the cable shall be armoured with Poly Ethylene sheathing. Cable shall be routed through suitable grade permanently lubricated HDPE protection pipe as per IS 4984, IS 12235 & TEC.G/CDS-08 /01of suitable size @ 53% fill factor.

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

- 5.04.00 Fiber optic cable shall be of loose tube design. Typically, fibers shall be housed in-groups of 6 (minimum) within gel-filled buffer tubes to protect against ingress of moisture and vibration. The tubes shall be manufactured with industry standard material like Poly-Butelene Terathylate (PBT). They shall be colored for easy identification. Buffer tubes shall be approachable with industry standard tools and practices. The buffer tubes shall be stranded around the Central Strength Member utilizing Reverse Oscillating Lay (ROL). Blank fillers shall be used as necessary to maintain circular cable structure. Cable shall withstand water penetration when tested with a one meter static head or equivalent continuous pressure applied at one end of a one meter length of filled cable for one hour. No water shall leak through the open cable end.
- 5.05.00 The central strength member of the cable shall be Fiberglass Reinforced Plastic (FRP) or other material with equivalent mechanical strength to provide both tensile and anti buckling strength to the cable.
- 5.06.00 In addition to central strength member, additional strengthening substance like aramid yarns shall be helically applied over the cable core to provide additional tensile strength to the cable.
- 5.07.00 The cable shall be of dual jacket & armoured. Inner sheath consists of a medium density polyethylene (MDPE) jacket extruded over the cable core. Two highly visible ripcords are placed under the jacket to aid in sheath removal. A co-polymer coated steel tape is corrugated and wrapped around the inner jacket to provide additional cable compression strength and rodent protection. The armor is covered with an outer black FRLS MDPE jacket. A ripcord is also placed underneath the armor for easy outer jacket removal.
- 5.08.00 Minimum bending radius shall be equal or more to 15 D. A continuous strength member shall be provided for the entire length of the cables. Every tube and fiber shall be colour coded to provide easy identification. The outer sheath shall be marked to show fiber type and cable classification at suitable intervals.
- 5.09.00 Entire length of the cable shall be marked with the following at regular intervals:
- a) Manufacturer's Name
 - b) Month and year of manufacturer
 - c) Coded description of the cable based on Telcordia's (Bellcore) SR-2014 Suggested Optical Cable Code (SOCC).
 - d) Sheath Identification Number
 - e) Sequential Length Marking in meter
 - f) A Telephone Handset symbol to distinguish communication from power cable as per NESC section –35 G.
- 5.10.00 Fiber optic cable shall provide a long life expectancy of minimum 25 years and shall meet the industrial standard of continuous operation at temperature

of 55 O C and humidity to 100% without degradation to optical or mechanical performance.

5.11.00 Optical fiber used in the plant shall generally conform to the following specification:

ATTRIBUTES		
a)	Cladding Diameter	125 $\mu\text{m} \pm 1.0 \mu\text{m}$
b)	Cladding non-circularity	$\leq 1.0\%$
c)	Attenuation Coefficient at	
	(a) 1290 nm to 1340 nm (b) 1525 nm to 1575 nm	$< 0.36 \text{ dB/km}$ $< 0.25 \text{ dB/km}$
d)	Chromatic Dispersion Coefficient at	
	(a) 1310 nm (b) 1550 nm	$< 3.5 \text{ ps/nm.km}$ $< 18 \text{ ps/nm}$
e)	Polarization Mode Dispersion (PMD)	$\leq 0.5 \text{ ps}/\sqrt{\text{km}}$
f)	Mode Field Diameter at	
	(a) 1310 nm (b) 1550 nm	$9.2 \pm 0.4 \mu\text{m}$ $10.50 \pm 1.0 \mu\text{m}$
g)	Mode Field Concentricity Error	$\leq 0.5 \mu\text{m}$
h)	Proof Test	$\geq 1\%$
i)	Fiber Curl (ROC)	$\geq 4.0 \text{ m}$
j)	Macro-bend Test on Fiber at 1550 nm	$\leq 0.1 \text{ dB}$

5.12.00 Cable Assembly

5.13.00 Optical Fiber Environmental Splice Enclosure

Optical fiber environmental splice joint enclosures shall be re-enterable and rack / wall mountable. The interior splice case shall be equipped to mechanically accommodate single-mode optical fibers connected by the

fusion method. Splice case shall be equipped to organize the splice trays and the required service loops of buffered incoming optical fibers and outgoing 'pigtails' in such a way that allows each completed splice and associated optical fiber to be maintained in an unstrained configuration. Splice enclosure shall be dust and weather proof.

5.14.00 Fiber Optic Distribution Patch Panel

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

5.15.00 Pigtail and Patch Cord

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

5.16.00 Fiber Optic Tool Kit

5.16.01 Optical Time Domain Reflectometer

- a) A recording optical time domain reflectometer (OTDR) will be utilized to test for end-to-end continuity and attenuation of each optical fiber. The OTDR shall be equipped with data storage, printer, help feature, compare trace features and OTDR software. The data storage unit must include a built-in floppy disk drive capable of storing a minimum of 100 test traces.
- b) Data traces saved to disk shall include the following labels:
 - Fiber Identification (ID) with a minimum of 10 characters
 - Cable ID with a minimum of 10 characters
 - OTDR location with a minimum of 20 characters
 - Far End location with a minimum of 20 characters
 - Test Operator initials with a minimum of 3 characters
- c) The printer shall preferably be internal. The printer shall be able to print data traces within 30 seconds or less. The machine settings used to repeat tests at a later time shall include: index, range, wavelength, average time,

pulse width and scale settings. The test results (on printout) shall provide information including: loss, distance, reflectance, date and time.

- d) The requirements for the compare trace feature include the ability to recall two historical traces from a diskette and display them simultaneously for analysis and printing. The compare trace must compute and display a single graph representing any differences between two traces. The compare trace must be able to recall historical traces from a diskette and perform the same tests on connected live fibers. The compare trace shall perform a two point loss measurement test for any two particular fibers in a comparison analysis. The losses between the two points on each fiber shall be displayed, and the differences between the two readings clearly shown.
- e) The OTDR must be equipped with software to support all of the required functions. The software shall provide for printing of whole set of traces (batch print) with minimal commands eliminating the time spent for printing traces individually.
- f) Contractor shall provide all mounting accessories, cables and connectors required to establish data communication.

5.16.02 Fiber Optic Splicer, Terminator And Tool Kit Box

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

5.16.03 Tests

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

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

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


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STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER

 PEM :: C&I	WORK ORDER NO.: PE-QP-999-145-1036				
	VOLUME IIB				
	SECTION D				
	REV. NO. 01 DATE: 24.08.2007				
	SHEET 1 OF 8				

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
1.0	Materials /Components											
1.1	Panels & Control Desks	Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardware, Hinges, Louvers & Filters, Fans & Panel Lamps	MA	Visual	100%	Contract specifications, Approved GA Drawings, BOQ	As per ref documents. No physical damage.	BHEL Quality Inspection Report.	3/2	2	1	
1.2	Power Supply/Packs, Battery & Battery charger, Transformer, UPS.	Physical Inspection Physical Damages Dimensions Mounting Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per reference documents, Test Report	BHEL Quality Inspection Report.	3/2	2	1	
1.3	Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Instruments, Single Loop Controllers	Physical Verification Physical Damages Dimensions Accessories	MA	Visual	100%	Contract specifications, BOQ.	As per ref documents No physical damage. Test/ Calibration report.	BHEL Quality Inspection Report	3/2	2	1	
1.4	PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet	Physical Inspection - Identification Labels - Physical Damages - Quantity - Spare Capacity	MA	Visual	100%	Product Catalogue, Data sheets, Approved Configuration diagram, BOQ	As per ref documents. Test Certificates	BHEL Quality Inspection Report.	3/2	2	1	

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

\$

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

1 - BHEL
 2 - Vendor
 3 - Sub-vendor




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WORK ORDER NO.: **PE-QP-999-145-1036**
 VOLUME **IIB**
 SECTION **D**
 REV. NO. **01** DATE: **24.08.2007**
 SHEET **2** OF **8**

STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
1.5	CPU, Monitor, Keyboard, Mouse, CD Drives, Printers, OS, System Software, Engineering software in the form of Licensed CD.	Physical Inspection Identification Labels, Tech. Specification Physical Damages Accessories Installation arrangements for Computers & Printers	MA	Visual	100%	Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ.	As per reference documents.	BHEL Quality Inspection Report.	3/2	2	1	

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



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WORK ORDER NO.: PE-QP-999-145-1036
 VOLUME IIB
 SECTION D
 REV. NO. 01 DATE: 24.08.2007
 SHEET 3 OF 8

STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER



Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	

2.0	Assembly											
2.1	Functional Test for HMI/OWS devices such as Monitors, Keyboards, Mouse, Printers etc.	Operation	MA	Functional	100%	Approved Configuration Diagram & BOQ and FAT	Correct Operation of interconnected Devices of HMI system.	BHEL Quality Inspection Report.	2	1	1	
2.2	Hardware Functional Verification.	Physical arrangement, Wiring check & labeling, Continuity Checking, IR & HV test	MA	Visual/ Electrical	100%	Approved GA Drawing, Panel Wiring Diagram, IR & HV as per relevant International standard	Test Certification	BHEL Quality Inspection Report.	2	2	1	
2.3	Powering Up	Healthiness of all the modules/equipment, associated with Powering of PLC system	MA	Visual /Electrical	100%	Approved power supply scheme	All equipment to be healthy on power ON	BHEL Quality Inspection Report.	2	1	1	
2.4	Burn in test for PLC modules	Healthiness of PLC modules on Continuous Energisation, Temperature maintenance	MA	Visual/ Electrical	100%	FAT Procedure	Test certification as per FAT	BHEL Quality Inspection Report.	2	2	1	

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 MA - Major characteristics
 MI - Minor characteristics

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STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER

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**STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER**

QUALITY PLAN NO.: **PE-QP-999-145-I036**

VOLUME IIB

SECTION D

REV. NO. **01**

DATE: **24.08.2007**

SHEET 5

OF

8

FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

This document covers procedure to conduct/witness PLC system functional tests in order to demonstrate conformity to purchase specifications and related engineering documents. The test shall be conducted at the system suppliers works. The system supplier shall conduct all functional tests before commencing FAT and test results shall be made available during FAT. Vendor must furnish following relevant drawings, duly approved by BHEL Engineering, for reference during FAT.

- a) Technical Specification of PLC.
- b) PLC System Configuration
- c) General Assembly Drawings.
- d) Panel Wiring Diagrams.
- e) Bill of Quantity for PLC System.
- f) Logic Diagram.
- g) HMI Schematics.
- h) Input / Output List.

Further the vendor shall furnish applicable product specification, datasheets, catalogues, test-certificates, and internal inspection records to enable FAT. Vendor shall also submit, [to the inspecting agency](#), his standard test procedure, for clauses given below; where vendor's standard practice has been referred.

APPLICABLE TEST PROCEDURE:

1. Input/Output Functional Verification.

Check for correctness of addressing of racks, slots and I/O modules as per applicable PLC configuration diagram. Appropriate signal generators shall be used to simulate Inputs and outputs to check operation and SCAN time. [Check online replacement of cards, processors, power supply etc.](#)

2. Processor Verification

PLC Configuration drawing to be referred for ascertaining

- i) Redundancy

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**STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER**

QUALITY PLAN NO.: PE-QP-999-145-I036			
VOLUME IIB			
SECTION D			
REV. NO. 00		DATE: 23.03.2005	
SHEET	6	OF	8

ii) Type (Hot or Cold)

Both the processors are to be checked for healthiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control from primary processor to standby processor shall be demonstrated for uninterrupted control and data processing as per vendor's standard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Processor's LEDs as per manufacturer's product standard.

Vendor shall demonstrate, as per Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating worst load operation of fully integrated PLC system.

3. Power Supply Module Verification

Check if PSM is in redundant mode as per specification. Check the healthiness of power supply from both the modules' lamp indication/measurement. Simulate failure of one PSM and verify that standby PSM has taken over without any interruption.

4. Communication System Verification

Communication system has to be in line with approved PLC Configuration Diagram. Verify that both the communication buses are intact and connected. Communication between PLC processors, I/O rack, OWS etc. is to be checked through simulation of input data. Simulate the bus failure by disconnection of working bus. Check that the communication continues without interruption or loss of data.

Following response times are to be demonstrated as per vendor's standard practice for conformance to contract specifications:

1. Screen update time
2. I/O scan time
3. SOE resolution time
4. Data transfer time with third party system using Communication Protocol as per Contract specification and as per quantum of data as per approved signal exchange list.

5. Diagnostic Verification

Product Catalogue/Literature shall be referred for checking of all diagnostic features. Hardware failure to be simulated by removing an I/O

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**STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER**

QUALITY PLAN NO.: PE-QP-999-145-I036			
VOLUME IIB			
SECTION D			
REV. NO. 00		DATE: 23.03.2005	
SHEET	7	OF	8

6. Control Panel /Desk Verification

- i) PLC driven annunciation system should be checked by alarm signal simulation.
- ii) Push Button and selector switch operation should be checked by verification of corresponding change of status of Data Base point.
- iii) Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

7. Software Verification

- i). Control Logics:- Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes
- ii). Engineering features:-
 - a) Online changing of parameters, set points.
 - b) Online modification in Control Logic Diagrams.
 - c) Online configuration of Graphics, Trends, Logs, HSR.
- iii). HMI features:-
Check for configuration & operation of Graphics, Trends, Logs, HSR and Alarms, in the form of Displays and Printouts, by simulation of Inputs as per approved documents.

8. Burn in Elevated Temperature test

Electronic equipments shall be subjected to Burn in elevated temperature test as per the procedure detailed below:

- a) (i) PLC modules are kept at 50 Deg c under continuous energized condition for 48 hours.

MUKESH K.S. SINGH
 S.A. KHAN
 20-11-2005

**STANDARD QUALITY PLAN
FOR
PROGRAMMABLE LOGIC CONTROLLER**

QUALITY PLAN NO.: PE-QP-999-145- I036		
VOLUME IIB		
SECTION D		
REV. NO. 00	DATE:	
23.03.2005		
SHEET 8	OF	8

ii) 48 hours test period shall be divided into 4 equal time segment of 12 hours duration each. For every 12 hours duration segment, after lapse of first 11 hours 110% of nominal voltage shall be applied to the panel under test for a period of 30 minutes followed by application of 90% of nominal voltage for the next 30 minutes.

b) Assembled Panels with complete wiring shall be kept under continuous energized condition for 120 hours at ambient temperature. Temperature rise in panels should be below 10 Deg C above ambient.


 S.A. KHAN

 S.A. KHAN

 MUKESH K.S. SINGH

Checklist for Serial Communication between maxDNA Systems and Foreign Device :BHEL

A Device Specific :

SN	Parameters	Options available	Remarks if any
1	Modle No.& Make of Device		
2	Communications Link Options	☐ Multidrop ☐ Peer to Peer ☐ N/w topology attached	
3	Protocol Mode (Device is a)	☐ Master ☐ Slave ☐ Master/Slave	
4	Protocol	☐ RTU ☐ ASCII ☐ Other -----	
5	Master	☐ System maxDNA ☐ Other -----	
6	Dist.bet.maxDNA System & Device*	☐ ----- Feet ☐ ----- Meters	

B Electrical Specific :

1	Interface Type	☐ RS232 ☐ RS422 ☐ RS485	
2	Wiring at Device end	☐ 2 Wire ☐ 4 Wire	
3	Transmission Channel	☐ Half Duplex ☐ Full Duplex	
4	Baud Rates (bps)	☐ 1200 ☐ 2400 ☐ 4800 ☐ 9600 ☐ 19200	
5	Databits	☐ 8 ☐ 7	
6	Stopbits	☐ 1 ☐ 2	
7	Parity	☐ None ☐ Odd ☐ Even	
8	H/w & Software Handshake	☐ Yes ☐ No	
9	Response Timeout time (Sec)	☐ ----- ☐ Configurable timeout	
10	Data Formats Supported	☐ Boolean ☐ Real ☐ Char ☐ Sn.Int ☐ UnSn.Int	
11	Transmission mode	☐ Asynchronous ☐ Synchronous	

C Application Specific : *

1	Primary Function*	☐ Data Acquisition ☐ Data Acquisition & Control	
		☐ Download parameter sets	
2	Analog Points to read	-----Nos. ☐ Details attached ☐ Details not attached	
3	Analog Points to write	-----Nos. ☐ Details attached ☐ Details not attached	
4	Digital Points to read	-----Nos. ☐ Details attached ☐ Details not attached	
5	Digital Points to write	-----Nos. ☐ Details attached ☐ Details not attached	
6	Memory / Flag Points to read	-----Nos. ☐ Details attached ☐ Details not attached	
7	Memory / Flag Points to write	-----Nos. ☐ Details attached ☐ Details not attached	

D Hardware Specific :

1	Cable type	☐ Boolean cable ☐ Twisted pair cable	
2	Cable Details Enclosed	☐ Yes ☐ No	
3	Any specific Converter required	☐ Yes ☐ No ☐ Details enclosed	

E Device Documents :

1	Manufacturer's Documents*	☐ Tech., Spec. ☐ Operating Manual	

*Notes:

A6 To identify converter requirement and cable length.

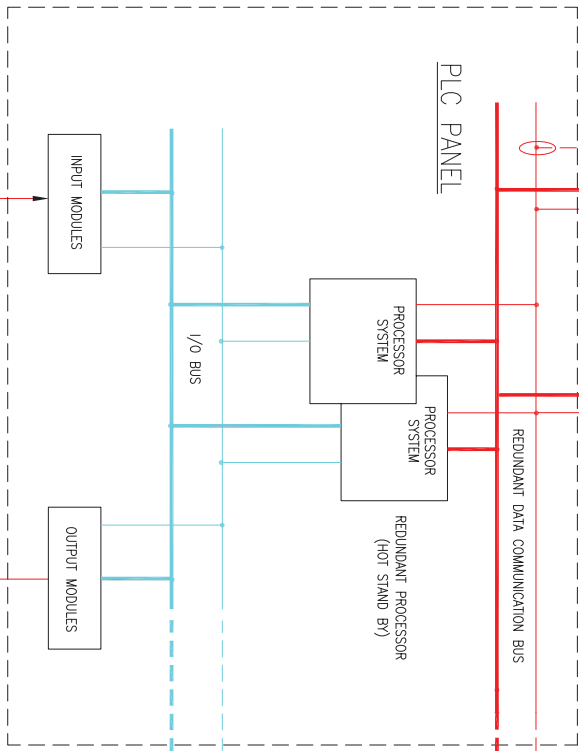
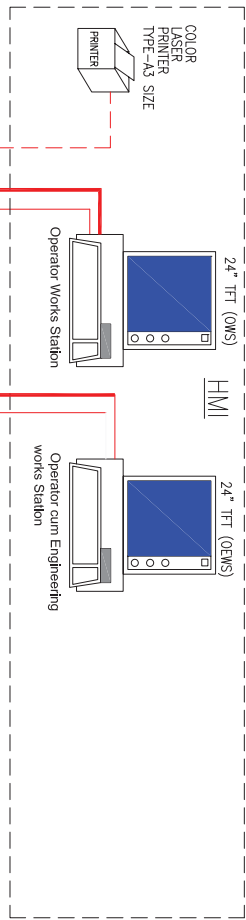
C The sr.no.1 to 7 are reqd.to be furnished for interface impl. :such as Tagname,Description,point type, modbus(Register) address,EU,range & device (dlave) address

C1 What is the primary purpose of the communications link?

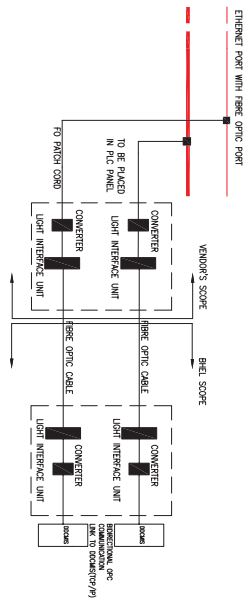
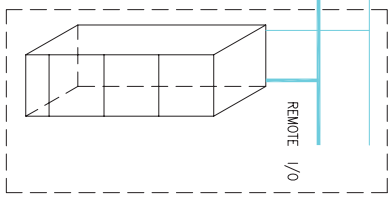
E1 Reqd. Contents : This document must provide an overview of the device including its intended use(a general technical,communication & electrical details)

Mukesh
MUKESH K.S. SINGH
S.A. IEMAN
S.A. IEMAN
20 MAY

[illegible]



- LEGEND:-**
- PLC - PROGRAMMABLE LOGIC CONTROLLER
 - DCS - DISTRIBUTED CONTROL SYSTEM
 - UPS - UNINTERRUPTED POWER SUPPLY
 - OWES - OPERATOR WORK CUM ENGINEERING WORK STATION
 - HMI - HUMAN MACHINE INTERFACE
 - NTP - NETWORK TIME PROTOCOL
 - OPC - OLE PROCESS CONTROL
 - RPU - REMOTE PROCESSING UNIT



- NOTES:**
- 1) PLC SYSTEM SHALL HAVE REDUNDANCY IN PROCESSOR, COMMUNICATION SYSTEM, POWER SUPPLY, MEMORY MODULES, RACK POWER SUPPLY UNITS, BULK IO POWER SUPPLY UNITS, IO COMMUNICATION MODULES, DATA HIGHWAY AND HIGH SPEED (100Mbps) DATA NETWORK CONNECTING THE OPERATOR STATIONS.
 - 2) UPS POWER SUPPLY SHALL BE PROVIDED FOR PLC PANEL(S), OWES, NETWORK COMPONENTS.
 - 3) PLC PANEL SHALL HAVE PROVISION TO ACCEPT TIME SYNC. SIGNAL (IRIG-B) FROM MASTER CLOCK SYSTEM (PLANT AREA).
 - 4) PLC PANEL SHALL HAVE PROVISION FOR REDUNDANT DATA EXCHANGE (OPC) WITH PLANT DCS.
 - 5) INTERNAL BUS AND EXTERNAL DATA NETWORK LOADING SHALL IN NO CASE BE MORE THAN 60% OF ITS CAPACITY.
 - 6) MAIN DATA NETWORK SHALL COMPLY WITH THE INTERNATIONAL STANDARD IEEE-802.3 (ETHERNET) FOR DATA EXCHANGE AND COMMUNICATION.



PLC SYSTEM CONFIGURATION

DRG. NO.	
REV. No.	DATE
SHEET	01 OF 01

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 13 of 18
	TECHNICAL REQUIREMENTS (C&I)	
CONTROL PANELS SPECIFICATION		

MUKESH K. SINGH

S.A. KHAN

2011-01-12

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.

- o) Wire sizes used for internal wiring shall not be lower than the followings :

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

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

4-20mA DC current and low : 1.0 Sq. mm
voltage signal upto 48V DC

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

7.12.04

Grounding

- a) System cabinet AC and DC ground shall be electrically isolated from each other and also electrically isolated from the Instrumentation signal ground. All the above ground shall be individually connected to the single point on the ground pit. Dedicated redundant earth pit shall be provided which shall be away from the HV equipment. This earth pit shall not be shared with other electrical equipment ground and shall also be insulated from other electrical system ground to ensure single point grounding of the system. Grounding resistance shall be better than 1.0 ohm. IEEE guideline shall be followed while designing the grounding system.
- b) Panels and cabinets shall be provided with a continuous tinned copper ground bus bar of minimum 25 mm x 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 mm². Terminal blocks shall conform to IEC 947-7-1.
- b) The characteristics of the terminal blocks shall be as follows.
- High contact force, independent of conductor cross-section and large contact surface area.
 - 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/cm²
Differential Pressure : mm of H₂O column / Kg/cm²
- ii) Draught : mm of H₂O column
- iii) Vacuum : Kg/cm² (abs)/mm of Hg column
- iv) Temperature : Degree Celsius (°C)
- v) Flow (Steam, Water) : Tonnes / hr, M³/Hr
- vi) Flow (Oil) : M³ / Hr, Litter/Hr
- vii) Flow Air : Tonnes / hr / M³ / 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 SO₂ 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;

- Heat cycle run test as per the prevailing standards;
- Functional test of a minimum 25 % of all configured points, logic routines, control functions, graphic displays, reports and logs;
- Demonstration of special calculations (e.g. efficiency calculation, performance calculations etc.);
- Testing of redundancy facilities to demonstrate automatic change over to standby data highway, power supply and control processor etc.;
- Demonstration of system diagnostic facilities;

The FAT shall be witnessed by the Owner / Engineer who shall be notified at least three (3) weeks before the commencement of the tests. The system shall have been fully pre-tested by the manufacturer at his works prior to notifying the Owner / Engineer to ensure any component, equipment or system fault have been identified and cleared. The test procedure for the FAT shall be issued to the Engineer and agreed prior to notification. All documents / drawings and test equipment shall be available at the manufacturer's works during the FAT.

The FAT shall include a 72 hour continuous operational run, any equipment fault or failure during this time shall make this part of the test null and void and the test run shall be re-started after rectification of the fault. A test certificate, accompanied by the relevant test results, shall be issued after successful completion of the tests.

(b) Site Acceptance Test (SAT)

After installation, connection, integration with other systems and all pre-commissioning checks have been carried out on the complete system, the SAT shall be performed and witnessed by the Engineer. The SAT shall include the following as a minimum:

- a) Complete hardware and installation inspection;
- b) Testing of redundancy facilities by simulating data highway, power supplies and control processor failures. All such units shall be tested to demonstrate of the automatic operation of the standby units and initiation of the relevant system alarms;
- c) Demonstration of system diagnostic facilities; by the simulation of the appropriate fault conditions. The system fault reporting techniques shall also be demonstrated;
- d) Testing of data highway integrity using continuity test equipment based on signal injection / reflection techniques;
- e) Demonstration of data logging, sequence of events and trending system operation.
- f) Pre-commissioning checks shall include the following:

- i) Calibration of all field instruments, analysers and equipment, in the scope of supply of this package, at site;
- ii) Loop checking, for all open and close loops, between source and destination with manual signal injection as well as from Operating Consoles for entire DCS I/Os;
- iii) Logic sequence check with the manual signal injection at signal source as well as checking of feed back signals.

All individual configured data points, logic routines, control functions, graphic displays and reporting facilities shall be verified as part of the loop tests.

The Owner shall be notified at least 2 weeks before the commencement of the test. The procedures shall be issued and agreed before notification.

A test certificate accompanied by the relevant test results shall be issued after successful completion of the calibration and test.

Similar tests shall also be applicable for other control system i.e. plant utility system PLC / Microprocessor based control systems.


S.A. KHAN

MUKESH K.S. SINGH

Signature

Signature

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MAHESH K.SINGH

S.A. - ICHAN

**STANDARD QUALITY PLAN
 FOR
 LOCAL CONTROL PANEL**



PEM :: C&I

PROJECT PLAN NO.: PE-QP-999-145-I056

VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	22-02-2008
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 \$			Remarks
									P	W	V	
INCOMING												
1.0	Sheet Steel (CRCA & HR)	1. Chemical Composition 2. Bend Test 3. Surface finish 4. Waviness 5. Thickness 6. Mill marking	MA CR MA MA MA MA	Chemical analysis Mech. test Visual Visual Measurement Visual	Sample Sample 100% 100% 100% 100%	IS:1079 IS:513 IS:1079 IS:513 Factory Standard / Sample Factory Standard BHEL Spec. Factory Standard	IS:1079 IS:513 IS:1079 IS:513 Factory Standard / Sample No Waviness BHEL Spec. Factory Standard	Test Certificate Log Book Log Book Log Book Log Book Log Book	3 2 2 2 2 2	---	2 --- --- --- --- 1	
2.0	Flats / Angles / Channels	1. Dimensions 2. Surface Defects 3. Straightness 4. Mill marking	MA MA MA MA	Measurement Visual Measurement Visual	Sample 100% 100% 100%	IS:2062 Factory Standard / Sample Factory Std. IS:2062	IS:2062 Factory Standard / Sample Factory Std. IS:2062	Log Book Log Book Log Book Log Book	2 2 2 2	---	---	
3.0	Cables / Wires	1. Visual / Surface defects 2. IR and HV	MA MA	Visual Electrical	100% 100%	BHEL Spec. and IS:1554 or IS:694 BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694 BHEL Spec. and IS:1554 or IS:694	Log Book Log Book	2 2	---	---	

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

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

1 - BHEL
 2 - Vendor
 3 - Sub-vendor

Signature
Signature
 S.A. - ICHANJ
 S.A. - ICHANJ

**STANDARD QUALITY PLAN
FOR
LOCAL CONTROL PANEL**

 PEM :: C&I	Y PLAN NO.: PE-QP-999-145-I056									
	VOLUME		IIB							
	SECTION		D							
	REV. NO.		01		DATE: 22-02-2008					
	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 \$			Remarks
									P	W	V	
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type	CR	Visual	Sample	BHEL Spec. and BOM	BHEL Spec. and BOM	Log Book	2	---	---	
		2. Verification of Test Certificates	CR	Scrutiny of Type / Routine T.Cs.	100%	Relevant IS	Relevant IS	Log Book	2	---	---	
		3. Operation / Functional check	CR	Electrical	Sample+ 100%@	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	+ for relay & contactors only
		4. I.R.	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	@ for all components except relays & contactors.
		5. H.V.	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	
		6. Calibration	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	1	
		7. Pick up / Drop off Voltage	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	

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

Signature

Signature

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 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL		Y PLAN NO.: PE-QP-999-145-I056	
VOLUME		IIB			
SECTION		D			
REV. NO.		01		DATE: 22-02-2008	
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 \$			Remarks
									P	W	V	
5.0	Misc. Components like Gaskets , Terminal Blocks etc.	1. Verification of Type / Make 2. Surface defects 3. IR / HV on Terminal Blocks	MA MA MA	Visual Visual Electrical	Sample Sample Sample	BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue	Log Book Log Book Log Book	2 2 2	---	---	---
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions 2. Surface defects after bending	MI MA	Measurement Visual	100% 100%	Approved Mfr. drgs. Factory Standard	Approved Mfr. drgs. Factory Standard	Log Book Log Book	2 2	---	---	---
7.0	Nibbling / Punching	1. Cutout Sizes 2. Deburring	MI MA	Measurement Visual	100% 100%	Approved Mfr. drgs. Approved Mfr. drgs.	Approved Mfr. drgs. Approved Mfr. drgs.	Log Book Log Book	2 2	---	---	---
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions 2. Alignment 3. Welding Quality 4. Surface defects	MA MA MA MA	Measurement Measurement Visual Visual	100% 100% 100% 100%	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Log Book Log Book Log Book Log Book	2 2 2 2	---	2 2 2 2	

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

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STANDARD QUALITY PLAN
FOR
LOCAL CONTROL PANEL

PROJECT PLAN NO.: PE-QP-999-145-I056
VOLUME IIB
SECTION D
REV. NO. 01 DATE: 22-02-2008
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 \$			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
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MI - Minor characteristics

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1 - BHEL
2 - Vendor
3 - Sub-vendor

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 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL		Y PLAN NO.: PE-QP-999-145-I056	
VOLUME		IIB			
SECTION		D			
REV. NO.		01		DATE: 22-02-2008	
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 \$			Remarks
									P	W	V	
10.	Panel Wiring	1. Wiring Layout 2. Wiring Termination (Crimped Lugs) 3. Ferrule numbers 4. Colour of wiring 5. Size of Conductor	MA MA MA MA MA	Visual Visual Visual Visual Measurement	100% 100% 100% 100% 100%	Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs.	Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs. Approved drgs. & Specs.	Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2	--- --- --- --- ---	--- --- --- 1 1	
11.	Component Mounting	1. Correct components 2. Fixing	MA MA	Visual Visual	100% 100%	Approved drgs., Specs. & BOM Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM Approved drgs., Specs. & BOM	Log Book Log Book	2 2	--- ---	--- ---	
12.	FINAL Final Inspection	1. Workmanship 2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components 3. Components identification Marking / Name plates	MA MA MA	Visual Visual Visual	100% 100% 100%	Factory Standard BHEL approved drg. / Spec. BHEL approved drg. / Spec.	Factory Standard BHEL approved drg. / Spec. BHEL approved drg. / Spec.	Inspection Report Inspection Report Inspection Report	2 2 2	1 1 1	1 1 1	At Random by BHEL, based on 100 % internal test reports by Mfr.

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

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PLAN NO.: PE-QP-999-145-I056

VOLUME IIB

SECTION D

REV. NO. 01 DATE: 22-02-2008

SHEET 6 OF 7

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL



PEM :: C&I

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$				Remarks
									P	W	V		
5.	Dimensions		MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	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	1	
7.	Paint Shade		CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	1	
8.	Paint Thickness		CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	1	
9.	Workmanship of Gaskets		MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	1	
10.	Wiring Layout		MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1	1	
11.	Wire Termination		MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1	1	
12.	Continuity		MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1	1	

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MI - Minor characteristics

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2 - Vendor
3 - Sub-vendor

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		Y PLAN NO.: PE-QP-999-145-I056	
VOLUME IIB		SECTION D	
REV. NO. 01		DATE: 22-02-2008	
SHEET 7		OF 7	

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			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. & 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	

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

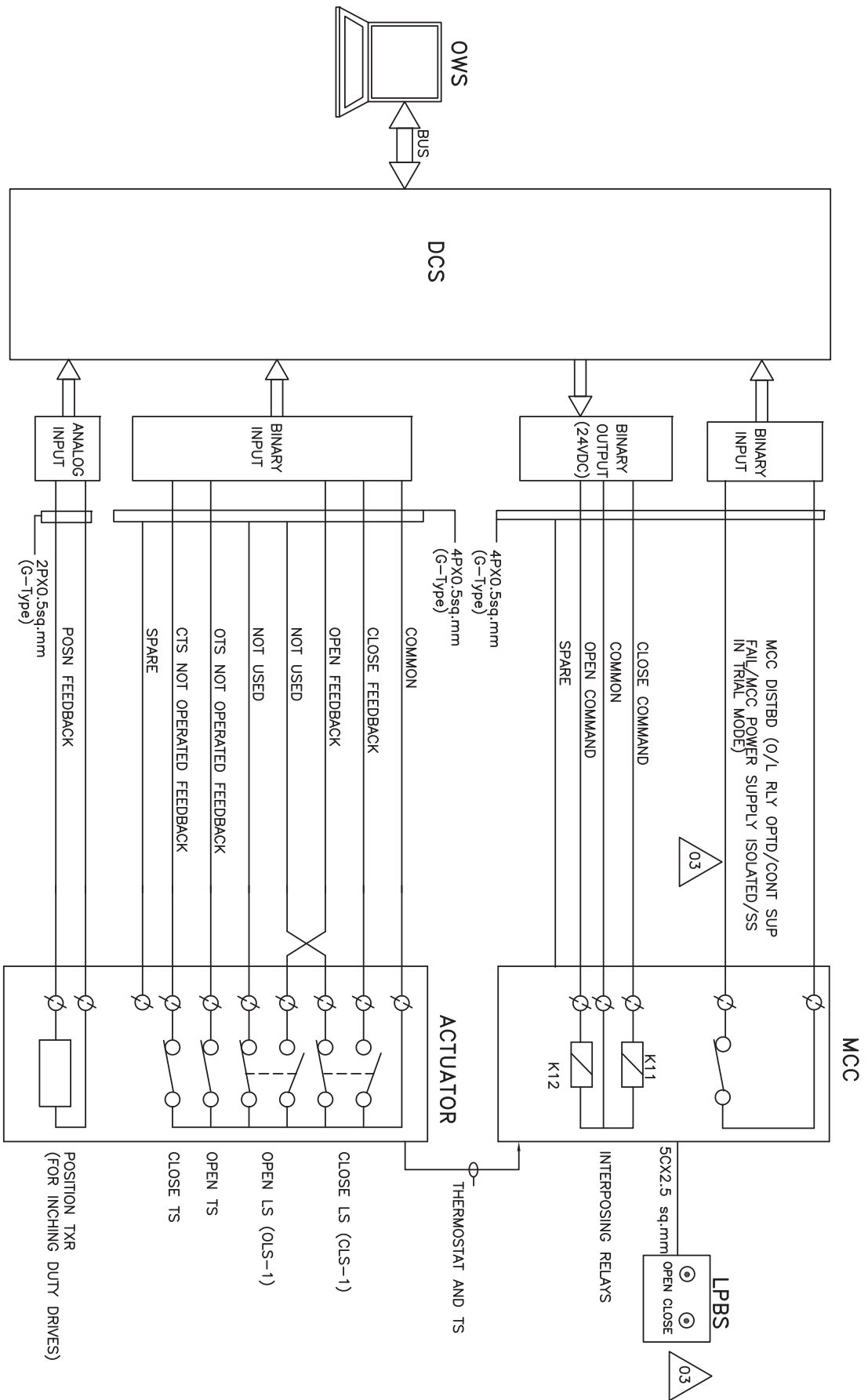
	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 14 of 18
	TECHNICAL REQUIREMENTS (C&I)	
DRIVE CONTROL PHILOSOPHY		

MUKESH K. SINGH

S.A. KHAN

2011-01-01

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH MCC)

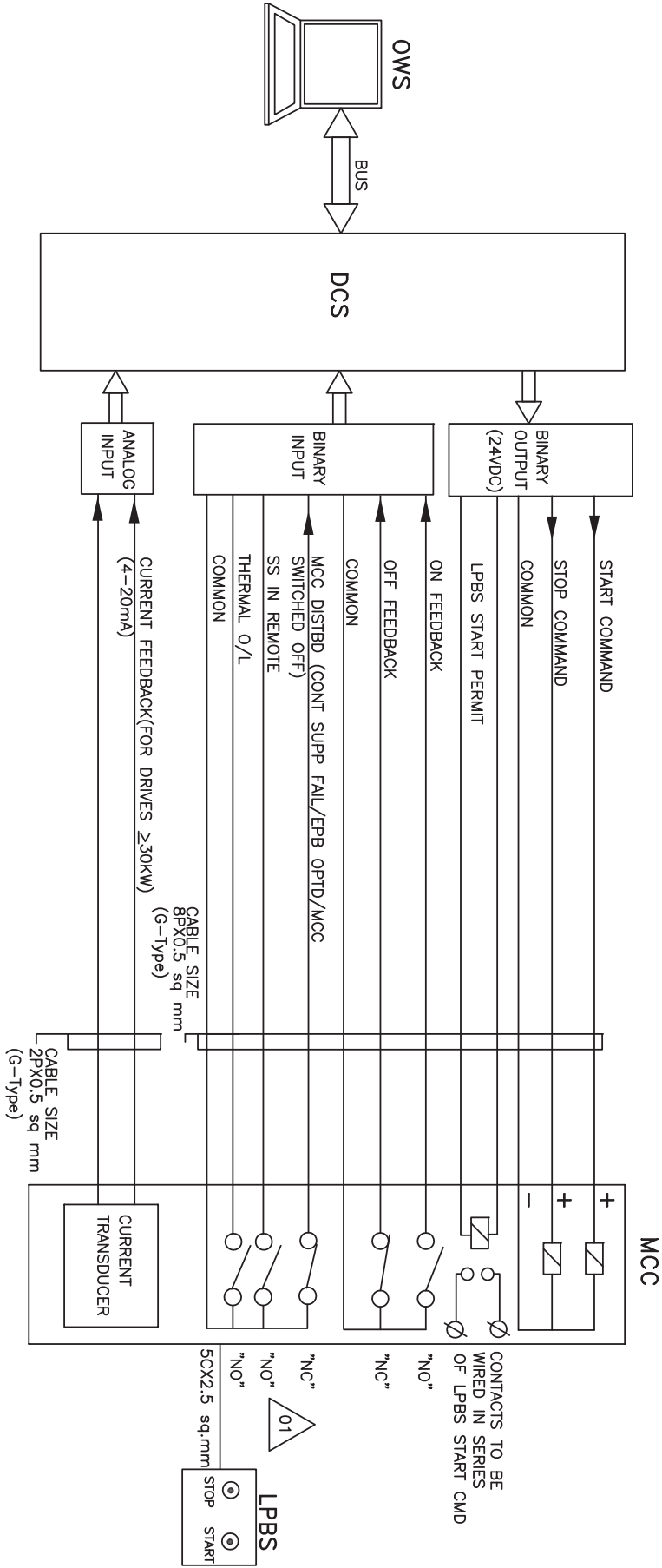


PROJECT: 1X800MW WANKABORI THERMAL POWER STN.
EXTN. UNIT-8

DRG.NO. PE-DM-408-145-1002
DATE 15.06.15
REV.NO. 03
SHT 8 OF 12

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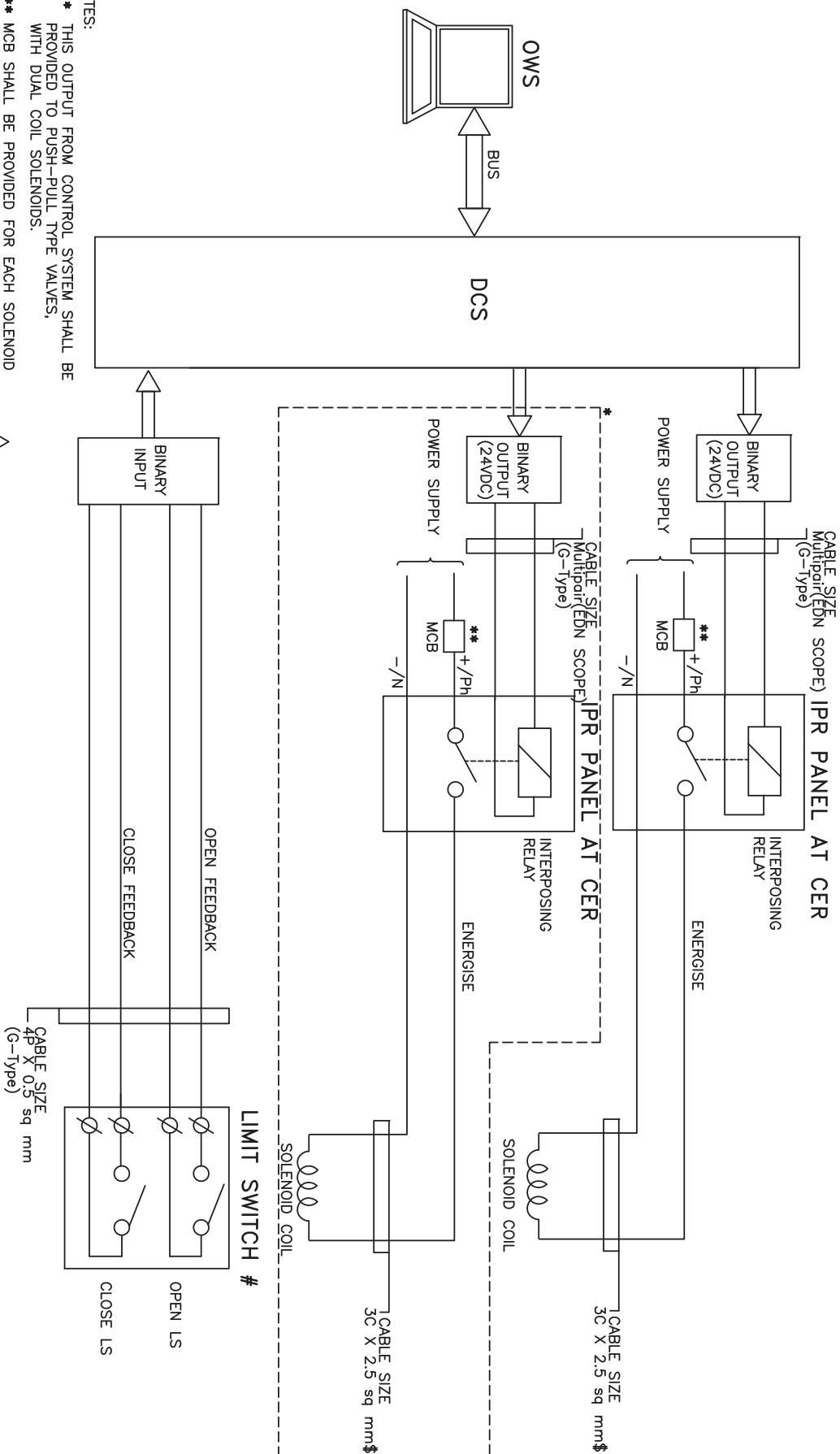
DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE



PROJECT: 1X800MW WANKABORI THERMAL POWER STN.
EXTN. UNIT-8
TITLE : 01 DCS INTERFACE FOR

DRG.NO.	PE-DM-408-145-1002
DATE	16.02.15
REV.NO.	01
SHT	8 OF 11

DCS INTERFACE FOR SOLENOID DRIVE (24V DC/220V DC/ 240V AC UPS)



- NOTES:
- * THIS OUTPUT FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.
 - ** MCB SHALL BE PROVIDED FOR EACH SOLENOID
 - # FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.

CER:-CONTROL EQUIPMENT ROOM
IPR:-INTER POSING RELAY
\$ SYSTEMS WHERE EVER MULTIPLE SOLENOIDS CAN BE GROUPED,MULTI CORE CABLE SHALL E

01



PROJECT: 1X800MW WANKABORI THERMAL POWER STN.
EXTN. UNIT-8

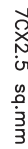
DRG.NO. PE-DM-408-145-1002
DATE 16.02.15

TITLE : 01 DCS INTERFACE FOR SOLENOID DRIVE

REV. NO. 01

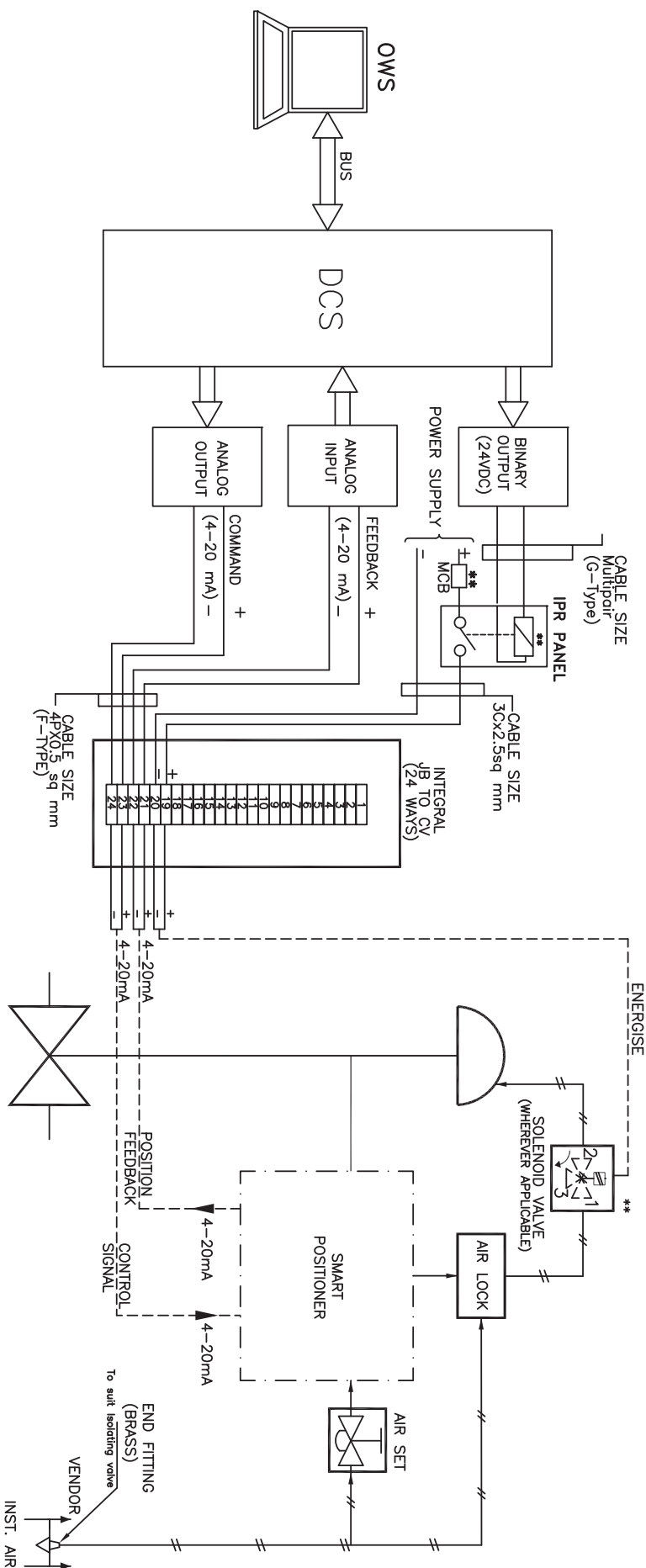
SHT 9 OF 11

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OFFICE

DCS INTERFACE FOR ANALOG DRIVE (WITH SMART POSITIONER)



NOTES:

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

		PROJECT: 1X800MW WANAKBORI THERMAL POWER STN. EXTN. UNIT-8		DRG.NO. PE-DM-408-145-1002	
TITLE : TYPICAL HOOK-UP DIAGRAM		DATE 16.02.15		REV.NO. 01	
R)		SHT 11		OF 11	

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 15 of 18
	TECHNICAL REQUIREMENTS (C&I)	
APPLICABLE CODES AND STANDARDS		

MUKESH K. SINGH

S.A. KHAN

2011-01-11

~~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 SUB SECTION : C&I SHEET 16 of 18
	TECHNICAL REQUIREMENTS (C&I)	

SPECIFICATION FOR QUALITY ASSURANCE & TESTING


MUKESH K. SINGH
S.A. KHAN
2011-01-11

~~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 SO₂ 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;

- Heat cycle run test as per the prevailing standards;
- Functional test of a minimum 25 % of all configured points, logic routines, control functions, graphic displays, reports and logs;
- Demonstration of special calculations (e.g. efficiency calculation, performance calculations etc.);
- Testing of redundancy facilities to demonstrate automatic change over to standby data highway, power supply and control processor etc.;
- Demonstration of system diagnostic facilities;

The FAT shall be witnessed by the Owner / Engineer who shall be notified at least three (3) weeks before the commencement of the tests. The system shall have been fully pre-tested by the manufacturer at his works prior to notifying the Owner / Engineer to ensure any component, equipment or system fault have been identified and cleared. The test procedure for the FAT shall be issued to the Engineer and agreed prior to notification. All documents / drawings and test equipment shall be available at the manufacturer's works during the FAT.

The FAT shall include a 72 hour continuous operational run, any equipment fault or failure during this time shall make this part of the test null and void and the test run shall be re-started after rectification of the fault. A test certificate, accompanied by the relevant test results, shall be issued after successful completion of the tests.

(b) Site Acceptance Test (SAT)

After installation, connection, integration with other systems and all pre-commissioning checks have been carried out on the complete system, the SAT shall be performed and witnessed by the Engineer. The SAT shall include the following as a minimum:

- a) Complete hardware and installation inspection;
- b) Testing of redundancy facilities by simulating data highway, power supplies and control processor failures. All such units shall be tested to demonstrate of the automatic operation of the standby units and initiation of the relevant system alarms;
- c) Demonstration of system diagnostic facilities; by the simulation of the appropriate fault conditions. The system fault reporting techniques shall also be demonstrated;
- d) Testing of data highway integrity using continuity test equipment based on signal injection / reflection techniques;
- e) Demonstration of data logging, sequence of events and trending system operation.
- f) Pre-commissioning checks shall include the following:

- i) Calibration of all field instruments, analysers and equipment, in the scope of supply of this package, at site;
- ii) Loop checking, for all open and close loops, between source and destination with manual signal injection as well as from Operating Consoles for entire DCS I/Os;
- iii) Logic sequence check with the manual signal injection at signal source as well as checking of feed back signals.

All individual configured data points, logic routines, control functions, graphic displays and reporting facilities shall be verified as part of the loop tests.

The Owner shall be notified at least 2 weeks before the commencement of the test. The procedures shall be issued and agreed before notification.

A test certificate accompanied by the relevant test results shall be issued after successful completion of the calibration and test.

Similar tests shall also be applicable for other control system i.e. plant utility system PLC / Microprocessor based control systems.


S.A. KHAN

MUKESH K.S. SINGH

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 17 of 18
	TECHNICAL REQUIREMENTS (C&I)	
MANDATORY SPARES		

MUKESH K. SINGH

S.A. KHAN

2011-01-12

મુલકેશ કાંડલગામ
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સી.આ.કાંડલગામ
સી.આ.કાંડલગામ

Sl. No.	Equipment/Package Name	Quantity	Remarks	Remarks as per post-bid resolution dt 9.01.2013 (BH-29)	Name of Unit
1.5	Flow Regulating Valve				TBG/ PEM TK PKG
1.5.1	For Air Washer	10% or Minimum 1No. Whichever is higher		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.5.2	For Unitary Air Filtration Unit	10% or Minimum 1No. Whichever is higher		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.6	Basket for POT Strainer				TBG/ PEM TK PKG
1.6.1	Strainer Basket for Air Washer	1No. for each type and size		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.6.2	Strainer Basket for Unitary Air Filtration unit	1No. for each type and size		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.7	Valves				TBG/ PEM TK PKG
1.7.1	Gate valve for Air washer	10% or Minimum 1No. Whichever is higher		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.7.2	NR Valve for Air Washer	10% or Minimum 1No. Whichever is higher		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.7.3	Gate valve for Unitary Air Filtration Unit	10% or Minimum 1No. Whichever is higher		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.7.4	NR valve for Unitary Air Filtration Unit	10% or Minimum 1No. Whichever is higher		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.7.5	Gate Valve for Make-up Drain of Air washer	10% or Minimum 1No. Whichever is higher		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.7.6	Gate valve for UAF	20% or Minimum 2Nos. Whichever is higher		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.8	Electrical Spares as applicable as per the Electrical List	Item & Quantity same as indicated in Electrical list 'B'		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.8.1	Field Instruments & Others as applicable as per the C&I List	Item & Quantity same as indicated in C&I list			TBG/ PEM TK PKG
1.9	Fan-Filter Units				TBG/ PEM TK PKG
1.9.1	Filter	1 set for each FFU		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.9.2	Fan-motor Bearing	1 set for each rating of FFU		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.9.3	Vibration Isolators	1 set for each FFU		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.9.4	Back Draft Dampers	1 no. of each size		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.9.5	Any other spare parts recommended by the Manufacturer	As recommended by the Manufacturer		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.10	Wall mounted supply/ Exhaust fan				TBG/ PEM TK PKG
1.10.1	Fan-motor Bearing	1 set for each rating of fan			TBG/ PEM TK PKG
1.10.2	Vibration Isolators	1 set for each fan			TBG/ PEM TK PKG
1.10.3	Fan Motor	1 set for each rating of fan			TBG/ PEM TK PKG
1.11	Electrical Spares for panels				TBG/ PEM TK PKG

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Sl. No.	Equipment/Package Name	Quantity	Remarks	Remarks as per post-bid resolution dt 9.01.2013 (BH-29)	Name of Unit
1.11.1	Control Supply Transformer	2 Nos. of each type and rating		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.11.2	Contactor	2 Nos. of each type and rating		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.11.3	Coils for contactor & aux. Contactor	5 Nos. for each contactor		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.11.4	Main & Aux. Contacts sets for contactor and Aux. Contactor	5 Sets. for each contactor		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.11.5	Air Break Switch	1 No. for each rating		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.11.6	Control ,Isolating and selector switches	5% of each type and rating		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.11.7	Fuses	6Nos,of each type and rating or 10% whichever is higher		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.11.8	Fuse Bases	3Nos,of each type and rating or 5% whichever is higher		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.11.9	Circuit Breaker	1 No. for each rating		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.11.10	Indicating Lamps	10% of installed quantity		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.11.11	Indicating lamps cover of different colour and holders	5% of installed quantity		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.11.12	Push Buttons of various colours	10 nos. of each type and colour		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.11.13	Terminal Blocks	5% of installed quantity		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.12	Electrical Spares for Motors				TBG/ PEM TK PKG
1.12.1	Terminal plates	10 Nos. each for small motors up to 30KW and 4 Nos. each for motors above 30 KW		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.12.2	Heaters	1 Set for each motor of rating above 30 KW		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.12.3	Greasing arrangements	4 sets for each type of motors		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.12.4	Motors below 0.75 KW	10% of the installed quantity or minimum 1 no. whichever is higher		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
1.12.5	Bearings (DE & NDE)	4 sets of each type and rating		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
2	Air Conditioning System			Lot Price for applicable items under Sno 2 covered at Sno above	TBG/ PEM TK PKG
2.1	Vapour Absorption Machine				TBG/ PEM TK PKG
2.1.1	Bearing for absorbent and refrigerant pump	1Set for each category			TBG/ PEM TK PKG
2.1.2	Gaskets as applicable for Condenser & Chiller Heads	1Set for each category			TBG/ PEM TK PKG
2.1.3	Steam Regulating Valve	1Set			TBG/ PEM TK PKG
2.2	Centrifugal fans				TBG/ PEM TK PKG
2.2.1	Bearings for fan & motor	2Sets for each category			TBG/ PEM TK PKG

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Sanjay
Sh. M. M. A. A.

Sl. No.	Equipment/Package Name	Quantity	Remarks	Remarks as per post-bid resolution dt 9.01.2013 (BH-29)	Name of Unit
2.2.2	V-belts	1Set for each category			TBG/ PEM TK PKG
2.2.3	Vibration Isolators	1Set			TBG/ PEM TK PKG
2.3	Screw Chiller				TBG/ PEM TK PKG
2.3.1	Bearing for the compressor	1Set			TBG/ PEM TK PKG
2.3.2	Gaskets as applicable for Condenser & Chiller Heads	1Set for each category			TBG/ PEM TK PKG
2.4	Air Handling Units				TBG/ PEM TK PKG
2.4.1	Bearings for each AHU blower & motor	1Set for each category			TBG/ PEM TK PKG
2.4.2	V-Belts	2 Sets for each category			TBG/ PEM TK PKG
2.4.3	Filters of each type	2 Sets for each category			TBG/ PEM TK PKG
2.5	Refrigerant & Oil				TBG/ PEM TK PKG
2.5.1	Refrigerant gas in a non-returnable cylinder	15% of installed charge	Price included at Sno 1 above		TBG/ PEM TK PKG
2.5.2	Empty cylinders of 68Kg capacity to hold the charge of the highest capacity system	As required to suit the above	Price included at Sno 1 above		TBG/ PEM TK PKG
2.5.3	Filter oil in sealed tins for the full set for 6 operations of cleaning	As required	Price included at Sno 1 above		TBG/ PEM TK PKG
2.6	Centrifugal Pump	5% of one Condenser		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
2.6.1	Bearings for each pump and motor	2 Sets for each category		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
2.6.2	Mechanical seal, wearing rings and lantern rings	1Set for each category		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
2.7	Cooling Tower			Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
2.7.1	Spray nozzles	10% of one Tower		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
2.7.2	Set of fills	10% of one Tower		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
2.7.3	Bearings for each fan and motor	2 sets		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
2.8	Precision Air Conditioners				TBG/ PEM TK PKG
2.8.1	Vibration Isolators	1Set for each category	Price included at Sno 1 above		TBG/ PEM TK PKG
2.8.2	Filters	1 set for each PAC unit	Price included at Sno 1 above		TBG/ PEM TK PKG
2.8.3	Bearings	1 set for each rating of PAC unit (both for condenser & Indoor Unit)	Price included at Sno 1 above		TBG/ PEM TK PKG
2.8.4	Condenser fan Impeller	1 set for each PAC unit	Price included at Sno 1 above		TBG/ PEM TK PKG
2.8.5	Expansion valve	1 set for each rating of PAC unit	Included		TBG/ PEM TK PKG
2.8.6	Any other spare parts recommended by the Manufacturer	1 set for each rating of PAC unit	No other items recommended		TBG/ PEM TK PKG
2.9	Split Air Conditioners		Price included at Sno 1 above		TBG/ PEM TK PKG

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Sl. No.	Equipment/Package Name	Quantity	Remarks	Remarks as per post-bid resolution dt 9.01.2013 (BH-29)	Name of Unit
2.9.1	Fan-motor bearing for outdoor unit	1 set for each rating of SAC unit	Price included at Sno 1 above		TBG/ PEM TK PKG
2.9.2	Vibration Isolators	1 set each for outdoor unit & Indoor unit for each SAC unit	Price included at Sno 1 above		TBG/ PEM TK PKG
2.9.3	Filter	1 set for each SAC unit	Included		TBG/ PEM TK PKG
2.9.4	Expansion valve	1 set for each rating of SAC unit	Included		TBG/ PEM TK PKG
2.9.5	Any other spare parts recommended by the Manufacturer	As recommended by the Manufacturer	Included		TBG/ PEM TK PKG
2.10	Electrical Spares		Included		TBG/ PEM TK PKG
2.10.1	Air Break Switches	1 No. of each rating	Included		TBG/ PEM TK PKG
2.10.2	Control , Isolating and selector switches	5% of each type and rating	Included		TBG/ PEM TK PKG
2.10.3	Fuses	6Nos.of each type and rating or 10% whichever is higher	Included		TBG/ PEM TK PKG
2.10.4	Fuse Bases	3Nos.of each type and rating or 5% whichever is higher	Included		TBG/ PEM TK PKG
2.10.5	Indicating Lamps	10% of installed quantity	Included		TBG/ PEM TK PKG
2.10.6	Indicating lamps cover of different colour and holders	5% of installed quantity	Included		TBG/ PEM TK PKG
2.10.7	Push Buttons of various colours	10 nos. of each type and colour	Included		TBG/ PEM TK PKG
2.10.8	Terminal Blocks	5% of installed quantity	Included		TBG/ PEM TK PKG
2.11	PLC System			Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
2.11.1	I/O cards	1 No. or 20% of equipped cards whichever is maximum		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
2.11.2	Process cards	1 No.		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
2.11.3	Power Supply module	1 No.		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
2.11.4	Communication Process cards	1 No.		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
2.11.5	Hand-held Programmer	1 No.		Refer Sno 15 of BH-29 attached herewith.	TBG/ PEM TK PKG
3	Fire Protection & Detection System		LOT PRICE for applicable items under Sno 3.		TBG/ PEM TK PKG
3.1	Diesel Engine				TBG/ PEM TK PKG
3.1.1	Element for lub oil Filter	2 Nos.			TBG/ PEM TK PKG
3.1.2	Element for Fuel Filter	2 Nos.			TBG/ PEM TK PKG
3.1.3	Outer Element for Air cleaner	2 Nos.			TBG/ PEM TK PKG
3.1.4	Inner Element for Air cleaner	2 Nos.			TBG/ PEM TK PKG
3.1.5	Turbo-charger	1No.			TBG/ PEM TK PKG
3.1.6	Engine - starter Motor	1No.			TBG/ PEM TK PKG

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8.1.15	Voltmeter	2 No. for each type and Rating for BTG Area & 1 No. for each type & Rating for BOP Area.	(0-3200 A)-2 No's, (0-800A)-2 No's,
8.1.16	Ammeter		
8.1.17	Auxiliary Control Contactor		
8.1.17.1	Auxiliary Control Contactor DC complete	25Nos.	Not offered as loose items are not feasible to offer.
8.1.17.2	Auxiliary Control Contactor DC spare kits	25Nos.	Not offered as loose items are not feasible to offer.
8.1.17.3	Auxiliary Control Contactor DC Coils	25Nos.	Not offered as loose items are not feasible to offer.
8.2	PMCC/MCC/ACDB		LOT (LOT PRICE FOR APPLICABLE ITEMS IN THE LIST OF ITEMS INDICATED BELOW IN SL NO 8.2.1 TO 8.2.15.3)
8.2.1	Contactor		
8.2.1.1	Power Contactor (AC)		
8.2.1.1.1	Power Contactor Complete Assembly	4 Nos for each type and rating	4Sets. (Each set comprises of 8A, 16A, 32A, 63A, 80A, 100A, 125A Contactors)
8.2.1.1.2	Power Contactor spare kits	10Sets for each type and rating	Refer Sno 15 of BH-29 attached herewith.
8.2.1.1.3	Power Contactor AC Coils	10Nos. Coils for each type and rating	Refer Sno 15 of BH-29 attached herewith.
8.2.1.2	Auxiliary Control Contactor (AC)		
8.2.1.2.1	Auxiliary Control Contactor Complete Assembly	30 Nos for each type and rating	
8.2.1.2.2	Auxiliary Control Contactor spare kits	40 Sets for each type and rating	Refer Sno 15 of BH-29 attached herewith.
8.2.1.2.3	Auxiliary Control Contactor AC Coils	35 Nos for each type and rating	Refer Sno 15 of BH-29 attached herewith.
8.2.2	MCCB (Power Circuit)	5 Nos. for each type and rating	5Sets (Each set comprises of 16A, 32A, 63A, 125 A, 315A, 320A, 400A-1No)
8.2.3	MCB (Control Circuit)	25 Nos for each type and rating	25 Set (Each set comprises of 2A, 4A, 6A, 8A, 10A-1No)
8.2.4	Switch		
8.2.4.1	Local / Remote Selector Switch	10Nos.	10No's.
8.2.4.2	MCCB Status (On/off) Monitoring Switch/Contact	5Nos.	Refer Sno 15 of BH-29 attached herewith.
8.2.4.3	Trial / Normal /MCC Selector Switch	15Nos.	Refer Sno 15 of BH-29 attached herewith.
8.2.4.4	MCC module Service Position Limit Switch	5Nos.	Loose items are not feasible to offer.
8.2.5	Thermal Overload Relay	5Nos. for each type and rating	5Set (Each set comprises of (1-1.6A)-1 No for Rapping motors & (1-3A)-1No for Onacity Monitor)

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Loose items are not feasible to offer.

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Incomer protection of breakers is applicable.
Transformer protection is not applicable.

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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		
11.2	SCR	10% of total quantity of each type used in the system or minimum 2(two) nos. whichever is more.		EDN
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 Moduler/ PCB	1 (one) no. each type of Electronic Card/PCB/modules used in the system		
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			EDN
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 pulley	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	Selecter 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

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12.3.2	Voltmeter					EDN
12.3.3	Frequency	10% for each type and range or minimum one (1) no. whichever is more				EDN
12.3.4	MW	10% for each type and range or minimum one (1) no. whichever is more				EDN
12.3.5	MVAR	10% for each type and range or minimum one (1) no. whichever is more				EDN
12.3.6	Power Factor	10% for each type and range or minimum one (1) no. whichever is more				EDN
12.3.7	Synroscope	10% for each type and range or minimum one (1) no. whichever is more				EDN
12.4	Indicating Lamps complete assembly	10% for each type and range or minimum one (1) no. whichever is more				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					EDN
12.8	Annunciation system					EDN
12.8.1	Lamp Box with Facia & Lamps (LED type)	1No.				EDN
12.8.2	Hooter	1(one) no.				EDN
12.8.3	Each type of PCB (for non-PLC driven system)				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	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	Complux 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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GSECL		BHEL	
Equipment/Package Name	Remarks	Remarks as per post-bid resolution dt 9.01.2013 (BH-29)	Name of Unit
General 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.			
Field Instruments (Transmitters/temperature elements (TC / RTD) / Gauges / 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.			
Steam & Water Analysis System (SWAS) 2 (two) numbers conductivity / pH transmitter along with probes. Electronic modules of each type for conductivity, pH, silica, dissolved oxygen, Hydrazine etc. Other items as recommended by Supplier.	Lot Price for applicable items		Trichy/ HWR/ HYD/ BAP/ PC Chennai/ EDN
Continuous Emissions Monitoring System (CEMS) Analyzer spares like transmitter lens & receiver lens, protection windows for transmitter & receiver, integral pressure & temperature sensors, Signal processing unit - one set of each type. 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.	EDN EDN EDN EDN
Vibration Monitoring System (TG, TDBFP & HT drives covered in supplied package) 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). 2 (two) numbers of power supply modules. 10 (ten) percent of each type of vibration monitor cards and other electronic cards or 2 (two) nos. of each type, whichever is higher.	Lot Price for applicable items		Trichy/ HYD/ EDN Trichy/ HYD/ EDN Trichy/ HYD/ EDN Trichy/ HYD/ EDN
Control System (DCS, PLC etc.) 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. 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.	Lot price for applicable items		HWR/ EDN
CCTV 2 (two) numbers of cameras and fixing accessories.	Price Included in electronic modules above For applicable Lot price for applicable items in the list of items indicated below		EDN Trichy/ EDN

Signature
Signature
MUKESH K. SINGH S.A. KHAN S.M.A.

Equipment/Package Name	Remarks	Remarks as per post-bid resolution dt 9.01.2013 (BH-29)	Name of Unit
Other items as recommended by Supplier.	No other items recommended by supplier	Refer Sno 15 of BH-29 attached herewith.	Trichy/ EDN
Large Video Screen (LVS)			EDN
1 (one) number controller module.			EDN
Other items as recommended by Supplier.	No other items recommended by supplier	Refer Sno 15 of BH-29 attached herewith.	EDN
Master Clock System			EDN
10 (ten) percent of the total qty. offered for each type of electronic modules or 1 (one) number whichever is higher.			EDN
Valves, Actuators & Accessories	Lot price for applicable items in the list of items indicated below. For ESP scope Pneumatic actuators only are quoted.		Trichy/ HYD/ BAP/ PC Chennai/ PEM
Control Valves			Trichy/ HYD/ BAP/ PC Chennai/ PEM
2 (two) sets of spare control valve stem packing for each of the control valves, as offered.			Trichy/ HYD/ BAP/ PC Chennai/ PEM
1 (one) set of spare valve trim (including cage, plug, stem, seat rings, guide bushings etc.) for both the units for each of the control valves, as offered.			Trichy/ HYD/ BAP/ PC Chennai/ PEM
Control valve Actuators			Trichy/ HYD/ BAP/ PC Chennai/ PEM
1 (one) set of spare actuators with drive of each type and rating.			Trichy/ HYD/ BAP/ PC Chennai/ PEM
10 (ten) percent of valve positioners of each type.			Trichy/ HYD/ BAP/ PC Chennai/ PEM
10 (ten) percent of position transmitters of each type.			Trichy/ HYD/ BAP/ PC Chennai/ PEM
10 (ten) percent of limit switches/torque switches of each type.			Trichy/ HYD/ BAP/ PC Chennai/ PEM
TOTAL			

	1X800 MW Wanakbori STPP	SECTION: C SUB SECTION : C&I SHEET 18 of 18
	TECHNICAL REQUIREMENTS (C&I)	
DRAWINGS		

MUKESH K. SINGH

S.A. KHAN

2011-01-12

GA DRAWING
TRANSMITTER RACK

SB	SR	SD		0	21.04.10
APPROVED	CHECKED	DRAWN			

GA DRAWING-TRANSMITTER RACK

1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WAMAKBORI THERMAL POWER STATION, GUJARAT)

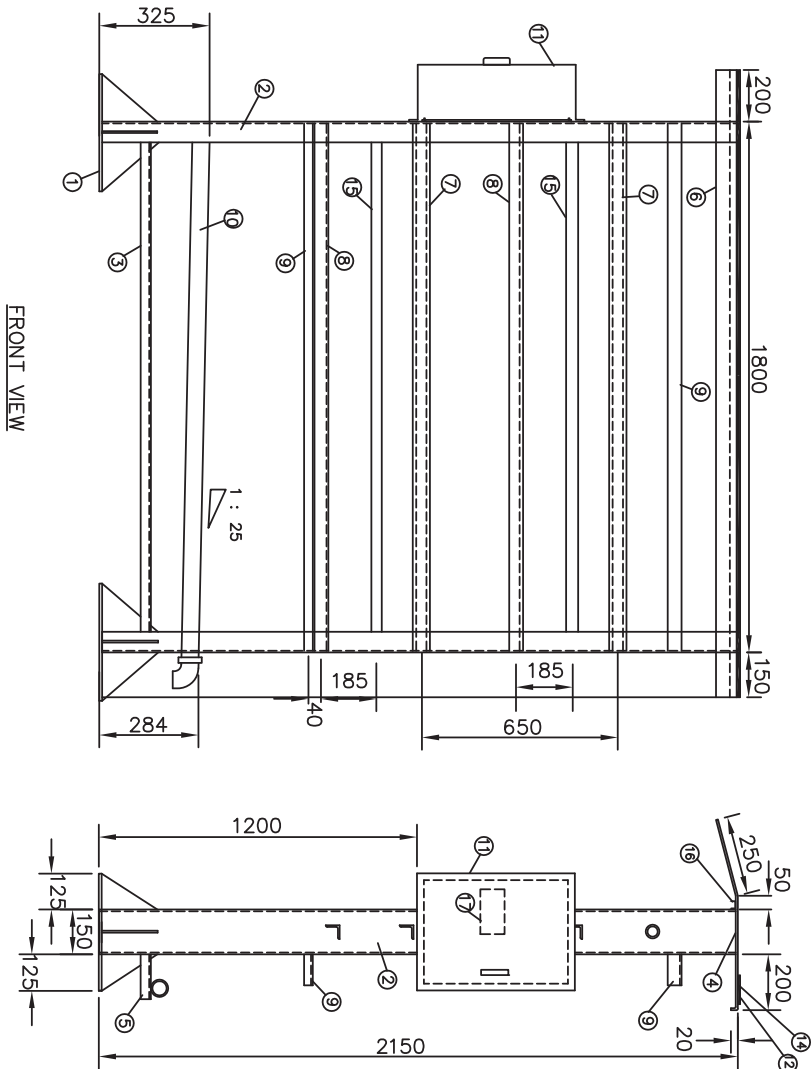
GUJARAT STATE ELECTRICITY CORPORATION LIMITED



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

JOB NO. DCPL-K9213R SCALE NIL SHT. 1 OF 10
DWG. NO. K9213R-DWG-I-0200 REV. 0

PRELIMINARY
TENDER PURPOSE ONLY



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.

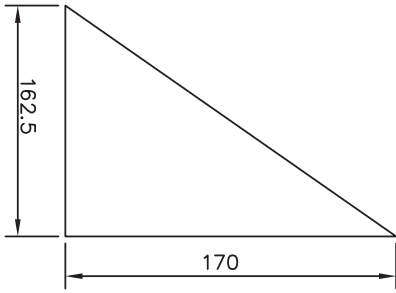
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MM

					G.A.DRAWING FOR LOCAL INSTRUMENT RACK	DEVELOPMENT CONSULTANTS PVT. LTD.					
					1x800MM SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WAMANBORI THERMAL POWER STATION, GUJARAT)	CONSULTING ENGINEERS					
						 KOLKATA, MUMBAI, CHENNAI, NEW DELHI					
S/S	SR	SD		0	21.04.10	JOB NO.	DGPL-K9213R	SCALE	NIL	SHT.	2 OF 10
APPROVED	CHECKED	DRAWN				DATE:	K9213R-DWG-I-0200			REV.	0

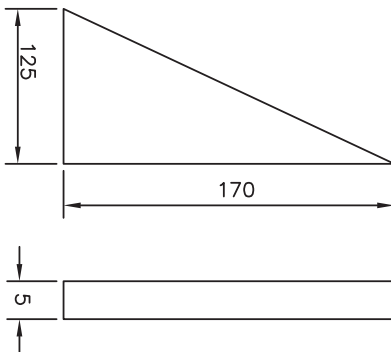
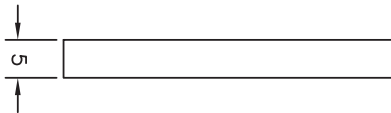


**PRELIMINARY
TENDER PURPOSE ONLY**

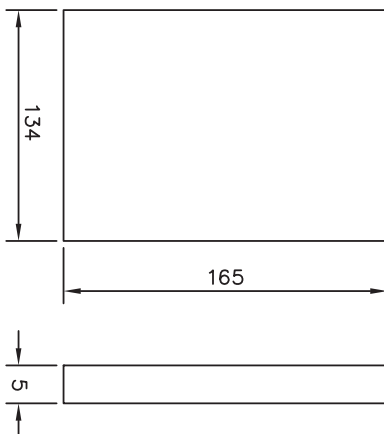
4. *Phragmites australis*



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.

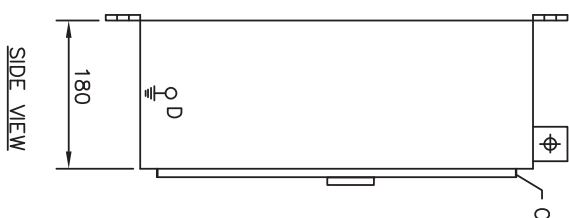
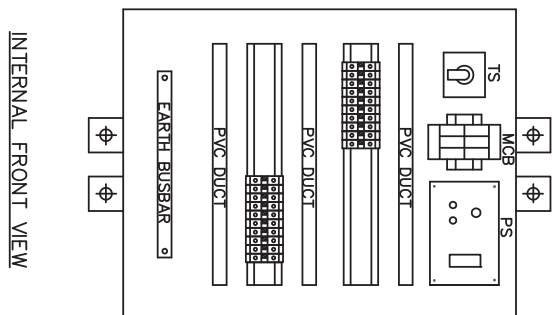
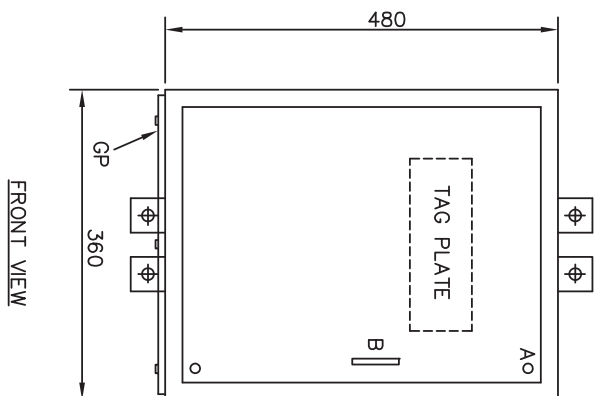
SB	SR	SD		0	21.04.10
APPROVED	CHECKED	DRAWN			

G.A. DRAWING OF CLEATS FOR LOCAL INSTRUMENT RACK			1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WAMAGORI THERMAL POWER STATION, GUJARAT)		
GUJARAT STATE ELECTRICITY CORPORATION LIMITED			JOB NO. DCPL-K9213R SCALE NIL SH. 4 OF 10		
K9213R-DWG-I-0200			REV. 0		



DEVELOPMENT CONSULTANTS PVT. LTD.
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PRELIMINARY
TENDER PURPOSE ONLY



- 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..PROTECTON CLASS IP-65.
- 3..COLOUR EXT-GREY IS-5-631, 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 WS-A-VIS 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.
- | |
|----------------------------|
| PRELIMINARY |
| TENDER PURPOSE ONLY |

**PRELIMINARY
TENDER PURPOSE ONLY**

G.A. DRAWING OF JUNCTION BOX FOR LOCAL INSTRUMENT RACK

1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED



CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO.	DCPL-K9213R	SCALE
DWG. NO.	K9213R-DWG-I-0200	

SB	SR	SD			0	21.04.10	
APPROVED	CHECKED	DRAWN		APPROVED:			

K9213-DWG-I-0200-5-10

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.

4..COLOUR :-

EXTERIOR : GREY IS5-631

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.

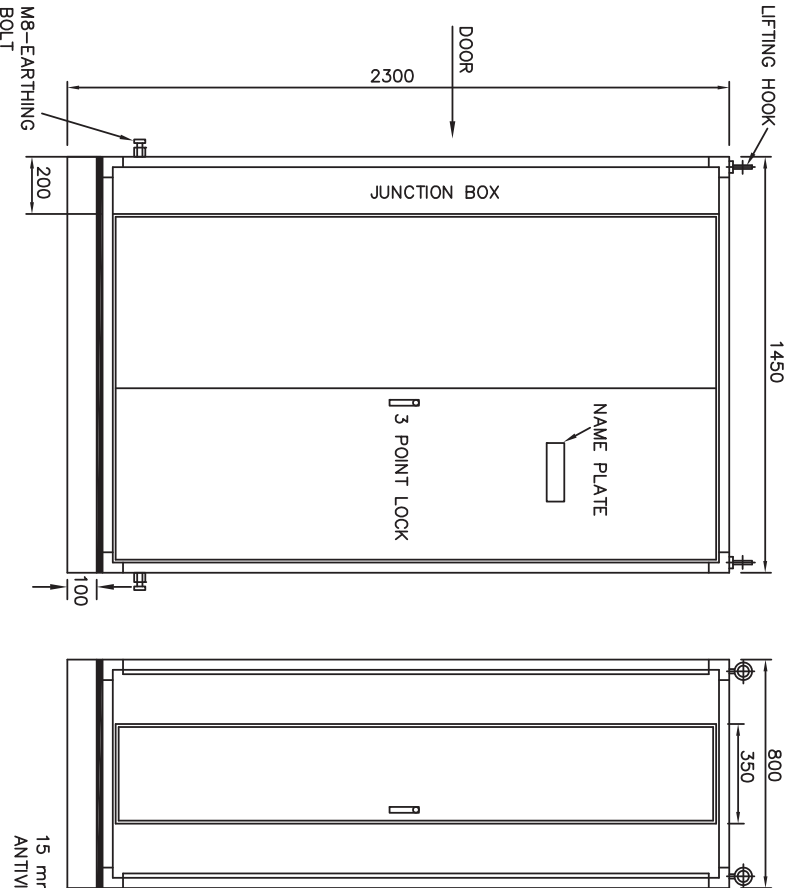
15..FOUNDATION BOLTS SHALL BE PROVIDED.

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

17..INSTRUMENT TAG VS-A-VIS 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.

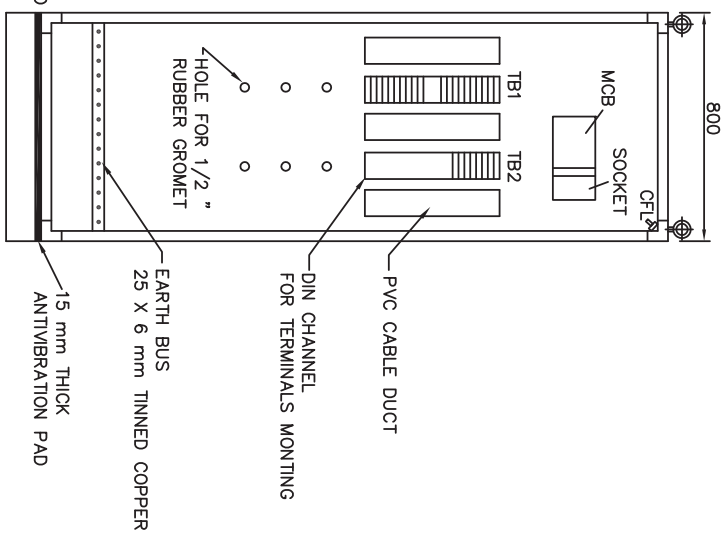
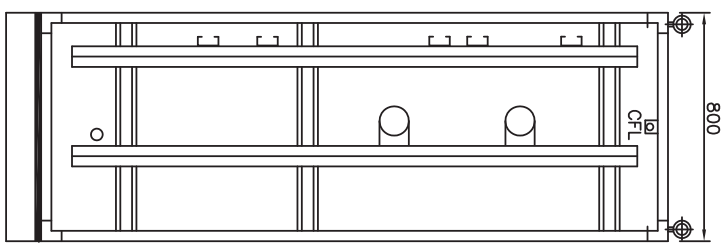
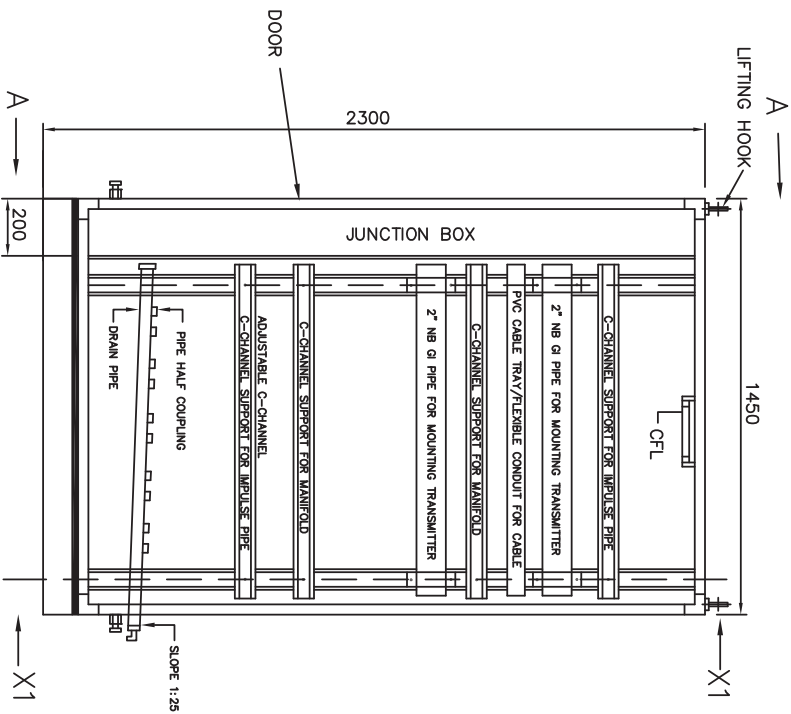


UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MM

G.A. DRAWING FOR				LOCAL INSTRUMENT ENCLOSURE			
1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAJORE THERMAL POWER STATION, GUJARAT)				GUJARAT STATE ELECTRICITY CORPORATION LIMITED			
JOB NO. DGPL-K9213R				SCALE NIL			
SHT. 6 OF 10				REV. 0			

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

PRELIMINARY
TENDER PURPOSE ONLY



FRONT INNER VIEW

SIDE VIEW FROM X1-X1

SIDE VIEW FROM A-A

NOTES: 1..PVC WIRE DUCT WITH COVER SHALL BE PROVIDED.

2. FOR ILLUMINATION COMPACT FLUORESCENT LAMP IN LIE AND IN JB SHALL BE PROVIDED.

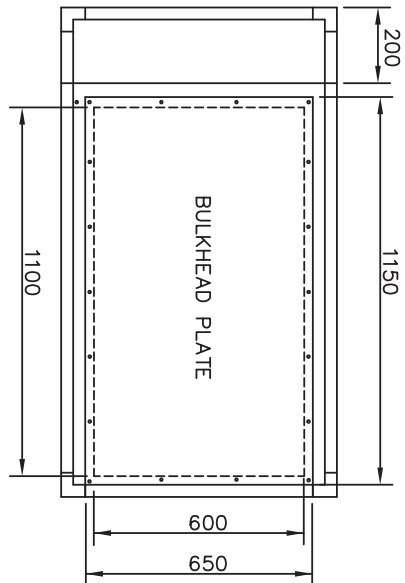
3. DRAIN HEADER IS APPLICABLE FOR STEAM/WATER PROCESS IMPULSE LINES ONLY.

4. DRAIN PIPE SHALL BE 2" NB ASTM A106 GRC SCH. 80.

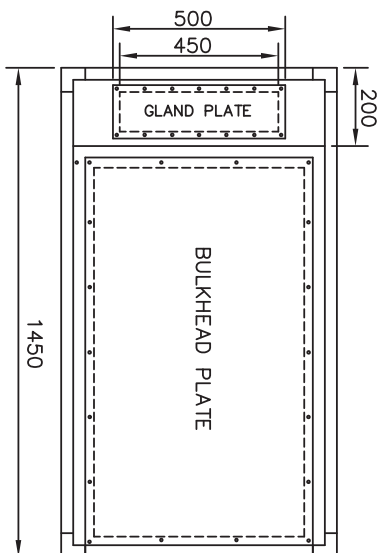
DO NOT REPLY

**PRELIMINARY
TENDER PURPOSE ONLY**

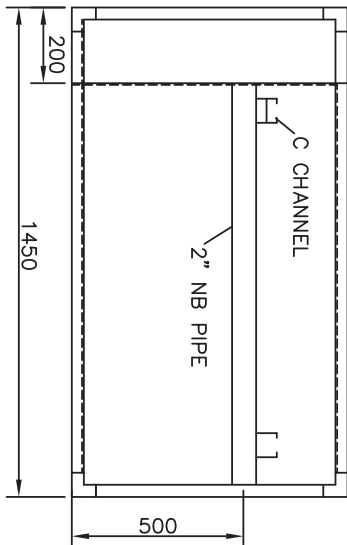
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TOP VIEW



BOTTOM VIEW



TOP VIEW WITHOUT BULKHEAD PLATE

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MM

NOTES:

- 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.

APPROVED	CHECKED	DRAWN	DATE	BY
SB	SR	SD	0	21.04.10

BULKHEAD PLATE DETAILS FOR
LOCAL INSTRUMENT ENCLOSURE

1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WAMAGBORI THERMAL POWER STATION, GUJARAT)

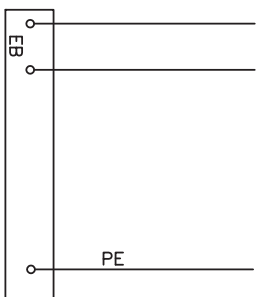
GUJARAT STATE ELECTRICITY CORPORATION LIMITED



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

JOB NO. DCPL-K9213R SCALE NIL SHT. 8 OF 10
K9213R-DWG-I-0200

PRELIMINARY
TENDER PURPOSE ONLY

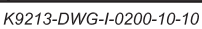


- NOTES:-
- 1.. COLOUR CODING FOR POWER SUPPLY : PHASE – RED, NEUTRAL – BLACK, EARTH–GREEN
 - 2.. CABLE ROUTING FROM TB TO PANEL LIGHT WILL BE 1.5 Sq:mm 1100V AC GRADE.
 - 3.. SIGNAL WIRING WILL BE DONE BY 4 PAIR X 0.5 Sq:mm ANNEALED TINNED COPPER, PAIR TWISTED OVERALL & SHIELDED, VOLTAGE GRADE 1100V,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

					DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA - MUMBAI - CHENNAI - NEW DELHI				
JOB NO.	DCPL-K9213R	SCALE	NIL	SMT.	9 OF 10				
DATE	K9213R-DWG-I-0200			REV.	0				

**PRELIMINARY
TENDER PURPOSE ONLY**

K9213-DWG-I-0200-9-10



**PRELIMINARY
TENDER PURPOSE ONLY**

JOB NO.	DCPL-K9213R	SCALE	NIL	SHT.	10 OF 10
DWG. NO.	K9213R-DWG-I-0200	REV.	0		

REV. 0

KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPPL-K9213R

K9213R-DWG-I-

44-38861-1000

2011年12月12日

1000

REVIEWED		APPROVED		REVIEWED		APPROVED	
1							

NOTES:

1. THIS DRAWING IS FOR DESIGN CONCEPT AND DETAIL OF FABRICATIONS SHALL BE VENDOR'S RESPONSIBILITY SUBJECT TO USER'S APPROVAL.
2. DESK PORTION i.e. SPACE FOR KEY BOARD SHALL BE FABRICATED FROM STAINLESS STEEL SHEET. REMAINING PARTS FROM CRCA SHEET STEEL. SHEET THICKNESS SUBJECT TO USER'S APPROVAL.
3. SUITABLE LOUVERS (WITH WIREMESH REMOVABLE FILTER), GLAND PLATES, DRAWING POCKET (METALLIC WELDED / SCREWED) SHALL BE PROVIDED.
4. OUTER COLOUR SHADE SHALL BE RAL 7032.
5. FILLER PANEL AS PER CONTROL ROOM LAYOUT SHALL BE PROVIDED.

VIEW AA

VIEW BB

VIEW AA

24" TFT SCREEN COLOURED MONITOR

PC UNIT

Base Frame

Anti Vibration Rubber Pad

Removable Cover & fixed with screws & rubber gasket

Space For Mounting Insert, EDLI, Push Buttons etc. Space For Key Board & Mouse

Door with Lock

TITLE: OPERATING STATION DESK PROFILE

PROJECT: 1x800 MW SUPERCritical THERMAL POWER PLANT (MTP)

JOB NO. K9213R

DWG. NO. K9213R-DWG-I-0161

SCALE: NONE

REV. A

FOR TENDERING PURPOSE ONLY

GUJARAT STATE ELECTRICITY CORPORATION LIMITED

DEVELOPMENT CONSULTANTS PVT. LTD.

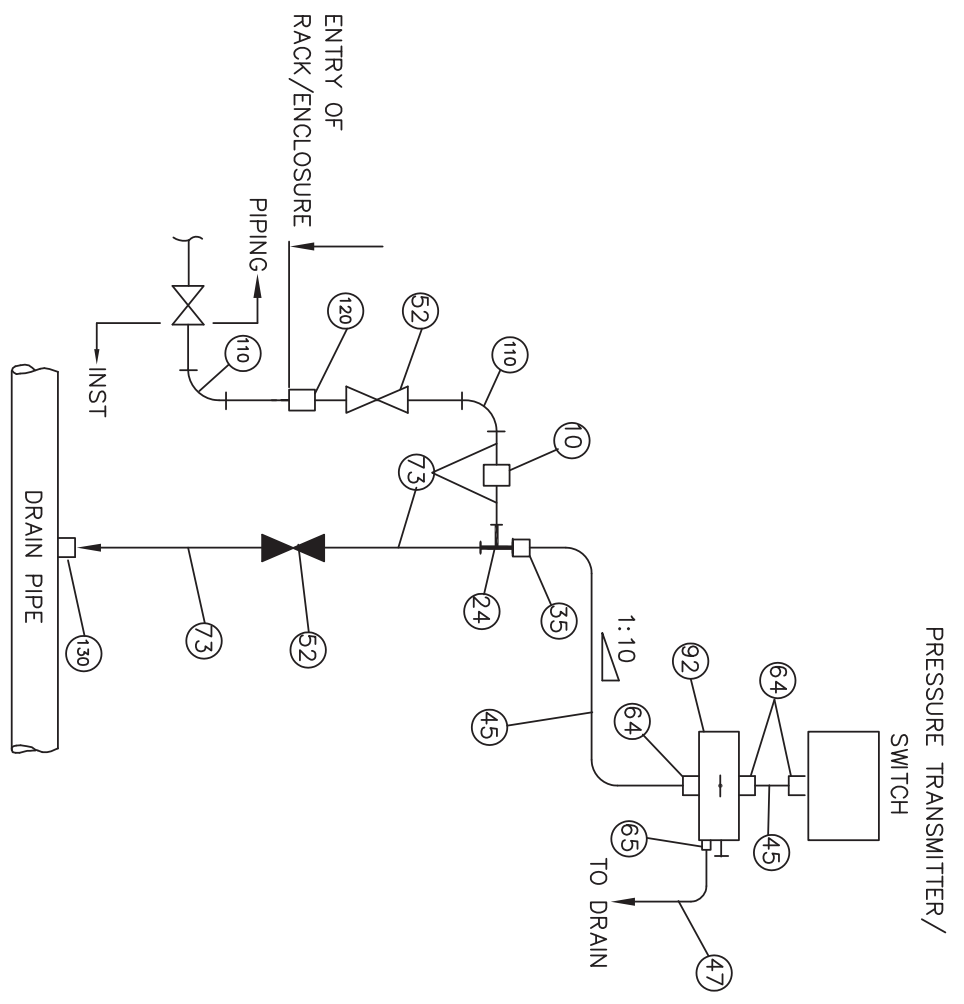
KOLKATA, MUMBAI, CHENNAI, NEW DELHI

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.

[illegible]

**PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED ABOVE SOURCE POINT**



BILL OF MATERIAL		
ITEM NO.	QTY / INST	DESCRIPTION
24	1	EQUAL TEE (FEMALE) 1/2" SW 3000lbs
35	1	MALE CONNECTOR 1/2" PE X 1/2" OD 3000 lbs
52	2	GLOBE VALVE 1/2" SW 600lbs
45	3Mtrs.	TUBE 1/2" OD 2.1 MM THICK
64	3 3000 lbs	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD
73	2Mtrs	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 3000 lbs	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD
110	2	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

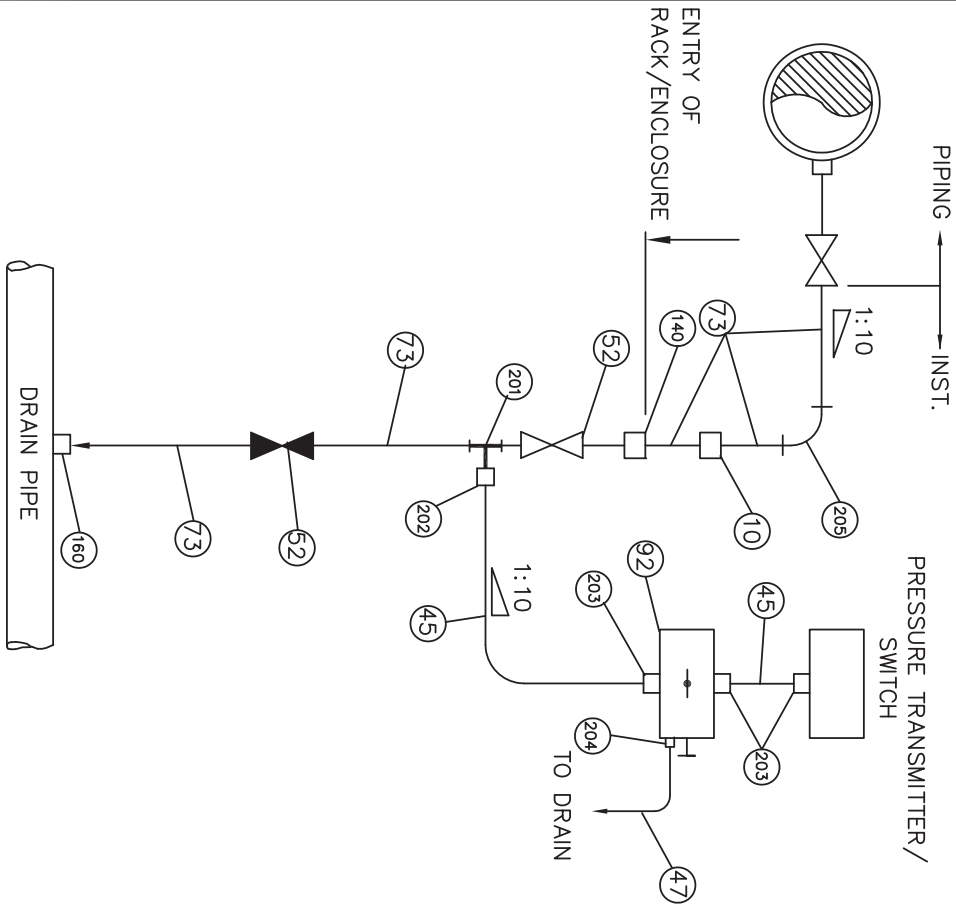
SERVICE : CONDENSER PRESSURE, INSTRUMENT AIR ETC.

TYPICAL INSTRUMENT INSTALLATION DIAGRAM			
1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WAMAKBORI THERMAL POWER STATION, GUJARAT)			
GUJARAT STATE ELECTRICITY CORPORATION LIMITED			
APPROVED	CHECKED	DRAWN	DATE
GP	AT	SD	0
			21.04.10
JOB NO. DCPL-K9213R SCALE NIL SHT. 3 OF 20			
TENDER NO. K9213R-DWG-I-0060			
REV. 0			

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

PRELIMINARY
TENDER PURPOSE ONLY

**PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED BELOW SOURCE POINT**



BILL OF MATERIAL	
ITEM NO.	DESCRIPTION
201	EQUAL TEE (FEMALE) 1/2" SW 6000lbs
202	MALE CONNECTOR 1/2" PE 1/2" OD 6000 lbs
52	GLOBE VALVES 1/2" SW 6000lbs
45	3 Mtrs TUBE 1/2" OD 2.1 MM THICK
203	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 6000 lbs
73	IMPULSE PIPE 15 NB GR.B SCH 80
92	2 VALVES MANIFOLD 1/2" NPT(F)
10	FULL COUPLING 1/2" SW 6000lbs
47	0.15Mtrs.TUBE 8 MM OD 1.0 MM THICK
204	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 6000 lbs
205	90° ELBOW 1/2" SW 6000lbs
140	BULK HEAD UNION/COUPLING CL:6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11
160	HALF COUPLING CL:6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

SERVICE : CONDENSATE, FEED WATER ETC.

PRELIMINARY
TENDER PURPOSE ONLY

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WAMABORI THERMAL POWER STATION, GUJARAT)



DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
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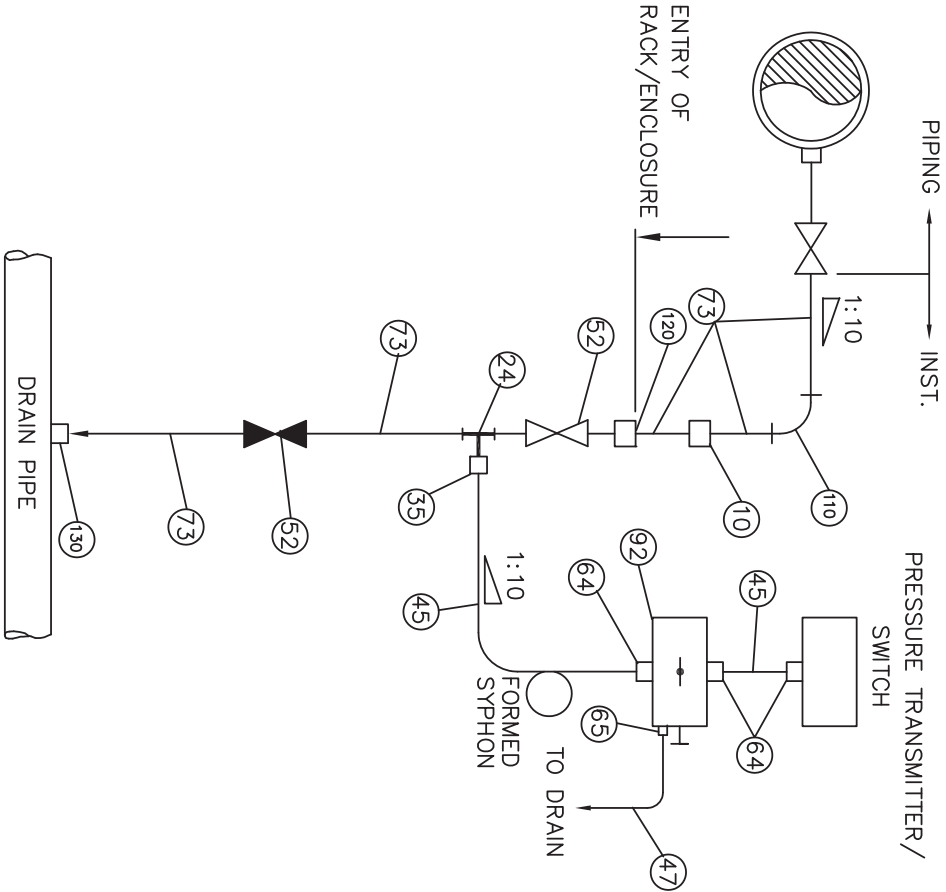
APPROVED	CHECKED	DRAWN	
GP	AT	SD	

GUJARAT STATE ELECTRICITY CORPORATION LIMITED

JOB NO. DGPL-K9213R SCALE NIL

SHT. 4 OF 20
REV. 0

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	HAIF 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

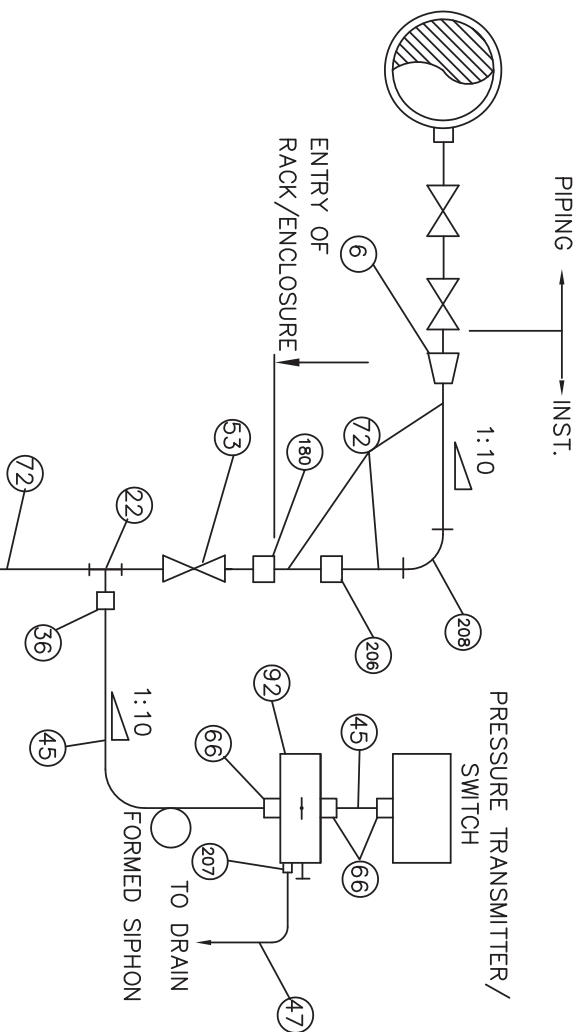
1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WAMAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED



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

JOB NO. DGPL-K9213R SCALE NIL SH. 5 OF 20
TENDER NO. K9213R-DWG-I-0060 REV. 0



BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
6	1	REDUCER 1"SW X 1/2"SW 9000lbs
22	1	EQUAL TEE (FEMALE)1/2" SW 9000lbs
36	1	MALE CONNECTOR 1/2" PE X 1/2" OD 9000 lbs
53	3	GLOBE VALVES 1/2" SW 1500 lbs
45	3 Mtrs	TUBE 1/2" OD 2.1 MM THICK
66	3	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 9000 lbs
72	15Mtrs	IMPULSE PIPE 15 NB SCH. 80
92	1	2 VALVES MANIFOLD 1/2" NPT(F)
206	1	FULL COUPLING 1/2" SW 9000lbs
47	0.15Mtrs	TUBE 8 MM OD 1.0 MM THICK
207	1	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 9000 lbs
180	1	BULK HEAD UNION/COUPLING CL:9000 LBS-AS PER ANSI B16.11,1/2" NB-SW
190	1	HAIF COUPLING CL:9000LBS/ 1/2" NB-SW AS PER ANSI B16.11
208	1	90° ELBOW 1/2" SW CL:9000 lbs

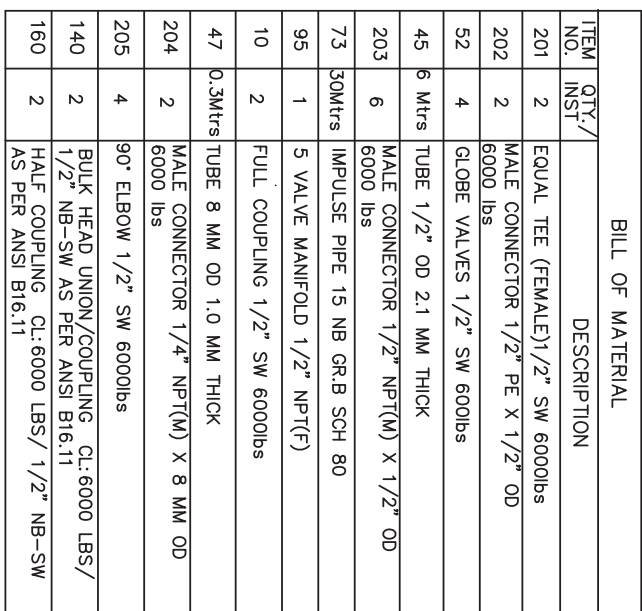
SERVICE : MEDIUM & HIGH PRESSURE STEAM

GP	AT	SD		0	21.04.10	
APPROVED	CHECKED	DRAWN				

TYPICAL INSTRUMENT INSTALLATION DIAGRAM		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA MUMBAI CHENNAI NEW DELHI					
1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAQORI THERMAL POWER STATION, GUARAT)		JOB NO.	DCPL-K9213R	SCALE	NIL	SHT.	6 OF 20
GUARAT STATE ELECTRICITY CORPORATION LIMITED		DRAWN BY		K9213R-DWG-I-0060		REV.	0

DRAIN PIPE

**PRELIMINARY
TENDER PURPOSE ONLY**

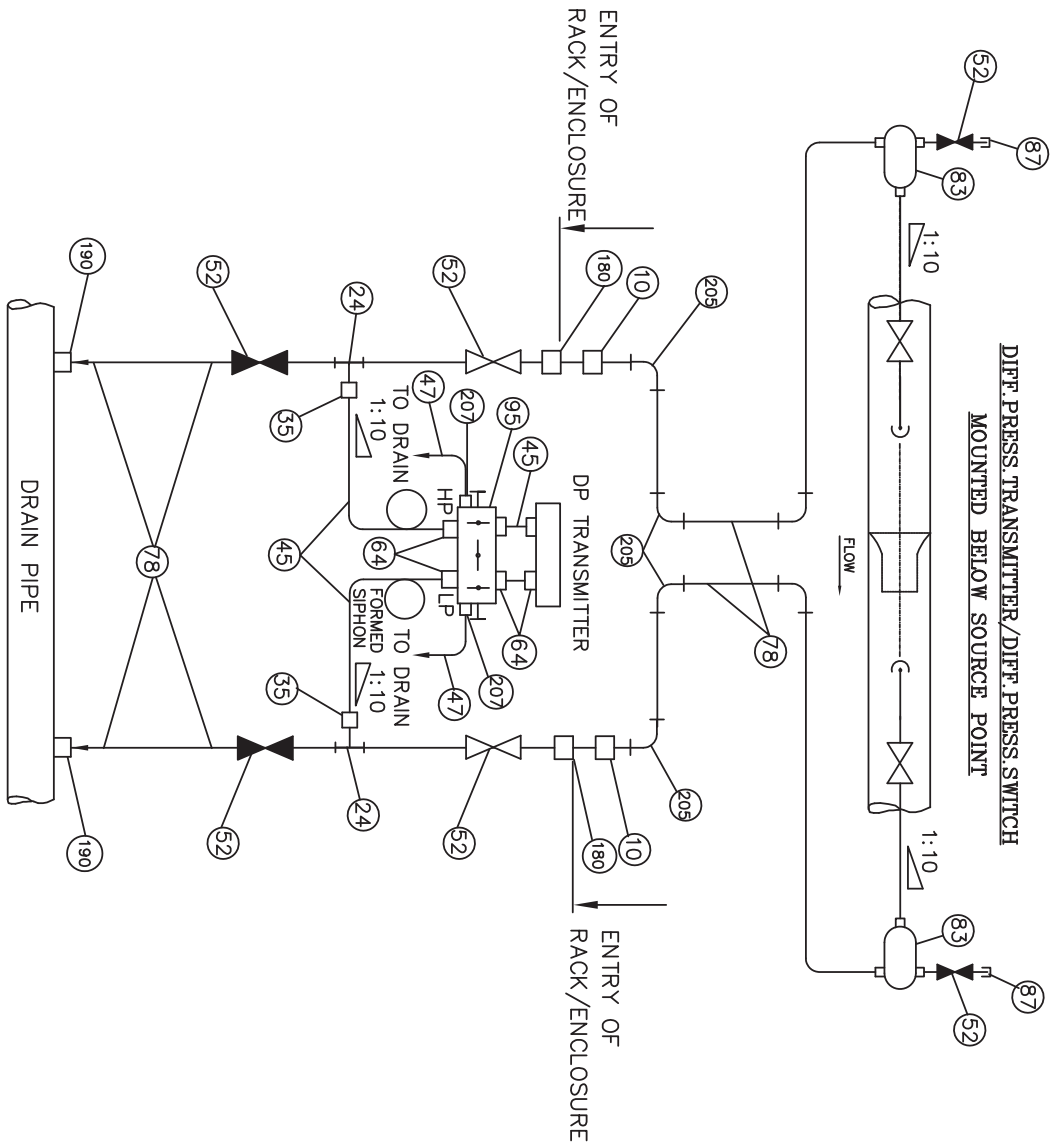


SERVICE : CONDENSATE,FEED WATER ETC.

PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE

**PRELIMINARY
TENDER PURPOSE ONLY**

						TYPICAL INSTRUMENT INSTALLATION DIAGRAM	DEVELOPMENT CONSULTANTS PVT. LTD.					
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WAMAKKORI THERMAL POWER STATION, GUJARAT)	CONSULTING ENGINEERS					
						GUJARATI STATE ELECTRICITY CORPORATION LIMITED	KOLKATA, MUMBAI, CHENNAI, NEW DELHI					
APPROVED	CHECKED	DRAWN					JOB NO.	DCPL-K9213R	SCALE	NIL	SHT.	7 OF 20
								K9213R-DWG-I-0060				REV. 0



BILL OF MATERIAL	
ITEM NO.	DESCRIPTION
24	EQUAL TEE (FEMALE) 1/2" SW 9000lbs
35	MALE CONNECTOR 1/2" PE X 1/2" OD 9000 lbs
52	GLOBE VALVES 1/2" SW 600lbs
45	TUBE 1/2" OD 2.1 MM THICK
64	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 9000 lbs
78	IMPULSE PIPE 15 NB SCH 80
95	5 VALVES MANIFOLD 1/2" NPT(F)
10	FULL COUPLING 1/2" SW 9000lbs
83	CONDENSATION POT 1/2" SW NPT(F) 9000 lbs
87	PLUG 1/2" NPT(F) 9000lbs
47	TUBE 8 MM OD 1.0 MM THICK
207	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 9000 lbs
205	90° ELBOW 1/2" SW 9000lbs
180	BULK HEAD UNION/COUPLING CL: 9000 LBS-AS PER ANSI B16.11/2" NB-SW
190	HALF COUPLING CL: 9000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

SERVICE : STEAM

PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WAMAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED

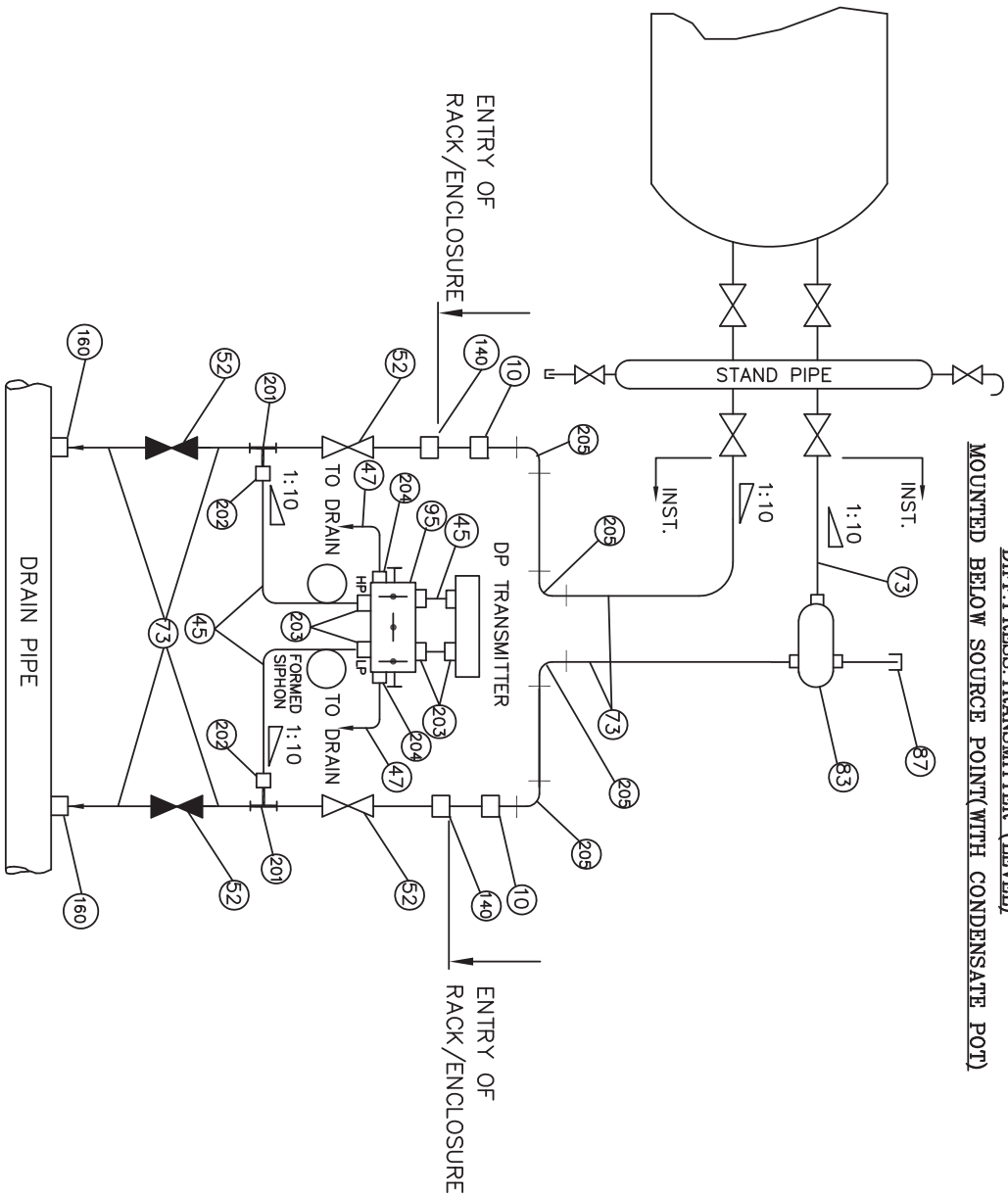


DEVELOPMENT CONSULTANTS PVT. LTD.
KOKATA - MUMBAI - CHENNAI - NEW DELHI

JOB NO. DGPL-K9213R SCALE NIL SH. 8 OF 20
DWG NO. K9213R-DWG-I-0060 REV. 0

PRELIMINARY
TENDER PURPOSE ONLY

DIFF. PRESS. TRANSMITTER (LEVEL)
MOUNTED BELOW SOURCE POINT(WITH CONDENSATE POT)



BILL OF MATERIAL	
ITEM NO.	DESCRIPTION
201	EQUAL TEE (FEMALE) 1/2" SW 6000lbs
202	MALE CONNECTOR 1/2" PE X 1/2" OD 6000 lbs
52	GLOBE VALVES 1/2" SW 600lbs
45	TUBE 1/2" OD 2.1 MM THICK
203	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 6000 lbs
73	IMPULSE PIPE 15 NB SCH 80
95	5 VALVES MANIFOLD 1/2" NPT(F)
10	FULL COUPLING 1/2" SW 6000lbs
83	CONDENSATE POT 1/2" SW 6000lbs
87	PLUG 1/2" NPT(M) 6000lbs
205	90° ELBOW 1/2" SW 6000lbs
47	TUBE 8 MM OD 1.0 MM THICK
204	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 6000 lbs
140	BULK HEAD UNION/COUPLING CL: 6000 LBS-AS PER ANSI B16.11, 1/2" NB-SW
160	HALE COUPLING CL: 6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

SERVICE : BOILER DRUM, DEAEATOR, HEATERS

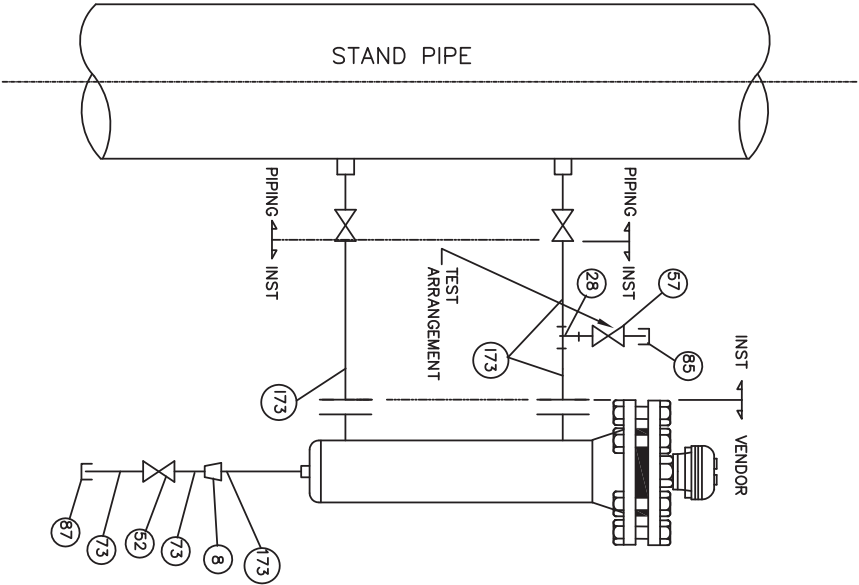
TYPICAL INSTRUMENT INSTALLATION DIAGRAM			
1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAJORI THERMAL POWER STATION, GUJARAT)			
GUJARAT STATE ELECTRICITY CORPORATION LIMITED			
APPROVED	CHECKED	DRAWN	REV. 0
GP	AT	SD	21.04.10
JOB NO. DQPL-K9213R SCALE NIL SHT. 9 OF 20			
TENDER PURPOSE ONLY			

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

FLOAT OPERATED LEVEL SWITCH

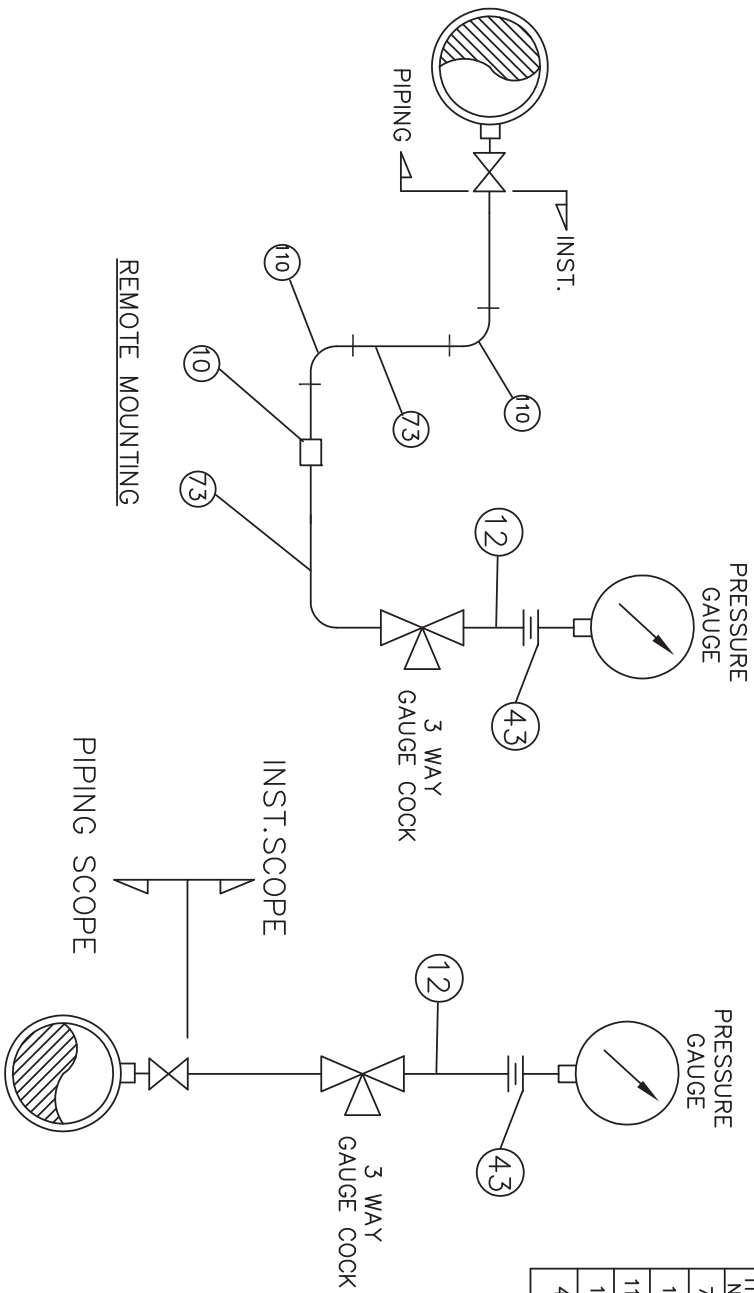
BILL OF MATERIALS		
ITEM NO	QTY/ INST	DESCRIPTION
52	1	GLOBE VALVE 1/2" SW 600lbs
73	0.5Mtrs	IMPULSE PIPE 15 NB SCH.80
87	1	PULG 1/2" NPT(M) 3000lbs
28	2	EQUAL TEE (FEMALE) 1" SW 3000lbs
173	1 Mtrs	IMPULSE PIPE 25 NB SCH.80
8	1	REDUCER 1" SW X 1/2" SW 3000lbs
57	1	GLOBE VALVE 1" SW 600 lbs
85	1	PLUG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

SERVICE : CONDENSATE



PRELIMINARY
TENDER PURPOSE ONLY

TYPICAL INSTRUMENT INSTALLATION DIAGRAM		1x800W SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)	
GUJARAT STATE ELECTRICITY CORPORATION LIMITED		DEVELOPMENT CONSULTANTS PVT. LTD. KOLKATA · BOMBAY · CHENNAI · NEW DELHI	
JOB NO. DCPL-K9213R		SCALE NIL	
SHT. 10 OF 20		REV. 0	



SERVICE : WATER, CONDENSATE ETC.

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
73	15mts	IMPULSE PIPE 15 NB SCH.80
10	1	FULL COUPLING 1/2" SW 3000lbs
110	2	90° ELBOW 1/2" SW 3000lbs
12	1	1/2" NPT(M) X 1/2" PE 4" LONG NIPPLE
43	1	NUT & TAIL FITTING WITH CU WASHER 1/2" NPT(F) X 1/2" PE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANKABORI THERMAL POWER STATION, GUJARAT)

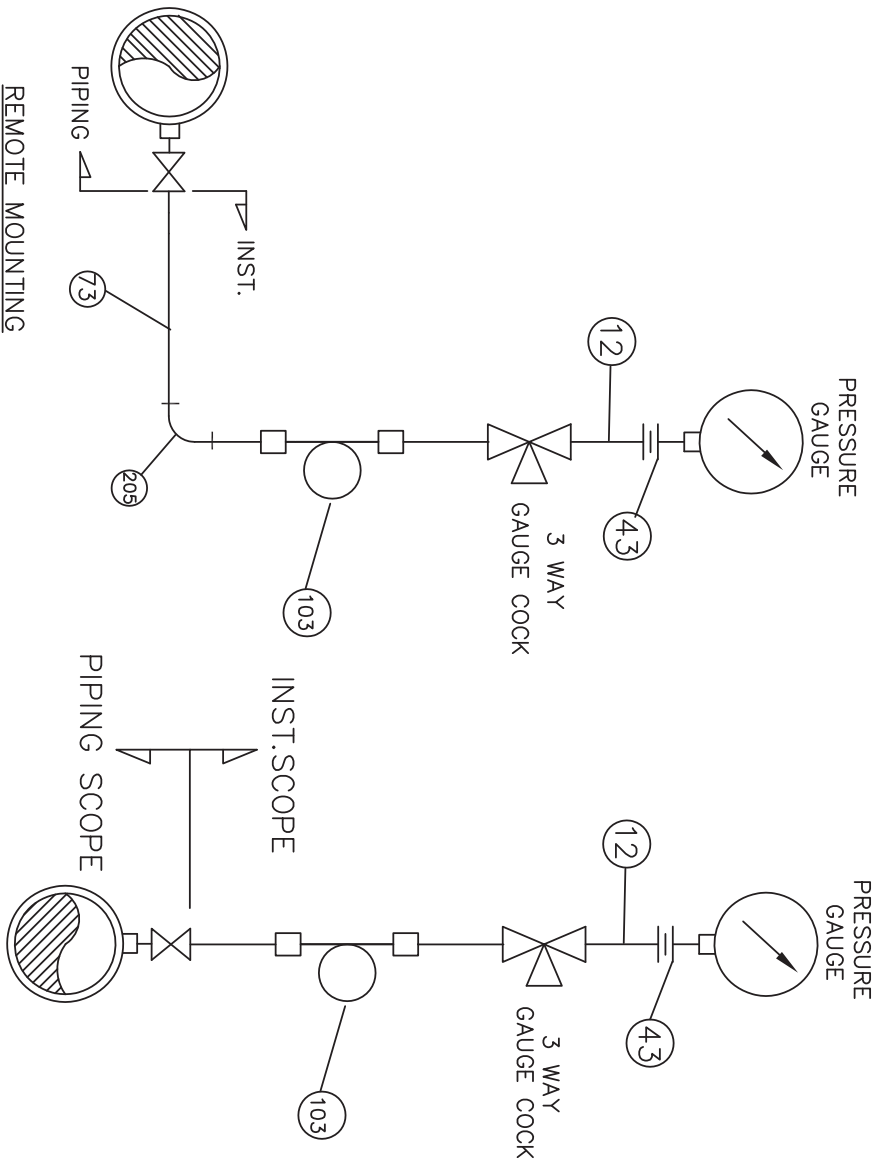
GUJARAT STATE ELECTRICITY CORPORATION LIMITED



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

JOB NO. DCPL-K9213R SCALE NIL SHT. 11 OF 20
NO. K9213R-DWG-I-0060

PRELIMINARY
TENDER PURPOSE ONLY



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

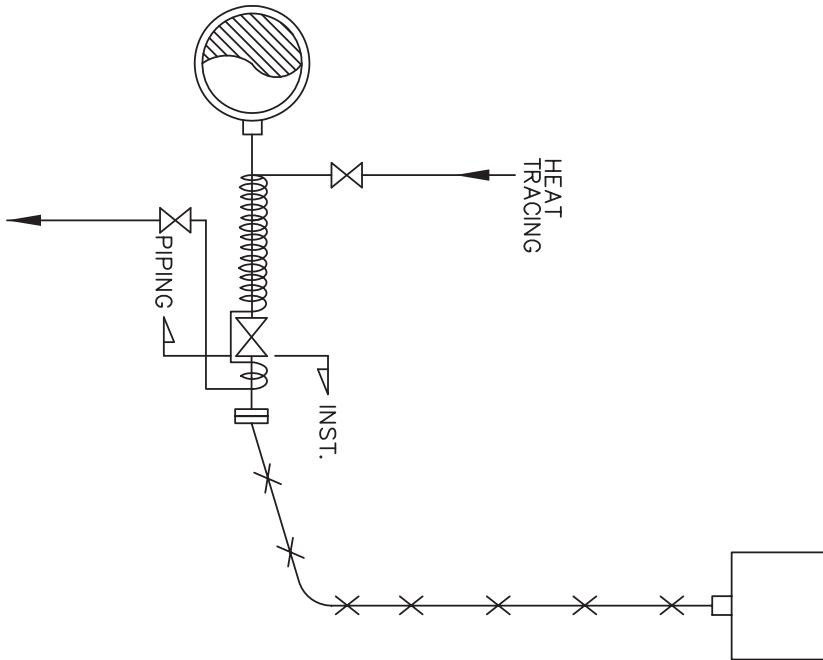
SERVICE : STEAM, FEED WATER

PRELIMINARY
TENDER PURPOSE ONLY

TYPICAL INSTRUMENT INSTALLATION DIAGRAM				DEVELOPMENT CONSULTANTS PVT. LTD.			
1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WAMAKBORI THERMAL POWER STATION, GUJARAT)				KOLKATA · MUMBAI · CHENNAI · NEW DELHI			
GUJARAT STATE ELECTRICITY CORPORATION LIMITED				JOB NO. DCPL-K9213R SCALE NIL SHT. 12 OF 20			
APPROVED				K9213R-DWG-I-0060 REV. 0			
CHECKED							
DRAWN							
AT							
SD							
0							
21.04.10							

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PRESSURE TRANSMITTER/PRESSURE SWITCH
IN HFO SERVICE
PRESSURE TRANSMITTER/
SWITCH



TYPICAL INSTRUMENT INSTALLATION DIAGRAM

1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANDKORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED



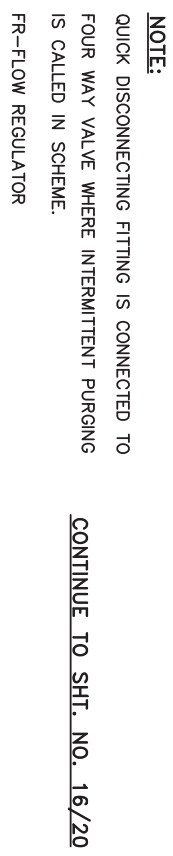
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL-K9213R SCALE NIL SHT. 14 OF 20
K9213R-DWG-I-0060 REV. 0

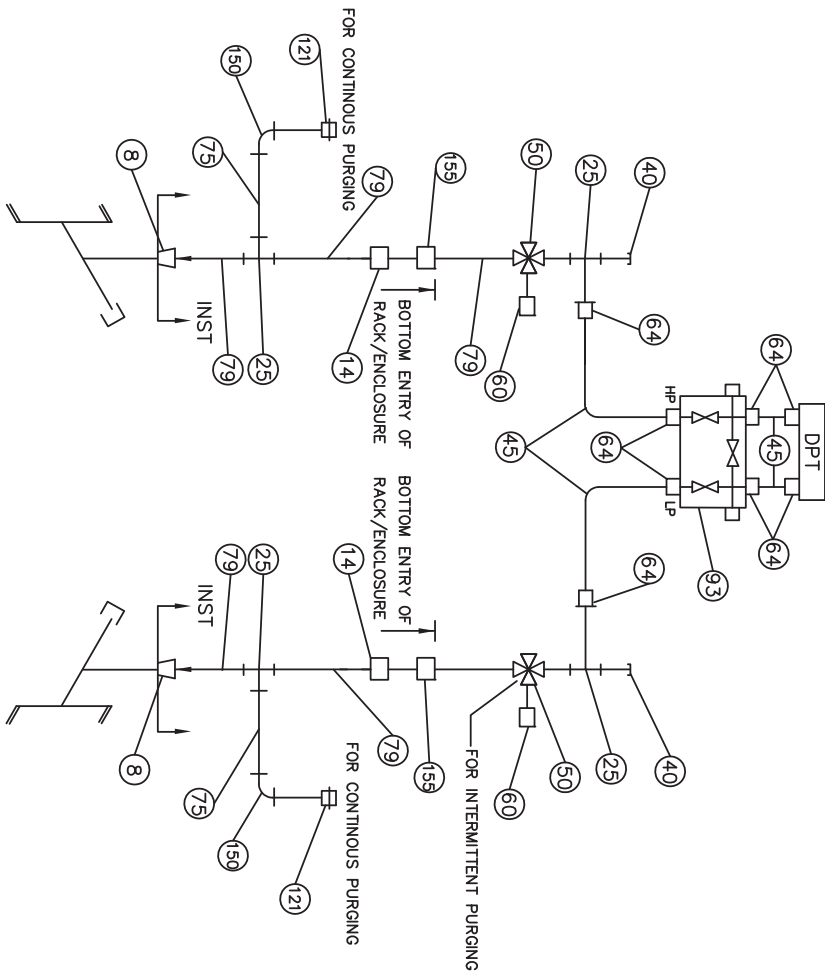
PRELIMINARY
TENDER PURPOSE ONLY

Diagram illustrating an **INTERMITTENT PURGING SCHEME**.

The system includes a **TRANSMITTER ENCLOSURE** connected to a **BULK HEAD** (170). The line from the enclosure passes through a valve (45) and a solenoid coil (09) to a four-way valve (08). This valve is controlled by a **FOUR WAY VALVE IN ENCLOSURE** (60) and a **REFER NOTE** (11). The line continues through another valve (45) to a pressure gauge (17) and a check valve (18). The line then goes through a valve (45) and a solenoid coil (09) back to the transmitter enclosure.

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K9213-DWG-I-0060-15-20-REV-0



BILL OF MATERIAL	
ITEM NO.	QTY./INST.
8	2
14	2
25	4
40	2
45	6 Mtrs.
50	2
60	2
64	8
79	30Mtrs
75	A/R
93	1
150	2
155	2
121	2

DESCRIPTION	
REDUCER 1" BSPF X 3/4" NB-SW CL 3000	
FORGED COUPLING 3/4" SW CL 3000/AS PER ANSI B16.11	
FORGED UNEQUAL TEE AS PER ANSI B16.11 SIZE : 2 X 3/4" NB-SW X 1/2" NPTF/CL3000	
NIPPLE & CAP 3/4" NB-SCH 80/CAP-3/4" NPTF	
SEAMLESS TUBE 1/2" OD X 2.1 MM THK.	
FOUR WAY VALVE SIZE : (2 X 3/4" NB-SW)X (2 X 1/2"NPTF) CL: 800	
QUICK DISCONNECTING FITTING SIZE:1/2"NPTM	
MALE CONNECTOR 1/2" NPT(M) X TO SUIT 1/2" OD TUBE	
SEAMLESS PIPE/3/4" NB SCH 80	
PIPE AS PER IS-1239 SIZE : 1/2" NB-HEAVY GRADE	
3 VALVE MANIFOLD 1/2" NPT(F)	
GALVANISED ELBOW CL 3000 SIZE : 1/2" NPTF	
BULK HEAD COUPLING CL 3000 SIZE : 3/4" NB SW /CL 3000/AS PER ANSI B16.11	
BULK HEAD COUPLING CL 3000 SIZE : 1/2" NPTF /AS PER ANSI B16.11	

SERVICE : FLUE GAS, FURNACE ETC.

APPROVED	CHECKED	DRAWN
AT	SD	
0	21.04.10	

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WAMAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED



DEVELOPMENT CONSULTANTS PVT. LTD.
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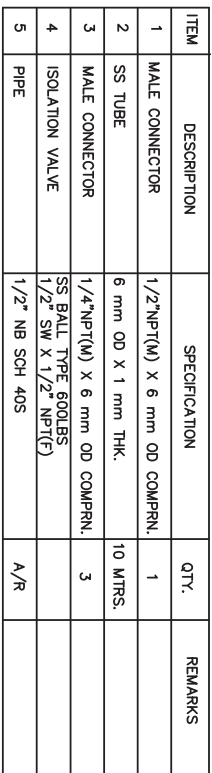
JOB NO. DGPL-K9213R SCALE NIL

SHT. 17 OF 20

K9213R-DWG-I-0060

REV. 0

PRELIMINARY
TENDER PURPOSE ONLY



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.

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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.

**PRELIMINARY
TENDER PURPOSE ONLY**

DEVELOPMENT CONSULTANTS PVT. LTD.
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JOB NO.	DCPL-K9213R	SCALE
DWG. NO.	K9213R-DWG-I-0060	

SHT. 20 OF 20



1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
STANDARD TECHNICAL SPECIFICATIONS

SPECIFICATION No: PE-TS-408-553-A001

VOLUME: II B

SECTION : D

REV. 00

SECTION: D
STANDARD TECHNICAL SPECIFICATIONS

Mukesh K. Singh
MUKESH K. SINGH
S.A. KHAN
S.A. KHAN
Dr. M. M. A. Khan
Dr. M. M. A. Khan



STANDARD TECHNICAL
SPECIFICATION
FOR
CENTRAL AIR-CONDITIONING

SPECIFICATION NO.PES-553-01

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 1 OF 6

STANDARD TECHNICAL SPECIFICATION
FOR
CENTRAL AIR-CONDITIONING PLANT

महेश कार्शन
महेश कार्शन
Sd/-
Sd/-
Sd/-



**STANDARD TECHNICAL
SPECIFICATION
FOR
CENTRAL AIR-CONDITIONING**

SPECIFICATION NO.PES-553-01

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 2 OF 6

1. GENERAL

1.1 This specification covers the design, manufacture, testing at Manufacturer's works, delivery to site, handling at site, installation, commissioning and carrying out acceptance tests and final painting at site of various equipment of the central air conditioning plant, as specified hereinafter.

2. CODES & STANDARDS

2.1 The design, manufacture and performance of air conditioning equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment are to be installed. The equipment shall also conform to the latest applicable Indian/British/American standards. Nothing in this specification shall be construed to relieve the tenderer of this responsibility. In particular the equipment shall conform to the latest editions of the following standards.

2.1.1	IS-660	:	Safety code for Mechanical Refrigeration.
2.1.2	ARI 520-90	:	Standard for Positive Displacement Refrigerant compressors and condensing units.
2.1.3	IS-5111	:	Code of Practice of Measurement for Testing Refrigeration compressors.
2.1.4	ASHRAE/23-93	:	Method of Testing for Rating Positive Displacement Refrigerant compressors and condensing units.
2.1.5	ARI-450:		Standard for water-cooled Refrigerant condensers, Remote Type.
2.1.6	ASME	:	Unfired pressure Vessels Code. (Section VIII)
2.1.7	IS-2825	:	-do-
2.1.8	IS-4503	:	Shell and tube type heat exchangers.
2.1.9	ASHRAE/22-92	:	Method of Testing for rating of Water Cooled refrigerant condensers.
2.1.10	IS-659	:	Safety code for Air conditioning.
2.1.11	IS-2379	:	Color Code for Identification of pipe lines.
2.1.12	TEMA	:	Standards of Tubular Exchanger manufacturers Association.
2.1.13	IS-1239 (Part-I)	:	Seamless steel tubes (Up to & including 168.2 mm OD.).
2.1.14	IS-3589	:	For piping above 168.2mm to 2032mm Outside Diameter.
2.1.15	IS-778	:	Valves up to 50 MM.
2.1.16	IS-780	:	Valves 50 MM to 300 MM.
2.1.17	ASHRAE 24	:	Method of Testing for Rating liquid coolers.



**STANDARD TECHNICAL
SPECIFICATION
FOR
CENTRAL AIR-CONDITIONING**

SPECIFICATION NO. PES-553-01

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 3 OF 6

2.1.18 ARI-480: Standard for refrigerant cooled liquid coolers-Remote type.

3. DESIGN & CONSTRUCTION REQUIREMENTS

3.1 The components of Central air conditioning plant comprising compressor, chiller refrigerant piping, valves and fittings etc. Shall be as given in Data sheet A. The type of all accessories, controls and instrumentation shall also be as indicated in data sheet A.

3.2 The various equipments supplied under this specification shall be fully compatible with each other & capable of operating as fully balanced integrated system to deliver the specified output under design conditions.

4. TESTING AND INSPECTION

(Refer standard quality plan)

4.1 Hydrostatic, Volumetric and refrigerant leak tests etc. shall be carried out at manufacturers works before dispatch of equipment in accordance with the applicable codes and standards.

Following minimum tests amongst others shall be conducted.

4.1.1 Material analysis, testing and identification (Data sheet/ Drg. Shall clearly indicate the specification, grade, class and Heat treatment condition of material for which TC will be furnished)

4.1.2 Hydrostatic pressure test of all pressure parts.(Testing pressure shall be clearly indicated for each component/ subassembly/ assembly)

4.1.3 Static and Dynamic balancing test of rotating parts at rated and over speed and to determine vibration & noise level.(Grade of balancing, type- whether dynamic or single plane balancing for components/ subassembly/ assembly shall be clearly indicated in data sheet/ approved drg.. Permissible vibration (velocity and displacement –peak to peak and noise level in dB(A) to be indicated in Data Sheet/Approved Drg.)

4.1.4 Radiography & magna-flux examination of materials & welds.(Components to be subjected to NDT with applicable, procedures and acceptance norms to be clearly indicated in Data sheet/ approved drg. If in a component only certain areas are to be subjected to NDT same shall be clearly brought out else it will be understood that the entire component is subject to NDT)

4.1.5 Ultrasonic test of castings & forgings.(Procedure and acceptance norms with areas subject to NDT to be clearly indicated in Quality Plan).

4.1.6 Performance test including determination of capacity, efficiency & characteristics etc.(Applicable standard, Acceptance norms, Procedure for test (if not covered in applicable standard),performance characteristics with applicable tolerances and drive to be used during shop test to be clearly indicated in Quality Plan). Performance data to be indicated in Approved Drg./ Data Sheet)

Approved:
 MUKESH K. SINGH
 Sd/- MANJ
 20-11-12



**STANDARD TECHNICAL
SPECIFICATION
FOR
CENTRAL AIR-CONDITIONING**

SPECIFICATION NO.PES-553-01

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 4 OF 6

4.1.7 Functional checks and adjustments of controls & instrumentation. (Functional checks required to be clearly indicated with extent of check and applicable standard in approved check list / Quality plan. Class of instruments / tolerances and performance data to be incorporated in Approved Data Sheet / Drg.)

4.1.8 Checking of working clearances.(desired working clearances to be indicated in approved Drg.)

4.1.9 Examination after selective opening up after testing.(basis/ reasons for selective opening up, areas to be examined and parameters to be checked to be brought out in Quality Plan)

4.2 TESTS AT SITE

Tests to prove guaranteed performance of the air conditioning plant, shall also be carried out at site after proper installation. The site test shall include performance testing (as per FQP) of equipment for 72 continuous hours each in all three seasons i.e. Summer, Winter and Monsoon. Unless specified elsewhere. All instruments, tools etc. as may be required to carry out site tests shall be arranged by the tenderer.

5. PERFORMANCE GUARANTEE

5.1 Each equipment of air conditioning system shall be guaranteed for its rated capacity under the specified site conditions.

5.2 If the shop/site performance tests indicate failure of equipment to meet specified requirement, it would be tenderer's responsibility to carry out required alterations at no extra cost to purchaser. Tests shall be repeated after carrying out the modifications to demonstrate the performance.

5.3 The air conditioning plant before being taken over by purchaser shall be subjected to running test for a minimum period of one week during which all readings shall be recorded. Any deficiencies noted during this period, shall be rectified by the tenderer /at no extra cost to purchaser. These running tests shall be in addition to the seasonal performance test specified under clause 4.2. The inside design conditions shall be guaranteed throughout the year.

MUKESH K. SINGH
S.D. - MANU
S.D. - MANU
S.D. - MANU



SPECIFICATION NO.PES-553-01	
VOLUME II B	
SECTION D	
REV. 02	DATE: 17.09.2012
SHEET 5 OF 6	

6.1	Final version of all drawings & data submitted with the along with technical schedules enclosed in Volume III.
6.2	Drawings including equipment layout, foundation & loading details etc. for civil works for the entire plant. These drawings must cover sufficient details so that design of civil works can be completed.
6.3	Inspection, operation & Maintenance Manuals.
6.4	Manuals for method of testing & calibration of all instruments.
6.5	Equipment description giving complete design calculations, basis of design, selection criteria etc.
6.6	Schematic piping diagrams.
6.7	Layout of piping.
6.8	Electrical drawings.
6.9	Test Certificates.
6.10	Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.



STANDARD TECHNICAL
SPECIFICATION
FOR
CENTRAL AIR-CONDITIONING

SPECIFICATION NO.PES-553-01

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 6 OF 6

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CENTRAL AIR-CONDITIONING PLANT
DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 1 OF 4

DESCRIPTION

DATA

1. GENERAL

- 1.1 Type of AC plant : Chilled Water Type.
- 1.2 Plant configuration/capacity. : Refer to Section-C of Specific Technical Requirements.
- 1.3 Location of AC plant rooms : As per Tender drawings.
- 1.4 Type of lifting facility provided. : Chain Pulley block with monorail (by BHEL)
- 1.5 Electrical work scope: -
i) MCC for AC plant : By Others
ii) Power cables / Control cables. : By Others
iii) Drives : By Bidder.
iv) Whether separate alarm/annunciation Panel/control panels required : Yes (By bidder), Refer to Section-C of Specific Technical Requirements.
v) Termination of cabling & earthing at Equipment end. : By Bidder for bidder supplied equipment.

2. REFRIGERATION COMPRESSOR

- 2.1. Type : SCREW CHILLE
- 2.2. Nos. (working + standby) : Refer to Section-C of Specific Technical Requirements.
- 2.3. Type of capacity control : Automatic.
- 2.4. Type of drive : Direct driven.
- 2.5. Restart after tripping : Manual.
- 2.6. Type of start : As per manufacturing standard.
- 2.7. Shaft Seal : Mechanical shaft seal.
- 2.8. Purge Recovery unit : As per manufacturing standard.
- 2.9. Type of lubrication : As per manufacturing standard.
- 2.10. Refrigerant used : Environment friendly HCFC, (CFC is not acceptable)



CENTRAL AIR-CONDITIONING PLANT
DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 2 OF 4

3. DESIGN REQUIREMENTS

3.1. Minimum capacity at Design conditions : Refer to Section-C of Specific Technical Requirements.

3.2. Capacity control : Microprocessor based Control Panel sheet metal panel, located on each Compressor/chiller unit including protection devices

3.3. Vibration isolator : Neoprene rubber pads/Equivalent approved to suit chiller package.

3.4. Type of foundation : Floating / As per manufacturing standard

4.0 CONDENSER

4.1 Type : Horizontal shell & tube type water-cooled

4.2 Number required : One no. for each machine.

4.3 Design requirements

4.3.1 Fluid : Refrigerant (Shell side) Water (tube side)

4.3.2 Cooling Water Quantity : To suit requirement.

4.3.3 Capacity of condensers : To match compressor & to provide at least 2°C sub cooling.

4.3.4 Cooling water inlet temp. : Refer to Section-C of Specific Technical Requirements.

4.3.5 Leaving Water Differential. : Refer to Section-C of Specific Technical Requirements.

4.3.6 Max. flow velocity through tubes. : 2.5 m/sec.

4.3.7 Design fouling factor : 0.0002 (MKS Unit)

4.3.8 Maximum pressure drop. : 0.6 Kg/cm² (g)

4.3.9 Tube wall Thickness : Not less than 18 SWG

4.4 Materials of construction

i/ Shell : M.S. Plate fusion welded.

ii/ Tube : Integrally bonded Seamless copper



CENTRAL AIR-CONDITIONING PLANT
DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 3 OF 4

- iii/ Head ends : Cast Iron.
- iv/ Tube sheet material : Steel
- v/ Baffle plate : Steel.
- 4.5 Accessories required
- i/ Purge & drain connections with valves. : Yes
- ii/ Relief valves : Yes
- iii/ Liquid line shut off valve. : Yes
- iv/ Isolating valves on water side. : Yes
- v/ Flow switch : Yes (interlocked with control of individual refrigeration system)
- vi/ Pressure/temperature gauges at inlet/outlet : Yes
- vii/ Descaling tee : Yes
- viii/Charging valve : Yes
- ix/ MS supporting frame work : Yes
- viii/Cooling thermostat : Yes
- ix/ MS supporting frame work. : Yes
- 5.0 **CHILLER** (Applicable for chilled water type plant only.)
- 5.1 Type : Horizontal shell & tube flooded type
- 5.2 Number required/standby : One no. for each chiller package.
- 5.3 Design requirements
- 5.3.1 Fluid to be cooled : Water
- 5.3.2 Water flow rate (Inside tube) : To suit requirement.
- 5.3.3 Water inlet temperature : 12 °C approx.
- 5.3.4 Water outlet temperature : 7 °C approx.
- 5.3.5 Super heating of refrigerant material : By at least 3 deg. C.
- 5.3.6 Insulation /thickness/finish : As per the manufacture standard.
- 5.3.7 Design fouling factor : 0.00010(MKS Unit)



CENTRAL AIR-CONDITIONING PLANT
DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 4 OF 4

- 5.3.8 Maximum pressure drop. : 0.6 Kg/cm² (g)
- 5.3.9 Tube wall Thickness : Not less than 22 SWG.
- 5.4 Materials of construction
- i/ Shell : M.S. Plate fusion welded.
 - ii/ Tube : Integrally Seamless copper (internally Corrugated)
 - iii/ Head ends : Cast Iron.
 - iv/ Tube sheet material : Steel.
 - v/ Baffle plate : Steel.
- 5.5 Accessories required
- i/ Purge & drain : Yes
 - ii/ Gate valves at water inlet/outlet. : Yes
 - iii/ Flow switch : Yes
 - iv/ Pressure/temperature gauges at inlet/outlet : Yes
 - v/ Anti-freeze thermostat : Yes
 - vi/ Thermostatic expansion valves : Yes
 - vii/ Pilot solenoid valve : Yes
 - viii/ Cooling thermostat : Yes
 - ix/ MS supporting frame work. : Yes

Note :-

The system shall also incorporate:

- 1) Auto operation of chilling plant for operation of the whole AC system.
- 2) A Central Control Panel with fault annunciators with provision for remote extension besides local control kiosks.
- 3) Water Chiller package shall be skid-mounted unit with microprocessor based control panel complete with all accessories and controls are assembled at manufacturing works on single unit.
- 4) Screw chiller shall be suitable for 415V $\pm$ 10 %/50 Hz $\pm$ 3%/3 phase operation with voltage & frequency variation as specified with built in starter etc.
- 5) Only supply feeders shall be provided for chillers.



TECHNICAL SPECIFICATION

AIR HANDLING UNITS

SPECIFICATION NO.PES-553-02

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 1 OF 6

STANDARD TECHNICAL SPECIFICATION FOR AIR HANDLING UNITS

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Siddharth



TECHNICAL SPECIFICATION

AIR HANDLING UNITS

SPECIFICATION NO.PES-553-02

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 2 OF 6

1. GENERAL

- 1.1 This specification covers the design, manufacture, Construction features, installation, commissioning, inspection and performance testing at site of AHUs.

2. CODES AND STANDARDS

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

- 2.1.1 IS-659 : Safety code for air conditioning
- 2.1.2 IS-660 : Safety code for mechanical refrigeration
- 2.1.3 ASHRAE: Method of testing forced circulation air-cooling and air heating coils.
standard 33
- 2.1.4 ARI 41 : Standard for forced circulation air cooling and air heating coils.
- 2.1.5 ARI 430/435 : Air-cooling and air heating coils Central Station AHU / Application of Central Station AHU.
- 2.1.6 AMCA : 211 and 311

In case of any conflict in the standards and this specification the decision of PEM,BHEL shall be final and binding.

3. CONSTRUCTION FEATURES

- 3.1 The casing of AHU shall be made of insulated double wall construction of min. 24 gauge galvanized sheet steel - IS 277 Gr. 120 (parent sheet: D/DD-IS-513) ribbed and reinforced for structural strength and rigidity with 25 mm thick polyurethane insulation of minimum 40 kg/m³ density in between. The external wall will be pre-plasticised over GI coating on the outside. Angle irons or channel sections made of 16 gauge galvanized sheet steel shall be used for reinforcing. The casing shall be of sectionalized construction with proper sealing at the joints to make them air tight. Fan section and panels with bearing support shall be reinforced with heavy gauge channels (min. 5 mm thick). Suitable number of forged hot dip galvanized (610 gm/sq.m) U brackets shall be provided for AHU suspended from ceiling/roof.

Necessary arrangement shall be provided on the casing for measuring temperature and pressure in cooling/heating coil. Class of instruments shall be min. 2.

- 3.2 Fan impeller shall be forwardly/backwardly inclined curved blade centrifugal type. Impeller shall be double width double inlet type. Fans shall be preferably low rpm (≤ 1500) to minimize vibration and noise. Noise shall be within 85 dB(A) at 1 metre distance from AHU casing. Max. Vibration level shall be acceptance and norms to be specified. Two to three wheels (impellers) shall be provided for each AHU. Impeller blades shall be fabricated from (min. 1.0 mm) galvanized/ epoxy powder coated sheet steel. Fan shall be of epoxy powder coated / galvanized sheet steel (min. 1.6



TECHNICAL SPECIFICATION

AIR HANDLING UNITS

SPECIFICATION NO. PES-553-02

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 3 OF 6

mm) scroll with die formed inlets for uniform air flow. Fan shafts shall be solid cold rolled carbon steel (EN8 normalised), ground and polished. Fan shaft bearings shall be of heavy duty type selected for average operating life of 100,00 hours. Bearings shall be self-aligning, permanently lubricated type. Make of Brgs (SKF/FAG/NORMA/TATA) to be specified. Bearing Housing shall be of casting of min. IS Gr. 210, split type and suitably supported. The V-belt drive with belt guard shall be provided. Motors shall have minimum 15% margin over maximum BHP in working range.

3.3 DX or chilled water cooling coils and steam/hot water coils shall be internally corrugated copper/ cupronickel tubes (as per manufacturer's standard) with smooth non corrugated external fins of aluminium (thickness 0.14 mm and grade 1100 as per spec) unless specified otherwise in specification. At least 5 fins /per cm. shall be provided. The chilled water/hot water coils shall have suitable (standardize class, size, threading) drain and vent connections.

3.4 The filters in the filter section shall be provided as detailed in data sheet A.

3.5 Humidifier shall be Pan type/as specified in the specification.

Pan type Humidifier consisting of SS304/316 tank, heater, geyserstat with piping connection to supply air duct shall be provided unless specified otherwise in data sheet A.

Heaters and branch line shall be of galvanized steel and nozzles shall be of brass (matl. grade) /SS 304.

3.6 Condenser water from coil or surplus water from spray humidifier shall be collected in 16 gauge SS-304 pan. Minimum 50mm dia GI pipe nipple shall be provided on each end for drain connection. The drains for these points shall be extended to the main drain in AHU room. Condensate drain pipe (GI) of required length with sealing loop shall be provided and insulated as specified in the specification for insulation. Minimum requirement For GI Pipes and fittings shall be ERW/Seamless of medium thickness as per IS-1239/3589 and Hot dip galvanized

3.7 Suitable number of Spring type vibration isolators shall be provided for fan and motor assembly. Neoprene rubber pads shall be provided below the AHU.

The AHU shall be provided with 18 G SS drain pan.

Signature
S. D. K. PANJABI
S. D. K. PANJABI
MUKESH K. SINGH



TECHNICAL SPECIFICATION

AIR HANDLING UNITS

SPECIFICATION NO. PES-553-02

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 4 OF 6

4.

TESTING AND INSPECTION AT MANUFACTURERS WORKS:

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

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TECHNICAL SPECIFICATION

AIR HANDLING UNITS

SPECIFICATION NO.PES-553-02

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 5 OF 6

- 4.1 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.
- 4.2 Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating. For pipes and fittings compliance report shall be furnished by Manufacturer for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.
- 4.3 Shaft: Mechanical and chemical.
- 4.4 Motors (of approved make): Routine TC.
- 4.5 Workmanship and dimensional check as per manufacturing drg. and approved Drgs.
- 4.6 Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked to avoid loosening. Balancing weights and fasteners used shall be galvanized.
- 4.7 Performance test of one Centrifugal fan/per type/per size as per AMCA standard (for indigenous make).
- 4.8 Centrifugal fans for AHUs will be 100% run tested by main contractor of BHEL. One centrifugal fan/per type/per size will be run tested. Vibration shall be within good zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.
- 4.9 Complete assembly of one AHU/per type/ per size (excluding cooling coil and filter) shall be witnessed.
- 4.10 Run test of one complete assembly/per type/per size (excluding cooling coil and filter). Vibration shall be within satisfactory zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.

Approved:
 Sd/- MANU J. D. M. M. A. A.
 MUKESH K. SINGH



TECHNICAL SPECIFICATION

AIR HANDLING UNITS

SPECIFICATION NO.PES-553-02

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 6 OF 6

5. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT

- 5.1 GA drawing of AHU & data- sheet to be submitted along with technical schedules enclosed in Volume III.
- 5.2 Drawing including equipment layout, foundation & loading details etc. for civil works. These drawings must cover sufficient details so that design of civil works can be completed.
- 5.3 Inspection, operation & Maintenance Manuals.
- 5.4 Equipment description giving complete design calculations, basis of design, selection criteria etc.
- 5.5 Test Certificates.
- 5.6 Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.
- 5.7 Performance Test Certificates.

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AIR HANDLING UNIT
DATA SHEET - A

VOLUME - II-B

SECTION - D

REV 00

DATE 17.09.2012

SHEET 1 OF 2

DESCRIPTION

DATA

1. Nos. required/working : Refer to Section-C of Specific technical requirement.
2. Location : Refer to Section-C of Specific technical requirement.
3. Service/type : Air Conditioning /Double skin.
4. Fan type : Centrifugal (forward/backward curve Blade) limit load.
 - a) Capacity : To Suit as per calculation.
 - b) Static pressure : To suit but not less than 60 mm wc for AHU's Micro-V filters.
 - c) Discharge direction : To suit layout.
 - d) Motor : By Bidder,
 - e) Local push button station (Start/Stop) : By Others
 - f) Motor location : Inside AHU Casing.
 - g) Drive : Belt, pulley, belt guard.
5. Face and Bypass Damper : Required (Opposed blade type) DX AHU's having
6. Cooling coil : Required (Opposed blade type) DX AHU's having
 - a) Duty sensible heat : To suit as per calculations
 - b) Duty latent heat : -do-
 - c) Type of coil : Chilled Water/DX/Hot Water.
 - d) No. of rows : To suit but not less than four (4)
 - e) Material of tube /Thickness : Seamless Copper to ASTM-A-75/Equivalent.
 - f) Material of fins : Aluminium to SAE-1100-/1145-0
 - g) Number of fins : Not greater than 5 per cm (13 per inch).
 - h) Max. face velocity : 2.5 m/sec.
 - i) Air flow quantity : To suit as per tender drawings/documents.
7. 3 - way motorised mixing valve with thermostat. : Required with thermostat & actuator for chilled water system for each AHU.



AIR HANDLING UNIT
DATA SHEET - A

VOLUME - II-B

SECTION - D

REV 00

DATE 17.09.2012

SHEET 2 OF 2

8. Damper at discharge : Manually operated at discharge of each AHU outlet.
a) Material of construction : Mild Steel, galvanised.
9. Filters (Pre-filters)
a) Type & thickness : Dry panel type/ 50 mm
b) Filter area. : To suit as per velocity requirements. "V" - Bank.
c) Filter efficiency : Average arrestance efficiency of 65-80 %
d) Press drop (Clean) : Not to exceed 2.5 mmwc when clean & 6.5 mmwc while dirty.
10. Humidification section : As per the System requirement.
a) Type : Pan type, unless otherwise specified.
b) Operation : Automatic with Humidification.
11. Fresh air arrangement : Required.
a) Fresh air fan : Tube axial flow fans with motor.
b) Accessories : i) Inlet cone with Bird screen.
: ii) Dry panel pre-filters,
: iii) High efficiency filters for control room areas.
: iv) Volume Control Dampers,
: v) Supports etc.
12. Vibration isolator required. : Yes
13. Type of vibration isolator. : Neoprene ribbed Rubber for AHU's.
14. Any other requirement : i) In addition to dry panel filters on AHU, High efficiency filters(average arrestance efficiency of 80-90 %) shall be provided in supply air duct side of AHU for all control room and allied areas.
: ii) Bidder to also provide suitable electrical strip heaters for winter heating & monsoon reheating with Contactor box etc. Heaters to be interlocked with airstat.
15. Instrument & controls : Lot.(including Control box for strip heaters, pan humidifiers etc. in each AHU room.)
16. Insulation of drain piping : Lot.



**STANDARD TECHNICAL
SPECIFICATION
FOR
COOLING TOWER**

SPECIFICATION NO.PES-553-03

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 1 OF 5

**STANDARD TECHNICAL SPECIFICATION
FOR
COOLING TOWER**

Signature
S. M. M. M.

Signature
S. M. M. M.

Signature
MUKESH K. SINGH



TECHNICAL SPECIFICATION

COOLING TOWER

SPECIFICATION NO.PES-553-03

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 2 OF 5

1. GENERAL

- 1.1 this standard specification covers the design, manufacture assembly, inspection & testing at manufacturer's works, suitable painting & packing, delivery, erection & commissioning at site of all materials and equipments for mechanical induced draught cooling tower complete with all accessories as specified hereinafter.

2. CODES & STANDARDS

- 2.1 the design, manufacture, inspection & testing and performance of the cooling tower as specified hereinafter shall comply with the requirements of all applicable latest Indian/British/American standards and codes of practice. the latest editions of the following standards & publications shall be followed in particular:
- 2.1.1 Cooling tower institute USA bulletin ATP-10S: Acceptance test procedure for industrial water-cooling tower.
- 2.1.2 PTC-23 ASME performance test code for Atmospheric water-cooling equipment.
- 2.1.3 In case of any conflict between the above codes & standards and this specification, the later shall prevail.

3. DESIGN REQUIREMENTS

- 3.1 the cooling tower shall be designed for continuous operation to cool not less than design flow of water from specified inlet temperature to the outlet temperature at a design ambient wet bulb temperature as indicated under data sheet a.
- 3.2 all the components shall be capable of safe, proper and continuous operation at all cooling water flows upto & including those specified under data sheet a & shall be designed with regard to case of maintenance, repair, cleaning & inspection.
- 3.3 the cooling tower shall be of induced draught cross flow or counter flow type and with multiple cells (if specified in data sheet a.) the cooling tower shall be suitable for handling the fluid and also for achieving the specified parameter as per data sheet a. the cooling tower shall be designed such that the drift losses & evaporation losses are minimum.

4. CONSTRUCTIONAL FEATURES

- 4.1 CASING & LOUVERS
- 4.1.1 The cooling tower casing shall be made of FRP/as specified in data sheet A. The louvers shall be made of FRP/as specified. Louvers, if provided, shall be designed for air entry to the tower with low velocity for minimum pressure drop & less chance of recirculation of moist air. To eliminate splash out, louvers shall slope to shed water inwards. Air intake shall be all along the base circumference of the casing & hotdip galvanised expanded metal mesh shall be provided to protect the air intake.



TECHNICAL SPECIFICATION

COOLING TOWER

SPECIFICATION NO.PES-553-03

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 3 OF 5

- 4.2 FILL
- 4.2.1 Cooling tower fills shall be made of noncombustible PVC/as specified in data sheet A. The design & arrangement of the fills shall be so as to expose maximum air/water surface with minimum pressure drop.
- 4.3 Drift Eliminators
- 4.3.1 Multi-pass drift eliminators with minimum two pass zig-zag path shall be provided so to minimise the drift losses.
- 4.3.2 In case of FRP cooling tower the drift eliminators shall be of multi-blade rotary type.
- 4.4 Fans & Accessories
- 4.4.1 The fans shall be multiple blade, low speed, high efficiency axial flow type located above the top deck level of the cooling tower. Fan rotating assembly shall be statically & dynamically balanced. The fan blades shall be preferably adjustable in stand still condition for propeller action. The fan shall be either directly mounted on the shaft of a totally enclosed weather proof motor or shall be suitable for V-belt drive.
- 4.4.2 The rating of drive motor shall have at least 15% margin over maximum fan power consumption. The design & construction of the drive motor shall be in accordance with enclosed specification for LVAC motors.
- 4.5 Water basin
- 4.5.1 The material of construction of water basin shall be FRP or RCC as specified in data sheet A. The basin shall be provided as a part of cooling tower in case of FRP construction. The sump shall have sufficient storage capacity for safe operation of AC plant.
- 4.6 Hot water distribution system
- 4.6.1 Manually operated flow control valves shall be provided in hot water distribution piping such that each cooling tower can be isolated without affecting the operation of other cells.
- 4.6.2 The nozzles shall be spaced to give even distribution of water over entire space occupied by top row of fills. The nozzles shall be made of brass /SS 304/316/316L (brass shall be as per manufacturer's standard) unless specified in data sheet A:
- 4.6.3 In case of FRP tower water shall be distributed over the fill by means of a multiple area fail safe rotary sprinkler made of PVC pipes fitted on a aluminium alloy (as per manufacturers standard) rotary head and mounted on sealed ball bearings (make) .
- 4.7 Access
- 4.7.1 A stair case paddle ladder (as per manufacturer's standard) shall be provided external to the cooling tower at one end of each tower along with stairways hand rails etc give safe & convenient access to the top deck from ground level.



TECHNICAL SPECIFICATION

COOLING TOWER

SPECIFICATION NO.PES-553-03

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 4 OF 5

4.8 Painting

4.8.1 The cooling towers shall be painted with suitable anti-corrosive paint as per approval of purchaser. All galvanized external surfaces shall be painted to match colouring scheme. Before painting galvanized surfaces -etch primer to be applied.

5. SHOP INSPECTION & TESTING

5.1 Compliance certificates for nozzles (Or rotary sprinkler), piping, fill material, drift eliminator, louvers components etc.

5.2 Certificate of conformance for all other material components.

5.3 Balancing report for Static & dynamic balancing of fan assembly.

6. TESTS AT SITE

6.1 Hydrostatic testing of complete hot water distribution piping at site.

7. PERFORMANCE GUARANTEE

7.1 The cooling tower shall be guaranteed to meet the performance requirements as specified & when tested in accordance with ATP-105.

7.2 The vendor shall furnish performance curves for the cooling tower showing variations in performance from design duty point with change in approach to wet bulb temperature, cooling range, water loading of cooling tower.

Signature
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TECHNICAL SPECIFICATION

COOLING TOWER

SPECIFICATION NO.PES-553-03

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 5 OF 5

8. DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT

- 8.1 General arrangement drawing of complete cooling tower (showing plan, front elevation and side elevation) incorporating principal dimensions, limits of scope of supply of piping, limits of civil works included showing extent of platforms, walkways, handrails, access doors, staircase etc. and the limits of scope of supply of electrical works.
- 8.2 General arrangement and sectional assembly drawings pertaining to the following components of the cooling tower:
- i) Tower fill with supporting arrangement.
 - ii) Drift eliminator installation and details.
 - iii) Complete hot water distribution system including flow regulating valves, distribution basin/pipes and nozzles etc.
- 8.3 Cooling tower performance curves showing WBT Vs cold-water temperature for design cooling range, 90% cooling range and 110% cooling range at 100%, 90%, and 110% design flow.
- 8.4 Performance curves of cooling tower fans.
- 8.5 Test procedure along with details of tests to be conducted for the offered cooling tower.
- 8.6 Quality Plan along with complete details of the testing and inspection requirements of mechanical and electrical items of the cooling tower in BHEL format.
- 8.7 Operation and maintenance instructions.

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**COOLING TOWER
DATA SHEET - A**

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 1 OF 2

A. GENERAL DATA

- 1) Service : Cooling of condenser water of AC plant.
- 2) Type : Fibreglass reinforced plastic construction induced draught.
- 3) Quantity : Refer to Section-C of Specific Technical Requirements.
- 4) Place of installation : Refer to Section-C of Specific Technical Requirements.

B. DESIGN DATA

- 1) Capacity at specified conditions. : To suit the system requirement.
- 2) Water flow rate : To suit the system requirement.
- 3) Design wet bulb temperature : 25 Deg. C.
- 4) Hot water inlet temperature : To suit requirement.
- 5) Cooled water temperature : To suit requirement.
- 6) Depth of sump Tank : As per manufacturer's standard.

C. MATERIAL

- 1) Sump tank & Casing : FRP
- 2) Louvers : FRP/PVC/Aluminium.
- 3) Type of fill : Non-combustible PVC/Eq.
- 4) Nozzles : Brass with chrome plating/polypropylene.
- 5) Ladder : Hot dip galvanized steel ladder for each tower.
- 6) Bird screen : 25 mm square made of GI/SS wire mesh of 16 gauge.
- 7) Fan impeller : Cast Aluminium Alloy/FRP propeller type and multi-blade aerofoil construction with adjustable pitch..
- 8) Supporting structure : MS with spray galvanization of epoxy painting.
- 9) Strainer : Plant strainer made of GI/SS wire mesh of 16 gauge.

D. ACCESSORIES

- 1) Make up connection : Yes.



COOLING TOWER

DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 2 OF 2

2)	Quick fill connection	: Yes.
3)	Overflow & drain & blow down connection	: Yes.
4)	Access door in louvers/fan deck	: Yes (if applicable).
5)	Supports & supporting structure for mounting	: Yes.
6)	Level switch	: Yes.
7)	Rain protection for motor	: Yes (suitable Canopy by Bidder)
E.	ELECTRICAL DATA	
i)	Power supply	: 415 V $\pm$ 10%/50 Hz $\pm$ 3%/3 phase.
ii)	Motor	: As per specification attached.
F.	INSPECTION & TESTING	
		: As per approved quality plan.

MURKESH KAS SINGH

Singapore

Dated

20-11-2019



TECHNICAL SPECIFICATION
LOW PRESSURE AIR DISTRIBUTION
SYSTEM

SPECIFICATION NO.PES-553-07

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 2 OF 9

1. GENERAL

1.1 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 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

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

3.2 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 technical requirement refer to Section-C of Specific Technical Requirements.

3.3 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

4.1 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.

4.2 RECTANGULAR DUCTS

4.2.1

S.No.	Max Side	Sheet Thickness	Type of transverse	Bracings



TECHNICAL SPECIFICATION
LOW PRESSURE AIR DISTRIBUTION
SYSTEM

SPECIFICATION NO.PES-553-07

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 3 OF 9

		(mm) GI	(mm) AI	Joint connections	
a)	Up to 600	0.63 (24G)	0.80	S-drive, pocket or bar slips or flanged joints on 2.5m centres	None
b)	601 to 750	0.63 (24G)	0.80	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
c)	751 to 1000	0.80 (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 to 1500	0.80 (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 to 2250	1.00 (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 (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				

- 4.2.2 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.
- 4.2.3 The seams on duct cones shall be of Pittsburgh type. Longitudinal seams shall be smooth inside the ducts.
- 4.2.4 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



TECHNICAL SPECIFICATION
LOW PRESSURE AIR DISTRIBUTION
SYSTEM

SPECIFICATION NO.PES-553-07

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 4 OF 9

4.2.5 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.

4.2.6 MS angles used for bracings shall be tack welded to the ducts or rivetted at 125mm centres, as applicable.

4.3 ROUND DUCTS

4.3.1

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

4.3.2 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.

4.3.3 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.

4.4 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



TECHNICAL SPECIFICATION
LOW PRESSURE AIR DISTRIBUTION
SYSTEM

SPECIFICATION NO.PES-553-07

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 5 OF 9

direct contact with ducts, for which purpose wooden pieces/ Resin bonded fibre glass sheets (50 mm thick) shall be used in between.

4.5 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 9r (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.

4.6 TRANSFORMATIONS AND BREACHES

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

4.7 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.

4.8 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.

4.9 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.

4.10 DAMPERS AND SPLITTERS

4.10.1 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.

4.10.2 FIRE DAMPERS

Fire dampers 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



TECHNICAL SPECIFICATION
LOW PRESSURE AIR DISTRIBUTION
SYSTEM

SPECIFICATION NO.PES-553-07

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 6 OF 9

sensor or fusible link type.

4.10.3

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.

4.10.4

FLASHING

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

4.11

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.

4.12

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 appox. 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.

4.13

ACCOUSTIC LINING

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

4.14

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.



TECHNICAL SPECIFICATION
LOW PRESSURE AIR DISTRIBUTION
SYSTEM

SPECIFICATION NO.PES-553-07

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 7 OF 9

4.15 THERMAL INSULATION

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

5. INSPECTION AND TESTING

5.1 INSPECTION & TESTING DURING FABRICATION

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.

5.1.2 Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.

5.1.3 Check for dimensions & mass as per latest IS-277.

5.1.4 Check for defect, twists, ungalvanised spots as per IS-2629.

5.1.5 Bend test & wrapping test as per IS-277.

5.1.6 Zinc coating test on samples as per IS-6745.

5.2 INSPECTION & TESTING AT SITE.

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.

5.2.2 After completion, all duct systems shall be checked and tested for air leakage, tightness, velocity, pressure drop, vibration and noise etc.

6. BALANCING

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

6.1.2 All instruments required for testing/balancing etc. of the air distribution system shall be provided by vendor.



TECHNICAL SPECIFICATION
LOW PRESSURE AIR DISTRIBUTION
SYSTEM

SPECIFICATION NO.PES-553-07

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 9 OF 9

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LOW PRESSURE AIR DISTRIBUTION SYSTEM

DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 1 OF 2

Description

Data

1. General (List of areas)	: As per Specification/Tender drawing.
2. GSS Duct Work	
a) Type	: GSS as per IS: 277 (Zinc coating as per Section-C of Specific Technical Requirements.)
b) Size	: As per Section-C of Specific Technical Requirements and bill of quantity.
3. Acoustic lining	: Up to 5m length from AHU Outlet.
4. Special painting	: Galvanised.
5. Thermal Insulation	: Required in supply air duct in AC entire length.
6. Diffusers (Circular/Square)	
300 mm size	
350 mm size	
450 mm size	
550 mm size	
600 mm size	
Any other size	
7. SA grilles (for each size)	: To suit air flow as per System requirements / Tender Drawings.
8. RA grilles (for each size)	: -do-

NOTE:

1. Duct sheet thickness shall be as per IS-655
2. Opposed blade type volume control damper shall be provided at each supply air diffusers/grilles.
3. Bidder to provide suitable gasketing at each duct flange.
4. Fire damper shall be motor operated type, when otherwise specified under Section-C.
5. Access door in ducting system shall be provided as required.
6. MS Angle (painted) shall be used for duct supports etc.
7. Velocity thru duct shall normally not exceed 9.0 M/sec for Air conditioning system. Maximum velocity (outlet) for supply air diffuser shall not exceed 2.5 m/sec.



LOW PRESSURE AIR DISTRIBUTION SYSTEM

DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 2 OF 2

8. All Grilles & diffusers shall be supported with frame. Frame etc. shall be supplied by bidder.

Signature
S.D. KUMAR

Signature
S.D. KUMAR

Signature
MUKESH K. SINGH



TECHNICAL SPECIFICATION
CENTRIFUGAL PUMPS

SPECIFICATION NO.PES-553-04

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 1 OF 10

STANDARD TECHNICAL SPECIFICATION
FOR
CENTRIFUGAL PUMPS

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TECHNICAL SPECIFICATION
CENTRIFUGAL PUMPS

SPECIFICATION NO.PES-553-04

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 2 OF 10

1. GENERAL

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

2. 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):

2.1.1 IS-1520 : Horizontal centrifugal pumps for clear, cold and fresh water.

2.1.2 IS-5120 : Technical requirements - Rotodynamic special purpose pump.

2.1.3 IS-1710 : Vertical turbine pumps for clear, cold and fresh water.

2.1.4 BS - 599 : Method of testing Pumps.

2.1.5 PTC - '6' : Centrifugal Pumps Power test code

2.1.6 API - 610

2.1.7 Hydraulic Institute Standards of USA

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 engineering shall be final and binding.

Approved: 
MUKESH K. SINGH
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TECHNICAL SPECIFICATION
CENTRIFUGAL PUMPS

SPECIFICATION NO. PES-553-04

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 3 OF 10

3. 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. CONSTRUCTION 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 1.5 times the maximum pressure developed by the pump at the pumping temperature.
- 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 or plugged with threaded plugs as required.
- 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

- 4.2.1 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 checked for eccentricity and statically and dynamically balanced individually. The assembled rotor shall be dynamically balanced and checked for eccentricity. Supplier shall ensure during balancing that wall thickness of impeller vane, shroud etc is maintained above the minimum thickness requirement as per design.

4.3 WEARING RING

- 4.3.1 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



TECHNICAL SPECIFICATION
CENTRIFUGAL PUMPS

SPECIFICATION NO.PES-553-04

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 4 OF 10

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

4.4.1 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 BEARING

4.5.1 Bearings and hydraulic devices, of approved make, (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 BOX

4.6.1 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. Tubings used for connections shall be flexible metallic type preferably SS-304/316. PVC/ rubber tubings are not acceptable.

4.7 SHAFT COUPLING

4.7.1 The pumps shall be directly coupled to their drives through heavy-duty flexible coupling. Suitable sturdy coupling guards of min. 1.5 mm MS sheet/ Aluminium sheet 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

4.8.1 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. The external corners of the base plate shall be rounded to avoid sharp corners. Drilled holes shall have sufficient space around for proper seating of washer with nut. If required in the data specification sheet, steel sole plates shall be provided, below the base plate.



TECHNICAL SPECIFICATION
CENTRIFUGAL PUMPS

SPECIFICATION NO. PES-553-04

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 5 OF 10

4.9 PRIME MOVER

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

4.10 LIFTING ARRANGEMENT

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

5. 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. 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.

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. SCOPE OF INSPECTION AND TESTING

7.1 CASTING

7.1.1 The Witnessing pouring and thereafter physical testing of castings of 'Critical' nature such as casings, impellers, diffusers. Castings shall have 'as cast' heat numbers



TECHNICAL SPECIFICATION **CENTRIFUGAL PUMPS**

SPECIFICATION NO.PES-553-04

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 6 OF 10

- unless they require overall machining. For partially machined components manufacturer shall ensure availability of as cast heat nos. on unmachined area.
- 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)
- 7.1.5 Castings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.
- 7.1.6 Surface finish of Steel castings shall meet MSS SP-55.
- 7.2 **FORGING**
- 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).
- 7.2.3 Forgings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.
- 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 as per ASME Sec IX.
- 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 **Note:** For para 7.1.2, 7.2.1 and 7.3.1 above; in case correlating original test certificates are not available, material shall be identified by Main Vendor and test conducted at NABL approved Laboratory.
- 7.4 **IN PROCESS INSPECTION AND TESTING**
- 7.4.1 Identification 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. Permissible defects and acceptance norms need to be specified. 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)

Checked by:
 Approved by:
 MUKESH K. SINGH



TECHNICAL SPECIFICATION **CENTRIFUGAL PUMPS**

SPECIFICATION NO.PES-553-04

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 7 OF 10

- as per applicable code, in absence of which as per ASTM E388 and acceptance norms as stipulated hereunder. Probe shall be of min. 2 MHz frequency.
- 7.4.3 Acceptance norms for UT for dynamic duty components. the following defects are unacceptable
- Cracks, flakes, seams and laps
 - Defects giving indications longer than that from a 4mm equivalent flaw.
 - 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%.
 - 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.
- 7.5.3 Vibration, noise level and temperature rise measurement. Noise level shall be within 85dB(A) at 1 metre distance. Vibration within satisfactory zone of VDI 2056 Group G machines. Temperature shall not exceed ambient + 40 deg. C.
- 7.5.4 Overall dimensions as per GA drawings. One pump/type/size assembly with job motor shall be mounted on base plate, provided the components are ordered on the same manufacturer.
- 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.

Checked by:
 MUKESH K. SINGH
 Sd/- MANU
 20-09-12



TECHNICAL SPECIFICATION
CENTRIFUGAL PUMPS

SPECIFICATION NO.PES-553-04

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 8 OF 10

7.6 TEST AT SITE

7.6.1 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

7.7.1 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. CLEANING, PROTECTION , PAINTING & PACKING

8.1 Before shipment of the equipment to be supplied under this specification the necessary cleaning, flushing etc., as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere shall be done to remove all dirts, scales etc. Shop coats of rust inhibiting paints, lacquers etc., shall be applied to various parts as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere. Flanges, inlet and outlet pipe, etc shall be protected. Packing shall be done as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere.

Signature
Sd/- M. M. A.
Sd/- K. M. A.
Sd/- K. M. A.
Sd/- K. M. A.



TECHNICAL SPECIFICATION
CENTRIFUGAL PUMPS

SPECIFICATION NO.PES-553-04

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 9 OF 10

9. 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:
- a) Foundation base plate and sole plate details as applicable
 - b) Civil foundation and anchor bolts details and loading data
 - c) 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 and/ make with standard applicable codes.
- 9.3 Performance characteristics (Discharge capacity vs head, BHP and efficiency of the pumps.
- 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. MANUFACTURERS NAME AND TAG. PLATES

- 10.1 Each pump shall have a permanently attached brass/ Stainless steel 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.

मुकुण्ड
 मुखेश कार्मण्ड
 सि. इंजन
 डी.एम.ए.
 17.09.2012



TECHNICAL SPECIFICATION
CENTRIFUGAL PUMPS

SPECIFICATION NO.PES-553-04

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 10 OF 10

11. DRAWINGS/DOCUMENT/DATA REQUIRED AFTER 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.
- 11.8 Installation , operation and maintenance manual.
- 11.9 Other drawings and data, if necessary.

Signature
Sd/-
MUKESH K. SINGH
Sd/-
Sd/-



CENTRIFUGAL PUMPS
DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 1 OF 2

DESCRIPTION

DATA

1. Designation	: Condenser water and Chilled Water pumps for AC plant.
2. Type	: Horizontal, Centrifugal pump or vertical split type casing pump .
3. Quantity	: Refer to section-C of Specific Technical Requirements
4. Installation	: On floating type foundation.
5. Fluid to be handled	: Water
6. Temperature of fluid	: To suit.
7. Capacity M3/hr and TDH at rated	: To suit system requirements but head shall not be less than 25 MWC.
8. Duty	: Continuous (24 hours / day)
9. Suction condition	: Flooded
10. Type of drive	: Direct
11. Prime Mover	: LV AC motor
12. Maximum speed	: 1500 RPM
13. Type of lubrication	: Grease Lubrication
14. Material	
a) Impeller	: Bronze to Grade IS: 318 Grade 2
b) Pump shaft	: EN - 8 / Equivalent (Approved).
c) Casing	: CAST IRON TO IS: 210 Grade - 260.
d) Wearing ring	: Bronze to Grade IS:318 GR-2, Renewable type.
e) Shaft Sleeve	: -do-
f) Base plate	: Cast Iron to Grade FG-200 IS-210/M.S. fabricated.
g) Bolt and nuts.	: MS
h) Stuffing Box gland/bush case.	: Deep Bronze packing to be renewable with



CENTRIFUGAL PUMPS
DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 2 OF 2

i) Stuffing box Packing. : Flexible Graphite or PTFE (Asbestos shall not be used)

j) Pump motor coupling. : Flexible.

15. ACCESSORIES REQUIRED:-

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

a) Suction & Discharge pressure gauges. : Yes.

b) Vent connection : Yes.

c) Drain piping up to common drain point
in plant room. : Yes

d) Companion flanges. : Yes

e) Common base plate. : Yes.

f) Suction strainer. : Yes

g) Isolating valve : Yes

h) NRV at pump outlet at inlet/outlet : Yes

i) Any special requirements : The Chilled Water pumps shall be suitably insulated as per spec.

j) Inspection & Testing : As per specification enclosed elsewhere.

MUKESH K. SINGH
S.D. - ICHM
S.D. - ICHM
S.D. - ICHM



TECHNICAL SPECIFICATION
FOR
PACKAGE CONDITIONING UNIT

SPECIFICATION NO.PES-553-05

VOLUME II B

SECTION D

REV. 02

DATE:17.09.2012

SHEET 1 OF 6

STANDARD TECHNICAL SPECIFICATION
FOR
PACKAGE CONDITIONING UNIT

महेश कार. सिंग
सि.एच.ई.एल.
डि.म.ए.ए.



TECHNICAL SPECIFICATION FOR PACKAGE CONDITIONING UNIT

SPECIFICATION NO.PES-553-05

VOLUME II B

SECTION D

REV. 02

DATE:17.09.2012

SHEET 2 OF 6

1 GENERAL

- 1.1 This specification covers the design, manufacture, inspection and testing at the manufacturer's works and suitable packing delivery and testing of the packaged air conditioning unit.

2 CODES AND STANDARDS

- 2.1 The design, manufacture, inspection, testing and performance of the packaged type air conditioning unit shall comply with all statutes, regulations and safety codes currently applicable in the locality where the equipment will be installed. The equipment shall also conform to the latest editions of the codes and standards specified herein under. Nothing in this specification shall be construed to relieve the vendor of this responsibility.

In particular, the packaged air conditioning Unit (max 7.5 TR capacity, ductable or non ductable type) or cassette type (up to 5 TR) shall conform to the latest editions of the following standards:

- 2.1.1 I.S.660 : Safety code for Mechanical Refrigeration.
- 2.1.2 I.S.5111 : Code of practice for measurement, and testing of refrigerant compressor.
- 2.1.3 I.S.659 : Safety code for air conditioning.
- 2.1.4 I.S.2494 : V Belt for industrial purpose.
- 2.1.5 I.S.3142 : V grooved pulleys for V Belts.
- 2.1.6 I.S.4503 : Shell and tube type heat exchanger.
- 2.1.7 ARI 210 : Standard for/unitary air conditioning equipment
- 2.1.8 ARI 270 : Standard for application installation and servicing of unitary equipment.
- 2.1.9 ASHRAE-37 : Standard methods of testing for rating unitary air conditioning and heat pump / equipment.
- 2.1.10 ANSI-B9-1 : Safety code for mechanical refrigeration.

3 DESIGN AND CONSTRUCTIONAL REQUIREMENTS

3.1 Compressor

The compressor shall be hermetic or semi-hermetic or screw rotary type or scroll type. The same shall be suitable for R410A/R407C/R134A refrigerant. The compressor shall be mounted on anti-vibration spring/rubber pads and shall be positioned in such a way that it is freely accessible with sufficient space all around for easy maintenance. Safety controls like High and Low pressure cut-out overload and single phasing protection for the motors shall be provided. A crankcase heater shall also be provided, if considered necessary by the vendor.

3.2 CONDENSING UNIT

Shell and tube type water cooled condenser or air cooled condenser with adequate area shall be provided as specified in Data Sheet-A. The condensing unit shall be complete with



**TECHNICAL SPECIFICATION
FOR
PACKAGE CONDITIONING UNIT**

SPECIFICATION NO.PES-553-05

VOLUME II B

SECTION D

REV. 02

DATE:17.09.2012

SHEET 3 OF 6

multipass heads and shall be fitted with the following:

- 3.2.1 Hot gas inlet and liquid outlet connection with shut off valve for liquid.
- 3.2.2 Drain plug, air vent and test valve.
- 3.2.3 Water inlet and outlet connection with thermowell and suitable cocks respectively.
- 3.2.4 Relief valve and air purge valve (Fusible plug in place of relief valve not acceptable)
- 3.2.5 Any other accessory as recommended by the manufacturer for proper functioning of the equipment.

3.3 AIR HANDLING FAN

The air handling fan shall be of the centrifugal type and with forward curved blades. This shall be driven by means of a three phase induction motor through V belt drive. The fan static pressure shall be selected for passing air through high efficiency absolute filters, if specified in Data Sheet-A.

3.4 FILTERS

Filters shall be of dry panel type and shall be cleanable. The velocity of air across the filters shall not exceed 1.75m/sec (350FPM).

3.5 COOLING COIL

The cooling coil shall be of direct expansion type and shall be made of heavy gauge copper with aluminium fins. The fins shall be bonded to the copper tubes under hydraulic pressure. A distributor shall be provided for feeding the refrigerant to different sections of the coil. Rows shall be staggered in the directions of airflow. The velocity of air across coil shall not exceed 2.5M/Sec. (500 FPM).

3.6 CONTROLS

All necessary controls and accessories like thermostatic expansion valve, refrigerant solenoid valve, distributor, filter drier in the liquid lines, shut off valves, HP/LP cut out for compressor, thermostat with adjustable settings, overload and single phasing preventer for motor etc. are to be provided. The microprocessor based control panel shall be provided outside the packaged unit on one side. The control panel shall generally be in line with the specification for control panels given elsewhere.

The control shall be so interlocked that the fan shall be started independently first, and then only the compressor. Tripping of the compressor by the thermostat or compressor cut outs shall not trip the fan. The thermostat setting shall be adjustable

3.7 REFRIGERANT PIPING

The refrigerant piping shall be either heavy gauge copper as furnished in Data Sheet-A. The piping shall be completely factory assembled, pressure tested, dehydrated and initially charged with FREON gas and compressor oil. The line accessories shall include liquid line shutoff valve dehydrator, strainer, flow indicator and distributor etc.

3.8 CABINET

All the equipments, except control panel, mentioned above shall be provided within a heavy gauge sheet metal cabinet, of floor/ wall mounted type. This shall be given two coats of anti-corrosive and rust proof paint, finished with two coats of final paint. Painting shall be as per manufacturers std unless specified otherwise in data sheet 'A'. The interior of the cabinet shall be provided with thermal and acoustic insulation of minimum 25mm thick. The insulating material shall be fire proof.



**TECHNICAL SPECIFICATION
FOR
PACKAGE CONDITIONING UNIT**

SPECIFICATION NO.PES-553-05

VOLUME II B

SECTION D

REV. 02

DATE:17.09.2012

SHEET 4 OF 6

The front and back side of the cabinets shall be easily removable providing maintenance to all the interior parts.

All the electric wires within the cabinet shall run in flexible conduits and carry identification tags. The bottom side of the panel shall be specially ribbed to take care of the transportation.

3.9 OTHER ACCESSORIES

Each packaged air conditioner shall be provided with required number of neoprene rubber isolating pads.

4 CONTROL AND INTERLOCK REQUIREMENTS

The compressor shall have all protective devices like HP/LP cutouts, overload protection for the motor, single phasing preventor for motor etc.

The interlocking requirement shall be as indicated below:

4.1 The compressor shall not start, unless condenser water flow is achieved for water cooled condenser. The condenser flow shall be sensed by means of a flow switch.

4.2 The compressor shall not start unless the evaporator fan is started.

4.3 The tripping of compressor on HP/LP, overload or on thermostat shall not trip the fan.

4.4 Strip heater (if provided in the ducting system) shall not be switched on, unless the evaporator fan is started and airflow is established. For this purpose, an air stat on flow switch shall be used. The heater shall be separately controlled by humidistat/thermostat

4.5 A humidifying package, if specified in data sheet A, shall be controlled by humidistat.

5 TEST AND INSPECTION

5.1 Inspection and Testing at Manufacturer's Works

5.1.1 static and dynamic test for fans

5.1.2 Hydrostatic static test on condenser and cooling coil.

5.1.3 vacuum/pressure test for the complete refrigeration circuit.

5.1.4 Visual and Free running test of the packaged unit on test bed.

5.1.5 Free running test on compressor.

5.1.6 AIR CAPACITY WITH ANEMOMETER.

5.1.7 NOISE LEVEL- ≤ 85 dB(A).

5.1.8 Other tests as per approved qualities plan/scope of inspection.

5.2 Inspection and Testing at Site

5.2.1 Performance testing of the packaged unit for 72 hours in summer / monsoon & 24-hours in winter- Up-to 3 TR (individual M/c capacity) inside room temperature (Dry & wet bulb) will be checked with all machines in the room operating.

The actual days of testing shall be mutually agreed. During the above testing, the following readings shall be taken to compare the same with guaranteed performance data.

5.2.1.1 Condenser inlet and outlet pressure and temperature

5.2.1.2 Entering and leaving air temperature of the cooling coil air filters.



**TECHNICAL SPECIFICATION
FOR
PACKAGE CONDITIONING UNIT**

SPECIFICATION NO.PES-553-05

VOLUME II B

SECTION D

REV. 02

DATE:17.09.2012

SHEET 5 OF 6

- 5.2.1.3 Motor current for the compressor and blower.
- 5.2.1.4 Air quantity delivered by the fan. This shall be computed by adding air quantity leaving all the grilles entering the air filters.
- Room temperature (Dry & wet bulb)
- 5.2.1.5 Test to ensure all controls and safety instruments are working properly.
- During the above testing, noise level also will be checked to ensure that the same are within acceptable limits. Any undue vibration detected physically will be corrected.
- All tools and instruments required for the above testing will be provided by the vendor.

6

PAINTING:

The packaged unit shall be given two coats of primer paint finished with two coats of finish paint as per Manufacturers std. unless specified otherwise elsewhere/ Data sheet 'A'. The colour of finish paint will be as specified in Data Sheet-A.

7

GUARANTEES

The package unit shall be guaranteed for performance measured in terms of the inside temperature maintained.

The packaged unit shall also be free from any manufacturing defects and shall be guaranteed as per contract after the first test as per 5.0 is successfully carried out, and the plant taken over by the purchaser.

8

NAME PLATES

Suitable Name plate as per Data Sheet 'A', depicting the equipment number as designated in Data Sheet A shall be provided for each packaged unit and screwed to a prominent position on the packaged unit.

Signature
Sd/- M. A. A.
Sd/- K. M. A.
Sd/- K. S. SINGH
MUKESH K. SINGH



**TECHNICAL SPECIFICATION
FOR
PACKAGE CONDITIONING UNIT**

SPECIFICATION NO.PES-553-05

VOLUME II B

SECTION D

REV. 02

DATE:17.09.2012

SHEET 6 OF 6

9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

- 9.1 Final technical data as per Data Sheet-B
- 9.2 G.A. and interior view of packaged unit
- 9.3 Electrical wiring diagram
- 9.4 Catalogues for all controls
- 9.5 O & M Manual
- 9.6 Erection Manual

Signature
Sd/- MANJIV K. SINGH
MANJIV K. SINGH



PACKAGE-CONDITIONING UNIT
DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 1 OF 1

DESCRIPTION

DATA

1) Capacity of the unit at operating conditions.	: As specified
2) Numbers required	: Refer to Section-C of Specific Technical Requirements
3) Designation of the unit	: Package AC Unit
4) Whether air cooled/water cooled	: Refer to Section-C of Specific Technical Requirements
5) The plant shall be suitable for maximum-ambient temp.	: Refer outdoor design condition as specified.
6) Whether a plenum Chamber required	: Units shall be connected to fresh air ducts.
OR	
Whether to be connected duct system.	: Yes.
7) Whether Humidifier required for humidity-control.	: Refer to Section-C of Specific Technical Requirements
8) Whether strip heaters required for winter heating.	: Refer to Section-C of Specific Technical Requirements
9) Whether strip heater required for Humidity control.	: Refer to Section-C of Specific Technical Requirements
10) Final painting colour shade stage.	: Subject to approval / during detail engineering
11) Whether fan static pressure is to be designed for filters arrangement shown.	: Yes.
12) Installation supporting structure/drain piping, insulation.	: Required. Drain piping with insulation up to the nearest drain point.
13) Controls & Instruments	: Yes (Lot)
14) Isolation Switch	: Yes



**STANDARD TECHNICAL SPECIFICATION
FOR
AIR FILTER**

SPECIFICATION NO. PES-553-06

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 2 OF 4

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 ≥ 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 ≥ 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.

All filters shall be capable of being cleaned of their accumulated dust by tap water flushing. The dry metallic filter shall have Average arrestance A_m (%) shall be ≥ 90 .



**STANDARD TECHNICAL SPECIFICATION
FOR
AIR FILTER**

SPECIFICATION NO. PES-553-06

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 3 OF 4

However oil wetted air filters shall have Average Efficiency E_m (%) ≥ 90 as per BS EN - 779..

3.4 AUTOMATIC CLEANING FILTERS

This shall consist of a filter mat and drop eliminator, driven by a suitably rated geared motor unit being supported on a steel framework. The filter mat shall consist of an endless steel wire mat insets of steel mesh held between an upper & a lower shall drop eliminator shall consist of an endless steel wire without insets of steel mesh. The unit shall include a suitable oil pump, gludge raking mechanism and sludge container and tensioning device. Pressure drop shall be limited to 0.5 / mm WG when clean & 10 mm when dirty. Air velocity across filter shall not exceed 3 M/sec.

3.5 ABSOLUTE FILTERS

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 dioctylphthalate 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.

3.6 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

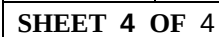
The scope of inspection for air filters shall be as below:

4.1 Dimensional inspection of frame & filter media.

4.2 Witnessing 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.

4.3 Verification of type test certificates for similar type & size of filters for sodium flame test as per BS-3928 (if applicable- refer data sheet).





**AIR FILTER
DATA SHEET - A**

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 1 OF 1

DESCRIPTION

DATA

1) General

1.1 Service	: Air Conditioning.
1.2 Location	: Central Air conditioning plant, & package AC plant, fresh air fan system. Also for split AC.
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 dry panel filters(prefilters). 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.



TECHNICAL SPECIFICATION
THERMAL INSULATION FOR COLD
SURFACES

SPECIFICATION NO.PES-553-08

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 1 OF 6

STANDARD TECHNICAL SPECIFICATION
FOR
THERMAL INSULATION FOR COLD SURFACES

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Siddhant
Siddhant
Siddhant



TECHNICAL SPECIFICATION
THERMAL INSULATION FOR COLD SURFACES

SPECIFICATION NO. PES-553-08

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 2 OF 6

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 :-

IS:3069: GLOSSARY OF TERMS & SYMBOLS & UNITS RELATING TO THERMAL INSULATION

materials.

2.1 IS:4671: Expanded polystyrene for thermal insulation purposes.

2.2 IS:3677: Mineral wool for thermal insulation.

2.3 IS:8183: Resin bonded mineral wool.

3. DESIGN REQUIREMENTS

3.1 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.

3.2 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.

3.3 The insulation material, density and thickness etc. Shall be as specified in DATA SHEET A.

4. APPLICATION DETAILS

4.1 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.

4.2 A layer of solvent free, anticorrosive paint shall be applied & allowed to dry.

4.3 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.

4.4 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



TECHNICAL SPECIFICATION
THERMAL INSULATION FOR COLD SURFACES

SPECIFICATION NO.PES-553-08

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 3 OF 6

bitumen/equivalent adhesive. Voids if any shall be packed with suitably cut pieces of insulation material.

- 4.5 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 of 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:

- 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 & allowed to dry.

- 5.4.2 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.

- 5.4.3 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.



TECHNICAL SPECIFICATION
THERMAL INSULATION FOR COLD SURFACES

SPECIFICATION NO.PES-553-08

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 4 OF 6

5.4.4

3 mm (1/8") thick coat of water proofing compound shall be applied & wrapped with fibre glass RP tissue. A final coat of 3mm thick water proofing compound shall then be applied over the fiberglass RP tissue & 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 & sealed with bitumen & over this 24 SWG. 25mm hexagonal GI mesh shall be fixed with 22 swig. GI lacing wire & finally bitumen paint shall be applied over wire netting.

Signature
S.D. KUMAR
S.D. KUMAR
MUKESH K. SINGH



TECHNICAL SPECIFICATION
THERMAL INSULATION FOR COLD SURFACES

SPECIFICATION NO.PES-553-08

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 5 OF 6

6. INSULATION OF PUMPS & VALVES

6.1 For all inspection covers & hatches on equipment, pump casing & 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 & replacement. Proper care shall be taken to maintain continuity of vapor seal between the static & removable partitions of the insulation.

6.2 The tenderer may offer thickness of insulation & finishes other than that specified in DATA SHEET A. However, calculations/reasons in support of alternative proposal shall be furnished for purchaser's approval.

7. INSPECTION & TESTING (REFER SPEC. NO - PES-553.00)

7.1 All necessary tests, as required to ensure that the material supplied conform to the requirements of applicable codes & standards, shall be carried out at manufacturer's works & test certificates including these for material/accessories shall be furnished for purchasers approval.

8. PAINTING

8.1 Pipe work having insulation & cladding shall be provided with color identification for the fluids handled and for indicating direction of flow.

8.2 Equipment surfaces having insulation and cladding shall also have identification numbers and any other relevant data provided on the insulated surface.

8.3 All painting for insulated surfaces shall conform to the requirement specified elsewhere.

Signature
Sd/-
MUKESH K. SINGH



TECHNICAL SPECIFICATION
THERMAL INSULATION FOR COLD SURFACES

SPECIFICATION NO.PES-553-08

VOLUME II B

SECTION D

REV. 02

DATE: 17.09.2012

SHEET 6 OF 6

9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

- 9.1 Final version of data sheet 'B' incorporating changes if any along with design data.
- 9.2 Test certificates/reports giving result of insulation to ensure conformance to applicable codes & standards & in particular the following:-
- a) Thermal conductivity test.
 - b) Sound absorption coefficient test.
 - c) Corrosion test.
 - d) Sulphur content, moisture content, shot content, moisture absorption etc.
 - e) Compressive strength & cross breaking strength test.
- 9.3 Sketches/technical literature/sectional drgs. indicating insulation materials finish and method of application etc.
- 9.4 Manual dealing with safety aspects & instructions for combating fire arising out of insulation work.
- 9.5 Instructions on maintenance of insulation work.

Signature
Sd/- M. M. A.
Signature
Sd/- K. M. A.
Signature
Sd/- K. M. A.
Signature
Sd/- K. M. A.



THERMAL INSULATION
FOR COLD SURFACE
DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

DATE 17.09.2012

SHEET 1 OF 1

Insulation Material

Insulation	Code	Thermal Conductivity MW/cm ⁰ C	Density Kg/m ³
Resin bonded mineral wool / glass wool	IS:8183	0.49 at 50 °C	At least 24 for duct insulation and 48 for acoustic lining.
Mineral Wool Pipe Section (min. Gr.2)	IS:9842	0.43 at 50 °C	At least 81
Expanded Polystyrene	IS:4671	0.37 at 10 °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 roll Mineral Wool (IS:8183)		25
ii)	Refrigerant Piping	a) Expanded Polystyrene or b) Mineral Wool	Pipe Section Pipe Section	75 75
iii)	AHU drain pipe	a) Expanded Polystyrene or b) Mineral Wool	Pipe Section Pipe Section	25 25
iv)	AHU drain pan coil section and fan section	a) Expanded Polystyrene or b) Mineral Wool	Slabs Slabs	25 25
v)	Chilled water piping, valves & specialties	a) Expanded Polystyrene or b) Mineral Wool	Pipe Section Pipe Section	75 75
vi)	Chiller	a) Expanded Polystyrene or b) Mineral Wool	Slabs Slabs	100 100
vii)	Chilled Water Pumps	a) Expanded Polystyrene or b) Mineral Wool	Slabs Slabs	50 50
viii)	Expansion tank with pipe	a) Expanded Polystyrene or b) Mineral Wool	Slabs/Pipe Section Slabs/Pipe Section	50 50



1X800 MW WANAKBORI STPP

AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS

SPECIFICATION NO. PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 1 OF 5

ANNEXURE-I

LIST OF MAKES OF SUB-VENDOR ITEMS

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



1X800 MW WANAKBORI STPP

AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS

SPECIFICATION NO. PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 2 OF 5

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
1	SCREW CHILLER	YORK / TRANE / CARRIER / KIRLOSKAR / DUNHAM BUSH / MCQUAY (DAIKIN) / BLUE STAR / VOLTAS
2	VAPOUR ABSORPTION MACHINE	VOLTAS / THERMAX
3	PRECISION PACKAGE UNITS	STULZ / UNIFLAIR / EMERSON / BLUEBOX / CLIMADENTA
4	PACKAGE UNIT	VOLTAS / BLUE STAR / CARRIER
5	SPLIT AIR CONDITIONER	VOLTAS / BLUE STAR / CARRIER / HITACHI / LG
6	AIR HANDLING UNITS	VOLTAS / BLUE STAR / ZECO / CARRIAIRE (FLAKT) / EDGETECH / ETHOS / SYSTEM AIR / WAVES AIRCON
7	AHU FAN (CENTRIFUGAL FAN)	CB.DOCTOR / FLAKT / KRUGER / NICOTRA / COMEFRI / MARATHON / PATEL AIR
8	CHILLED & CONDENSER 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
9	COOLING TOWER (FRP)	PAHARPUR / MIHIR / PCT / FLOWTECH / BELL
10	INDUCTION MOTORS (LT)	SIEMENS / ABB / CGL / MARATHON / KEC / BHARAT BIJLEE / NGEF / JYOTI / LHP / BHARAT ELECTRIC
11	AIR FILTER	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER / SPECTRUM / AIR TECH / PUROMATIC
12	AXIAL FANS / F.A. FANS	FLAKT / KHAITAN / PATEL / NICOTRA / SARLA / KRUGER / MARATHON / C DOCTOR
13	INSULATION MATERIAL (Fibreglass / EPS/ PUF / Nitrile /EPDM)	BEARDSHELL / K-FLEX / PARAMONT / ARMAFLEX / SUPREME / LLOYDS / UP TWIGA
14	BALANCING VALVE	ADVANCE
15	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
16	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
17	GATE / GLOBE VALVES (CI)	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / LEADER / H.SARKAR /



1X800 MW WANAKBORI STPP

AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS

SPECIFICATION NO. PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 3 OF 5

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
		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
18	GUN METAL VALVES	LEADER / A V VALVES / ATAM VALVES / VALTECH INDUSTRY / SANT VALVES
19	FLOAT VALVE	H.SARKAR / LEADER / GM DAULI & SONS
20	3 WAY MIXING VALVE WITH ACTUATING MOTOR	SIEMENS BUILDING TECHNOLOGY / JOHNSON / BELIMO / HONEYWELL / RAPID CONTROL / ALC
21	MOTORIZED BUTTERFLY VALVE	ANERGY / ADVANCE / BELIMO / JOHNSON / HONEYWELL / SIEMENS/ LEADER / H.SARKAR / FLUID LINE / A V VALVES / BANKIM & COMPANY / SURYA VALVES AND INSTRUMENT MANUFACTURING / ATAM VALVES / GM DAULI & SONS / KBL / VENUS PUMPS AND ENGINEERING WORKS
22	ACTUATOR FOR MOTORIZED BUTTERFLY VALVE	SIEMENS BUILDING TECHNOLOGY / JOHNSON / BELIMO / HONEYWELL / RAPID CONTROL / ALC / AUMA / LIMITORQUE
23	Y / POT STRAINER	MULTITEX / GREAVES COTTON / JAYPEE / SANT / OTOKLIN / GRAND PRIX / GUJARAT OTOLIFT / DS ENGG / SAROJINI ENTERPRISE / BHATIA ENGINEERING / FILTRATION ENGINEERS INDIA PVT LTD / SUNGOV ENGINEERING/ OTOKLIN GLOBAL BUSINESS LTD
24	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
25	PIPING - CS SEAMLESS (ASTM A 106)	ISMT / MAHARASHTRA SEAMLESS
26	SS PIPES (FOR SMALL QUANTITY 500M)	REMI / RATNAMANI / APEX TUBES / CHOKSI
27	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
28	FIRE DAMPER	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)
29	GRILL/DIFFUSER/VOLUME CONTROL DAMPER	AIR FLOW/ TSC /AIR MASTER/ CARYAIRE/RAVI STAR (SYSTEM AIR)
30	STRIP HEATER	ESCORTS / RACOLD / DASPASS/ ALCO/ HEATCO / HOTSET
31	PAN HUMIDIFIER	RAPID COOL/ HOTSET /ALCO
32	RELIEF / PURGE VALVE	BRASSOMATIC
33	THERMOSTATS	HONEYWELL / RANCO / PENN / DANFOSS / INDFOSS / JHONSON CONTROL /RANUTROL
34	HUMID STAT	JHONSON CONTROL / HONEYWELL / PENN
35	ANTI FREEZE THERMOSTAT	RANCO / HONEYWELL / PENN / DANFOSS / INDFOSS



1X800 MW WANAKBORI STPP

AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS

SPECIFICATION NO. PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 4 OF 5

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
36	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
37	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.
38	LEVEL GAUGE	GENERAL INSTRUMENTS / CHEMTROLS / SBEM, PUNE/ AUTOMAT MUMBAI /SIGMA / TOSHNIWAL / TECHNOMATIC / TELACO /LEVCON / D K INSTRUMENTS / PUNE TECHTROL / FLOW STAR
39	PRESSURE SWITCH / DP SWITCHES	BELLS / DANFOSS / DK INSTRUMENTS/ DRESSER / SOR INC / VASU / SWITZER / INDFOSS / TRAFAG / GIC / ASHCROFT / DELTA CONTROL
40	TEMPERATURE SWITCH	INDFOSS/ SEIMENS / DANFOSS/ DK INSTRUMENTS/ SOR INC / VASU / DRESSER / TOSHNIWAL / SWITZER
41	FLOW SWITCH	SWITZER / LEVCON / DK INSTRUMENT / SBEM / V. AUTOMATE/ SIEMENS
42	LEVEL SWITCH	SBEM / BLISS ANAND / HI TECH / RAMAN INST / SIGMA / SOR INC / WAREE INST / LEVCON / DK INSTURMENT / V ATUOMATE /CHEMTROLS / SIMENS / FLOW STAR / TRAC
43	LEVEL INDICATOR	SBEM / SIGMA / LEVCON / DK INSTURMENT / V ATUOMATE / FLOW STAR / SCIENTIFIC DEVICES / GAUGES BOURDON / PNE TECHTROL
44	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 / Endress + Hauser (India) Pvt. Ltd. / Moore Industries International Inc. / NIVO CONTROLS PVT. LTD. / Pune Techtrol Pvt. Ltd./ SIEMENS LIMITED / TOSHNIWAL /
45	SIGHT FLOW INDICATORS	SIGMA / LEVCON /V AUTOMAT / TELLACE /EUREKA / TATA HONEYWELL/BLISS
46	FLOW ELEMENT	BRISTOL BABCOCK / BALIGA /LIGHTING EQUIP /ENGINEERING SPECIALITIES /IL / MINCO/ MICRO PRECISION / STAR MECH
47	TEMPERATURE ELEMENT	GENERAL INST CONSORTIUM/ PYRO ELECTRIC /WAAREE INSTRUMENTS/ DETRIVE INST & ELECTRONICS / TOSHNIWAL
48	FLOW METER	EUREKA / INSTRUMENTATION ENGINEERS PVT LTD / PLACKA /TRAC / FLOW STAR/ SCIENTIFIC DEVICE
49	RH SENSOR/TEMP SENSOR	HONEY WELL /JOHNSON /SIEMENS / GENERAL INSTRUMENTS
50	PLC BASED PANEL	SIEMENS / SCHENIEDER / ROCKWELL / GE INTELLIGENT / HONEYWELL AUTOMATION / ABB
51	OWS / PC	HP / COMPAQ / DELL / HCL / IBM / LENOVO



1X800 MW WANAKBORI STPP

AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS

SPECIFICATION NO. PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 5 OF 5

SI. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
52	PRINTER	HP / CANON / EPSON / XEROX / IBM / LEXMARK
53	UPS	HITACHI-HIREL / APC / DELTA / EMERSON / DB POWER / APLAB
54	FIBRE OPTIC CABLE	BIRLA ERICSON / FINOLEX / AKSH FIBRE
55	ANNUNCIATOR FOR PANEL	ICC / PECON/ PROCON
56	LT ADAPTER BOX FOR AL TO CU CABLE CONVERTOR	CONTROL DEVICE / SYSTEM POWER CONTROL / JACKSON / UNILEC / ELECTRIC ALLIED PRODUCT
57	METERING PUMP	SHAPO TOOLS / VK PUMPS
58	WATER SOFTENING PLANT	THERMAX / ION EXCHANGE / DOSI ION
59	PRESSURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL / FUJI
60	TEMPERATURE TRANSMITTER	ABB / ENDRESS + HAUSER (INDIA) / MOORE / SIEMENS / SMART INSTRUMENT BRAZIL / SBEM / TOSHNIWAL / V. AUTOMAT / EMERSON / YOKOGAWA / HONEYWELL
61	ROTAMETER	CHEMTROLS SAMIL / EUREKA IND / TRANSDUCERS AND CONTROL / Flow Star Engineering Pvt. Ltd. / FLOWTECH INSTRUMENTS SERVICRS / INSTRUMENTATION ENGINEERS PVT LTD / SCIENTIFIC DEVICES (BOMBAY) PVT LTD,
62	BATTERY CHARGER	AMARARAJA/ CHHABI ELECTRICAL / DUBAS ENGG. / HBL POWER SYSTEM / STATCON / CALDYNE
63	BATTERY (NI -Cd)	HBL POWER / AMCO SAFT / SAFT
64	BATTERY (Maintenance free for PLC)	EXIDE / HBL POWER / AMARAJA /
65	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS / FLEXPRO ELECTRICALS PVT. LTD. / K.S.INSTRUMENTS PVT.LTD./ SUCHITRA INDUSTRIES / Shrenik & Company,
66	STEAM TRAP	LEADER VALVES LTD./ PENNANT ENGINEERING PVT. LTD. / FORBES MARSHALL STEAM SYSTEM PVT. LTD.
67	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

- ABOVE SUB-VENDORS ARE SUBJECTED TO CUSTOMER APPROVAL DURING DETAILED ENGINEERING WITHOUT ANY COST AND TIME IMPLICATION.



**1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
MANDATORY SPARE LIST**

SPECIFICATION NO. PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 1 OF 6

ANNEXURE-II

MANDATORY SPARE LIST

Signature
S.A. KHAN
MUKESH K.S. SINGH



**1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
MANDATORY SPARE LIST**

SPECIFICATION NO. PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 2 OF 6

S.No.	Equipment / Package name	Qty.	Remarks(BHEL)
	AIR CONDITIONING SYSTEM		
1.	Vapour Absorption Machine		
1.1	Bearing for absorbent and refrigerant pump	1 Set for each category	
1.2	Gaskets as applicable for Condenser & Chiller Heads	1 Set for each category	
1.3	Steam Regulating Valve	1 Set	
2.	Centrifugal fans		
2.1	Bearings for fan & motor	2 Sets for each category	
2.2	V-belts	1 Set for each category	
2.3	Vibration Isolators	1Set	
3.	Screw Chiller		
3.1	Bearing for the compressor	1Set	
3.2	Gaskets as applicable for Condenser & Chiller Heads	1Set for each category	
4.	Air Handling Units		
4.1	Bearings for each AHU blower & motor	1Set for each category	
4.2	V-Belts	2 Sets for each category	
4.3	Filters of each type	2 Sets for each category	
5.	Refrigerant & Oil		
5.1	Refrigerant gas in a non-returnable cylinder	15% of installed charge	
5.2	Empty cylinders of 68Kg 2.5.2 capacity to hold the charge of the highest capacity system	As required to suit the above	
5.3	Filter oil in sealed tins for the full set for 6 operations of cleaning	As required	
6.	Centrifugal pump		
6.1	Bearings for each pump and motor	2 Sets for each category	
6.2	Mechanical seal, wearing rings and lantern rings	1Set for each category	
7.	Cooling Tower		
7.1	Spray nozzles	10% of one Tower	
7.2	Set of fills	10% of one Tower	



1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
MANDATORY SPARE LIST

SPECIFICATION NO. PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 3 OF 6

7.3	Bearings for each fan and motor	2 sets	
8.	Precision Air Conditioners		
8.1	Vibration Isolators	1Set for each category	
8.2	Filters	1 set for each PAC unit	
8.3	Bearings	1 set for each rating of PAC unit (both for condenser & Indoor Unit)	
8.4	Condenser fan Impeller	1 set for each PAC unit	
8.5	Expansion valve	1 set for each rating of PAC unit	
8.6	Any other spare parts recommended by the Manufacturer	1 set for each rating of PAC unit	
9.	Split Air Conditioners		
9.1	Fan-motor bearing for outdoor unit	1 set for each rating of SAC unit	
9.2	Vibration Isolators	1 set each for outdoor unit & Indoor unit for each SAC unit	
9.3	Filter	1 set for each SAC unit	
9.4	Expansion valve	1 set for each rating of SAC unit	
9.5	Any other spare parts recommended by the Manufacturer	As recommended by the Manufacturer	
10.	Electrical spares		
10.1	Air Break Switches	1 No. of each rating	
10.2	Control ,Isolating and selector switches	5% of each type and rating	
10.3	Fuses	6Nos,of each type and rating or 10% whichever is higher	
10.4	Fuse Bases	3Nos,of each type and rating or 5% whichever is higher	
10.5	Indicating Lamps	10% of installed quantity	
10.6	Indicating lamps cover of different colour and holders	5% of installed quantity	
10.7	Push Buttons of various colours	10 nos. of each type and colour	
10.8	Terminal Blocks	5% of installed quantity	
10.9	415 Volt Motor (above 30 KW Rating upto 160 KW)		
10.9.1	End Shield Cover Driving & Non-Driving End	1Set for each type and rating of Motor	
10.9.2	Driving End & Non-Driving End Bearing	1Set for each type and rating of Motor	
10.9.3	Cooling Fan	1No. for each type and rating of Motor	
10.9.4	Motor Space Heater	1No. for each type and	



1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
MANDATORY SPARE LIST

SPECIFICATION NO. PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 4 OF 6

		rating of Motor	
10.9.5	Motor Terminal Block	1No. for each type and rating of Motor	
10.9.6	Complete Set of Coupling	1Set for each Application	
10.20	415 Volt Motor (Upto 30KW Rating)		
10.20.1	Driving End & Non-Driving End Bearing	3Set for each type and rating of Motor	
10.20.2	Cooling Fan	2No. for each type and rating of Motor	
10.20.3	Motor Terminal Block	5No. for each type and rating of Motor	
10.20.4	Complete Set of Coupling	1Set for each Application	
11.	PLC System		
11.1	I/O cards	1 No. or 20% of equipped cards whichever is maximum	
11.2	Process cards	1 No.	
11.3	Power Supply module	1 No.	
11.4	Communication Process cards	1 No.	
11.5	Hand-held Programmer	1 No.	
11.6	Keyboard and cursor control devices.	2 (two) numbers for each type	
11.7	LCD TFT (24") Monitors.	2 (two) numbers	
11.8	Interface cables with connecting plugs for each type of peripherals & I / O hardware.	10 (ten) sets	
11.9	Power supply modules.	10 (ten) percent of the total qty. offered for each type or 4 (four) numbers, whichever is higher	
11.10	electronic modules (I / O)	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.	
11.11	Bus couplers and communication interface cards	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.	
11.12	Controllers for control system of PLC	10%of each type(at least 1 no. of each type) whichever is higher	
12.	CONTROL VALVES		



**1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
MANDATORY SPARE LIST**

SPECIFICATION NO. PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 5 OF 6

12.1	Control valve stem packing for each of the control valves, as offered.	2 (two) sets	
12.2	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	
13.	ACTUATORS FOR CONTROL VALVES		
13.1	Actuators with drive of each type and rating.	1 (one) set	
13.2	Valve positioners of each type.	10 (ten) percent	
13.3	Position transmitters of each type.	10 (ten) percent	
13.4	Limit switches/torque switches of each type.	10 (ten) percent	
14.	Field instruments (transmitters, temperature elements (TC/ RTD)/ gauges/ 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.	
15.	Control panel/ Desk Mounted Items		
15.1	Push Button		
15.1.1	Complete assembly	5 nos. of each colour	
15.1.2	Contact Element (1 NO + 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	
15.4	Indicating Lamps complete assembly	10Nos. for each Colour and type	



**1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
MANDATORY SPARE LIST**

SPECIFICATION NO. PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 6 OF 6

15.5	Mimic Lamps	10Nos. for each Colour and type	
15.6	MCB	2Nos. for each type and rating	
15.7	Door Limit Switch	2Nos.	
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 (for non-PLC driven system)	1(one) no.	
16.	Actuator (Motorised Valve)		
16.1	Complete set of Actuator	1No. for each type and rating	
16.2	Limit Switch	2 Nos each type and rating	
16.3	Torque Switch	2 Nos each type and rating	
16.4	Auxiliary Contact	1 no each type and rating	
16.5	Motor	1 no each type and rating	
16.6	Complete Seal kit	1Set for each type and rating	
16.7	Complete O-Ring Set	1Set	

Signature
S.A. KHAN
MUKESH K.S. SINGH



**1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
PAINTING & COLOUR SCHEME**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 1 OF 10

ANNEXURE-III

PAINTING & COLOUR SCHEME

Signature
S.A. KHAN
MUKESH K.S. SINGH



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

1.0 **GENERAL PAINTING REQUIREMENTS**

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.

1.2 The following latest Indian Standards may be referred to for carrying out the painting job:

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

1

1.3 **Preparation of Surfaces**

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.



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

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.

1.4 Primer Paint

After the surface is prepared one coat of Zinc Phosphate primer conforming to IS 2074 shall be applied.

1.5 Tie Paint

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 & II enclosed. Insulated surfaces will have only primer coating and no finish painting.

1.6 Finish Paint

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.

Note For structural painting, customer's specification V II/G2/8 Cl 3.03.11 shall be followed however DFT and coating system shall be followed in line with paint manufacturer's recommendation.

1.7 Painting and Corrosion Protection for Pipes & Fittings

1.7.1 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.

1.7.2 Before application of paint, Contractor shall clean the pipes of all mill scale, dirt dust, soot grease, rust etc.

1.7.3 All pipe lines, piping components shall be adequately protected against corrosion during manufacture, fabrication, shipment and storage by appropriate protective paint.

1



TITLE

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

PAINTING SCHEDULE**1x800 MW WANAKBORI TPS**

REV.NO. 02 DATE 15/09/2015

SHEET 3 OF 3

- 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.

1.8 **Painting and Corrosion Protection for Valves & Specialties**



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 valves shall be covered immediately after testing, draining and drying with suitable plastic end covers to avoid ingress of foreign materials.

1.9 **Suggested Colour Codes for Painting**

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.

2.0 **Approved Paint Makes**

i) Asian Paints (I) Ltd.	vii) Addison Paints Ltd
ii) Berger Paints India Ltd	viii) Grand Polycoat
iii) Goodlass Nerolac	ix) Bombay Paints
iv) Jenson & Nicholson (I) Ltd	x) Hemple Paints (Singapore)
v) CDC carboline (I) Ltd.	xi) Jotun Paints
vi) Shalimar Paints Ltd.	xii) Akzonobel coatings

2.1 **PAINTING SCHEDULES**

- 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.



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/v alve, 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										1

MUKESH K. SINGH

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TITLE

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

PAINTING SCHEDULE
1x800 MW WANAKBORI TPS

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**

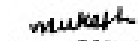
DOCUMENT NO. PE-DC-408-100-A999

REV.NO. 02 DATE 15/09/2015

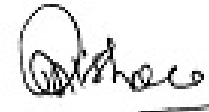
SHEET 1 OF 1

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

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


MUKESH K.R. SINGH


S.A. KHAN


S.A. KHAN


MUKESH K.R. SINGH


S.A. KHAN


S.A. KHAN

MUKESH K. SINGH S.A. KHAN 20.11.2018
Mukesh B. Khan 20.11.2018



TITLE

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

PAINTING SCHEDULE**1x800 MW WANAKBORI TPS**

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.



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

SPECIFICATION No: PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 1 OF 2

ANNEXURE-IV

LIST OF TOOLS & TACKLES

Signature
S.A. ICHMAN
MUKESH K.R. SINGH



1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
LIST OF TOOLS & TACKLES

SPECIFICATION No: PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 2 OF 2

FLAT D WRENCH - 6 MM TO 32 MM (12 Pcs)	SET	1
BOX WRENCHES - 6 MM TO 22 MM (14 Pcs)	SET	1
RING SPANNER - 6 MM TO 32 MM (12 Pcs)	SET	1
ALLEN KEYS - 2 MM TO 10 MM	SET	1
CRESCENT SCREW SPANNER	NO.	1
SCREW DRIVER	NO.	1
OFFSET SCREW DRIVER	NO.	1
INSULATED PLIER	NO.	1
TORCH LIGHT FOR 2 CELL	NO.	1
HAMMER 1 LB	NO.	1
OIL CAN	NO.	1
POCKET THERMOMETER - 0 TO 50 DEG. C)	NO.	1
INSULATION TAPE ROLL	NO.	1
STEEL FOOT RULE - 12"	NO.	1
FEELER GAUGE 9 BLADES	NO.	1
PIPE WRENCH	NO.	1
FLARE NUT (1/4")	NOS.	6
FLARING TOOL	NO.	1
TUBE CUTTER	NO.	1
GAS CHARGING PIPE	NO.	1
NITROGEN CHARGING ADAPTER	NO.	1
FREON PRESSURE GAUGE (2 1/2" DIA DIAL)) 0 - 300 MM PSI	NO.	1
FREON PRESSURE GAUGE (2 1/2" DIA DIAL)) 30 - 150 MM PSI	NO.	1
PSYCHRO METER	NO.	1
LOCK WITH KEY FOR TOOL BOX	NO.	1
RATCHET 1/4"	NO.	1
MS TOOL BOX	NO.	1

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



**1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
CLARIFIED WATER ANALYSIS**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 1 OF 1

ANNEXURE-V

CLARIFIED WATER ANALYSIS

PLEASE REFER PROJECT INFORMATION, SECTION-B

Signature
S.A. ICHMAN
MUKESH K.R. SINGH



**1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
DRAWINGS / DOCUMENTS SUBMISSION
PROCEDURE**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

DATE: August 2015

SHEET 1 OF 1

ANNEXURE-VI

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

Signature
S.A. ICHMAN
MUKESH K.R. SINGH



**1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
INSPECTION AND TESTING**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 1 OF 1

ANNEXURE-VII

INSPECTION AND TESTING

PLEASE REFER SECTION C2-B UNDER GTR

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S.D. MANI

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MUKESH K.R. SINGH



1X800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
MASTER DRAWING LIST WITH SCHEDULE
OF SUBMISSION

SPECIFICATION No: PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 1 OF 4

ANNEXURE-VIII

MASTER DRAWING LIST WITH SCHEDULE OF
SUBMISSION

Signature
S.A. ICHMAN
MUKESH K.R. SINGH



**1X800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
MASTER DRAWING LIST WITH SCHEDULE
OF SUBMISSION**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 2 OF 4

S. NO.	DRAWING NO	DRG. / DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
1*	PE-V0-408-553-A001	INSPECTION CATEGORISATION PLAN	4
2*	PE-V0-408-553-A002	QAP OF SCREW CHILLER PACKAGE/VAM	14
3*	PE-V0-408-553-A003	QAP OF AIR HANDLING UNIT	14
4*	PE-V0-408-553-A004	QAP OF PUMPS	15
5*	PE-V0-408-553-A005	QAP OF COOLING TOWER	15
6*	PE-V0-408-553-A006	QAP OF MOTORS	15
7*	PE-V0-408-553-A007	QAP OF PLC/DDC/RELAY BASED PANEL	20
8*	PE-V0-408-553-A101	HEAT LOAD CALCULATION FOR MAIN PLANT, ESP / VFD CONTROL ROOMS AND SERVICE BUILDING ETC	4
9*	PE-V0-408-553-A102	OPERATION & CONTROL PHILOSOPHY FOR AIR CONDITIONING SYSTEM	12
10*	PE-V0-408-553-A103	PRESSURE DROP CALCULATIONS FOR CHILLED AND CONDENSER WATER PIPING	10
11*	PE-V0-408-553-A201	TDS AND GA OF VAPOUR ABSORPTION CHILLER / SCREW CHILLER ALONG WITH FOUNDATION DETAILS	16
12*	PE-V0-408-553-A202	TDS AND GA OF COOLING TOWER ALONG WITH FOUNDATION DETAILS	15
13*	PE-V0-408-553-A203	TDS AND GA OF AIR HANDLING UNITS ALONG WITH FOUNDATION DETAILS	14
14*	PE-V0-408-553-A204	TDS AND GA OF CONDENSER AND CHILLED WATER PUMPS ALONG WITH FOUNDATION DETAILS	15
15*	PE-V0-408-553-A205	TDS AND GA OF PAC / SPLIT AIR CONDITIONER	12
16*	PE-V0-408-553-A206	TDS AND GA OF MOTOR (PUMP, COOLING TOWER, AHU)	15
17*	PE-V0-408-553-A207	TDS OF INSULATION MATERIAL (DUCT INSULATION, DUCT LINING, PIPE INSULATION)	12
18*	PE-V0-408-553-A208	TDS AND GA OF FRESH AIR FANS	12
19*	PE-V0-408-553-A209	TDS AND GA OF DESUPERHEATING STATION	14
20*	PE-V0-408-553-A210	TDS AND GA OF WATER SOFTENING PLANT	16
21*	PE-V0-408-553-A211	TDS AND GA OF AIR COOLED PRECISION AC UNITS ALONG WITH FOUNDATION DETAILS	12
22*	PE-V0-408-553-A212	TDS AND GA OF HEATERS AND HUMIDIFIER	7
23*	PE-V0-408-553-A213	TDS AND GA OF FIRE DAMPER WITH ACTUATOR	10
24*	PE-V0-408-553-A214	TDS AND GA OF FOR 3-WAY MIXING VALVE	8
25*	PE-V0-408-553-A215	TDS AND GA OF VALVEES (BALANCING VALVE, GATE VALVE, CHECK VALVE , Y ATRAINER)	9
26*	PE-V0-408-553-A216	TDS AND GA OF SUPPLY / RETURN AIR DIFFUSER/GRILL	8
27*	PE-V0-408-553-A217	TDS OF GI SHEET	5
28*	PE-V0-408-553-A218	TDS OF PIPES	5
29*	PE-V0-408-553-A219	TDS AND GA OF EXPANSION TANK, MAKEUP WATER AND SOFT WATER TANK	5



**1X800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
MASTER DRAWING LIST WITH SCHEDULE
OF SUBMISSION**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 3 OF 4

S. NO.	DRAWING NO	DRG./ DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
30*	PE-V0-408-553-A220	TDS AND GA OF FILTERS	10
31*	PE-V0-408-553-A221	TDS FOR INSTRUMENTS (PRESSURE GAUGE, TEMPERATURE GAUGE, LEVEL GAUGE, PRESSURE SWITCH, TEMPERATURE SWITCH, LEVEL SWITCH, DP SWITCH, TEMPERATURE AND HUMIDITY SENSORS ETC)	12
32*	PE-V0-408-553-A501	PID FOR MAIN PLANT, SERVICE BUILDING ESP ETC	8
33*	PE-V0-408-553-A502	TYPICAL Details DUCT FABRICATION DRAWING / SUPPORT / ERECTION. INSULATION OF DUCTING / PIPING & EQUIPMENTS CHILLED AND CONDENSER WATER PIPE ERECTION	7
34*	PE-V0-408-553-A503	AC DUCT LAYOUT DRAWING FOR CONTROL ROOM ARES AT 17M ALONG WITH AHU ROOM LAYOUT WITH FOUNDATION DETAILS	16
35*	PE-V0-408-553-A504	AC DUCT & AHU ROOM LAYOUT WITH FOUNDATION DETAIL FOR UPS BATTERY CHARGER ROOM AT 8.5M AND SWAS ROOM AT 0 M	17
36*	PE-V0-408-553-A505	AC DUCT LAYOUT DRAWING FOR ESP CONTROL ROOM ARES ALONGWITH PU ROOM LAYOUT WITH FOUNDATION DETAILS FOR INDOOR AND OUTDOOR UNITS	18
37*	PE-V0-408-553-A506	AC DUCT LAYOUT DRAWING FOR SERVICE BUILDING WITH AHU ROOM LAYOUT AND FOUNDATION DETAILS	18
38*	PE-V0-408-553-A507	AC PLANT ROOM LAYOUT & COOLING TOWER AREA LAYOUT WITH COMPLETE FOUNDATION DETAIL OF ALL EQUIPMENT	15
39*	PE-V0-408-553-A508	CHILLED & CONDENSER WATER PIPING LAYOUT WITHIN PLANT ROON & UPTO VARIOUS AHU ROOMS, & COOLING TOWER AREA.	20
40*	PE-V0-408-553-A509	SPLIT AC SCHEDULE ALONGWITH HEAT LOAD CALCULATION FOR AUXILIARY BUILDING	22
41*	PE-V0-408-553-A701	TDS OF PLC WITH CONFIGURATION DIAGRAM, BILL OF MATERIAL, GA & INTERNAL WIRING DIAGRAM, LOGIC FLOW DIAGRAM, IO WIRING DIAGRAM , PLC ROOM LAYOUT	20
42*	PE-V0-408-553-A702	I/O LIST FOR AC SYSTEM	20
43*	PE-V0-408-553-A751	ELECTRICAL FEEDER LIST	18
44*	PE-V0-408-553-A752	CABLE SCHEDULE	22
45*	PE-V0-408-553-A901	PG TEST PROCEDURE	12



**1X800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
MASTER DRAWING LIST WITH SCHEDULE
OF SUBMISSION**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 4 OF 4

S. NO.	DRAWING NO	DRG. / DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
46*	PE-V0-408-553-A902	O&M MANUAL	25

Note:

1. The above is not the complete list 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 documents shall be resubmitted by vendor 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.

(Signature)
S.A. ICHAN
S.A. ICHAN
MUKESH K.R. SINGH



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

SPECIFICATION No: PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 1 OF 4

ANNEXURE-IX

**FORMAT FOR OPERATION AND MAINTENANCE
MANUAL**

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

SPECIFICATION No: PE-TS-408-553-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	
1.	COVER PAGE				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	INDEX				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	DESCRIPTION OF PLANT/SYSTEM				
3.1	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				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				



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

SPECIFICATION No: PE-TS-408-553-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	COMMISSIONING ACTIVITIES (IF NOT COVERED IN SEPARATE DOCUMENT I.E. ERECTION MANUAL, COMMISSIONING MANUAL)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	OPERATION GUIDELINES FOR PLANT PERSONAL/USER/OPERATOR				
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	MAINTENANCE GUIDELINES FOR PLANT				



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

SPECIFICATION No: PE-TS-408-553-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	
	PERSONAL				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	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.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	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.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	Statutory and other specific requirements considerations.				
8.0	List of reference documents				
9.0	Binding as per requirement				

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MUKESH K.R. SINGH



**1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
SITE STORAGE AND PRESERVATION**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

SHEET 1 OF 16

ANNEXURE-X

SITE STORAGE AND PRESERVATION

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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

महेश क. सिंह
MUKESH K.SINGH
Sd/-
Sd/-
Sd/-

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

Signature
S. D. MANI

Signature
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Signature
MUKESH K. SINGH

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.

Signature
S.D. KUMAR
Signature
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MUKESH K.S. SINGH

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
- Rust preventive fluid (RPF)
 - Rust protective paints
 - Tarpaulin covers, in case of outdoor storage
 - De-oxy aluminate for weld-ments

c) **GENERAL INSPECTION REQUIREMENTS**

- 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.
- 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.



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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.



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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	
Mechanical components like valves, fittings, cables glands, spares etc.)				
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
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
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	
Miscellaneous items like chain pulley blocks, hoists etc.				
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	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

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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	

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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
Electrical and C & I items (motors, cables etc.)				
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	
Special items		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.

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S.D. - ICNAN
S.D. - ICNAN

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S.D. MANJ

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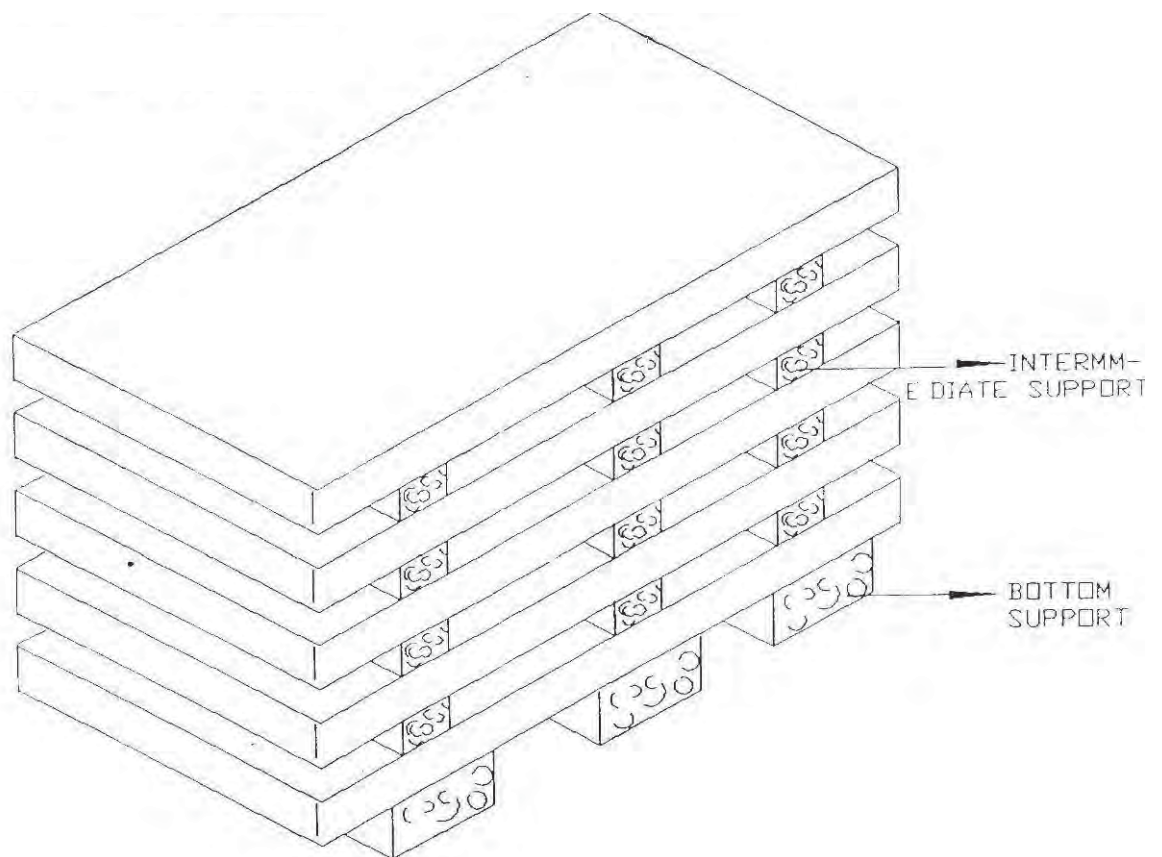


Figure – 1 – PLATE STACKING ARRANGEMENT

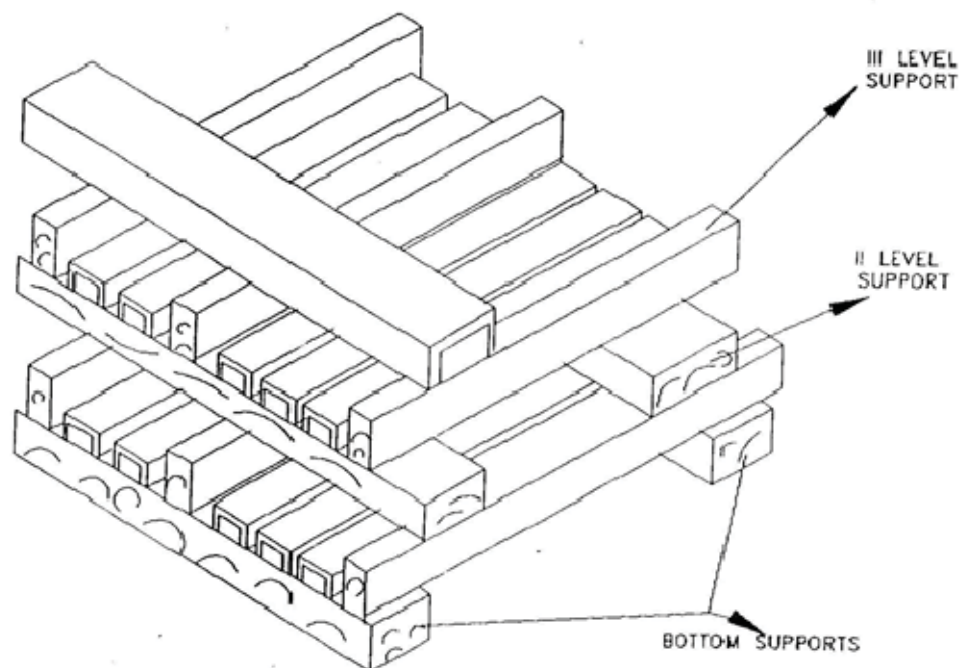


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



**1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
PACKING PROCEDURE**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME : II B

SECTION : E

REV 00

DATE: August 2015

SHEET 1 OF 1

ANNEXURE-XI

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

Signature
S.A. ICHMAN
MUKESH K.R. SINGH



**1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME: III

REV. 00

VOLUME III

MUKESH K. SINGH
S.A. ICHMAN
2011-01-12



1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
LIST OF DOCUMENTS TO BE SUBMITTED WITH
BID

SPECIFICATION No: PE-TS-408-553-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

(Signature)
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MUKESH K.R. SINGH



**1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
COMPLIANCE CUM CONFIRMATION
CERTIFICATE**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME: III

SECTION: 2

REV. NO. 00

SHEET: 1 OF 2

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing / stamping this compliance certificate (every sheet) and furnish same with the offer.

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.
- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.
- h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site

(Signature)
S.A. KHAM
MUKESH K.S. SINGH



**1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
COMPLIANCE CUM CONFIRMATION
CERTIFICATE**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME: III

SECTION: 2

REV. NO. 00

SHEET: 2 OF 2

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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MUKESH K. SINGH
S.A. KHAM
S.A. KHAM
S.A. KHAM



**1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
PRE-BID CLARIFICATION SCHEDULE**

SPECIFICATION No: PE-TS-408-553-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

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: _____

Company Seal

(Signature)
S.A. ICHAN
MUKESH K. SINGH



1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
NO DEVIATION CERTIFICATE

SPECIFICATION No: PE-TS-408-553-A001

VOLUME : III

SECTION : 4

REV: 00

SHEET 1 OF 2

NO DEVIATION CERTIFICATE

Signature
S.A. KHAN
MUKESH K. SINGH



**1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
NO DEVIATION CERTIFICATE**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME : III

SECTION : 4

REV: 00

SHEET 2 OF 2

SL NO	VOULME / SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION / TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF DEVIATION	PORTION OF PRICE SCHEDULE ON WHICH COST OF DEVIATION IS APPLICABLE	NATURE OF COST OF DEVIATION (POSITIVE/ NEGATIVE)	WHETHER COST OF DEVIATION INCLUDED/ EXCLUDED IN PRICE BID	REMARKS
TECHNICAL DEVIATIONS										
PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE										
NAME				DESIGNATIONS		SIGN & DATE			COMPANY SEAL	
NOTES:										
1. Cost of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.										
2. All the bidders have to list out all of their Technical Deviations in detail in the above format on cost basis (if any).										
3. Any deviation not mentioned above and shown separately will not be taken cognizance of and the offer shall be liable for rejection.										
4. Bidder shall indicate "quoted" in cost of deviation column of the schedule above along with their Technical offer.										
5. Bidder shall furnish priced schedule of technical deviation along with price bid in sealed envelop.										
6. The final decision of acceptance/ rejection of the deviations quoted by the bidder along with its cost shall be at discretion of the Purchaser.										
7. Bidders to note that any deviation not listed above and asked after Part I Bid opening shall not be considered.										
8. Bidders to note that no Price Impact will be acceptable after Part I Bid opening subject to if there is any change in Technical Specification/NIT terms from BHEL side.										
9. Deviation listed above without any cost of deviation, if found acceptable to BHEL, will be considered without any price implication.										

Signature
S.A. ICHMAN
S.A. ICHMAN
MUKESH K. SINGH



**1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
GAURANTEE POWE CONSUMPTION**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME: III

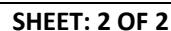
SECTION: 5

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 AT MOTOR INPUT TERMINAL AND CONTROL PANEL (IN KW)	DUTY FACTOR	TOTAL KW
		WORKING	STANDBY				
		3A	3B	4	5	6=3Ax4x5	
1	AC-Plant-1: (CENTRAL CHILLED WATER SYSTEM FOR MAIN CR AREAS AND SERVICE BUILDING)						
1.1	Refrigerant pump, solution pump, control panel etc. for VAM package	1	0		1		
1.2	Water chilling machine -Screw chiller	0	2		1		
1.3	AHUs for Common control room areas, CER, computer room etc	2	0		1		
1.4	AHUs for UPS room	2	0		1		
1.5	AHUs for Service building	10	0		1		
1.6	Cooling tower fans for AC plant	2	1		1		
1.7	Condenser water pumps for AC plant	2	1		1		
1.8	Chilled water pumps for AC plant	2	1		1		
1.9	Make up booster pump	1	1		1		
1.10	Fresh air fans for above AHU rooms	7	0		1		
1.11	Smoke exhaust fans for above AHU rooms	7	0		1		
3	AC PLANT-3 (ESP Control room)						
3.1	Precision AC for ESP control room	2	1		1		
3.2	Fresh air fans for above PAC room.	1	0		1		
3.3	Smoke exhaust fans for above AHU rooms.	1	0		1		
				TOTAL (KW)			410

Signature
S.D. KHAM
MUKESH K.S. SINGH



<u>murkath</u> <u>MUKESH KAS SINGH</u>	<u>Received</u> <u>S.A-16MAN</u>	<u>Adhoco</u> <u>DD M-MAY</u>



**1x800 MW WANAKBORI STPP
AIR CONDITIONING SYSTEM
SUGGESTIVE PRICE FORMAT**

SPECIFICATION No: PE-TS-408-553-A001

VOLUME : III

SECTION : 6

REV 00

SUGGESTIVE PRICE FORMAT

Signature
S.A. ICHMAN
MUKESH K.R. SINGH
MUKESH

SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	SUPPLY		SUPPLY						ERECTION AND COMMISIONING				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 Service tax)	Total Price Supply FOR site and E&C including service tax (Rs)
	LUMPSUM PRICES													
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 PE-TS-408-553-A001 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.													
A	AC-Plant-1: CENTRAL CHILLED WATER SYSTEM FOR MAIN CR AREAS AND SERVICE BUILDING													
1	Water Chilling packages, each of minimum 320 TR capacity consisting of a) Vapour Absorption Machine complete with high temparature generator, low temperature generator / condenser assembly, Evaporator / absorber assembly with eliminators, regenerative heat exchangers, purge recovery units, absorbent pumps, refrigerant pumps all interconnecting piping, valve and other accessories, microprocessor based / PLC control panel incorporating controls safety & interlocks, required charge of lithiumbromide solution and refrigerant for all the units, cooling / heating switch valves, structural mounting base for all the components etc and accessories as specified including PRDS , condensate tank, condensate pump and desuperheating pump.	1	NO.											
2	Water chilling packages, each of minimum 160 TR capacity consisting of (a) Screw refrigerant compressor complete with motors, control panel, multi drive set, controls and interlocks other accessories as specified; (b) Water cooled condenser adequately sized & other accessories and (c) Shell & tube type water chiller & other accessories, as specified.	2	NO.											
3	Sheet metal cabinet type air handling units (double skin as per specification) consisting of chilled water cooling coil, centrifugal blower, TEFC sq cage induction motor, drive set, pre filters at inlet inside the AHU and high efficiency filter (at the outlet duct of each AHU), 3 way motorised mixing valve with thermostatic controls and other accessories to meet the AC load of the main CR areas at 17 m.	2	NO.											
4	Sheet metal cabinet type air handling units (double skin as per specification) consisting of chilled water cooling coil, centrifugal blower, TEFC sq cage induction motor, drive set,pre filters at inlet inside the AHU and high efficiency filter (at the outlet duct of each AHU), 3 way motorised mixing valve with thermostatic controls and other accessories to meet the AC load of the UPS room at 8.5 m.	2	NO.											
5	Sheet metal cabinet type air handling units (double skin as per specification) consisting of chilled water cooling coil, centrifugal blower, TEFC sq cage induction motor, drive set,pre filters at inlet inside the AHU and high efficiency filter (at the outlet duct of each AHU), 3 way motorised mixing valve with thermostatic controls and other accessories to meet the AC load of each floor of service building.	10	NO.											
6	Fibreglass reinforced plastic (FRP) construction cooling towers complete with fan, motor, FRP basin, nozzles, make-up water & quick fill water connection, Level witch, drains, piping, valves, strainers, ladder, structural support & all accessories as specified.	3	NO.											

Signature

Signature

Signature

SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	SUPPLY		SUPPLY						ERECTION AND COMMISIONING				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 Service tax)	Total Price Supply FOR site and E&C including service tax (Rs)
	LUMPSUM PRICES													
7	Centrifugal pump sets for condenser water recirculation complete with TEFC motor & all accessories as specified.	3	NO.											
8	Centrifugal pump sets for chilled water recirculation complete with TEFC motor & all accessories, as specified.	3	NO.											
9	MAKE UP Booster pump with motor and accessories, as specified as per Technical specification.	2	NO.											
10	Make up Water GI / FRP Storage tank to cooling towers with level switch, pr switch and other accessories as required as per technical specification, capacity 8 m3.	2	NO.											
11	GI / FRP Expansion Tank (insulated) for chilled water with all accessories as required as per technical specification, capacity 1 m3.	1	NO.											
12	Non Chemical water treatment erquipment as per specification.	1	NO.											
13	Condenser water piping with necessary fittings, strainers, valves including piping from make up water storage tank to humidifiers of AHU room as specified as per Technical specification	1	LOT											
14	Chilled water piping from AC plant to AHU rooms of power house building and service building complete with valves supports, fittings, strainers, insulation with finish as per Technical specification specification.	1	LOT											
15	Monsoon reheating/ winter heating kit comprising strip heaters, safety controls, air-stat, contactors, frame work, thermostat & humidistat/ sensors etc. as per specification.	1	LOT											
16	Electrode type humidifier for each AHU room as per specification.	1	LOT											
17	Fresh air fan (axial flow type), complete with motor, inlet cone, air filters (pre and high efficeincy filters), dampers etc. as per specification.	1	LOT											
18	Smoke evacuation system with exhaust fan and all other accessories as per specification	1	LOT											
B	AC Plant -2 (ESP building)													
1	Water cooled Precision type Package air conditionig units of 20TR (Net) capacity complete with scroll compressors (suitable for R-410/407c refrigerant) and water cooled shell and tube condensers, interconnecting refrigerant piping (duly insulated) between condensers and PAC units, evaporator fans with highly efficient EC motors and their controls, high efficiency filters, cooling coils with electronic expansion valve, electrode type humidifiers with controls, electric strip heaters, thermally and acoustically lined powder coated MS casing, insulated SS drain pan, insulated drain piping, and built-in microprocessor based control panel as per specification. The cost shall include cool;ing water recirculation piping with valves and accessoried from the terminal point.	3	NO.											
2	Fresh air fan (axial flow type), complete with motor, inlet cone, air filters (pre and fine), dampers etc. as per specification.	1	LOT											
3	Smoke evacuation system with exhaust fan and all other accessories as per specification	1	LOT											
4	Non Chemical water treatment erquipment as per specification.	1	NO.											
C	ITEMS COMMON TO ALL AC PLANTS													

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SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	SUPPLY		SUPPLY						ERECTION AND COMMISIONING				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 Service tax)	Total Price Supply FOR site and E&C including service tax (Rs)
	LUMPSUM PRICES													
1*	Fan coil unit (FCU) consisting of chilled water cooling coil, blower, motor, drive set, filters (pre filter), 3 way motorised mixing valve with thermostatic controls and other accessories. All accessories like vibration isolation pads, hanger rods, supporting arrangement, canvass connection, nuts, bolts, washers and other items required to make the installation complete in all respect shall be supplied in adequate quantity along with the FCUs.													
a*	3 TR	3	NO											
b*	2 TR	1	NO											
2*	Fire damper.													
a*	Fire damper with auto resetting, limit switches, indication lamps etc.	15	SQM											
b*	Motorized actuator with single phase power supply for the above fire damper.	20	NO											
3*	Finished ductwork fabricated from GSS sheet having zinc coating of 180 gms/ m ² complete with hangers/ supports, and all other accessories to make the duct complete in all respect.													
a*	18G.	1500	SQM											
b*	20G.	1750	SQM											
c*	22G.	1450	SQM											
d*	24G.	2500	SQM											
e*	Supply air diffuser with VCD (Extruded Aluminium).	30	SQM											
f*	Return air diffuser without VCD (Extruded Aluminium).	50	SQM											
g*	GI Volume control dampers	15	SQM											
4	Acoustic insulation of the first 5 of ducting from AHU outlets.	1	LOT											
5*	Thermal insulation of supply air duct & return air duct with finish as specified.	6480	SQM											
6*	MS medium class drain piping upto nearest drain point with and without insulation as per specification													
6.1*	50 mm	250	M											
6.2*	40 mm	150	M											
7	PLC control system complete with PLC panels , RIO panels and all accessories like OWS, printer, furniture, RIO panel etc. as specified in the specification.	1	LOT											
8	Field instruments like pressure gauge, temperature gauge, pressure switch, differential pressure switch, flow switch, flow meter etc.	1	LOT											
9*	Fibre optic cable and special type of cable	200	RMT											
D	Air conditioning system for aux control rooms/ aux building as specified.													
1*	Water cooled Precision type Package air conditionig units of 10TR (Net) capacity complete with scroll compressors (suitable for R-410/407c refrigerant) and water cooled shell and tube condensers, interconnecting refrigerant piping (duly insulated) between condensers and PAC units, evaporator fans with highly efficient EC motors and their controls, high efficiency filters, cooling coils with electronic expansion valve electrode type humidifiers with controls, electric strip heaters, thermally and acoustically lined powder coated MS casing, insulated SS drain pan, insulated drain piping, and built-in microprocessor based control panel as per specification.	3	NO.											

Signature

Signature

Signature

PROJECT :1X800 MW WANAKBORI STTP

PACKAGE : AIR CONDITIONING 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 Service tax)	Total Price Supply FOR site and E&C including service tax (Rs)
	LUMPSUM PRICES													
2*	Centrifugal pump sets for condenser water recirculation complete with TEFC motor & all accessories as specified. The capacity of each condenser water pump shall match the capacity of each PAC.	3	NO.											
3*	Fibreglass reinforced plastic (FRP) construction cooling towers complete with fan, motor, FRP basin, nozzles, make-up water & quick fill water connection, Level witch, drains, piping, valves, strainers, ladder structural support & all accessories as specified. The capacity of each cooling tower shall match the capacity of each PAC.	3	NO.											
4*	MAKE UP Booster pump with motor and accessories, as specified.	2	NO.											
5*	Make up Water GI/ FRP Storage tank to cooling towers with level switch, pr switch and other accessories as required. capacity 2 m3.	2	NO.											
6*	Non Chemical water treatment erquipment as per specification.	1	NO.											
7*	Condenser water piping with necessary fittings, strainers, valves including as specified.	20	RMT											
8*	Fresh air fan (axial flow type), complete with motor, inlet cone, air filters (pre and fine), dampers etc. as per specification.	1	NO.											
9*	Smoke evacuation system with exhaust fan and all other accessories as per specification	1	NO.											
10*	Air Cooled PAC-Unit complete with all accessories as specified The package unit shall be complete with all accessories like duct hetaers, humidifier, filters, acoustic insulation of duct for 5m from PAC, drain piping with insulation upto nearest drain, required instrumentation etc													
10.1*	Capacity 15 TR	1	NO.											
10.2*	Capacity 10 TR	1	NO.											
11*	Air-cooled split type AC units consisting of condensing unit & evaporating unit including refrigerant pipes & fittings with insulation etc. (Minimum BEE Rating 5 Star for non ductable units except 5 TR capacity)													
11.1*	5.0 TR capacity (ductable type, 415 V, 3 phase with isolation switch i.e MCB of suitable rating as specified, Voltage stablizer, cabling, all supporting structure and refrigerent piping to suit as per actual site condition)	1	NO											
11.2*	2.0 TR capacity (non-ductable type, 240 V, 1 phase isolation switch) with isolation switch , i.e MCB of suitable rating as specified, Voltage stablizer, cabling, all supporting structure and refrigerent piping to suit as per actual site condition.	30	NO											
11.3*	1.5 TR capacity (non-ductable type, 240 V, 1 phase isolation switch) with isolation switch , i.e MCB of suitable rating as specified, Voltage stablizer, cabling, all supporting structure and refrigerent piping to suit as per actual site condition.	70	NO											
12*	Energy recovery ventilator of suitable capacity as per specification	20	NO											
E	Manually operated palteform trolly of 1 ton capacity with base area 2 m X 1.5 m	1	NO											
F	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											

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PROJECT :1X800 MW WANAKBORI STTP														
PACKAGE : AIR CONDITIONING SYSTEM --- SUGGESTIVE PRICE FORMAT														
SL NO	DESCRIPTION OF EQUIPMENT/ ITEM	SUPPLY		SUPPLY						ERECTION AND COMMISIONING				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 Service tax)	Total Price Supply FOR site and E&C including service tax (Rs)
	LUMPSUM PRICES													
G	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											
H	Total lumpsum price for mand spares inclusive of packing forwarding, transportation up to site, etc. (Bidder shall submit item-wise price break-up).	1	LOT											
I	Any other item, not covered above, but required to complete the system, complete in all respect (bidder shall submit itemwise brekup in technocomercial offer as well as in price offer)	1	LOT											
NOTES														
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.														
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														
3 Price format shall not be changed by the bidder as the bidder may get disqualified by doing so.														
4 For limitation on payment, percentages of individual items/equipments, as specified in the Appendix-A shall be applicable														

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COST ESTIMATION SHEET													
DEPARTMENT : MAUX													
PROJECT : 1X800 MW WANAKBORI													
PACKAGE : AIR CONDITIONING													
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)				
1	MECHANICAL AND GENERAL												
1	Vapour Absorption Machine												
1.1	Bearing for absorbent and refrigerant pump	1 Set for each category											
1.2	Gaskets as applicable for Condenser & Chiller Heads	1 Set for each category											
1.3	Steam Regulating Valve	1 Set											
2.	Centrifugal fans												
2.1	Bearings for fan & motor	2 Sets for each category											
2.2	V-belts	1 Set for each category											
2.3	Vibration Isolators	1Set											
3.	Screw Chiller												
3.1	Bearing for the compressor	1Set											
3.2	Gaskets as applicable for Condenser & Chiller Heads	1Set for each category											
4.	Air Handling Units												
4.1	Bearings for each AHU blower & motor	1Set for each category											
4.2	V-Belts	2 Sets for each category											
4.3	Filters of each type	2 Sets for each category											
5.	Refrigerant & Oil												
5.1	Refrigerant gas in a non-returnable cylinder	15% of installed charge											
5.2	Empty cylinders of 68Kg 2.5.2 capacity to hold the charge of the highest capacity system	As required to suit the above											
5.3	Filter oil in sealed tins for the full set for 6 operations of cleaning	As required											
6.	Centrifugal pump												
6.1	Bearings for each pump and motor	2 Sets for each category											
6.2	Mechanical seal, wearing rings and lantern rings	1Set for each category											
7.	Cooling Tower												
7.1	Spray nozzles	10% of one Tower											
7.2	Set of fills	10% of one Tower											
7.3	Bearings for each fan and motor	2 sets											
8.	Precision Air Conditioners												
8.1	Vibration Isolators	1Set for each category											
8.2	Filters	1 set for each PAC unit											
8.3	Bearings	1 set for each rating of PAC unit (both for condenser & Indoor Unit)											
8.4	Condenser fan Impeller	1 set for each PAC unit											
8.5	Expansion valve	1 set for each rating of PAC unit											
8.6	Any other spare parts recommended by the Manufacturer	1 set for each rating of PAC unit											
9.	Split Air Conditioners												
9.1	Fan-motor bearing for outdoor unit	1 set for each rating of SAC unit											

COST ESTIMATION SHEET													
DEPARTMENT : MAUX													
PROJECT : 1X800 MW WANAKBORI													
PACKAGE : AIR CONDITIONING													
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)				
9.2	Vibration Isolators	1 set each for outdoor unit & Indoor unit for each SAC unit											
9.3	Filter	1 set for each SAC unit											
9.4	Expansion valve	1 set for each rating of SAC unit											
9.5	Any other spare parts recommended by the Manufacturer	As recommended by the Manufacturer											
10.	Electrical spares												
10.1	Air Break Switches	1 No. of each rating											
10.2	Control ,Isolating and selector switches	5% of each type and rating											
10.3	Fuses	6Nos,of each type and rating or 10% whichever is higher											
10.4	Fuse Bases	3Nos,of each type and rating or 5% whichever is higher											
10.5	Indicating Lamps	10% of installed quantity											
10.6	Indicating lamps cover of different colour and holders	5% of installed quantity											
10.7	Push Buttons of various colours	10 nos. of each type and colour											
10.8	Terminal Blocks	5% of installed quantity											
10.9	415 Volt Motor (above 30 KW Rating upto 160 KW)												
10.9.1	End Shield Cover Driving & Non-Driving End	1Set for each type and rating of Motor											
10.9.2	Driving End & Non-Driving End Bearing	1Set for each type and rating of Motor											
10.9.3	Cooling Fan	1No. for each type and rating of Motor											
10.9.4	Motor Space Heater	1No. for each type and rating of Motor											
10.9.5	Motor Terminal Block	1No. for each type and rating of Motor											
10.9.6	Complete Set of Coupling	1Set for each Application											
10.2	415 Volt Motor (Upto 30KW Rating)												
10.20.1	Driving End & Non-Driving End Bearing	3Set for each type and rating of Motor											
10.20.2	Cooling Fan	2No. for each type and rating of Motor											
10.20.3	Motor Terminal Block	5No. for each type and rating of Motor											
10.20.4	Complete Set of Coupling	1Set for each Application											
11.	PLC System												
11.1	I/O cards	1 No. or 20% of equipped cards whichever is maximum											
11.2	Process cards	1 No.											
11.3	Power Supply module	1 No.											
11.4	Communication Process cards	1 No.											
11.5	Hand-held Programmer	1 No.											

Signature

Signature

Signature

COST ESTIMATION SHEET													
DEPARTMENT : MAUX													
PROJECT : 1X800 MW WANAKBORI													
PACKAGE : AIR CONDITIONING													
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)				
11.6	Keyboard and cursor control devices.	2 (two) numbers for each type											
11.7	LCD TFT (24") Monitors.	2 (two) numbers											
11.8	Interface cables with connecting plugs for each type of peripherals & I / O hardware.	10 (ten) sets											
11.9	Power supply modules.	10 (ten) percent of the total qty. offered for each type or 4 (four) numbers, whichever is higher											
11.1	electronic modules (I / O)	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.											
11.11	Bus couplers and communication interface cards	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.											
11.12	Controllers for control system of PLC	10%of each type(at least 1 no. of each type) whichever is higher											
12.	CONTROL VALVES												
12.1	Control valve stem packing for each of the control valves, as offered.	2 (two) sets											
12.2	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											
13.	ACTUATORS FOR CONTROL VALVES												
13.1	Actuators with drive of each type and rating.	1 (one) set											
13.2	Valve positioners of each type.	10 (ten) percent											
13.3	Position transmitters of each type.	10 (ten) percent											
13.4	Limit switches/torque switches of each type.	10 (ten) percent											
14.	Field instruments (transmitters,/ temperature elements (TC/ RTD)/ gauges/ 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.											
15.	Control panel/ Desk Mounted Items												
15.1	Push Button												
15.1.1	Complete assembly	5 nos. of each colour											
15.1.2	Contact Element (1 NO + 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											

Signature
Signature
Signature

COST ESTIMATION SHEET													
DEPARTMENT : MAUX													
PROJECT : 1X800 MW WANAKBORI													
PACKAGE : AIR CONDITIONING													
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)				
15.3.2	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	10Nos. for each Colour and type											
15.5	Mimic Lamps	10Nos. for each Colour and type											
15.6	MCB	2Nos. for each type and rating											
15.7	Door Limit Switch	2Nos.											
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 (for non-PLC driven system)	1(one) no.											
16.	Actuator (Motorised Valve)												
16.1	Complete set of Actuator	1No. for each type and rating											
16.2	Limit Switch	2 Nos each type and rating											
16.3	Torque Switch	2 Nos each type and rating											
16.4	Auxiliary Contact	1 no each type and rating											
16.5	Motor	1 no each type and rating											
16.6	Complete Seal kit	1Set for each type and rating											
16.7	Complete O-Ring Set	1Set											

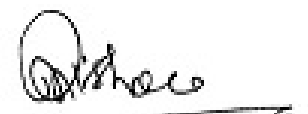
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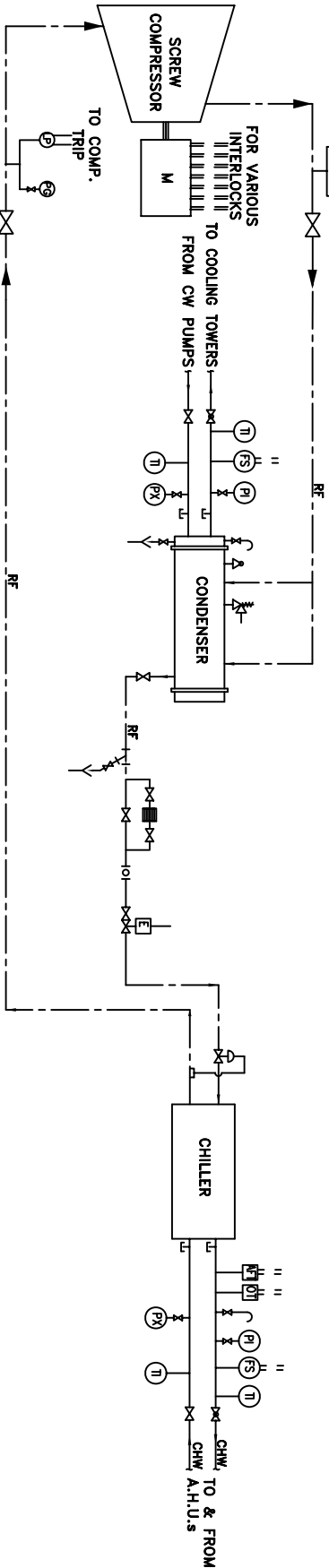
Approved

PROJECT : 1 X 800 WANAKBORI AIR CONDITIONING SYSTEM		
PACKAGE : AIR CONDITIONING 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 air conditioning system on turnkey basis as per specification PE-TS-408-553-A001 including special tool & tackels for maintenance, commissioning spares, all taxes, duties etc. (Without mandatory spare - Sr. No. 2.10 of	100%
2.0	BREAK-UP OF PRICES GIVEN IN 1.0 ABOVE (To be used during contract execution for payment)	
2.1	Total lump sum firm price for EQUIPMENT (SUPPLY) 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 air conditioning system and as defined in the technical specification (PE-TS-408-553-A001)	80%
2.1	Erection & commissioning, carrying out acceptance tests at site, final painting and handing over to customer the complete AC system on turnkey basis as per specification PE-TS-408-553-A001 including all taxes, duties etc.	20%
3.0	Break-up (%) of prices given at Sl No-2.1 above (To be used during contract execution for payment)	Percentage of total price of SL No 2.1 above
3.1	Water Chilling machine - VAM - (Item no A 1 of Suggestive price format)	15%
3.2	Water Chilling machine - Screw Chiller - (Item no A2 of suggestive price format)	12%
3.3	Air handling units (Item Nos A3, A4 & A5 of Suggestive price format)	9%
3.4	Cooling Towers (Item no A6 & D2* of Suggestive price format)	5%
3.5	Pumps (Item no A7, A8, A9, D2* & D4* of Suggestive price format)	5%
3.6	Tanks (Item Nos A10, A11 & D5* of Suggestive price format)	2%
3.7	Water treatment equipment (Item no A12, B4 & D6* of Suggestive price format)	1%
3.8	Condenser water piping (Item no A13 & D7* of Suggestive price format)	4%
3.9	Chilled & Drain water piping (Item no A14 & C6* of Suggestive price format)	4%
3.10	Heaters and humidifiers (Item no A15 & A16 of Suggestive price format)	2%
3.11	Fresh air Fans and smoke exhaust fan (Item no A17/ A18, B2, B3, D8* & D9* of Suggestive price format)	1%
3.12	Water cooled Precision AC - (Item no B1 & D1* of Suggestive price format)	6%
3.13	Air cooled PAC units (Item no D10* of Suggestive price format)	1%
3.14	Air cooled split type AC units (Item no D11* of Suggestive price format)	8%
3.15	Fan coil units (Item no C1* of Suggestive price format)	1%
3.16	Fire Dampers (Item no C2* of Suggestive price format)	1%
3.17	GSS Duct work with airline accessories (Item no C3* of Suggestive price format)	9%
3.18	Acoustic insulation (Item no C4 of Suggestive price format)	1.5%
3.19	Thermal Insulation (Item no C5* of Suggestive price format)	3%
3.20	Field instruments - (Item no C8 of Suggestive price format)	1%
3.21	PLC including cable (Item no C7 & C9* of Suggestive price format)	6%
3.22	Energy recovery ventilator (Item no D12* of Suggestive price format)	1%
3.23	Manually operated platform trolley (Item no E of Suggestive price format)	0.2%
3.24	Special Tools tackels & Commissioning Spares (Item no F & G of Suggestive price format)	1%


MUKESH K. SINGH

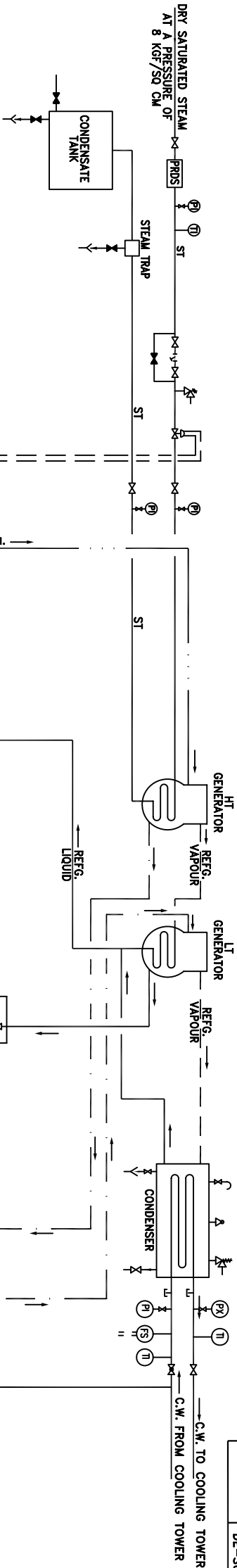

S.A. KHAN


D.K. MALIK

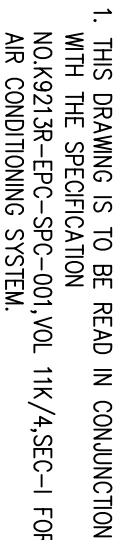


TYPICAL SCHEME FOR PACKAGED SCREW CHILLER UNIT

L E G E N D		
SYMBOL	DESCRIPTION	SYMBOL
	NORMALLY CLOSED GATE VALVE	
	GATE VALVE	
	SAFETY VALVE	
	CHECK VALVE	
	GLOBE VALVE	
	THERMOSTATIC EXPANSION VALVE	
	STEAM REGULATING VALVE	
	SOLENOID VALVE	
	TEMPERATURE INDICATOR	
	PRESSURE INDICATOR	
	PRESSURE TEST POINT	
	LOW PRESSURE SWITCH	
	HIGH PRESSURE SWITCH	
	MOISTURE INDICATOR	
	PRESSURE REDUCING & DE-SUPERHEATING STATION	



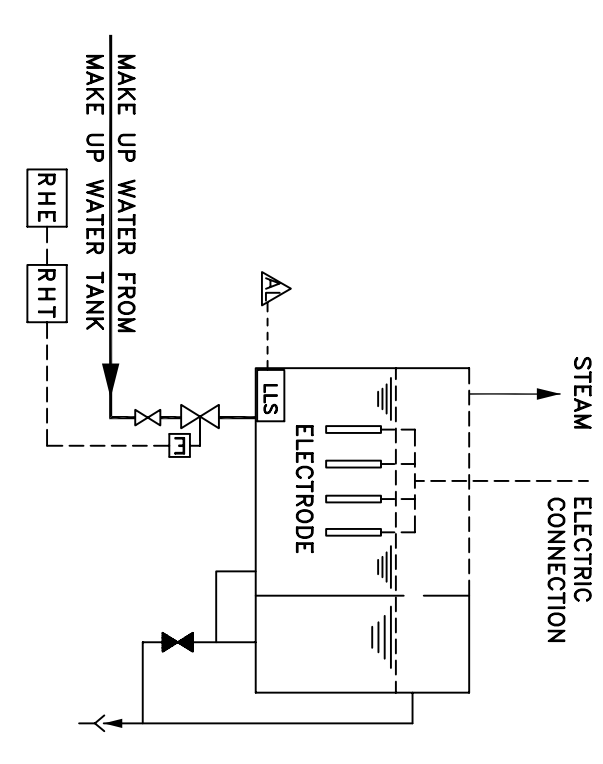
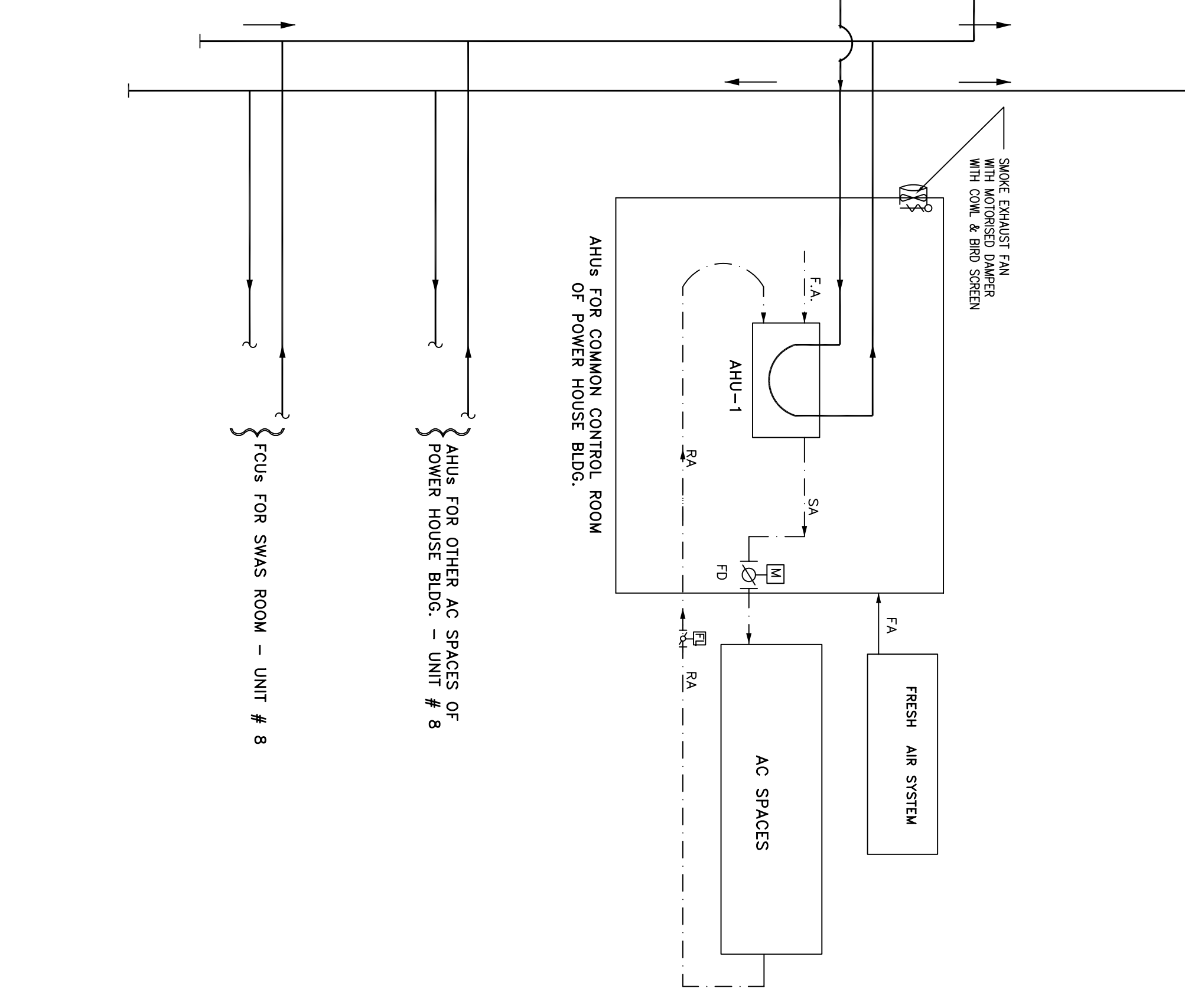
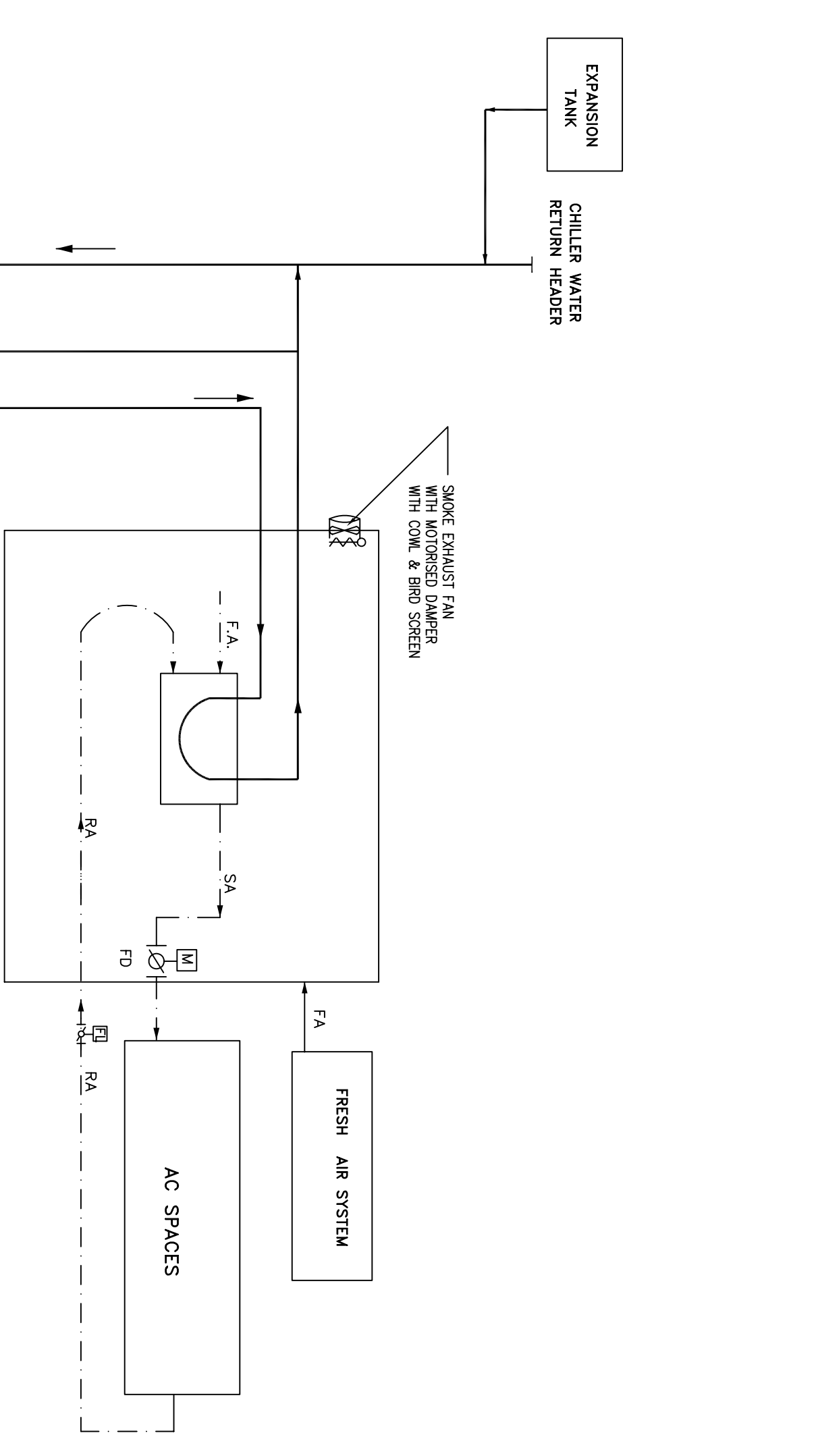
TYPICAL SCHEME FOR VAPOUR ABSORPTION MACHINE
(DOUBLE EFFECT TYPE)



FOR TENDER PURPOSE ONLY

L E G E N D			
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	GATE VALVE		TEMPERATURE TRANSMITTER
	GATE VALVE (NORMALLY CLOSED)		PRE FILTER
	SAFETY VALVE		AIR VENT
	FUSIBLE PLUG		OPEN/ DRY FUNNEL
	ELECTRONIC EXPANSION VALVE		BUTTERFLY VALVE
	SCREWED PLUG		CONDENSER COOLING WATER LINE
	TEMPERATURE INDICATOR		SUPPLY AIR LINE
	PRESSURE INDICATOR		RETURN AIR LINE
	LOW PRESSURE SWITCH		MOTORISED FIRE DAMPER
	HIGH PRESSURE SWITCH		FUSIBLE LINK TYPE FIRE DAMPER
	Y-STRAINER		LOUVRE
	FILTER DRIER		HEATER
	ELECTRICAL LINE		RELATIVE HUMIDITY ELEMENT
	DAMPER		RELATIVE HUMIDITY TRANSMITTER
	TEMPERATURE ELEMENT		GLOBE VALVE

TITLE: SCHEMATIC DIAGRAM OF WATER COOLED PRECISION AIR-CONDITIONER		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA . MUMBAI . CHENNAI . NEW DELHI	
PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #8 AT WANKAORI THERMAL POWER STATION, GUJARAT)		JOB NO. K9213	SCALE : NTS
DWG. NO. K9213R-DWG-003-VA-002		REV. 1	



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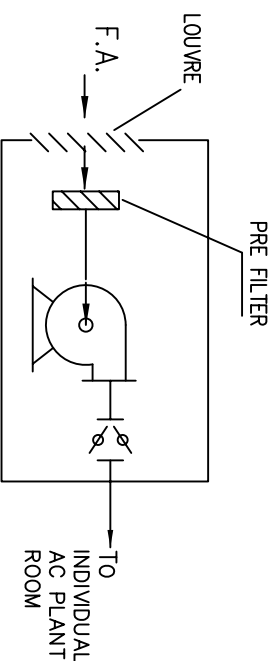
LEGEND			
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	ROOM VALVE		TEMPERATURE THERMOSTAT
	DATE VALVE		RELATIVE HUMIDITY TRANSMITTER
	SAFETY VALVE		RELATIVE HUMIDITY ELEMENT
	TRANSFER PLUG		AIRSTAT
	REFRIGERANTIC EXPANSION VALVE		DAMPER
	SEQUENT PLUG		CHILLED WATER LINE
	SOLENO VALVE		SECTION TRAYMARK
	TEMPERATURE INDICATOR		ANTISEPTIC THERMOSTAT
	TEMPERATURE TRANSMITTER		FINE FILTER (AS APPLICABLE)
	OIL PRESSURE SWITCH		AIR VENT
	LOW PRESSURE SWITCH		OPEN/AIR/FUNNEL
	HIGH PRESSURE SWITCH		MANUAL REGULATING VALVE
	PRESSURE SWITCH		LEVEL DETECTOR
	LOW LEVEL SWITCH		AVAIL FLOW FAN
	HIGH LEVEL SWITCH		CONDENSER COOLING WATER LINE
	ROOM REQUIRING CLEAN AIR		THERMAL WATER INTERPOSED VALVE
	ROOM REQUIRING CLEAN AIR		AIR SUPPLY / RETURN LINE
	WATERMARK		POT TRAYMARK
	SAFETY THERMOSTAT		BLOWER
	PRESSURE TEST POINT		DIFFERENTIAL PRESSURE SWITCH
	DATE (WHEN/WHEN CLOSED)		

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE SPECIFICATION NO.K92135-EPG-SPC-001 VOL. 11K/4/SEC-1 FOR AIR CONDITIONING SYSTEM.
2. IN EACH AHU ROOM 2,56,076 CAPACITY AHUS SHALL BE PROVIDED.
3. FINE FILTER IS APPLICABLE FOR MAIN CONTROL ROOM AND CRITICAL AREA ONLY.

TENDER PURPOSE ONLY

[illegible]

		1800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #3 AT WAKHARI THERMAL POWER STATION, GULBART)	
GULBART STATE ELECTRICITY CORPORATION LIMITED VADODRA, GULBART		DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLATA, WILERA - CHENNAI NEW DELHI	
DRWING : SC APPROVED : RM	REVISION : POR CHECKED : CH	SCALE : NIL DATE : 27.06.12 DES NO : DCE-04923W	DWG. NO. : K9213R-DWG-003-V4-003 REV. : 1



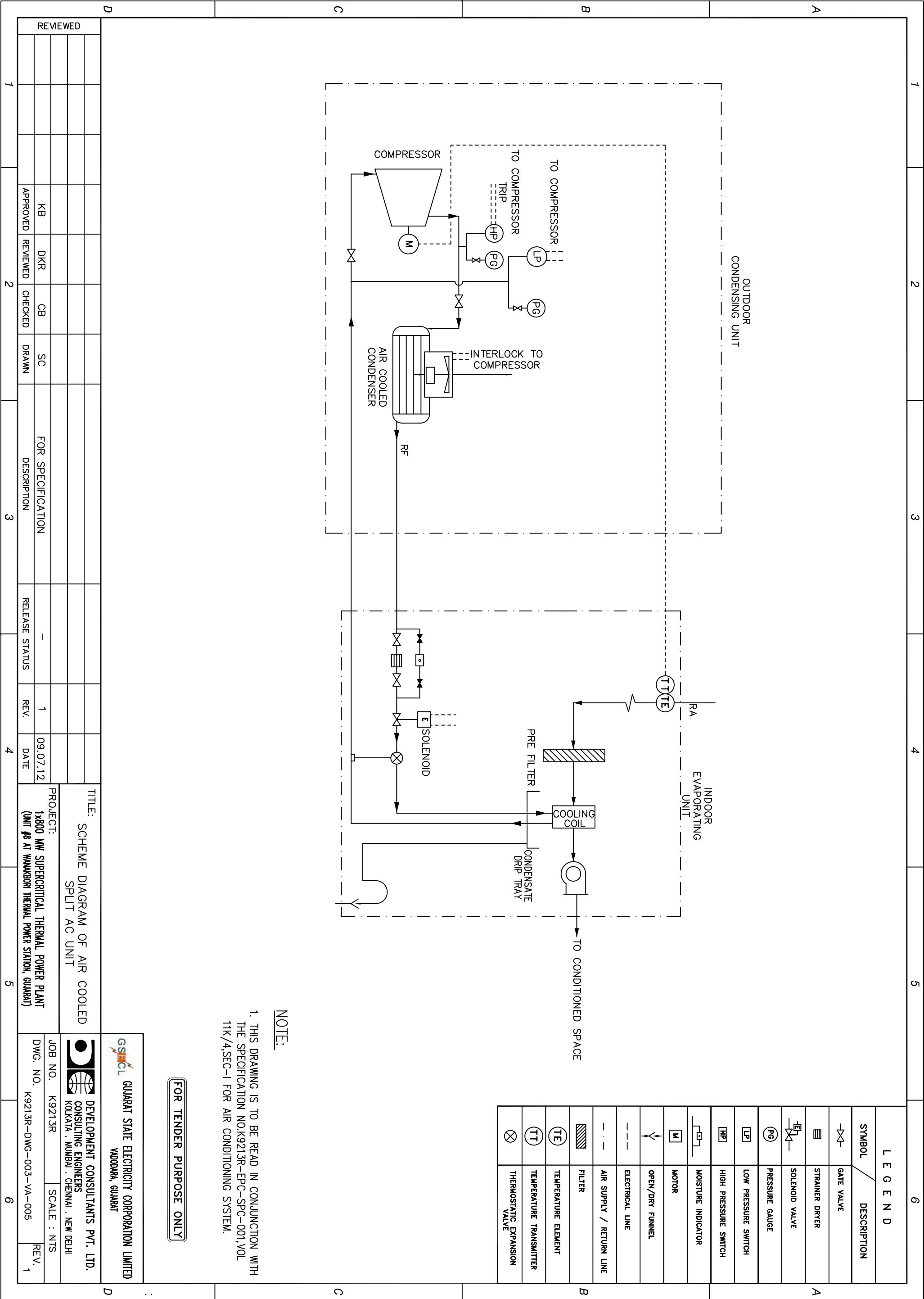
LEGEND	
SYMBOL	DESCRIPTION
	GATE VALVE
	GATE VALVE (NORMALLY CLOSED)
	ELECTRONIC EXPANSION VALVE
	TEMPERATURE TEST POINT
	PRESSURE TEST POINT
	LOW PRESSURE SWITCH
	HIGH PRESSURE SWITCH
	Y-STRAINER
	FILTER DRIER
	ELECTRICAL LINE
	DAMPER
	FILTER
	INDUCED FAN
	AIR SUPPLY / RETURN LINE
	MOTORISED FIRE DAMPER
	FUSIBLE LINK TYPE FIRE DAMPER
	TEMPERATURE TRANSMITTER
	TEMPERATURE ELEMENT
	RELATIVE HUMIDITY TRANSMITTER
	RELATIVE HUMIDITY ELEMENT

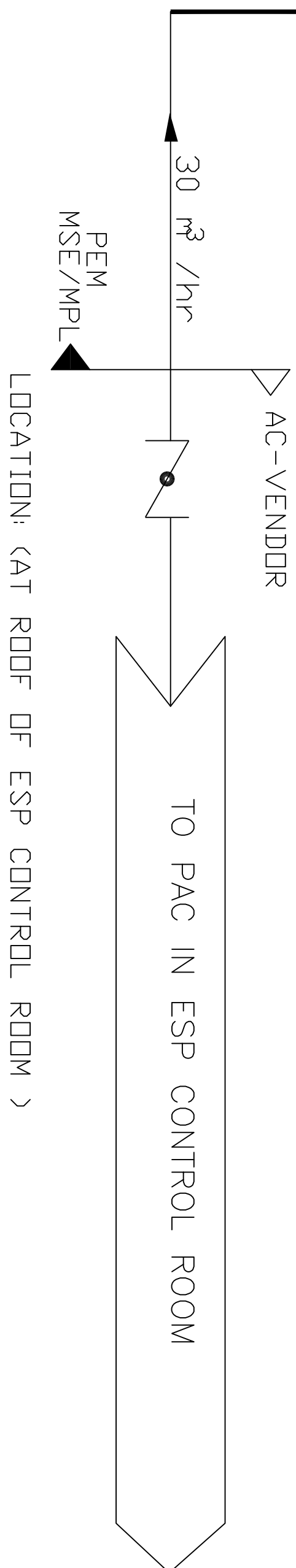
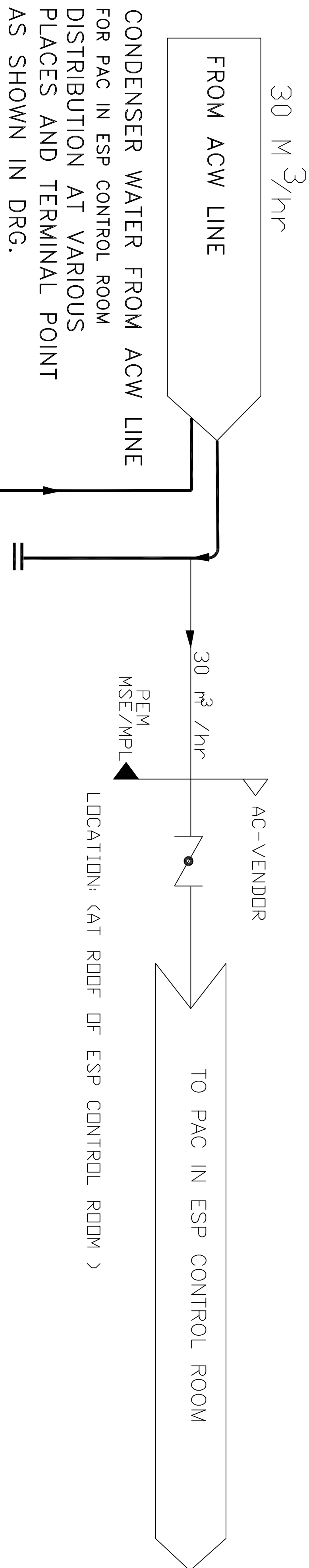
1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE SPECIFICATION NO.K9213R-EPC-SPC-001,VOL 11K/4,SEC-1 FOR AIR CONDITIONING SYSTEM.

FOR TENDER PURPOSE ONLY

TITLE:	SCHEMATIC DIAGRAM OF AIR COOLED PRECISION AIR-CONDITIONER
PROJECT:	1x800 MW SUPERCritical THERMAL POWER PLANT (UNIT #8 AT WAKABORI THERMAL POWER STATION, GUJARAT)

		GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODRA, GUJARAT	
		DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA . MUMBAI . CHENNAI . NEW DELHI	
JOB NO. K9213R		SCALE : NTS	
DWG. NO. K9213R-DWG-003-VA-004		REV. 1	





- NOTE:—**
1. MPL TO PROVIDE HVAC CONDENSER WATER PIPING/FITTINGS UP TO THE TERMINAL POINT AS SHOWN IN DRG.
 2. HVAC CONDENSER WATER PIPING INCLUDING FITTINGS SHALL BE TERMINATED WITHIN THE RANGE OF 5 METER DISTANCE FROM PAC ROOM IN ESP CONTROL ROOM FURTHER PIPING SHALL BE DONE BY RESPECTIVE PLANT SUPPLIER AS MARKED IN THIS DRG.
 3. THE HVAC CONDENSER WATER ISOLATING VALVES SHALL BE ARRANGED BY MPL (VALVE GROUP) AS PER THE SCHEME AS MARKED IN THE DRG.
 4. CONDENSER WATER PR. AT EACH TERMINAL POINT SHALL BE MAINTAINED 0.5 kg/cm².
 5. CONDENSER WATER PIPING FROM TERMINAL POINT TO PAC ROOM IN ESP CONTROL ROOM SHALL BE IN BIDDER'S SCOPE.
 6. PRESSURE DROP ACROSS CONDENSER OF PAC WILL BE 6 MWC (MAX.)
 7. TEMPERATURE RISE IN CONDENSER WILL BE 5 DEG. C (MAX.)

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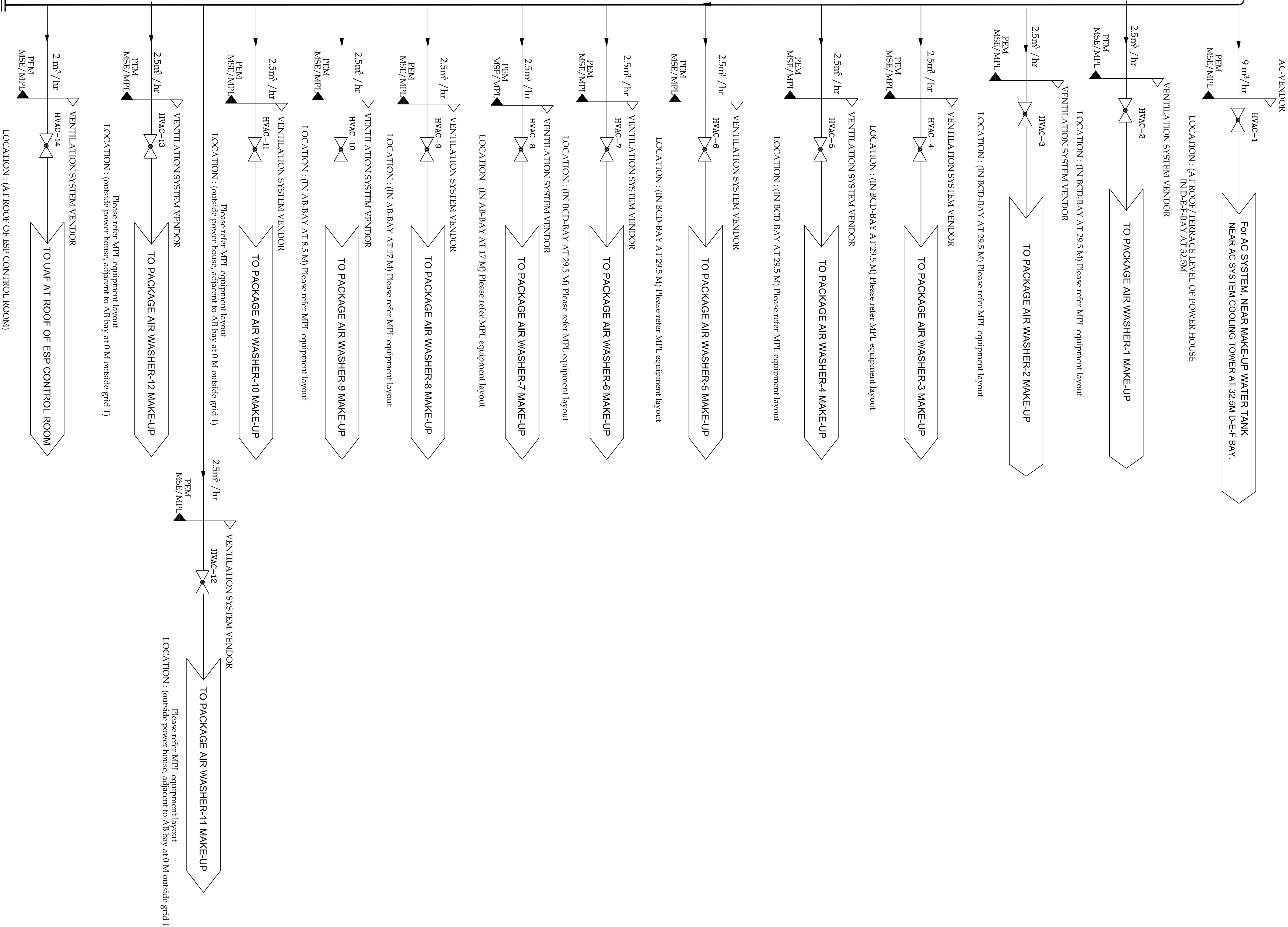
TITLE	DATE	BY	REVISION	DATE	BY	REVISION
SCHEMATIC DIAGRAM FOR CONDENSED WATER FROM ACW LINE TO PAC ROOM AT ROOF OF ESP CTR ROOM.						

DRD NO.	408
STATUS	CONTRACT
DRG/SET. NO. (INTERNAL)	
PRINT SCALE	
 BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT PPEI BLDG. SECTOR-16 A, INDIA	
SPRT CODE	
WAVE	
13800 MW WALKABORI GSCJ	

41 M³/hr

REFER P&ID OF
PLANT WATER SYSTEM:

HVAC MAKE-UP (Clarified water)
FOR HVAC MAKE-UP
DISTRIBUTION AT VARIOUS
PLACES AND TERMINAL POINT
AS SHOWN IN DRG.



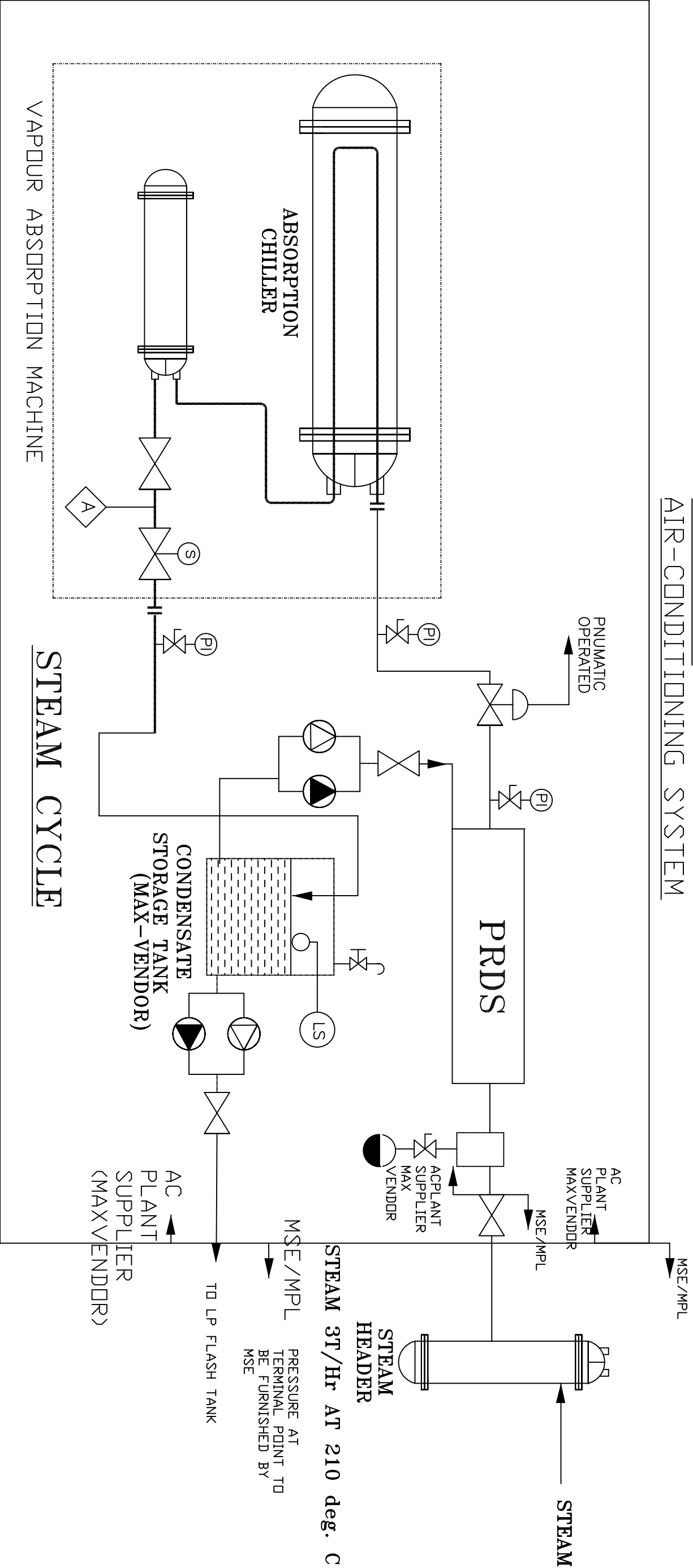
NOTE:-

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 VENDOR'S 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 :		GSCCL									
JOB No. : 408		1 X 800 MW WANAKBORI									
STATUS		CONTRACT		</							

WANAKBORI PROPOSAL
(1X800 MW)

AIR-CONDITIONING SYSTEM



VAPOUR ABSORPTION MACHINE

STEAM CYCLE

AC PLANT (VAM BUILDING)
BOUNDARY WALL

NOTE:

1. STEAM PIPING WITH ISOLATION VALVE SHALL BE PROVIDED AT ONE POINT BY BHEL.
2. STEAM PIPING INCLUDING PRDS AS MARKED INSIDE THE AC PLANT ROOM IN THE SCOPE OF AC PLANT SUPPLIER (MAX-VENDOR).
3. CONDENSATE DRAIN PIPING UPTO TERMINAL POINT BY VENDOR
4. CONDENSATE LINE FOR DE SUPERHEATING SHALL BE TAKEN FROM CONDENSATE TANK BY AC VENDOR

SCOPE OF WORK & TERMINAL POINTS FOR STEAM & CONDENSATE WATER FOR VAPOUR
ABSORPTION MACHINES IN AC SYSTEM BETWEEN MSE & AC PLANT SUPPLIER (MAX-VENDOR)