SECTION: D
STANDARD TECHNICAL SPECIFICATIONS

SECTION-D1

(GENERAL TECHNICAL REQUIREMENT FOR MECHANICAL)

1.0 SYSTEM DESCRIPTION FOR CW TREATMENT PLANT (Ref. Drg. no. PE-DG-408-156- A001):

The treatment shall be designed to minimize the formation of scale and build up of micro – organisms, and prevent fouling, and corrosion of the turbine condenser and other heat exchanger.

To inhibit scale formation in the CW system it is proposed to dose Sulphuric acid to convert calcium and magnesium bicarbonates into sulphates, which have higher solubility in water. Scale/Corrosion inhibitor and Biocide and H_2SO_4 dosing Systems have been designed to dose required quantity of chemical to maintain CW quality at CW fore bay.

Sulphuric acid will be unloaded from road tankers through unloading pumps.

Chlorine dosing also being envisaged in CW forebay and pump pit. Shock dosing of chlorine at the rate of 5 ppm for 0.5 hr in a shift in each pump pit and continuous dosing at the rate of 1.0 ppm for 7.5 hrs per shift in forebay. The chlorine dosing system shall be supplied by Chlorination plant supplier **[Not in CW Treatment plant supplier scope**].

2.0 TANK AND PUMP CAPACITY SELECTION:

Acid Dosing (98% H_2SO_4)		
Acid dosage rate	=	[Make-up M-Alkalinity-(Desired M-Alkalinity in Make-up water/COC)] X Make-up water X 24/1000
	=	[(160-150/5] X 1864 X 24/1000
	=	5815.68 kg/day
	=	247.26 kg/hr (98% H_2SO_4)
Specific Gravity	=	1.84
Acid dosage rate	=	247.26/1.84 LPH.
	=	134.38 LPH.
Acid Dosing Pumps	=	150 LPH (1W+1S).
Capacity of H_2SO_4 Day Tank for 24 Hrs	=	3225.2 Litter.
Capacity of H_2SO_4 Day Tank for 24 Hrs	=	3500 Litter.
Capacity of H_2SO_4 Storage Tank for 15 days	=	48378 Litter. (2 nos. tanks, each of 25000 Litters Capacity)

Scale inhibitor /corrosion inhibitor Continuous dosing rate (Dosing Rate @ 10 ppm).		
Dosing rate	=	Blowdown (m3/hr) X dosage (ppm) /1000
	=	329X 10/1000
	=	3.29 kg/hr
Specific gravity	=	1 (approx).
Chemical dosage rate Solution.	=	3.29/1(Approx).
	=	3.29 LPH.
Chemical Injection Pump (selected)	=	10 LPH (1W+1S).
Storage for 1 day storage	=	3.29X24 Litter.

	=	78.96 Litter (required).
Tank capacity selected (each)	=	3000 Litter (1W+1S).
Biocide Shock dosing rate @ 3 ppm.		
CW/ACW Flow	=	92303 Cum/Hr
Hold up volume (approx 50% of total flow)	=	92303X50/100 =46151.5 CuM
Dosing rate	=	Hold up volume X dosage (ppm) /1000
	=	46151.5X 3/1000
	=	138.45 kg
Specific gravity	=	1 (approx).
Chemical dosage	=	138.45/1 Ltrs (Approx).
	=	138.45 Ltrs (Approx).
Chemical Injection Pump (required) [shock dosing shall be done in half an hour once in 7 day]	=	277 LPH (1W+1S).
Chemical injection pump selected	=	300 LPH (1W+1S).
Storage for 1 shock dose in a week.	=	138.45 Litter.
	=	138.45 Litter.
Tank capacity selected (each)	=	3000 Litter (1W+1S).

SECTION-D2

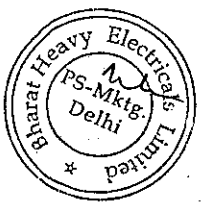
(GENERAL TECHNICAL REQUIREMENT FOR ELECTRICAL)

1.1 GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS (NO OF SHEET=26)
1.2 CABLE SCHEDUEL FORMAT AND CABLE DETAILS (NO OF SHEET=3)

VOLUME : IIF/1

SECTION-II

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



CONTENT

Bharat Heavy Electricals Limited PS-Mktg. Delhi

VOLUME : IIF/1

SECTION-II

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

1.00.00 SCOPE

1.01.00 This section covers the general requirements of the drive motors for power station auxiliary equipment.

1.02.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.

1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

2.00.00 STANDARDS

2.01.00 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/ Publications except when otherwise stated herein or in the driven equipment specification.

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

IS-325

IS-12615

IEC-34

3.00.00 SERVICE CONDITIONS

3.01.00 The motors will be installed in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.

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

3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 **TYPE AND RATING**

4.01.00 **A.C. Motors**

4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

4.01.02 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.

4.01.03 The motor name-plate rating at 50°C shall have at least 10% margin over the input power requirement of the driven HT equipment and 15% for LT driven equipment at rated duty point unless stated otherwise in driven equipment specification or in general electrical specification.

4.01.04 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.

4.01.05 All HT & LT motors shall be energy efficient type as per IS. However for HT motors, if the same is not specified in IS, minimum efficiency of all HT motors shall be considered as 90%.

4.02.00 **D.C. Motors**

4.02.01 D.C. motor provided for emergency service shall be shunt/compound wound type. All DC motors shall be energy efficient type with minimum efficiency of 80%.

4.02.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.

Starter panel complete with all accessories shall be included in the scope of supply.

5.00.00 **PERFORMANCE**

5.01.00 **Running Requirements**

5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure

5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.

5.01.03 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.

5.02.00 **Starting Requirements**

Motor shall be designed for direct online starting at full voltage. Starting current shall not exceed 6 times full load current for all HT motors except boiler feed pump motor where the starting current shall be limited to 4.5 times. No further tolerances are applicable on starting current specified above

for HT motors. For LT motors, the applicable starting current shall be limited to 7.2 times of full load current including all tolerance.

5.02.01 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

5.02.02 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminal except BFP motor. In case of BFP motor, it shall be 80% rated voltage. Minimum starting requirement for mill motor (double cage) shall be 80% rated voltage at motor terminals. However for mill motors if the minimum starting voltage is more than 80% rated voltage at motor terminal and within 90% rated voltage, bidder shall provide necessary arrangement to keep the motor terminal voltage above that voltage to achieve smooth start of the motor.

5.02.03
a) Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition.

b) Cranking motor shall be capable of six equally spread starts per hour, three starts in quick succession from cold condition and one restart from hot condition. The coal conveyor and crusher motors shall be suitable for 3 consecutive hot starts with maximum 20 starts per day.

c) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.

5.02.04 HT pump motors shall be suitable to start with forward rotation.

5.02.05 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage

5.03.00 **Stress During Bus Transfer**

5.03.01 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.

5.04.00 **Locked Rotor Withstand Time**

5.04.01 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 2.5 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.

5.04.02 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.

5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting within motor rated capacity.

6.00.00 **SPECIFIC REQUIREMENTS**

6.01.00 **Enclosure**

6.01.01 All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.

6.01.02 Motors for circulating water pumps of large output ratings, located indoor and not directly exposed to coal dust or fly ash, could have screen protected drip proof enclosure conforming to IP-23.

6.01.03 For hazardous area approved type of increased safety enclosure shall be furnished.

6.02.00 **Cooling**

6.02.01 The motor shall be self ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air- cooled (CACA) or totally enclosed tube ventilated (TETV) type. Totally enclosed tube ventilated (TETV) type motors shall be acceptable for HT motors only.

6.02.02 For large capacity motors, closed air circuit water cooled (CACW) may be considered for acceptance.

6.03.00 **Winding and Insulation**

6.03.01 All insulated winding shall be of copper.

6.03.02 All motors shall have class F insulation but limited to class B temperature rise.

6.03.03 Windings shall be impregnated to make them non-hygroscopic and oil resistant.

6.04.00 **Tropical Protection**

6.04.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

6.04.02 All fittings and hardwares shall be corrosion resistant.

6.05.00 **Bearings**

6.05.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application.

6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.

6.05.03 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.

6.05.04 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.

6.05.05 Grease lubricated bearings shall be prelubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication.

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 metres from the motor at no load condition.

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 HT Motor terminal box (Phase side) shall be Phase Segregated (PSTB) type and LT motor terminal box shall be non-phase segregated type. Both HT & LT motor terminal box shall be 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 HT motor phase side terminal box shall be phase-segregated type and HT motor neutral leads shall be brought out in a separate terminal box preferably

opposite side of phase terminal box & may not be necessarily phase segregated type with shorting links for star connection.

6.07.10 Motor terminal box shall be furnished with suitable cable lugs and nickel plated 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 :

a) Temperature rise in Deg.C under rated condition and method of measurement.

b) Degree of protection.

c) Bearing identification no. and recommended lubricant.

d) 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. Six (6) nos. duplex type winding temperature detectors, two (2) nos. per phase shall only be acceptable for special application motors only subject to approval of owner.

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.

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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.

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

Furnished type test certificates of motor shall not be older than five (5) years from the date of Inspection, otherwise type test shall be conducted without any price implication.

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

ANNEXURE-A
DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.T. Supply	11000 V, 3Ø, 3W, 50 Hz, non-effectively earthed	Motors above 2000 KW & all mill motors
	Fault level 44 KA symm.	
	3300 V, 3Ø, 3W, 50 Hz, non-effectively earthed	Motors above 160 KW upto and including 2000 KW
	6600 V, 3Ø, 3W, 50 Hz, non-effectively earthed	Motors of CHP system and Water System above 160kW
	Fault level 40 KA symm for 3300V & 6600V	
L.T. Supply	415V, 3Ø, 3W, 50 Hz effectively earthed	Motors upto and including160KW
	Fault level 50 KA symm.	
	240V, 1Ø, 2W, 50 Hz effectively earthed	Lighting, space heating, A.C. control & protective devices
D.C. Supply	220V, 2W, unearthed	D.C. alarm, control & protective devices
	Fault level 25* KA.	

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

2.0 RANGE OF VARIATION

A.C. Supply :

Voltage : ± 10% Frequency : ± 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

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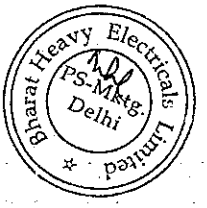
SECTION-III

TECHNICAL SPECIFICATION FOR ELECTRIC MOTOR ACTUATORS



CONTENT

Bharat Heavy Electricals Limited PS-Mktg. Delhi

Gujarat State Electricity Corpn. Ltd. GSECL Baroda

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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.

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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.

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 :

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 frequrecy,

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

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)

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

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)

iii) No load Armature current (Amp)

6. Full load Field current (Amp)

7. No load Aramature current (Amp)

8. Minimum permissible field current(Amp) to avoid overspeeding at

   i) Maximum permissible voltage

   ii) Rated voltage

   iii) Minimum Permissible Voltage

9. Resistance (indicative Values) in ohm

   i) Armature winding (Arm + IP + Series) at 25 deg.C

   ii) Field Winding at 25 deg. C

10. Inductance (indicative values)

    i) Armature winding

    ii) Field winding

11. Value of trimmer resistance (ohm) to be connected in series with the shunt field to obtain rated speed at

    i) 220 V DC

    ii) 250 V DC

    iii) 187 V DC

12. Value of the external resistance (ohm) required to be connected in series with armature during starting only

13. Technical data sheet for external resistance box

14. GA drawing of motor

15. Starting time calculation

16. Starter resistance design calculation

17. Electrical connection diagram of motor

CABLE SCHEDULE FORMAT **ANNEXURE III**

UNITCABLENO	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/ VENDOR)	REMARKS	CABLESIZE	PATHCABLENO	TENTATIVE CABLE LENGTH

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

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

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

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

PVC Aluminium

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

XLPE Copper

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

XLPE Aluminium

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

SECTION-D3

(GENERAL TECHNICAL REQUIREMENT FOR C&I)

TABLE OF CONTENTS

GENERAL & SPECIFIC TECHNICAL REQUIREMENT

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.

Specific Technical Requirements (C&I):

The control of CW Treatment Plant shall be through PLC based control system having hot redundant Central Processing Unit. The operation and control philosophy of CW treatment plant has been elaborated in separate section in the specification. The PLC shall be located in CW Treatment Plant Control Room. One (1) nos. OWS(Operator Works Station) and one(1) no. OEWS(Operator cum Engineering Work Station) with 24" colour TFT monitor ,one(01) nos.A3 size colour laser printers, keyboard, mouse etc. shall be provided by the bidder. OWS/EWS shall be provided with anti-glare coating. 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,Remote I/Os, Printer, UPS (for PLC, OWS, Remote I/Os,Printer etc.), desk along with furniture shall be in Bidder's scope. PC for OWS shall be of workstation grade. Additional laptop shall be provided.

1) 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.

2) 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.

3) 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 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.

4) All electrical actuators shall be non-integral type.

5) 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.

6) The solenoid valves shall have limit switches for open/close feedback.

7) 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.

8) 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.

9) 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.

10) UPS for PLC, OWS etc. shall be in bidder's scope with 2X100% configuration along with SVS(Static Voltage Stabiliser). UPS shall have 2X100%, VRLA type battery bank with 60 min back up. For further details UPS specification attached elsewhere shall be referred.

11) Bidder shall provide Customer training on the proper application and maintenance of PLC Hardware & Software at Vendor's work or at Wanakbori site.

12) 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

13) 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.

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

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

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

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

18) 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.

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 matricx for the Auxiliaary 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 & Loacl 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 propriatory 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

~~various equipments/components of the plant and their status/ parameters like different filters, exchanger units, measuring tanks, opening / closing of different valves, ON / OFF status of different pumps and blowers, etc. Colour coding shall be used to differentiate lines for different services, such as, service water line, backwash lines, acid/alkali lines, etc.~~

~~3.02.06~~ ~~Potable water plant shall be controlled from the DM plant PLC.~~

3.03.00 CW Treatment Plant

3.03.01 Circulating Water Treatment Plant shall be controlled through redundant PLC and shall be monitored from the Operating Station located in Control Room inside C.W. Treatment Building.

3.03.02 There shall be 1no Operator's Station for operation of the plant. A separate, work station shall carry out the engineering activities (control loop tuning, program / sequence generation etc.).The operator's / engineer's work stations shall have 24" colour TFT monitor, keyboard, mouse etc. Also one colour laser printer is envisaged for printing of various logs, reports, graphics etc.

3.03.03 The PLC system shall meet the requirement of monitoring, sequential starting / stopping of drives, interlock and protection, individual / sequential control metering, annunciation and on-line monitoring including electrical power distribution systems and all other routine functions with minimum operator's intervention.

3.03.04 ON / OFF / TRIP status of all pumps, blowers, agitators and drive motors as required shall be displayed in Operating Station. Ammeters for drive motors wherever required shall be displayed in Operating Station.

3.03.05 All drive motors shall be provided with arrangement of local starting and stopping. Local starting shall be possible through remote/local selection key in Operating Station or in MCC. Tripping of drive motors locally shall be permissible irrespective of position of remote/local selector switch. Provision for locking the local stop push buttons after tripping the motor from local push button shall be there. All drive motors, valves etc shall be connected to PLC and the functions described above shall be performed in PLC.

3.03.06 Annunciation showing tripping of different motors, level alarms from level switches shall be located in the Operating Station.

~~3.04.00~~ ~~Waste Water Treatment System~~

~~3.04.01~~ ~~Waste Water Treatment System shall be controlled through Local Control Panels (LCP) to be located at different strategic locations of the plant as described below:~~

~~a)~~ ~~One (1) no. LCP is to be provided within CMB Wastewater Pump House adjacent to Central Monitoring Basin~~

~~b)~~ ~~One (1) no. LCP is to be provided near Cooling Towers~~

~~c)~~ ~~One (1) no. LCP is to be provided near Coal Handling Area~~ (Within Chemical House for Coal Pile Rainfall Run-off-Single storied)

SPECIFICATION FOR FIELD INSTRUMENTS

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 ^{O}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) ½” 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 ^{O}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 ^{O}C
15.	Load Impedance		:	600 Ohms at 24 Volts (minimum)
16.	Process Connection		:	2" Companion flange with nuts, bolts and gaskets
17.	Performance -			
	Accuracy		:	$\pm$ 0.5 % of span or better
18.	Accessories		:	a) Counter Flange, nuts, bolts, gaskets etc. b) Weights for 5 point calibration of instruments. c) Vent and drain plugs d) Special calibration tool/configurator,if any. e) ½"NPT cable gland

	19.	Preferred Features	:	a) Test plug connection and cutout terminals physically separated from other electronics. b) Electronic Damping facility (adjustable).
1.04.00		Mass Flow meter		
1.04.01		Sensor		
	01.	Measuring Principle	:	Coriolis Mass flow.
	02.	Primary Element	:	Flow Tube of 316SS or better
	03.	Heating Arrangement	:	Integral.
	04.	Temperature Control	:	For heavy fuel oil application.
	05.	Process Connection	:	Flanged of rating as per process requirement.
	06.	Drain	:	Self-draining facility
	07.	Enclosure	:	Stainless steel
	08.	Accessories	:	Counter flanges, Mounting nuts, bolts, gaskets etc.
1.04.02		Transmitter		
	01.	Measured quantities	:	Mass Flow rate, Total Mass Flow, Density.
	02.	Input Signal Processing	:	Digital Processing.
	03.	Display	:	Digital Display (LCD).
	04.	Output	:	2 off. isolated 4-20mA DC output.
	05.	Load	:	< 750 ohms.
	06.	Power supply	:	240V AC, 50 Hz.
	07.	Turn Down	:	100:1
	08.	Accuracy	:	$\pm$ 0.2 % of measured value
	09.	Housing	:	IP 65
	10.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
	11.	Accessories	:	a) Handheld configurator b) Mounting U-bolts, nuts, bolts, prefab cable etc. c) ½"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 ^{O} arc.

07.	Window	:	Shatterproof glass
08.	Range Selection	:	Normal process pressure: 50~70 % of range
09.	Over-range Protection	:	125% of maximum range by internal stop. External stop at zero.
10.	Adjustment	:	Micrometer screw for zero. Internal micrometer screw for range.
11.	Element Connection	:	Argon welding
12.	Process Connection	:	1/2" NPT (M) Bottom for local, back for panel mounting.
13.	Performance	:	Accuracy of $\pm$ 1.0 % of span or better.
14.	Operating ambient	:	0 - 50 ^{O}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	:	½" NPT
09.	Case Material	:	Stainless steel
10.	Dial Size	:	150 mm in general
11.	Scale	:	Black lettering on white in 270 ^{O} arc.
12.	Mounting	:	Surface/Panel
13.	Over range Protection	:	125 % of range or more

14.	Instrument connection	:	Bottom for local and back for panel mounting.
15.	Range	:	Normal temperature–50~70% of range.
16.	Zero adjuster	:	Micrometer screw adjustable from front.
17.	Window	:	Shatterproof glass.
18.	Accuracy	:	± 1 % or better
19.	Enclosure Class	:	IP-65
20.	Capillary	:	5 meters (local surface)/15.0 meters (local panel) - armoured stainless steel
21.	Compensation	:	Capillary and Case Compensation
22.	Accessories	:	a) Forged barstock thermowell screwed as per ASME PTC code. Process connection M 33X2 (M). 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	:	± 1.1^0 C up to 300 ^{0} C & 0.4% of measured temperature range above 300 ^{0} 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 to well : ½" NPT

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 ^{O}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 : $\pm$ 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 ± 1.0% b) Accuracy of Setting Indication of ± 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 ± 1.0% b) Accuracy of set point Indication: ±1.5%

14.	Operating Ambient	:	0 - 50 ^{O}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 Tapings	:	As required plus one additional pair of taps
	04.	Diameter Ratio	:	Between 0.4 to 0.7
	05.	Thickness	:	3 mm for main pipe diameter up to 250 mm, 6 mm for main pipe diameter above 250 mm and 10 mm for main pipe diameter of 500 mm and above.

	06.	Document	:	Beta ratio calculation, assembly drawing and Flow vs. DP curve.
	07.	Meter run pipe	:	Same as pipe material
	08.	Accessories	:	Flanges, gaskets, nuts & bolts, root valves jack screw, meter run pipe, Drain & vent hole as per application etc..
1.14.00		Flow Nozzle		
	01.	Application	:	High fluid velocity flow measurement
	02.	Design Standard	:	ASME PTC 19.5
	03.	Number of Tapings	:	As required plus one additional pair of taps
	04.	Diameter Ratio	:	Between 0.4 and 0.7
	05.	Thickness	:	Suitable for the application
	06.	Document	:	Beta ratio calculation, assembly drawing and Flow vs. DP curve.
	07.	Meter run pipe	:	Same as pipe material
	08.	Accessories	:	Meter run pipe, nipples and root valves. (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.	Hysterisis	:	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/m^3, 0-999 mg/Nm^3, 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 ^{O}C (max 600 ^{O}C)
	12.	Ambient temperature	:	0 - 60 ^{O}C
	13.	Operating temperature	:	Transmitter & receiver- 0-90^{O}C, Electronic unit - 70 ^{O}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

19.	Automatic compensation of lens contamination	:	Required
20.	Purge air Failure	:	Purge air to be provided from Blower unit and to be monitored for failure.
21.	Span and Zero Check	:	Automatic periodic with manual override
22.	Housing	:	Corrosion resistant painted aluminium rated at IP-65
23.	Fail safe shutter	:	Automatic fail safe shutter against power and air failure
24.	Input normalisation	:	Correction for temperature, pressure, oxygen and water vapour to be provided.
25.	Preferred Features	:	"Power Supply On" LED visible from front
26.	Accessories	:	a) Mounting pads suitable for mounting projector and receiver units on duct, flanges, etc. b) Blower unit (Purging System) with purge fail alarm at CCR c) Enclosure for electronic units & indicators d) Control unit for interface with PC based data logger
27.	Application	:	At chimney At each ESP oulet

1.18.00 SOx, NOx, CO, CO2 , O2 & Moisture Analyzer

01.	Type	:	In-situ Probe type combined analyser / Sampling extraction type.
02.	Gases to be measured	:	SOx, NOx, CO, CO_2, O_2 and Moisture
03.	Principle of measurement	:	Infrared absorption
04.	Flue gas Temperature	:	350 ^{O} C
05.	Ambient temperature	:	60 ^{O} C
06.	Mounting	:	On chimney
07.	Measurement range	:	0-3000 ppm / mg/Nm^3 for SOx, NOx, CO, O_2 and 0-25% for CO_2 and Moisture - fully selectable
08.	Units of measurement	:	PPM, mg / Nm^3 and %
09.	Power Supply	:	240V, 50 Hz, 1 Phase
10.	Local Display	:	Back lit LCD / LED
11.	Measurement averaging	:	10 sec to 60minutes (selectable)
12.	Accuracy	:	2% of measured value
13.	Repeatability	:	2% of full scale
14.	Response time	:	5 seconds or better for 95% of full scale

	15.	Zero & Span drift	:	2% per month
	16.	Calibration	:	Zero and Span calibration in manual and automatic mode. Automatic calibration interval shall be fully selectable.
	17.	Analog output	:	4-20 mA DC (in 500 ohm resistor) to for each channel
	18.	Alarm output	:	1NO + 1NC rated at 230V AC, 5A
	19.	Input normalisation	:	Required–online with pressure and temperature sensor and also provision for key pad entry of inputs
	20.	Probe material	:	Stainless Steel 316L
	21.	Enclosure	:	Corrosion resistant epoxy painted aluminium housing & enclosure rated to IP-65.
	22.	Accessories	:	a) Blower unit, tubes & fittings for calibration and purging, purge fail alarm in CCR b) Calibration gas cylinders for SO_2, NO_x CO_2, O_2 and CO filled in 10 Ltrs. Of WC carbon cylinder with necessary SS regulators with pressure & flow gauges, solenoid valve & SS tubings and SS fittings etc. as required. c) Mounting flanges, gasket etc. d) Control unit for interface with PC based data logger
	23.	Application	:	On flue gas stack.
1.19.00		Stack Gas Velocity Monitor		
	01.	Type	:	Non contact type
	02.	Measurement	:	Flue gas velocity
	03.	Principle of measurement	:	Time delay correlation of flue gas Infrared emission received by two detectors located at a distance apart on the chimney.
	04.	Flue gas Temperature	:	Up to 350 ^{O} C
	05.	Ambient temperature	:	60 ^{O} C
	06.	Mounting	:	On chimney
	07.	Measurement range	:	As required
	08.	Units of measurement	:	velocity- m/sec, flow- m^3 /sec
	09.	Power Supply	:	240V, 50 Hz, 1 Phase
	10.	Local Display	:	Back lit LCD / LED
	11.	Measurement averaging	:	10 sec to 60minutes (selectable)
	12.	Accuracy	:	2% of measured value
	13.	Linearity	:	2% of full scale

	14.	Response time	:	5 seconds or better for 95% of full scale
	15.	Zero & Span drift	:	2% per month
	16.	Calibration	:	Zero and Span adjustment
	17.	Analog output	:	4-20 mA DC (in 500 ohm resistor) to for each channel
	18.	Probe material	:	Stainless Steel 316L
	19.	Enclosure	:	Corrosion resistant epoxy painted aluminium housing & enclosure rated to IP-65.
	20.	Accessories	:	a) Blower unit, tubes & fittings for calibration and purging, purge fail alarm in CCR b) Mounting flanges, gasket etc. c) Control unit for interface with PC based data logger
	21.	Application	:	On chimney
1.20.00		Oxygen Analyzer		
	01.	Type	:	In-situ, Zirconium sensor, micro-processor-based transmitter, field repairable.
	02.	Range	:	0.1-10% / 0.25-25% by volume
	03.	Output	:	4-20 mA DC linear
	04	Probe Length	:	1800 mm (approximate depending on duct size)
	05.	Process Temperature	:	850 ^{O} C approx.
	06.	Measurement Reference	:	Instrument Air
	07.	Accuracy	:	$\pm$1% of F.S.
	08.	Response Time	:	Less than 5 (five) seconds
	09.	Amplifier Housing	:	IP-65
	10.	Calibration	:	Automatic periodic
	11.	Calibration Frequency	:	Once every 24 hours
	12.	Power Supply	:	240V, 50 Hz, 1 Phase
	13.	Material for Gas Carrying Components	:	Stainless Steel
	14.	Read Out	:	LED/LCD Local indicating meter
	15.	Protection	:	Automatic cell protection against reducing atmosphere
	16.	Alarm Facility	:	1 HI and 1 LO independently adjustable over span. Contact rating 500 mA at 220 V DC (minimum).
	17.	Preferred Features	:	a) HI and LO alarm LED visible from front. b) Power Supply On/Failure LED visible from front

18.	Accessories	:	a)	Mounting flanges, adaptor plate and protection shield
			b)	Gasket, nuts and bolts
			c)	Cable with conduit from cell to amplifier (as required) and other special cables (if any)
			d)	Automatic calibration kit (complete with all accessories and standard Gas Cylinders)
19.	Application	:	a)	At each economizer outlet
			b)	At each air preheater outlet

1.21.00 CO, NOx & Moisture Analyzer

01.	Type	:	In-situ Probe type combined analyser
02.	Gases to be measured	:	CO, NOx and Moisture
03.	Principle of measurement	:	Infrared absorption
04.	Flue gas Temperature	:	850 ^{O} C (max)
05.	Ambient temperature	:	60 ^{O} C
06.	Mounting	:	On duct
07.	Measurement range	:	0-3000 fully selectable
08.	Units of measurement	:	PPM and mg / Nm^3
09.	Power Supply	:	240V, 50 Hz, 1 Phase
10.	Display	:	Back lit LCD / LED
11.	Measurement averaging	:	10 sec to 60minutes (selectable)
12.	Accuracy	:	2% of measured value
13.	Repeatability	:	2% of full scale
14.	Response time	:	5 seconds or better for 95% of full scale
15.	Zero & Span drift	:	2% per month
16.	Calibration	:	Zero and Span calibration in manual and automatic mode. Automatic calibration interval shall be fully selectable.
17.	Analog output	:	4-20 mA DC (in 500 ohm resistor) to for each channel
18.	Alarm output	:	1NO + 1NC rated at 230V AC, 5A
19.	Input normalisation	:	Required – online with pressure and temperature sensor and also provision for keypad entry of inputs
20.	Probe material	:	Stainless Steel 316L
21.	Enclosure	:	Corrosion resistant epoxy coated aluminium housing & enclosure rated to IP-65.

	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 (H_2 in CO_2, H_2 in air and CO_2 in air)
	03.	Range	:	As required
	04.	Output	:	4-20mA DC (Isolated)
	05.	Operating ambient temp.	:	10 ^{O} 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 ºC
	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 Hestalloy (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"ETcable 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	:	¼" 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 ^{O} C
10.	Fluid Temperature	:	0-150 ^{O} 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	:	3/4" ET
16.	Accessories	:	Mounting brackets, nuts and bolts

	17.	Preferred feature	:	a) Solenoid valve directly integral to actuator body shall have NAMOOR interface for uniformity b) Local indication for power
1.29.00		Sight Glass		
	01.	Type	:	Flap-type
	02.	End connection	:	Screwed / Flanged
	03.	Material:		
		a) Body	:	CS/SS as per process medium
		b) Indicator	:	Stainless steel
	04.	Sight Glass	:	Toughened Borosilicate
	05.	Gasket	:	Neoprene
	06.	Bolts & Nuts	:	High tensile steel
	07.	Hydraulic Test Pressure	:	1.5 times maximum working pressure
	08.	Accessories	:	As required
1.30.00		Flow Indicating Switch		
	01.	Type	:	On line metal tube Rotameter
	02.	End connection	:	Flanged
	03.	Material:		
		a) Body	:	CS/SS as per process medium
		b) Float	:	Stainless steel
		c) End fittings/flange	:	Stainless steel
		d) Other wetted part	:	Stainless steel
		b) Casing	:	Di cast Alluminium
	04.	Accuracy	:	+/- 2.0% of FSR
	05.	Rangeability	:	10:1
	06.	Electrical connection	:	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.~~

21.00.00	**WATER SYSTEM RELATED SPECIAL INSTRUMENTS(DM PLANT, CPU PLANT, PT PLANT, AWRS ETC)**		
21.01.00	**ANALYSER INSTRUMENTS:**		
	Common Requirements		
	1	Output signals Analog	4-20 mA DC
	2.	Zero & span Adjustment	To be provided
	3.	Ambient temp.	50°C
	4.	Indication	LCD
	5.	Enclosure Type/Material	Weather & Dust proof (IP 55) Die cast Aluminium/SS
	6.	Type of Electronics	Microprocessor based
	7.	Calibration	Auto & Manual (hand held HART calibrator)
	8.	Error Diagnostic	To be provided.
	9.	Power supply	240V AC 50, Hz single phase/ 24 V DC. Power supply is to be arranged by Contractor. In case the Analysers require UPS, then the same shall also be in the scope of Contractor.

	10	Load	500 Ohms minimum
	11.	Other Requirements	Instruments shall be HART compatible All mounting arrangements for the sensors and the monitors are to be provided by the Contractor. A free standing cabinet is to be provided by the Contractor for mounting the transmitters/meters. All weather canopy for protecting the electronics/sensors are to be provided. The analyser type, model and make shall be as approved by Employer during detailed Engineering. The estimated volume of reagents required for 30 days continuous operation of each analyser and their estimated cost FOB shipping point with freight allowed to the plant site shall be submitted. All chemical reagents for 12 months operation of the analyser shall be furnished. Shelf life of reagents shall also be indicated in the proposal. Auto & Manual (hand held HART calibrator) To be provided.
21.02.00	**pH Analyser**		
	1.	Type	Cell - flow through
	2.	Accuracy	< ± 1% of span
	3.	Response time	< 5 minutes.
	4.	Range	0 - 14 pH, programmable
	5.	No. of steams	Single
	6.	Stability	< 0.001 pH / week
	7.	Temp. coefficient / Temp. error	0.001 pH / Deg. C

	8.	Type of electronics	Microprocessor based with self-diagnostic Facility.
	9.	Indication	Digital
	10.	Enclosure	Weather dust proof (IP55) Die cast aluminum.

21.03.00 **Conductivity Monitors**

Specific conductance cell

Specific conductance cell shall be provided with suitable electrode material and cell body material taking into account the various factors of actual service conditions, corrosion resistance etc. Cell constant shall be subject to Owner's approval, the cell shall be provided with automatic temperature compensation. The specific conductance cell shall be suitable for use in the plant discharge water.

Conductivity cells are shall be compatible with the conductivity monitors.

The monitor shall have the following design features :

a)	Power supply	:	240V AC 50, Hz single phase/ 24 V DC
b)	Range	:	0-1, 0-10, 0-100, 0- 1000, 0- 10,000 micro mho/cm programmable. 0-2500 ppm for dissolved solids.
c)	Signal accuracy excluding meter accuracy	:	Approximately 1% of full scale
d)	Temperature compensation	:	Automatic
e)	Response time	:	<=1 sec.
f)	Identification	:	Phenolic nameplate stating monitor number, sample and conductivity cell number.
g)	Output	:	4-20 mA DC buffered output capable of driving a minimum load impedance of 500 Ohms.

Analysers, monitors shall be microprocessor based.

The monitor shall be of multi-range type, single range monitor shall not be acceptable.

~~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 ^{O} 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	:	$\pm$1% or better
07.	Protection Class	:	IP-42
08.	Operating Ambient Temp.	:	0-50 ^{O}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, $\pm$2 digit
05.	Input	:	4-20mA DC/1-5 V DC/RTD/Thermocouple
06.	Mounting	:	Flush Panel
07.	Power Supply	:	240V $\pm$10%, 50 $\pm$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 275ºC	:	Cast carbon steel ASTM A216 Gr. WCB
2.	Non corrosive, non-flashing and non cavitating service for fluid temperature above 275ºC	:	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 :

a) The valves shall pass normal flow (MCR condition) with 60 to 70 percent opening for linear characterised valves and between 70 to 80 percent opening for equal percentage characterised valves.

b) The valves shall have adequate rangeability to pass the minimum and maximum flows at 10% and 85% of the valve opening respectively. Valve stem travel range from minimum to maximum flow condition shall not be less than 50% of the total valve stem travel.

c) Valve Cv shall be selected in such a way that the valve shall be capable of handling at least 120% of required maximum flow.

d) The valve selection shall be based on the highest size dictated by the above considerations unless noise, flashing or other factors dictate the final selection.

e) Trim 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 (232ºC 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 275ºC.	:	SS 316 stellited
2.	Non corrosive, non-flashing and non cavitating service for fluid temperature above 275ºC.	:	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 80O 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

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

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

5.10.00 Control Desks

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

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

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

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

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

5.10.06 Desks shall have concealed cable trays for wire dressing.

5.10.07 Design shall include Earthing bolts.

5.10.08 Back installed items shall be suitably concealed from front view.

5.11.00 Back Up Panel

5.11.01 Construction shall be from sheet steel of thickness not less than 3mm.

5.11.02 Electrical upright Panel construction & design shall be similar to back up panel. Control switches, meters, indicators, synchronizer, excitation control switch, annunciation window etc. along with associated mimic diagram, as recommended, shall be provided for manual synchronization of generator.

5.12.00 Cabinets / Enclosure / Panels

01.	Material of construction	:	Cold rolled steel sheet
02.	Thickness of Sheet	:	a) 3.0 mm for faces supporting instruments / terminals. b) 2 mm for other sides and top.
03.	Construction	:	Welded throughout as per approved National Standards.
04.	Panel height	:	2300 mm (approx)
05.	i) Corners	:	7 mm inner radius
	ii) Dimensional Tolerances	:	a) In height & length - 3 mm b) In height between adjacent sections - 2 mm. c) Total for a group - 6 mm
06.	Doors	:	Double, recessed, turned back edges
	i) Thickness of Sheet	:	2 mm
	ii) Hinges	:	Stainless steel
	iii) Door latches	:	Three point type
	iv) Door gaskets	:	Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure.
	v) Opening of the doors	:	Outward
	vi) Louvers	:	With removable wire mesh to ensure dust and vermin proof.
07.	Color of interior	:	Brilliant white
08.	Colour external	:	RAL 7032
09.	Painting	:	Epoxy powder coated or better
10.	Gland plates	:	Removable 4 mm thick (bottom)
11.	Cable entry	:	Bottom
12.	Hardware	:	a) Anti vibration pad- 15 mm b) Predrilled base channel ISMC - 100 or equivalent for all sides.

c) Stainless steel buff- finished 2 mm thick kick plate for all sides.

d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws.

e) Rubber strips to ensure air tightness between kick plate and finished floor.

f) Lifting hook / Eye bolt

g) Drawing pocket

h) Door switch, lamps, thermostat, heaters and fans

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

5.13.00 Local Instrument Racks & Enclosure

5.13.01 General Requirements

a) Devices located in the field shall be grouped and installed in the enclosure (Open / Closed Rack) in Boiler and TG Building.

b) Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc.

c) No more than six instruments shall be grouped in a single rack / enclosure.

d) Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point.

e) Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.

f) Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.

g) Instrument piping and tubing shall be hydrostatically tested at one and one-half times the maximum system pressure except for low pressure and vacuum measurement for which the test pressure will be as per piping standard.

h) Service air connection shall be provided for continuous and intermittent purging of impulse pipe in dusty medium. Continuous purging shall be adopted for differential pressure measurement such as flue gas and coal air mixture application. Pressure measurement shall have only intermittent purging whenever required. In case of continuous purging, an air header shall be formed this shall receive service air through isolation valve and air filter regulator. Air shall be fed from the air header to both the impulse pipes near to take off points through isolation valves and flow regulators. Air header shall be constructed from stainless steel. Impulse pipe for such applications shall have a four-way valve. One port of the valve shall have an adaptor to connect flexible stainless steel braided nylon hose to the service air. Rating of the hose shall not be less than 10 Kg/sq.cm.

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

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

j) Drawing K9213R-DWG-I-0200 shall be referred for typical arrangement of Local instrument enclosure and rack.

5.13.02 Closed Instrument Rack

a) Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load-bearing posts shall be suitably supported by gusset plates or moment members.

b) Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.

c) 2” NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any member, which would reduce access, shall be avoided.

d) Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior. Key shall be of identical for all enclosures.

e) Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box.

f) Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket Impulse lines within the enclosures shall be properly clamped.

g) All internal wirings between the instruments and junction box shall run through flexible conduits.

h) Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Header shall be of 2” NB ASTM A 106, Sch-80 Gr. C installed at a slope of 1:25 and extended beyond the rack for connection to plant drain header.

i) Each rack shall be provided with one receptacle, light fixtures each at instrument & Junction box compartments with wire guard.

5.13.03 Open Instrument Rack

a) Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or falling objects and shall be epoxy painted. Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable protective grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project. Canopy shall be of CRCA steel sheet of at least 3 mm thickness. Center posts or any member, which would reduce access, shall be avoided.

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

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

d) All racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Header shall be of 2" NB ASTM A 106, Sch-80 Gr. C installed at a slope of 1:25 and extended beyond the rack for connection to plant drain header.

5.13.04 Junction Box

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

a) Junction box shall be provided at a dry compartment at one side of the enclosure / rack with front opening type door. Earth stud shall be furnished at rack for safety grounding.

b) Terminals shall be screwless cage clamp type of reputed make and 20% spare terminals shall be furnished in the junction box.

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

~~6.01.00 System Functional Description~~

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

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

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

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

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

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

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

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 ^{O} 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 ± 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 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.

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 20^0 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 ^{O}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 ^{O} 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 ASTMD 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	: ainless steel	: tainless 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	: ¼” 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/cm^2
	Differential Pressure	: mm of H_2O column / Kg/cm^2
ii)	Draught	: mm of H_2O column
iii)	Vacuum	: Kg/cm^2 (abs)/mm of Hg column
iv)	Temperature	: Degree Celsius (^{O} C)
v)	Flow (Steam, Water)	: Tonnes / hr, M^3/Hr
vi)	Flow (Oil)	: M^3 / Hr, Litter/Hr
vii)	Flow Air	: Tonnes / hr / M^3 / 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 :

a) For liquid service within 45 ^{O} at lower half of the pipe horizontal plane.

b) For gas service within 90 ^{O} at upper half of the pipe horizontal plane.

c) For steam service within 45 ^{O} 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~~

PLC SPECIFICATION

~~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, oli flow, oil termperature 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:

a) Internal bus and external data network loading shall in no case be more than 60% of its capacity.

b) Disrupted message shall be automatically retransmitted when the system is restored.

c) Failure or physical removal of any module connected on the system bus shall not lead to any loss of communication.

d) Diagnostics message shall be issued on fault detection.

e) 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 ± 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 μm ±1.0 μm
b)	Cladding non-circularity	≤ 1.0%
c)	Attenuation Coefficient at (a) 1290 nm to 1340 nm (b) 1525 nm to 1575 nm	 < 0.36 dB/km < 0.25 dB/km
d)	Chromatic Dispersion Coefficient at (a) 1310 nm (b) 1550 nm	 < 3.5 ps/nm.km < 18 ps/nm
e)	Polarization Mode Dispersion (PMD)	≤ 0.5 ps/√ km
f)	Mode Field Diameter at (a) 1310 nm (b) 1550 nm	 9.2 ± 0.4 μm 10.50 ± 1.0 μm
g)	Mode Field Concentricity Error	≤ 0.5 μm
h)	Proof Test	≥1%
i)	Fiber Curl (ROC)	≥ 4.0 m
j)	Macro-bend Test on Fiber at 1550 nm	≤ 0.1 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, than the fiber optic distribution panels shall be equipped with splice trays for storage and protection of fusion splice connections of single-mode fiber optic cable and pigtails. Each fiber optic distribution panel shall be fully equipped with 'SC' type 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)

PEM :: C&I

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	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, Hardwares, 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

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
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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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1 - BHEL 2 - Vendor 3 - Sub-vendor

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	
3.0	**Factory Acceptance Test (FAT)**											
3.1	Input Output Functional Verification	I/O configuration, I/O operation	MA	Visual/ Eletrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.2	Processor Verification	Processor configuration, Powering up, standby operation (as applicable) and Loading	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.3	Power Supply Module Verification	Redundancy Operation	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.4	Communication System Verification	Redundancy operation of Communication System, Measurement of Response Time, Communication with third party system	MA	Electrical	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.5	Diagnostic Verification	Self Diagnostic features of PLC system	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.6	Control Panel/Desk Verification	Operation of PLC driven annunciation system, Mosaic, Push buttons & selector switches, Indicating lamps	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	1	
3.7	Software Verification	(i) Control Logics (ii) Engineering Features (iii) HMI Features	MA	Visual	100%	FAT Procedure	AS per FAT	BHEL Quality Inspection Report.	2	1	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

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

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

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.

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.

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 Spcific :

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?

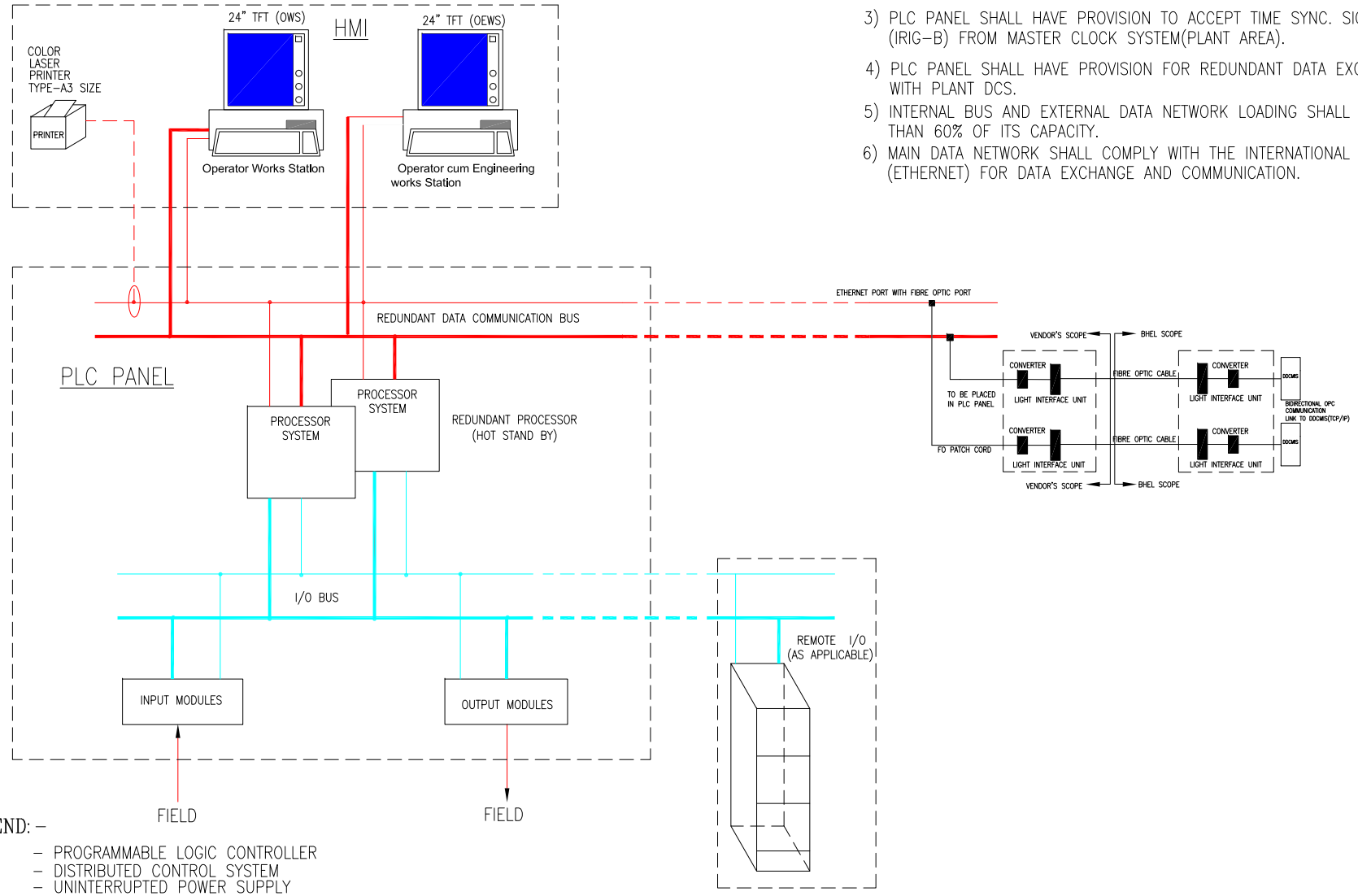
E1 Reqd. Contents : This document must provide an overview of the device including its intended use(a general technical,communication & electrical details)

Format for vendor to furnish signal
Exchange list between DCS-PLC

Tag Name	Tag Description	Modbus address	Point type	Range	Alarm Setpoint	Alarm priority	History reqd	Function code	

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.

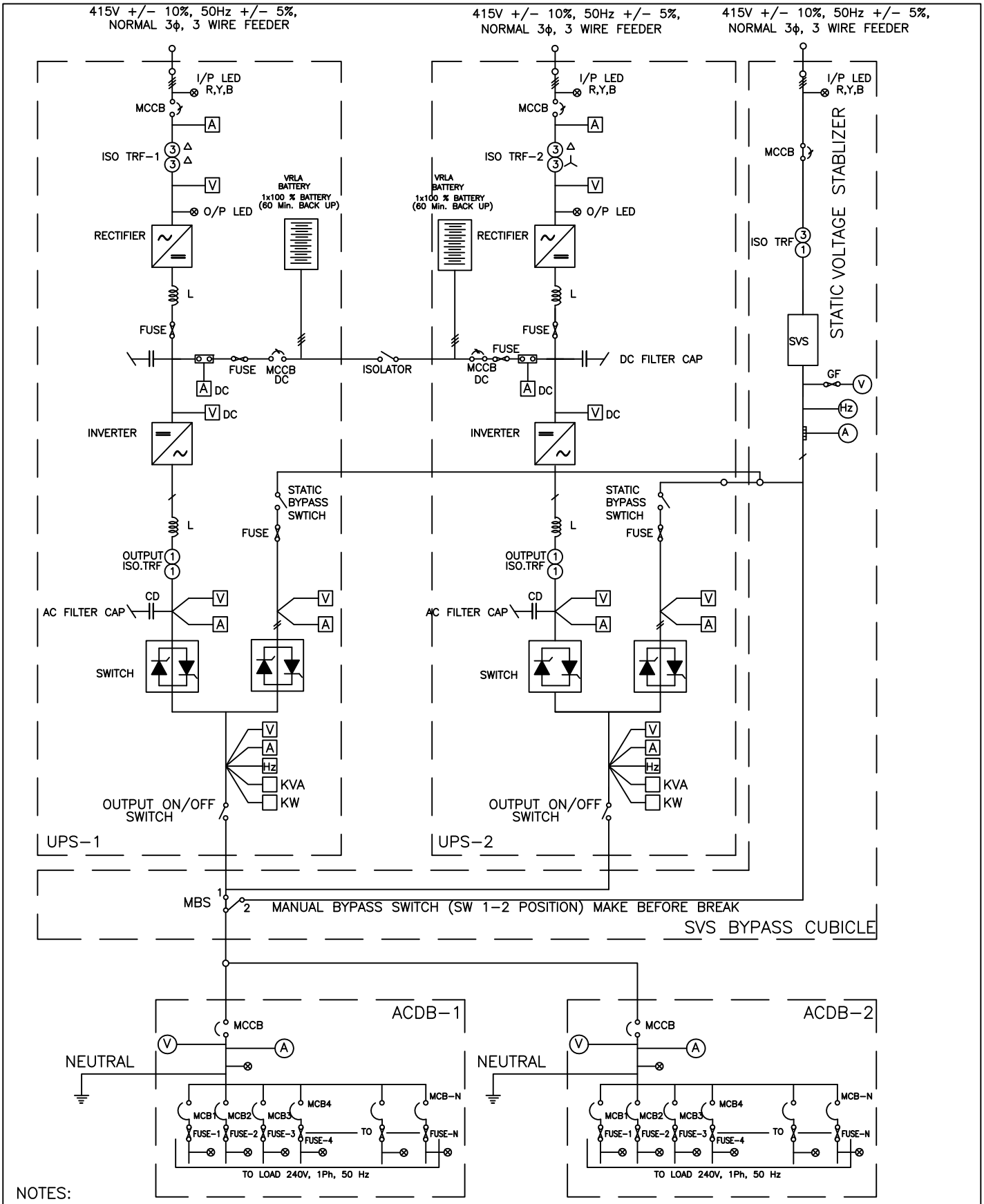


LEGEND: –

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

BHEL	PLC SYSTEM CONFIGURATION	DRG. NO.	
		REV. No.	DATE
		SHEET	01 OF 01

UPS SPECIFICATION



NOTES:

1. ACDB-1&2 NEUTRAL TO BE GROUNDED TO A DEDICATED GROUND.
2. ALL OUTPUT FEEDERS OF ACDB SHALL BE PROVIDED WITH AN LED AFTER THE FUSE FOR FEEDER ON INDICATION WITH FEEDER DESCRIPTION.
3. REDUNDANT FEEDERS SHALL BE LOCATED IN DIFFERENT ACDBs.

BHEL	1x800 MW WANAKBORI THERMAL POWER STN	DRG. No.	
TITLE:- UPS SCHEME		REV. No.	DATE
		SHEET	

CONTENT

ATTACHMENTS

SECTION-XIV

TECHNICAL SPECIFICATION FOR UNINTERRUPTIBLE POWER SUPPLY

1.00.00 SCOPE OF WORK

1.01.00 Scope of Supply

The scope of supply shall include Uninterruptible Power Supply (UPS) Systems with parallel redundant arrangement as specified below.

i) Each set of UPS system will consist of :

a. 2x100% capacity static inverter & input isolation transformer

b. 100 % capacity static switches (2 nos.)

c. One manual bypass switch

d. 2x100% capacity float-cum-boost chargers

e. 2x100% capacity UPS system battery (VRLA Type) with back up time of 1 hour

f. One step down transformer; (415 V three phase to 240 V single phase) for bypass

g. One static voltage regulator

h. Two AC distribution boards (ACDB-1A and ACDB-1B)

i. Interconnecting cable between UPS Equipment, battery and ACDB.

j. Two (2) nos. input output isolation transformer

Any other equipment necessary for complete of the system

ii) One (1) set of special tools and tackle.

iii) Mandatory Spare parts.

iv) List of recommended spare parts for three (3) years satisfactory and trouble-free operation of the equipment.

v) All relevant drawings, data and instruction manuals.

2.00.00 CODES AND STANDARDS

a) All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) except where modified and/or supplemented by this specification.

b) Equipment and materials conforming to any other standard which ensures equal or better quality may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

c) The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules or regulations applicable to the work shall be followed.

3.00.00 DESIGN CRITERIA

3.01.00 Design Basis

a) UPS System provides a regulated and uninterrupted single phase A.C. power, within specified tolerances, to critical station loads during normal and emergency operation. Capacity of inverter output shall be computed by the contractor considering the above requirement. 25% spare margin shall be kept on the total of above requirement.

b) The UPS system excluding its battery shall be installed indoors in A.C. environment.

c) UPS shall be worked at its full capacity even battery is not connected with the system.

d) UPS system shall be compatible for satisfactory and well-coordinated operation with other related equipment as well as with input and output systems.

e) Energizing or de-energizing any portion of the system serviced by the UPS shall not cause output changes which will affect the operation or integrity of the remaining portions of the system in any way.

f) The equipment shall be self-protecting against all A.C. and D.C. transients, voltage surges and steady state abnormal voltages and currents.

g) The circuit protection shall be coordinated with UPS short circuit capacity and protective device characteristics so that a fault on any circuit shall result in minimum loss of function.

h) All non-interrupting components of UPS system shall be capable of withstanding the prevailing short circuit current without damage.

i) All circuit interrupting components shall be capable of withstanding and interrupting the prevailing short circuit currents without damage.

j) The procedure for battery sizing calculation shall be generally as per IS 15549, considering design margin as 15% and aging factor as 1.25

k) For continuous operation at specified ratings, temperature rise of the various components of UPS system shall be limited to the permissible values stipulated in the relevant standards and/or this specification.

l) The chargers, inverters, static switches, regulating transformers and voltage stabilizers should be arranged in such a way that any equipment can be fully isolated for maintenance without affecting in any way the operation of other panels/components.

m) The chargers, inverters, static switches, regulating transformers and voltage stabilizers should be arranged in such a way that any equipment will be fully isolated for maintenance without affecting in any way the operation of other panels/ components.

n) In the A.C. Distribution Board, the Bidder shall provide 10% or minimum one (1) no. spare feeder of each size and type of the outgoing feeders.

3.02.00 **System Concept**

A D.C. power source and an A.C. power source are available to the UPS system. The system is so designed that its load shall be served without interruption as long as one of the above power sources is available within specified limit of voltage and/or frequency.

Two inverters, each of 100% capacity will normally work, each sharing 50% UPS load. On failure of any inverter, its load gets automatically transferred to the other inverter through static transfer switch.

If one inverter is out of service for any reason then the second inverter will be working with 100% UPS load. On failure of this inverter the standby A.C. source will back up to supply the 100% UPS load automatically through static transfer switch.

3.03.00 **Layout Criteria**

The UPS system will be located indoor.

The Contractor shall indicate the space requirement for the equipment offered by them separately for UPS cabinet, UPS battery and UPS distribution board.

Battery room ventilation shall be under the scope of the Contractor.

4.00.00 **SPECIFIC REQUIREMENTS**

4.01.00 **Static Inverter**

a) The static inverters shall be static type consisting of IGBT PWM type inverter, static filters, integrated control modules including necessary oscillators, voltage regulators, current limiting and surge suppression.

b) The inverter equipment shall include all necessary circuitry and devices to conform requirements like voltage regulation, soft start, transient recovery, protection, automatic synchronisation, wave shaping, etc. as specified herein.

c) Upon transfer of full load, the inverter output voltage shall not drop below 80% of nominal voltage during the first half cycle after transfer and 90% of nominal voltage in the next half cycle. The recovery to within ± 2% of voltage shall be in less than 50 milli-seconds.

d) On occurrence of a fault in branch circuit, the inverter shall be capable of clearing the highest rated branch circuit fuse in 4 milli-seconds or less.

e) The inverter shall be protected against overload, short circuit, 100% loss of load, as well as excursions, loss or restoration of D.C. input voltage and synchronising voltage. The overload capacity shall be 125% for 10 mins., 150% for 60 secs. and 300% for 4 msecs.

f) The D.C. input current shall never exceed twice the full load current except for a short circuit within the inverter.

g) For any value of the load and load power factor drawn by the equipment served, the inverter shall not impose on D.C. source any voltage oscillations in excess of 5 volts (RMS total all frequencies) or any current oscillations in excess of 3 percent (RMS total all frequencies) of the D.C. current at full load.

h) The inverter will be self protecting against A.C. and D.C. Transients, voltage surges and steady state abnormal voltage and currents likely to be encountered in the plant.

4.02.00 **Automatic Synchronisation**

a) Inverter equipment shall include stable solid state oscillator devices designed to automatically maintain the inverter output in phase and in synchronism with the stand-by A.C. source.

b) Facility shall be provided for automatic transfer to internal oscillator operation when the stand-by source frequency is beyond specified limits and the frequency shall be automatically controlled within 50 Hz plus or minus 0.5 Hz when the inverter operates in this mode.

c) Retransfer to stand-by A.C. source for synchronisation shall be automatic after the stand-by source frequency is restored to permissible limits and remains within this limit for an adjustable time delay period (up to 5 seconds).

d) Provision shall be made for stepless adjustment of synch- disconnect frequency range from 50 Hz ± 0.5 Hz to 50 Hz ± 2 Hz.

e) Automatic adjustment of phase relationship between inverter output and stand-by A.C. source shall be gradual at a controlled slow rate, which shall not exceed one hertz per second.

4.03.00 **Static Transfer Switch**

a) The static transfer switch shall be solid-state type using SCR for automatic/manual transfer of load from "inverter" to "stand-by" source and vice-versa.

b) Stand-by source can be either of the inverter or A.C. source depending on whether both the inverters are supplying 50% load each or one of the inverter is carrying 100% load.

c) The transfer time including sensing shall not be more than one-fourth cycle. Further the transition shall be make-before-break in both directions.

d) The capacity of static transfer switch shall be equal to the continuous full-load capacity of the inverter. The switch shall be provided with protective devices in both normal and alternate power source.

e) Static transfer switch shall be furnished with contact to alarm failure of the alternate source or opening of any fuse protecting the static switch.

f) Static transfer switch shall include all necessary circuitry and devices to meet the functional requirements of transfer initiation, transfer inhibit and re-transfer back to normal as detailed below

g) Transfer Initiation

i) The transfer of static switch from normal 'Inverter' position to 'stand-by' position shall be initiated by one of the following causes.

- Inverter failure and UPS system trouble
- Inverter output voltage failure.
- Manual push button operation

ii) The UPS bus shall be monitored by two voltage detectors. One fast acting circuit shall be used for detecting a complete and instantaneous voltage loss while the other slower acting averaging circuit with adjustable trip level shall be employed to detect voltage deviation beyond selected limits. Both voltage detector circuits shall automatically initiate operation of transfer switch.

iii) The static switch shall automatic transfer the load from inverter to stand-by source when the maximum I^2t capability of the inverter is reached and when the inverter output drops below 90%.

h) Transfer Inhibit

Automatic or manual transfer from inverter to stand-by A.C. source vice versa shall be inhibited when the inverter frequency is not synchronised to the alternate source.

i) Retransfer to Normal

1) The return to inverter mode shall be manual in all cases.

2) Manual transfer shall be initiated by push button actuation.

4.04.00 **Manual By-pass Switch**

a) Manual by-pass switch is used to isolate any static transfer switch for maintenance or repair without interruption to the UPS load.

b) The switch has also the facility of by-passing both the static transfer switches during start-up at the option of the operator.

c) Switch contact shall be make-before-break type.

d) The switch shall have current rating equal to the full load inverter current and necessary short time load carrying and interrupting capacity to meet the requirement of UPS system.

4.05.00 **Battery**

a) General

i. Each set of battery shall consist of number of cells assembled together on mounting racks.

ii. The battery shall be Valve Regulated Lead Acid (VRLA) maintenance free batteries. Each battery set will have sufficient capacity to maintain output at full rated load. The battery in normal case is not allowed to discharge beyond 80% of rated capacity at 10 hrs rate of discharge.

iii) The battery sets will meet the requirement of IS 15549 and will be suitable for continuous operation. The batteries will be suitable for float /boost charging

b) Constructional Requirement

The design of battery will be as per field proven practices. Partial plating of cells is not permitted. Paralleling of cells externally for enhancement of capacity will not be permitted. Protective transparent front covers with each module will be provided to prevent accidentally contact with lie module / electrical connections.

c) Container

Each cell will be assembled in heat resistant, acid resistant, shock absorbing robust, clear glass or lead lined wooden container having chemical and electro-chemical compatibility. The material will meet all the requirements of VRLA batteries and be consistent with the life of the battery. The container will be fire retardant. The porosity of the container will be such as not to allow any gases to escape except from the regulation valve. The tensile strength of the material of the container will be such as to handle the internal cell pressure of the cells in the worst working conditions. The container will be capable of withstanding the rigours of transport, storage and handling.

d) Cell covers

The cell covers will be made of suitable compatible with the container material and permanently fixed with the container it will be fire retardant. Fixing of Pressure Regulated Valve terminal posts in the cover will be such that the seepage of electrolyte gas escapes and entry of electro static spark are prevented.

e) Plates

Positive grid will be of pure lead calcium tin alloys and maintenance free characteristics. Positive plate will be free from cadmium. The positive & negative plates will be flat pasted.

Both positive & negative plates will be tanked formed to ensure that plates are fully formed.

f) Grid Growth Provision

This Provision should be made in the cell design to prevent failure due to internal shorting / rupture of cell because of grid growth.

g) Separators

The separators cells will be glass mat or synthetic material having high acid absorption capability, resistant to Sulphuric acid and good insulating properties. Proper arrangement to keep the separator plates in position will be furnished.

h) Pressure Regulating Valve

Each cell will be provided with a pressure-regulating valve. The valves will be self re-sealable and flame retardant. The valve unit will be such that it cannot be opened without a proper tool. The valve will be capable to withstand the internal cell pressure specified by the manufacturer.

i) Terminal posts

Both the positive and the negative terminals of the cells will be capable of proper termination and will ensure its consistency with the life of the battery. The surface of the terminal post extending above the cell cover including bolthole will be coated with an acid resistant and corrosion and retarding material. Terminal posts of any other metal part, which is in contact with the electrolyte, will be made of same alloy as that of the plates or of a proven material that does not have any harmful effects on cell performance. Both positive and negative posts will be clearly and unambiguously identifiable.

j) Connectors, Nuts, Bolts, Heat Shrinkable Sleeves

Nuts and bolts for connecting the cells will be made of copper, brass or stainless steel. Copper or brass nuts and bolts will be lead coated.

Wherever required separate non-corroding lead or copper connectors of suitable size will be provided to enable connection of the cells. Copper connections will be suitable lead coated to withstand corrosion due to Sulphuric acid.

All inter cell connectors will be protected with heat shrinkable silicon sleeves for reducing environmental impact including a corrosive environment.

k) Flame Arrestors

Each cell will be equipped with a Flame Arrestor to defuse the Hydrogen gas escaped during charge and discharge.

l) Battery Bank Stand and cell orientation

All batteries will be mounted in a suitable metallic trays / frame. Cells will be housed in a ventilated & protected modular steel tray to facilitate airflow between the cells. The partitions will have grooves to facilitate airflow. The steel tray will have partitions for each cell to maintain consistent compression & single cell replacement. The steel trays will be powder coated for acid resistance. The Cell orientation in the steel trays will be horizontal (i.e. the positive & negative plates should be parallel to ground.

m) Capacity requirements

The battery will be capable to deliver the rated load of the UPS for 60 minutes.

When the battery is discharged at 10 hours rate, it will deliver 80% of rated capacity corrected at 27^{o}C before any of the cells in the battery bank reaches 1.85 V / Cell.

4.06.00 **Float-cum-Boost Charger**

4.06.01 The charger shall be solid-state type with full wave fully controlled, bridge configurations. It shall be suitable for the inverter of IGBT type.

4.06.02 The charger shall be provided with automatic voltage regulation, current limiting, smoothing filter circuit and soft-start feature.

4.06.03 The charger shall have the provision of float, equalizing and boost charging. Further the charger shall be suitable for single and parallel operation.

4.06.04 Suitable circuitry shall be provided to ensure that the charging current is voltage regulated and current limited.

4.06.05 Each charger shall be rated to meet 100% UPS load plus recharge the fully discharged UPS battery within 8 hours.

4.06.06 Voltage control shall be stepless smooth and continuous. Float & equalizing control shall have an adjustable range of ± 5%.

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 gasketted 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.

c) The arrangement shall be such that on occurrence of a fault the corresponding window will light up and stays lighted until the fault is cleared and reset button pressed.

d) Each time a window lights up a master relay will get energized to provide group alarm signals for remote DCS alarm system.

e) The requirements of indication/metering/alarms are given in the annexure.

f) Alarm contacts shall be rated 0.5 A at 220 V DC and 5A at 240 V A.C.

g) All indicating meter shall be digital type with in-built transducers (4-20mA) for hooking up with DCS.

4.11.00 **Lamp / Space Heaters / Receptacles**

a) The panels shall be provided with :

i) Internal illumination lamp with door switch.

ii) Space heater with thermostat control.

iii) 3-pin 6A receptacle with plug.

b) Lamp, heater and receptacle circuits shall have individual switch fuse units.

4.12.00 **Wiring / Cabling**

a) The panels shall be completely wired up. All wiring shall be done with flexible, 1100V grade, fire resistance PVC insulated wires with stranded 2.5 Sq.mm. copper conductors and routed through wiring troughs. Each wire shall be ferruled by plastic tube with indelible ink print at both end having terminal block No., terminal number as per approved wiring diagram.

b) Panels shall have removable gland plate for cable entry. All incoming/ outgoing cables shall be terminated in suitable terminal block.

c) Control terminal blocks shall be box-clamp type, minimum 10 Sq.mm. 20% spare terminals shall be furnished.

4.13.00 **Nameplate**

a) Engraved nameplates shall be provided for each panel and for each equipment/device mounted on it.

b) The material shall be anodised aluminium / lamicoid, 3 mm thick, with white letters on black background.

c) Nameplates shall be held by self-tapping screws. The size of nameplates shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for panels.

d) Nameplates for panels shall be provided both on the front and rear.

e) Control and meter selection switches shall have integral nameplates. Nameplates for all other devices shall be located below the respective devices.

f) Instruments and devices mounted on the face of the panels shall also be identified on the rear with the instrument/device number. The number may be painted on or adjacent to the instrument or device case.

g) Caution notice on suitable metal plate shall be affixed at the back of each panel.

4.14.00 **Grounding**

a) Normal 3-phase A.C power supply will be grounded at the source. For grounding other than this, isolation transformer shall be furnished with the U.P.S.

b) The inverter D.C. input and A.C. output shall be electrically isolated from each other and from cabinet ground.

c) Panels shall have fully rated ground bus with two ground terminals, one at each end.

d) Each terminal shall comprise two-bolt drilling M10 G.I. bolts and nuts to receive ground connection of 50 x 6 mm G.S. flat.

e) Separate electronic grounding shall be provided for each UPS system.

4.15.00 **Tropical protection**

a) All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus insects and corrosion.

b) Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent the entrance of insects.

4.16.00 **Painting**

a) The panels shall be finished in light grey shade (RAL 7032) two coats of synthetic enamel paint. The panels shall have a matt finish to prevent any glare from surface due to illumination.

5.00.00 **TESTS**

5.01.00 **Shop Tests**

5.01.01 Type and routine test for various components

5.01.02 Functional tests to demonstrate compliance with all specified requirements and published specifications such as frequency regulation, voltage regulation,

current limiting, fuse clearing capability of inverters, demonstration of phase and frequency control of inverter for synchronisation with range of adjustments, transfer and re-transfer of static switches under influence of under voltage and over current, tests on chargers, batteries and other system component to confirm compliance with specification.

5.01.03 All equipment provided under the specification shall be operated under rated conditions and maximum ambient temperature for not less than 120 hours prior to release of shipment.

In addition static switches shall be subjected to not less than 1000 transfer/re-transfer cycles at full load.

5.02.00 **Test Witness**

Tests shall be performed with presence of Owner's representative if so desired by the Owner. The Contractor shall give at least thrity (30) days' advance notice of the date when the tests are to be carried out.

5.03.00 **Test Certificates**

5.03.01 Certified reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner.

5.03.02 The equipment shall be despatched from works only after receipt of Owner's written approval of the test reports.

5.03.03 Type test certificates on any equipment, if so desired by the Owner, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

6.00.00 **DRAWINGS, DATA & MANUALS**

6.01.00 **To be submitted with the Bid**

6.01.01 UPS panels, Battery Charger and Battery layout drawing with dimensions

6.01.02 General Arrangement drawing of UPS panels

6.01.03 Bill of Material

6.01.04 Schematic drawing of UPS circuits

6.01.05 Battery cell voltage characteristics and data for different discharge rates

6.01.06 Technical leaflets on :

a) UPS System

b) Battery

c) Battery charger

d) Inverter

e) Static Switch

f) Manual bypass Switch

6.01.07 Duty cycle diagram and battery sizing calculation in the format of relevant IS Standard

6.01.08 Sizing calculation of UPS system, charger main equipment, viz. SCRs, rectifier transformers etc

6.01.09 Type test certificates for similar equipment.

6.02.00 **To be submitted after Award of Contract**

6.02.01 Dimensional UPS, battery layout diagram in plan & section.

6.02.02 Connection details of take-off terminals.

6.02.03 Dimensional general arrangement drawings of UPS, battery charger, battery clearly showing device dispositions, cable entry, space requirement, etc.

6.02.04 Sectional views of UPS System panels

6.02.05 Panel foundation plan and loading

6.02.06 UPS system schematics and wiring diagrams

6.02.07 Test reports

6.02.08 Detailed bill of materials

6.02.09 Any other relevant drawing or data necessary for satisfactory installation, operation, and maintenance.

5.02.10 Cable schedule & Inter-connection charts.

6.02.11 Instruction manuals of UPS system

The manual shall clearly indicate method of installation, check-ups, and tests to be carried out before commissioning of the equipment.

6.03.00 The Tenderers may note that the drawings, data and manuals listed above are minimum requirement only. Tenderers shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment offered are submitted with their bids.

ANNEXURE-A

RATINGS & REQUIREMENTS

1.00.00	STATIC INVERTER		
1.01.00	Application	:	UPS System for MMI, SWAS and CEMS etc.
1.02.00	Type	:	static IGBT PWM type
1.03.00	Duty	:	Continuous
1.04.00	Enclosure	:	Sheet steel, IP42
1.05.00	Cooling	:	Natural convection or forced cooling using redundant fans.
1.06.00	Design Ambient temperature	:	50 Deg.C
1.07.00	Inverter capacity	:	To be decided by the Bidder
1.08.00	Overload capacity	:	300% for 4 m secs. 150% for 60 secs 125% for 10 mins 110% for continuous
1.09.00	Voltage		
	a) Inverter input, Battery output	:	To be decided by the Bidder
	b) Nominal output	:	240 V, 50 Hz, 1-phase
1.10.00	Voltage Regulation :		
	a) Steady state (0-100% load at all input voltages and all power factors)	:	$\pm$ 1.5%
	b) Transient voltage (On application or removal of 100% load)	:	$\pm$ 10%
	c) Time to recover from transient to normal voltage	:	50 milliseconds.
1.11.00	Wave form :		
	a) Nominal frequency	:	50 Hz

	b) Frequency range for all conditions of input supplies, loads & temperature occurring simultaneous or in any combination (automatically controlled)	:	± 0.05 Hz.
	c) Synchronisation limits (for maintenance of synchronism between inverter and standby A.C source)	:	49 Hz to 51 Hz (factory set)
	d) Field adjustment range for (c) above	:	50± 0.05 Hz to 50± 2 Hz
	e) Total Harmonic Content	:	5% maximum at rated load
	f) Harmonic content for any single harmonic	:	3% maximum
1.12.00	Rated output current at rated output voltage with current limit not operating		
	a) Current	:	200%
	b) Duration	:	100 milliseconds.
1.13.00	Efficiency at full load (Watt output/watt input)	:	90% or better.
1.14.00	SCR derating from peak voltage and peak rating	:	50%
2.00.00	STATIC SWITCH		
2.01.00	Type	:	Solid-state, SCR
2.02.00	Duty	:	Continuous
2.03.00	Enclosure	:	Sheet Steel, IP42
2.04.00	Cooling	:	Natural convection or forced cooling using redundant fans.
2.05.00	Ambient Temperature	:	50 Deg.C
2.06.00	Capacity		
	a) Continuous	:	Equal to full load capacity of the inverter.
	b) Overload	:	300% for 4 m secs. 150% for 60 secs 125% for 10 mins 110% for continuous

	c) Peak	:	1000% of continuous rating for 5 cycle.
2.07.00	Normal Voltage	:	240V, 50 Hz, 1-phase.
2.08.00	Transient Voltage Tolerance	:	340V peak above the nominal line voltage.
2.09.00	Transfer Time	:	less than 4 m secs.
3.00.00	MANUAL BY-PASS SWITCH/BREAKER		
3.01.00	Type	:	Maintained, make before break.
3.02.00	Voltage	:	600V
3.03.00	Rated Current	:	To meet the requirement as specified in clause no.: 3.04.00 d)
4.00.00	BATTERY		
4.01.00	Application	:	UPS Battery
4.02.00	Design Ambient Temperature	:	50 Deg.C
4.03.00	Type	:	VRLA type
4.04.00	Nos. of Cells per Battery	:	To be decided by the Bidder
4.05.00	Battery nominal voltage	:	To be decided by the Bidder
4.06.00	Battery AH rating	:	Bidder to compute considering 100% UPS load for 1 hour.
4.07.00	Method of working		
	a) Float charge (Normal)	:	2.23 Volts / Cell
	b) Boost charge (After complete discharge)	:	2.30 Volts / Cell
4.08.00	Mounting	:	Steel Rack
4.09.00	Connection	:	Cables
5.00.00	BATTERY CHARGER		
5.01.00	Charger	:	Float + Boost
5.02.00	Type	:	Solid-state, full wave, fully controlled.
5.03.00	Duty	:	Continuous
5.04.00	Enclosure	:	Sheet Steel, IP42

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	:	±10%
	c) Frequency variation	:	± 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 ± 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 ± 1% with battery and less than ± 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)

ANNEXURE-B

SET OF ACCESSORIES TO BE PROVIDED FOR EACH BATTERY BANK

a) One battery log book.

b) Two copies of printed instruction sheet.

c) One no. cell testing voltmeter (3-0-3 volts) complete with leads.

d) One no. rubber syringe type hydrometer suitable for specific gravity reading.

e) Three nos. pocket thermometer.

f) One no. thermometer (0 to 100°) with specific gravity correction scale.

g) One set cell bridging connector.

h) Battery racks suitable for accommodating the cells coated with paint.

i) Delrin insulator (with 5% extra), rubber pad etc. for rack.

j) Two nos. plastic filling bottle for filling up.

k) One pair of spanners.

l) Two pairs of rubber hand gloves.

m) Two nos. cell lifting straps.

n) One set of inter cell, inter tie and inter bank connectors as required for complete installation.

o) Apron.

p) Goggles.

q) 'No Smoking' Notice Board

NOTE: Any other accessories if required for satisfactory operation of the complete battery system shall also be included under the Scope of Contractor without any price implication.

CONTROL PANELS SPECIFICATION

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 gasketted 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, pushbuttons etc.)	: 1.5 Sq.mm
Power supply/receptacle /illumination wiring	: 2.5 sq. mm or higher as per load
4-20mA DC current and low voltage signal upto 48V DC	: 1.0 Sq. mm

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 mm^2. Terminal blocks shall conform to IEC 947-7-1.

b) The characteristics of the terminal blocks shall be as follows.

i) High contact force, independent of conductor cross-section and large contact surface area.

ii) Self-loosening protection.

iii) Resistant to thermal aging and vibration.

iv) Low and constant voltage drop

c) Tension spring shall be made of high quality, non-rusting, acid-resistant steel. The current bar shall be of tin-lead plated copper or brass.

d) Terminals shall be of non flammable suitable thermoplastic material such as polyamide.

e) Terminal blocks shall be mounted vertically in panels and cubicles with clearance for at least 100 mm between two sets and between wall and terminal block.

f) Terminal blocks shall be provided with white marking strips / self-adhesive marker cards. Power terminals shall have protection covers.

g) At least 10%percent spare unwired terminals shall be provided for all panels /cabinets /desks /junction box etc.. This shall be in addition to 10%spare wired terminals of spare IO channels and 10% wired spare modules.

h) Bottom of the terminal block shall be at least 200 mm above the cable gland plate for bottom entry type panels.

i) For extending 24 V / 48 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.

j) Other requirements of the terminal blocks are as follows:

i) The last block in a rail-mounted assembly shall be closed with an end plate and end bracket.

ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.

iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.

iv) It shall be possible to use jumper plugs through the test plug socket to connect adjacent terminals.

v) Where more than one connection to a terminal block is required, two tier terminals shall be used.

vi) Terminal blocks shall be of different colors depending on voltage levels.

7.12.07 Nameplates and Labels

a) Each item shall have permanently attached to it, in a prominent position, a rating plate of non-corrosive material upon which is to be engraved the manufacturer's name, equipment, type / model number, range, serial number, together with details of the loading conditions under which the item of plant in question has been designed to operate.

b) Such nameplates or labels are to be of white non-hygroscopic material with engraved black lettering, or alternatively of transparent plastic

material with suitably colored lettering engraved on the back.

c) The nameplates shall be held by self-tapping screws. The size of nameplate shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for the panels.

d) Items of plant such as valves, which are subject to handling, are to be provided with an engraved chromium plated nameplate or label with engraving filled with enamel, suitably mounted or affixed with strong rustproof chain.

e) All such nameplates, instruction plates, lubrication charts etc. shall be with English inscriptions.

8.00.00 **METERING BASES AND CHART UNITS**

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

i)	Pressure	: Kg/cm^2
	Differential Pressure	: mm of H_2O column / Kg/cm^2
ii)	Draught	: mm of H_2O column
iii)	Vacuum	: Kg/cm^2 (abs)/mm of Hg column
iv)	Temperature	: Degree Celsius (^{O} C)
v)	Flow (Steam, Water)	: Tonnes / hr, M^3/Hr
vi)	Flow (Oil)	: M^3 / Hr, Litter/Hr
vii)	Flow Air	: Tonnes / hr / M^3 / 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.

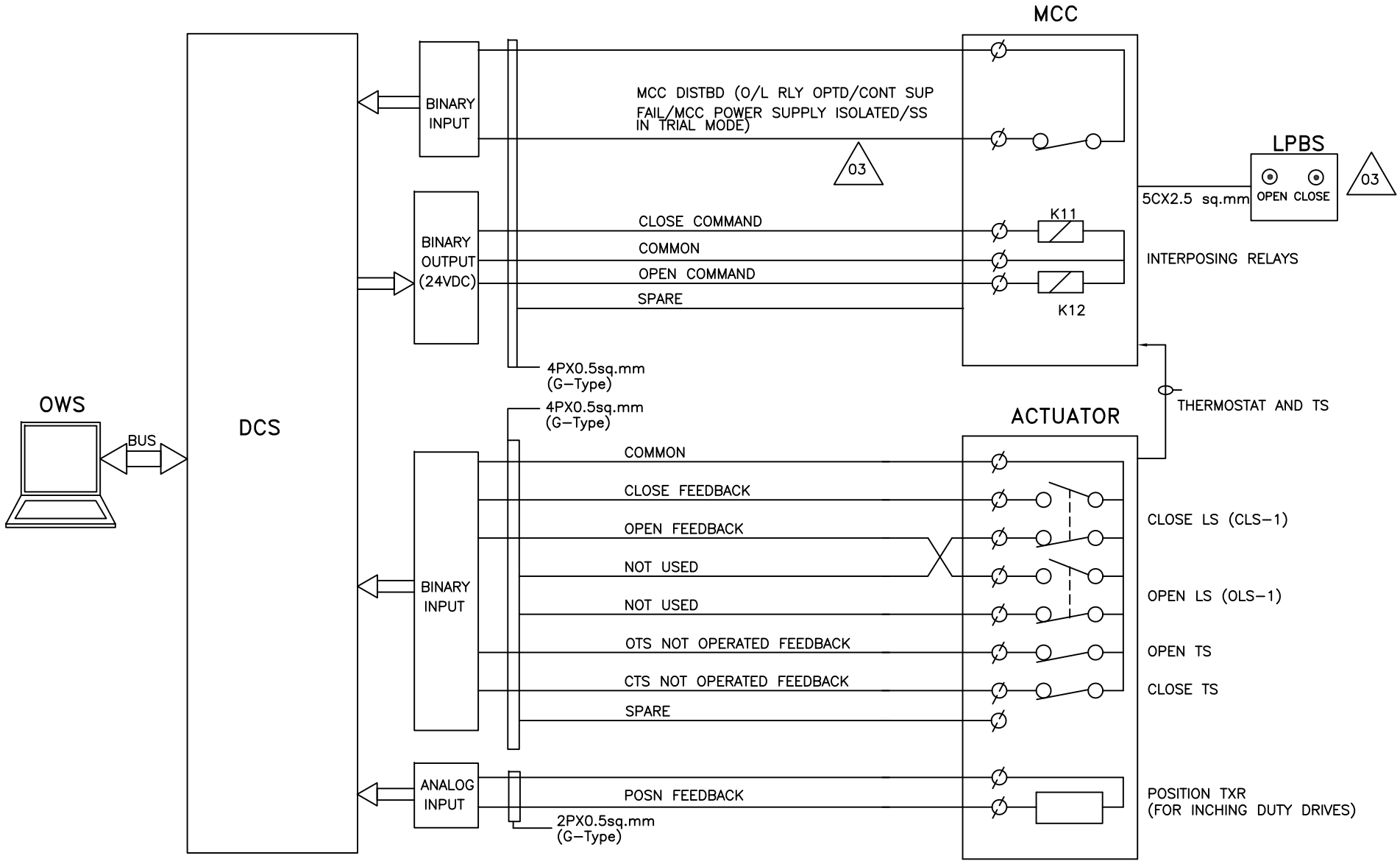
The Owner shall be notified at least 2 weeks before the commencement of the test. The procedures shall be issued and agreed before notification.

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.

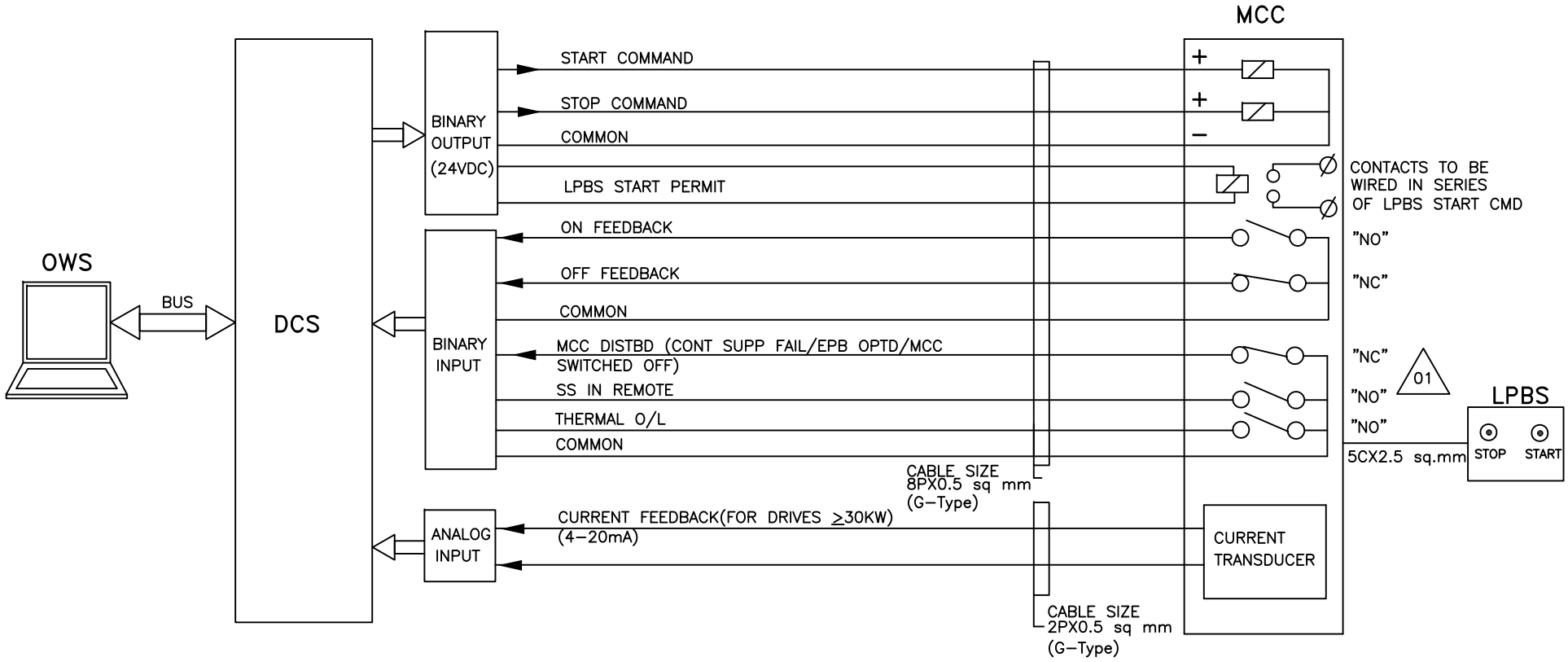
DRIVE CONTROL PHILOSOPHY

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH MCC)



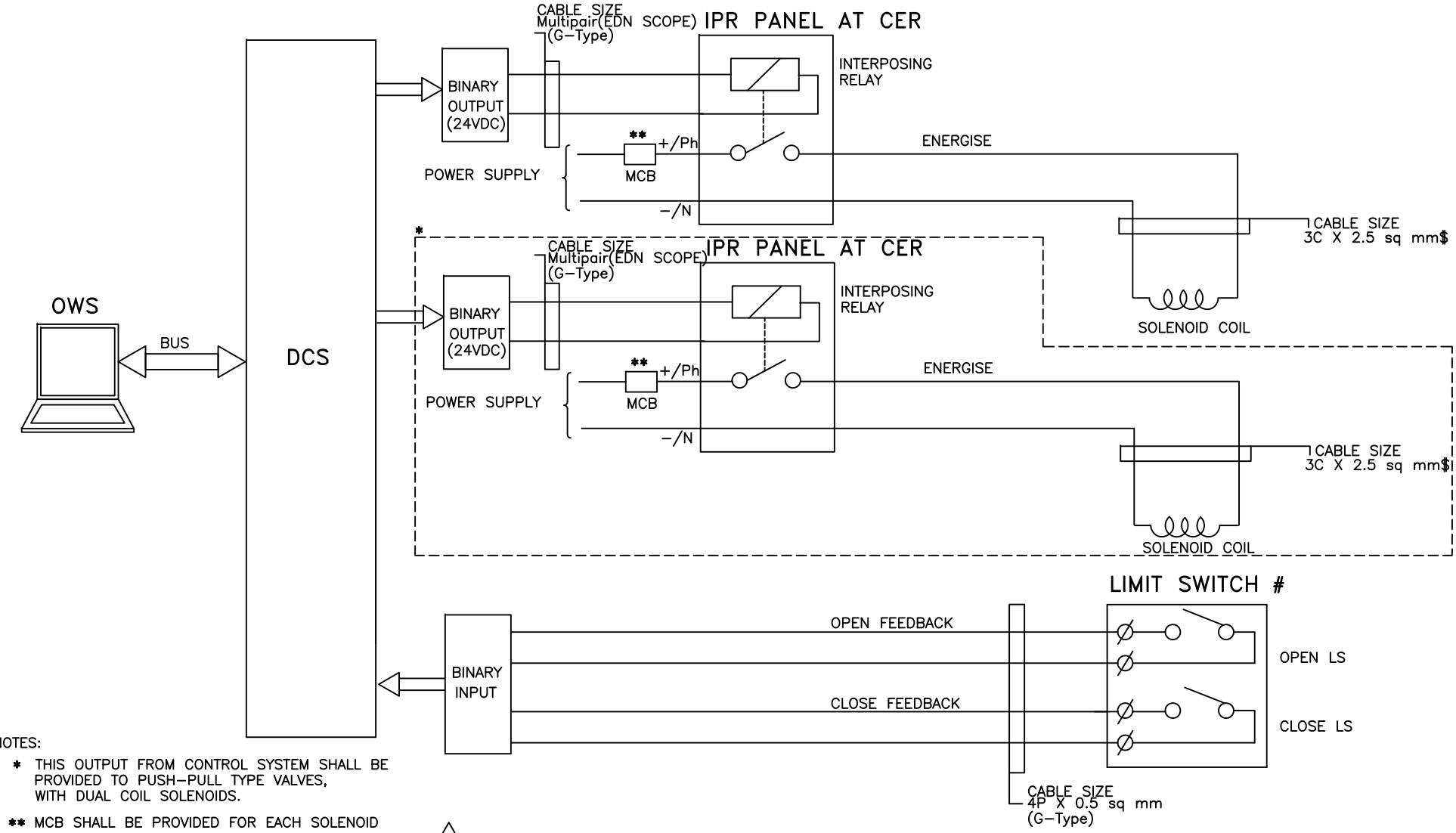
BHEL	PROJECT: 1X800MW WANAKBORI THERMAL POWER STN. EXTN. UNIT–8	DRG.NO.	PE–DM–408–145–I002
		DATE	15.06.15
	TITLE : 01 DCS INTERFACE FOR BIDIRECTIONAL DRIVE	REV.NO.	03
		SHT	8 OF 12

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE



BHEL	PROJECT: 1X800MW WANAKBORI THERMAL POWER STN. EXTN. UNIT–8	DRG.NO.	PE–DM–408–145–I002
		DATE	16.02.15
	TITLE : 01 DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE	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

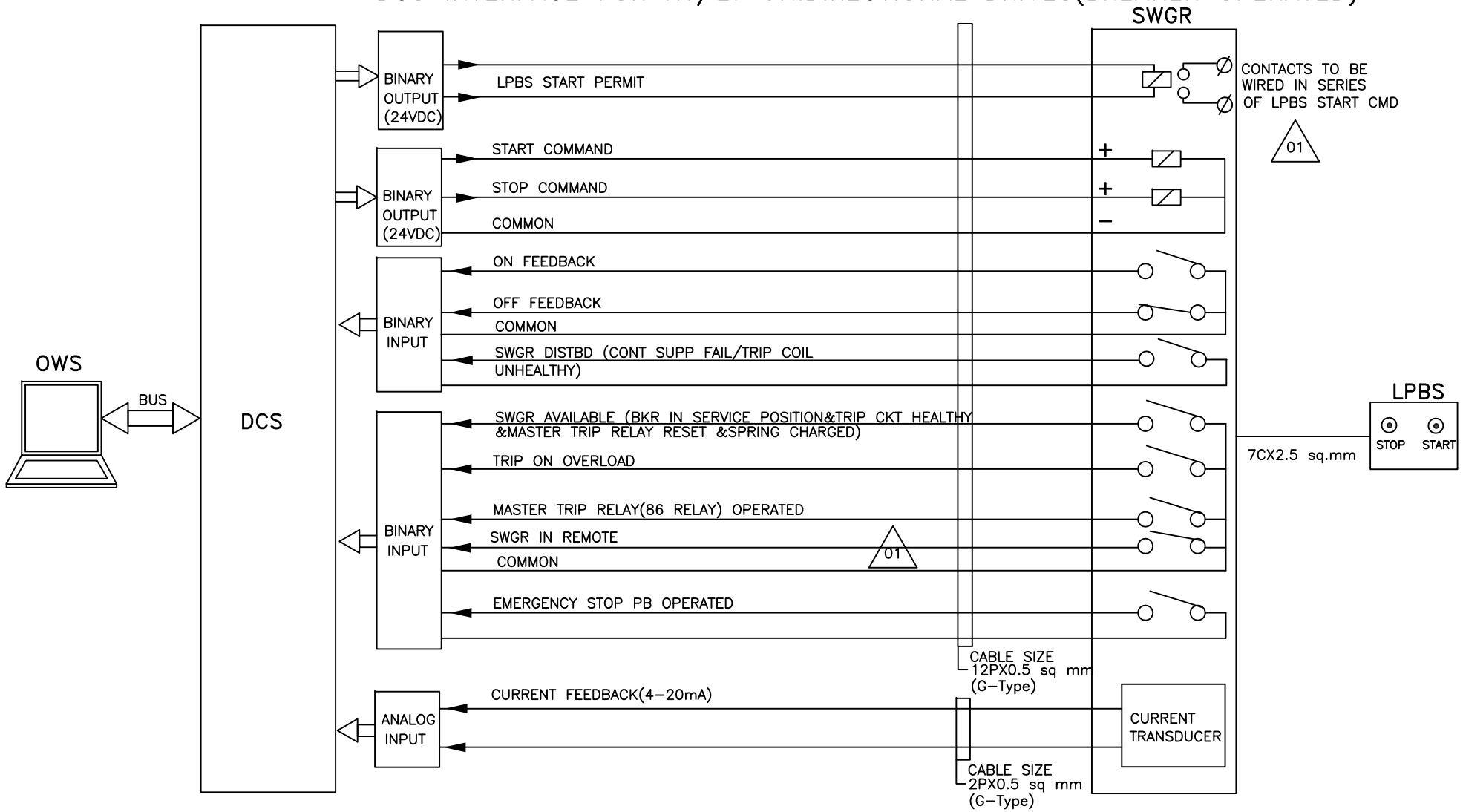
IPR:–INTER POSING RELAY

$ SYSTEMS WHERE EVER MULTIPLE SOLENOIDS CAN BE GROUPED,MULTI CORE CABLE SHALL BE USED.

01

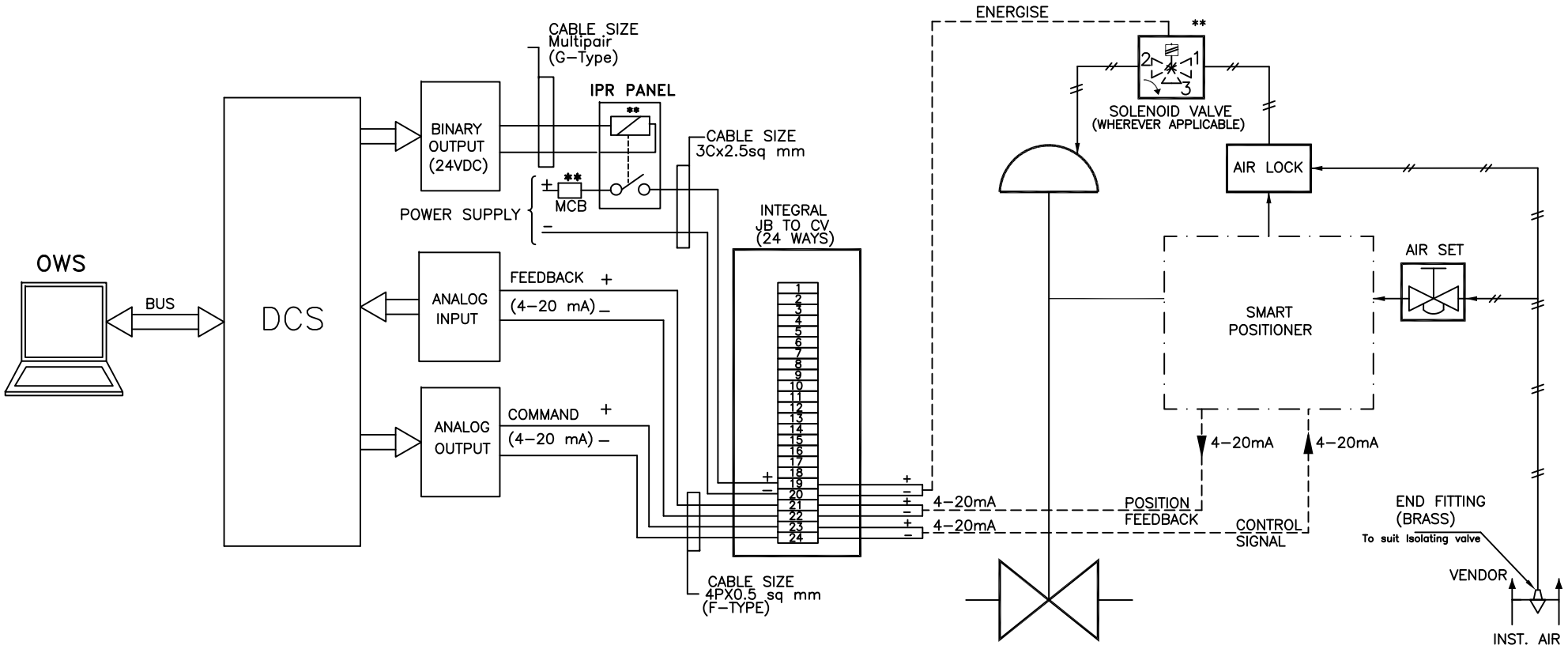
BHEL	PROJECT: 1X800MW WANAKBORI THERMAL POWER STN. EXTN. UNIT–8	DRG.NO.	PE–DM–408–145–I002
		DATE	16.02.15
	TITLE : 01 DCS INTERFACE FOR SOLENOID DRIVE	REV.NO.	01
		SHT	9 OF 11

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



BHEL	PROJECT: 1X800MW WANAKBORI THERMAL POWER STN. EXTN. UNIT-8	DRG.NO.	PE-DM-408-145-I002
		DATE	16.02.15
	TITLE : 01 DCS INTERFACE FOR UNIDIRECTIONAL HT DRIVE	REV.NO.	01
		SHT	10 OF 11

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.

BHEL	PROJECT: 1X800MW WANAKBORI THERMAL POWER STN. EXTN. UNIT–8	DRG.NO.	PE–DM–408–145–I002
		DATE	16.02.15
	TITLE : TYPICAL HOOK–UP DIAGRAM ANALOG DRIVE (WITH SMART POSITIONER)	REV.NO.	01
		SHT	11 OF 11

APPLICABLE CODES AND STANDARDS

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 then 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 then 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.~~

SPECIFICATION FOR QUALITY ASSURANCE & TESTING

~~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.

DRAWINGS

GA DRAWING
TRANSMITTER RACK

PRELIMINARY
TENDER PURPOSE ONLY

SB	SR	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

GA DRAWING–TRANSMITTER RACK

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

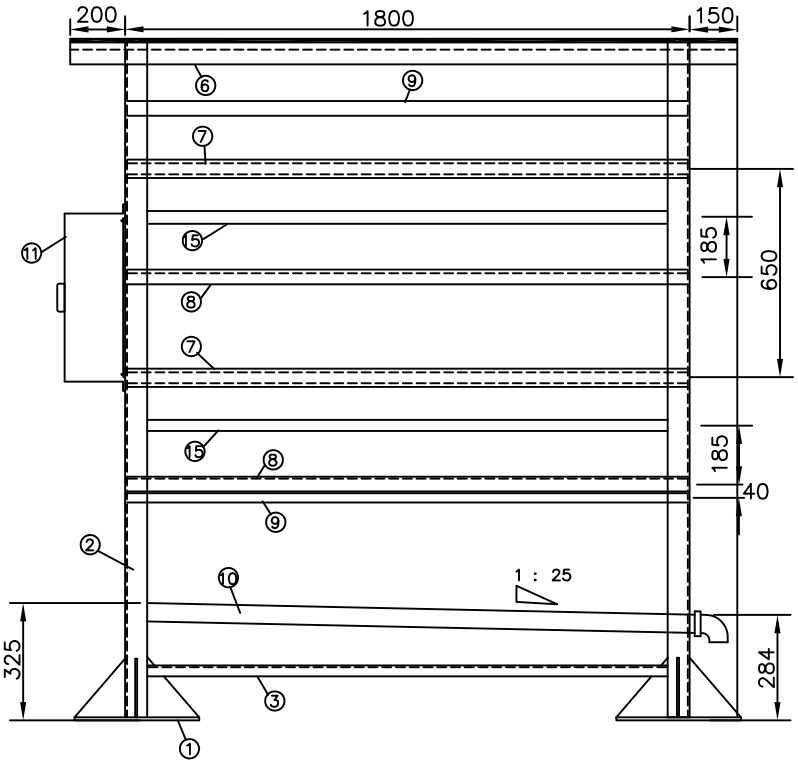
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 1 OF 10

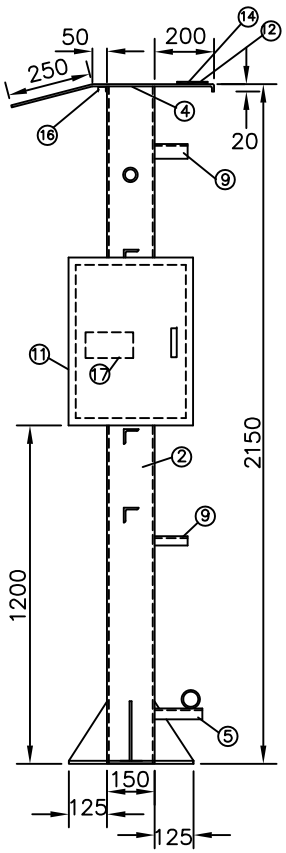
DWG. NO. K9213R–DWG–I–0200 | REV. 0

K9213-DWG-I-0200-1-10

A4_H (08–'06) [297 x 210]



FRONT VIEW



RH SIDE VIEW

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

PRELIMINARY
TENDER PURPOSE ONLY

SB	SR	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

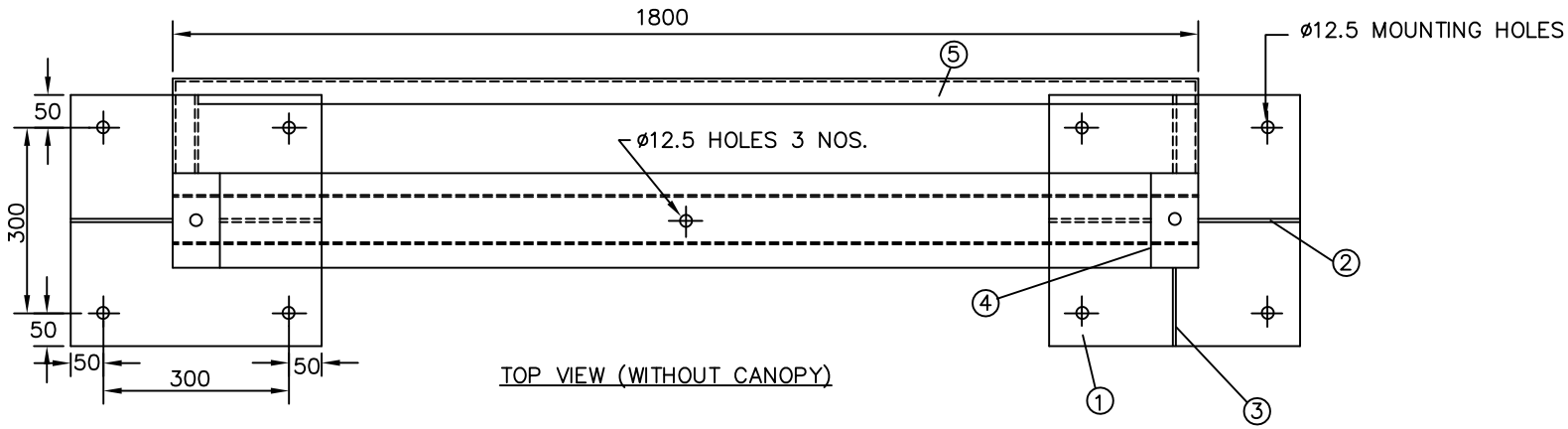
G.A.DRAWING FOR LOCAL INSTRUMENT RACK

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL-K9213R | SCALE NIL | SHT. 2 OF 10
DWG. NO. K9213R-DWG-I-0200 | REV. 0



TOP VIEW (WITHOUT CANOPY)

NOTES:

1..M.S. PLATE 400 X 400 X 10 mm.

2..RIB M.S. PLATE 162.5 X 170 X 5 mm THICK.

3..RIB M.S. PLATE 125 X 170 X 5 mm THICK.

4..RIB M.S. PLATE 134 X 165 X 5 mm THICK. (CANOPY MOUNTING PLATE SUPPORT)

5..BRACKET FOR IMPULSE PIPE SUPPORT.

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MM

PRELIMINARY
TENDER PURPOSE ONLY

SB	SR	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

VIEW OF
LOCAL INSTRUMENT RACK W/O CANOPY

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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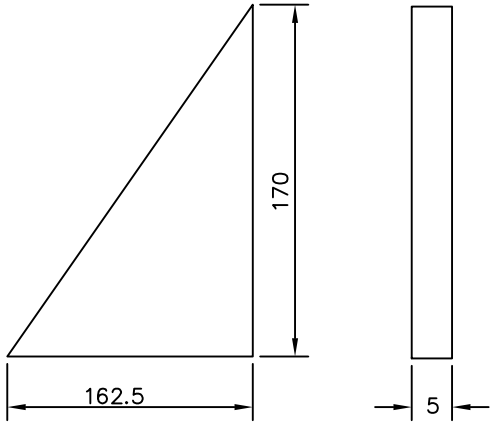
JOB NO. DCPL–K9213R | SCALE NIL | SHT. 3 OF 10

DWG. NO. K9213R–DWG–I–0200 | REV. 0

K9213-DWG-I-0200-3-10

A4_H (08–'06) [297 x 210]



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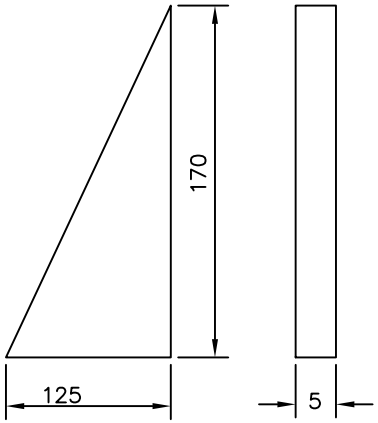
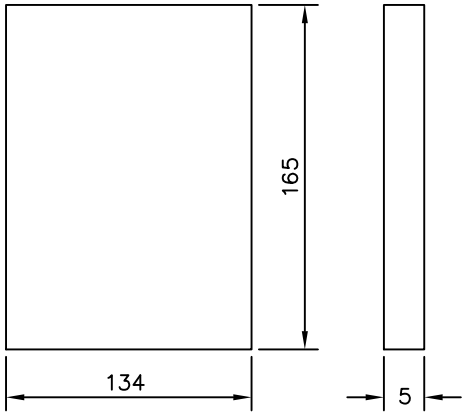


DETAIL OF–2



DETAIL OF–3

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.

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MM

PRELIMINARY
TENDER PURPOSE ONLY

SB	SR	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

G.A. DRAWING OF CLEATS FOR LOCAL INSTRUMENT RACK

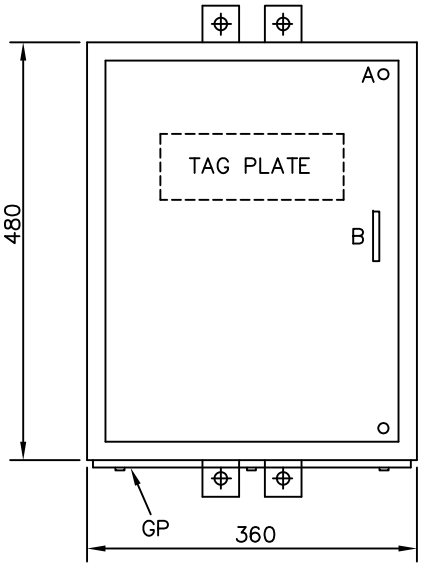
1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

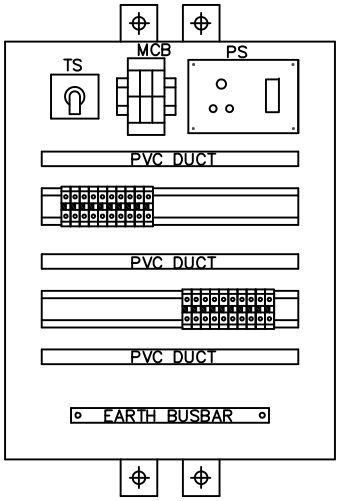
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 4 OF 10

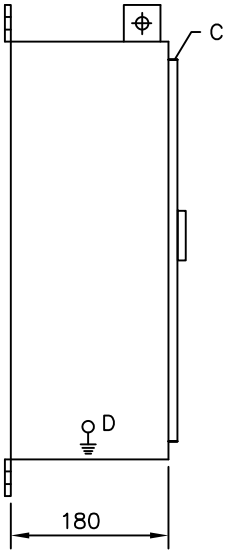
DWG. NO. K9213R–DWG–I–0200 | REV. 0



FRONT VIEW



INTERNAL FRONT VIEW



SIDE VIEW

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 IS5–631, INTERNAL–BRILLIANT WHITE.
4..NUTS FOR MOUNTING THE JUNCTION BOX SHALL BE PROVIDED.
5..3 MM THICK CRCA GLAND PLATE (GP) AT BOTTOM SHALL BE PROVIDED.
6..SCREWLESS CAGE CLAMP TERMINALS SHALL BE USED.
7..EARTH BUS BAR SHALL BE OF 25X6 MM TINNED COPPER.
8..INSTRUMENT TAG VIS–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

SB	SR	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

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

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

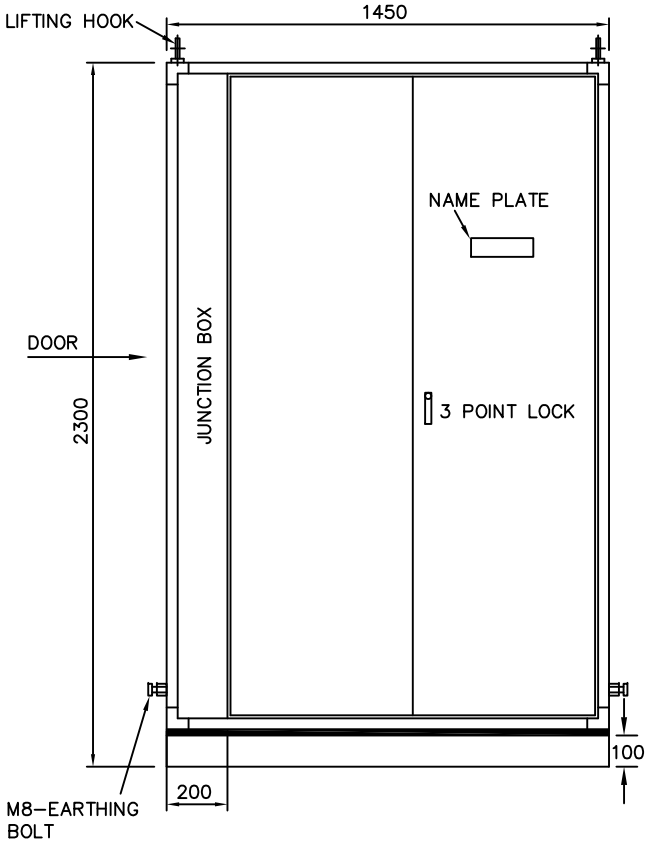
GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT

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

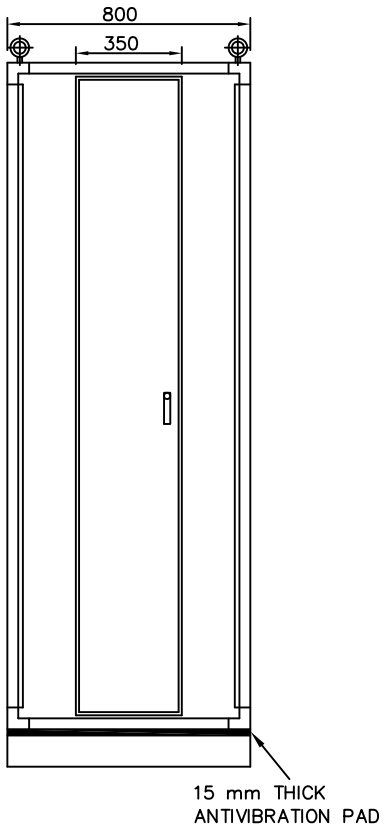
JOB NO. DCPL–K9213R | SCALE NIL | SHT. 5 OF 10

DWG. NO. K9213R–DWG–I–0200 | REV. 0

LOCAL INSTRUMENT ENCLOSURE



FRONT VIEW



LH SIDE VIEW

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 VIS–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

PRELIMINARY
TENDER PURPOSE ONLY

SB	SR	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

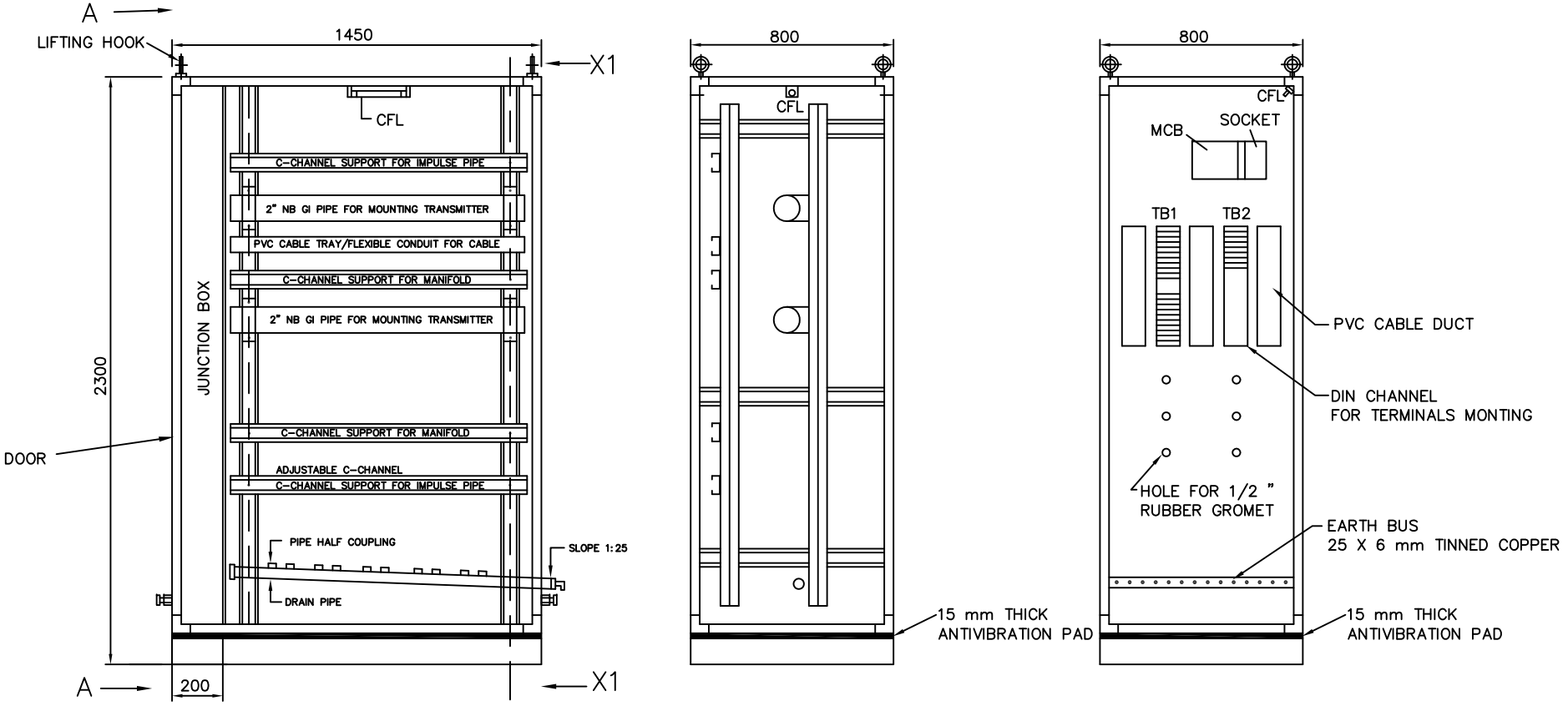
G.A. DRAWING FOR
LOCAL INSTRUMENT ENCLOSURE

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 6 OF 10
DWG. NO. K9213R–DWG–I–0200 | REV. 0



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.

PRELIMINARY
TENDER PURPOSE ONLY

SB	SR	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

INNER G.A. DRAWING FOR
LOCAL INSTRUMENT ENCLOSURE

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

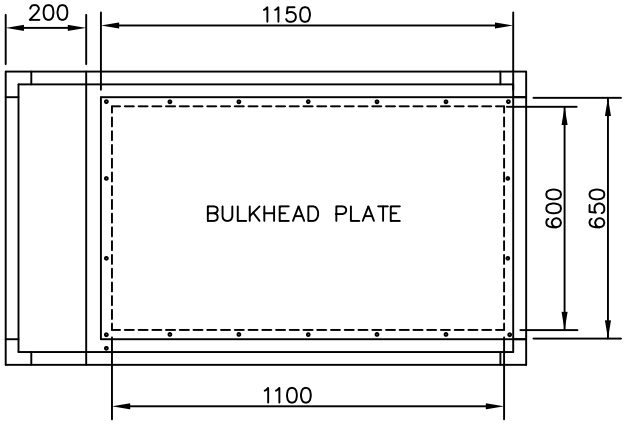
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 7 OF 10

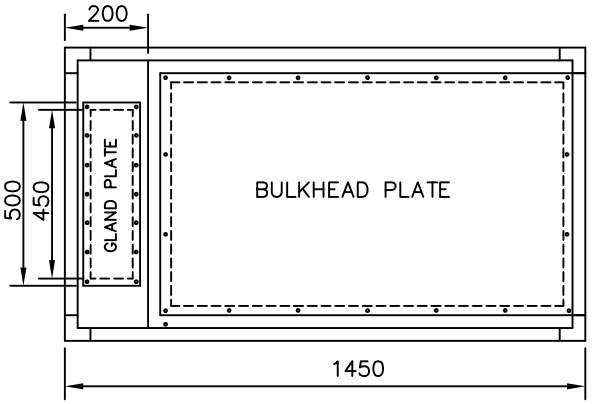
DWG. NO. K9213R–DWG–I–0200 | REV. 0

K9213-DWG-I-0200-7-10

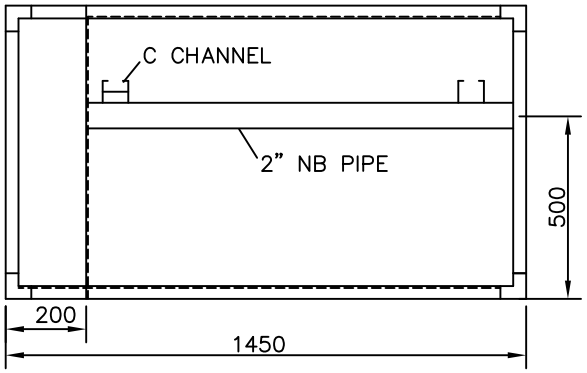
A4_H (08–'06) [297 x 210]



TOP VIEW



BOTTOM VIEW



TOP VIEW WITHOUT BULKHEAD PLATE

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.

UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE IN MM

PRELIMINARY
TENDER PURPOSE ONLY

SB	SR	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

BULKHEAD PLATE DETAILS FOR LOCAL INSTRUMENT ENCLOSURE

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

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VADODARA, GUJARAT

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

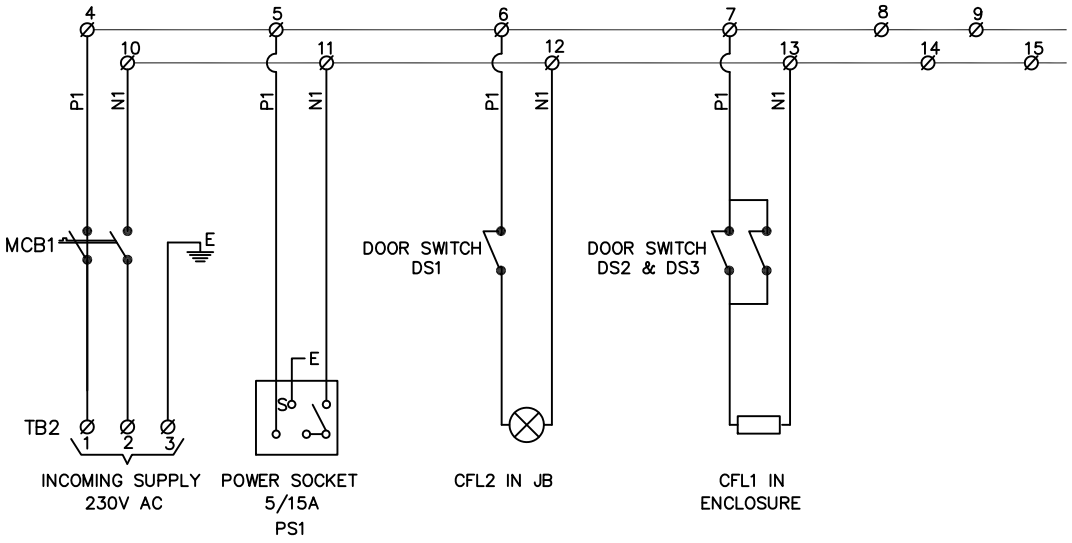
JOB NO. DCPL-K9213R | SCALE NIL | SHT. 8 OF 10

DWG. NO. K9213R-DWG-I-0200 | REV. 0

K9213-DWG-I-0200-8-10

A4_H (08-'06) [297 x 210]

POWER WIRING CIRCUIT

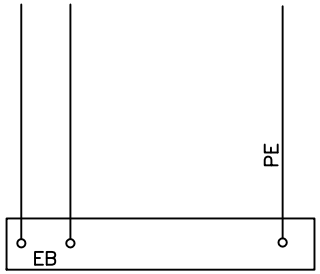


NOTES :

1.. COLOUR CODING FOR POWER SUPPLY : PHASE – RED, NEUTRAL– BLACK, EARTH–GREEN

2.. CABLE ROUTING FROM TB TO PANEL LIGHT WILL BE 1.5 Sq.mm 1100V AC GRADE.

3.. SIGNAL WIRING WILL BE DONE BY 4 PAIR X 0.5 Sq.mm ANNEALED TINNED COPPER, PAIR TWISTED OVERALL & SHIELDED, VOLTAGE GRADE 1100V, UNARMOURED FRLS PVC SHIELDED CABLE.



PRELIMINARY
TENDER PURPOSE ONLY

APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE
SB	SR	SD		0	21.04.10

ELECTRICAL WIRING AND TERMINATION DRAWING FOR LOCAL INSTRMENT ENCLOSURE

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT

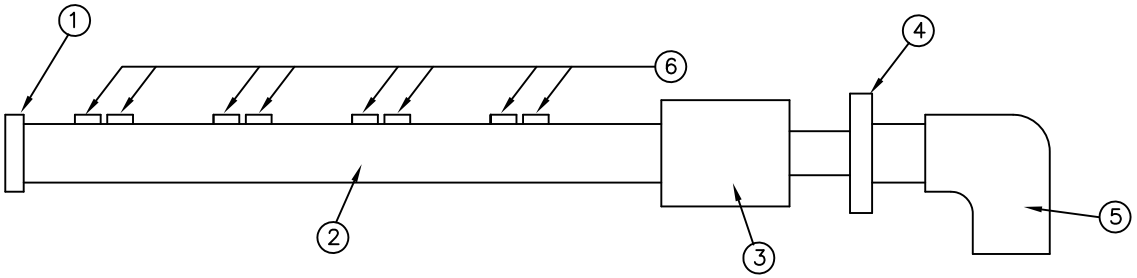
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 9 OF 10

DWG. NO. K9213R–DWG–I–0200 | REV. 0

K9213-DWG-I-0200-9-10

A4_H (08–'06) [297 x 210]



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

PRELIMINARY
TENDER PURPOSE ONLY

APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE
SB	SR	SD		0	21.04.10

DRAIN HEADER DETAILS FOR
LOCAL INSTRUMENT ENCLOSURE

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

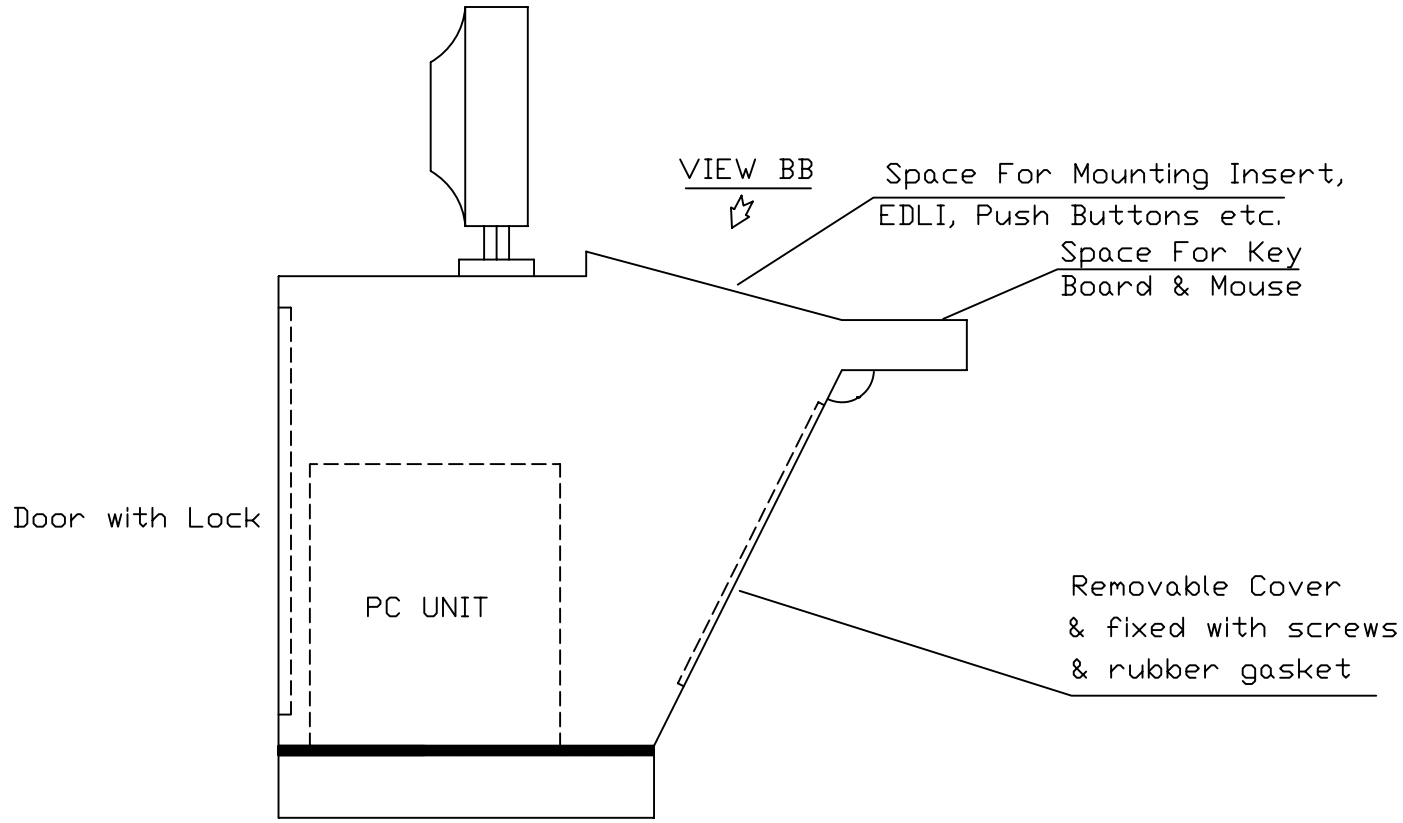
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

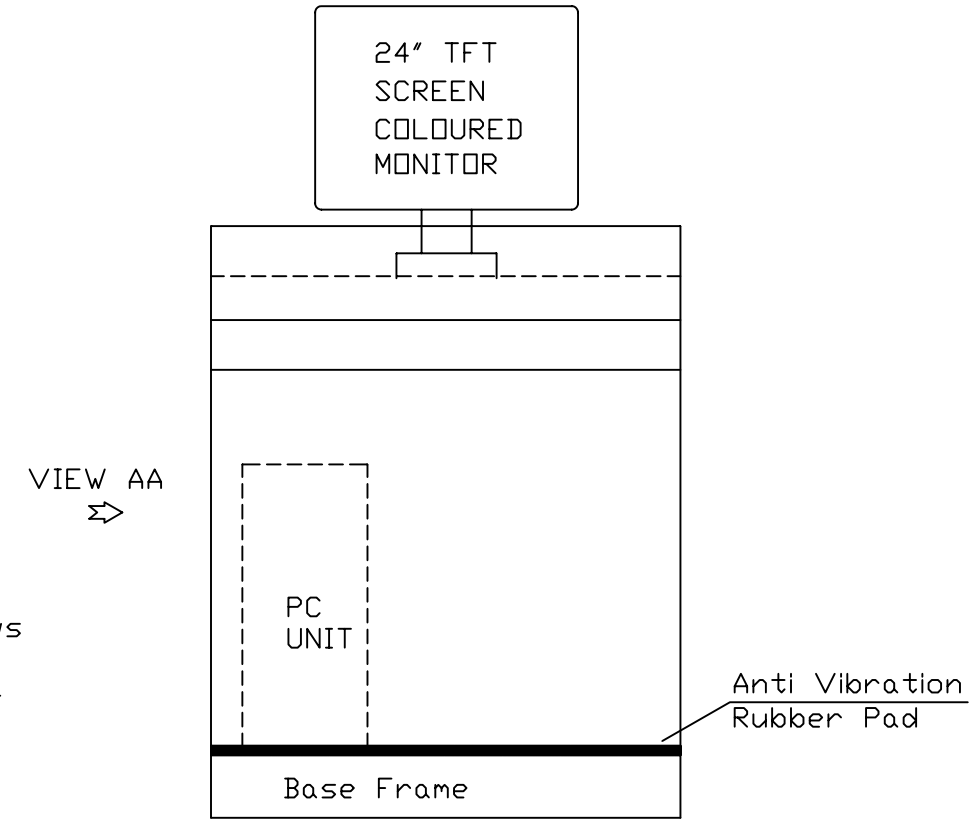
JOB NO. DCPL–K9213R | SCALE NIL | SHT. 10 OF 10

DWG. NO. K9213R–DWG–I–0200 | REV. 0

K9213-DWG-I-0200-10-10

A4_H (08–'06) [297 x 210]





VIEW AA

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 TKICKNESS SUBJECT TO USER'S APPROVAL.
3. SUITABLE LOUVERS (WITH WIREMESH REMOVEABLE 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.

FOR TENDERING PURPOSE ONLY

REVIEWED											
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TITLE: OPERATING STATION DESK PROFILE

PROJECT: 1x800 MW SUPERCRITICAL THERMAL POWER PLANT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GSECL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. K9213R | SCALE : NONE

DWG. NO. K9213R-DWG-I-0161 | REV. A

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.

PRELIMINARY
TENDER PURPOSE ONLY

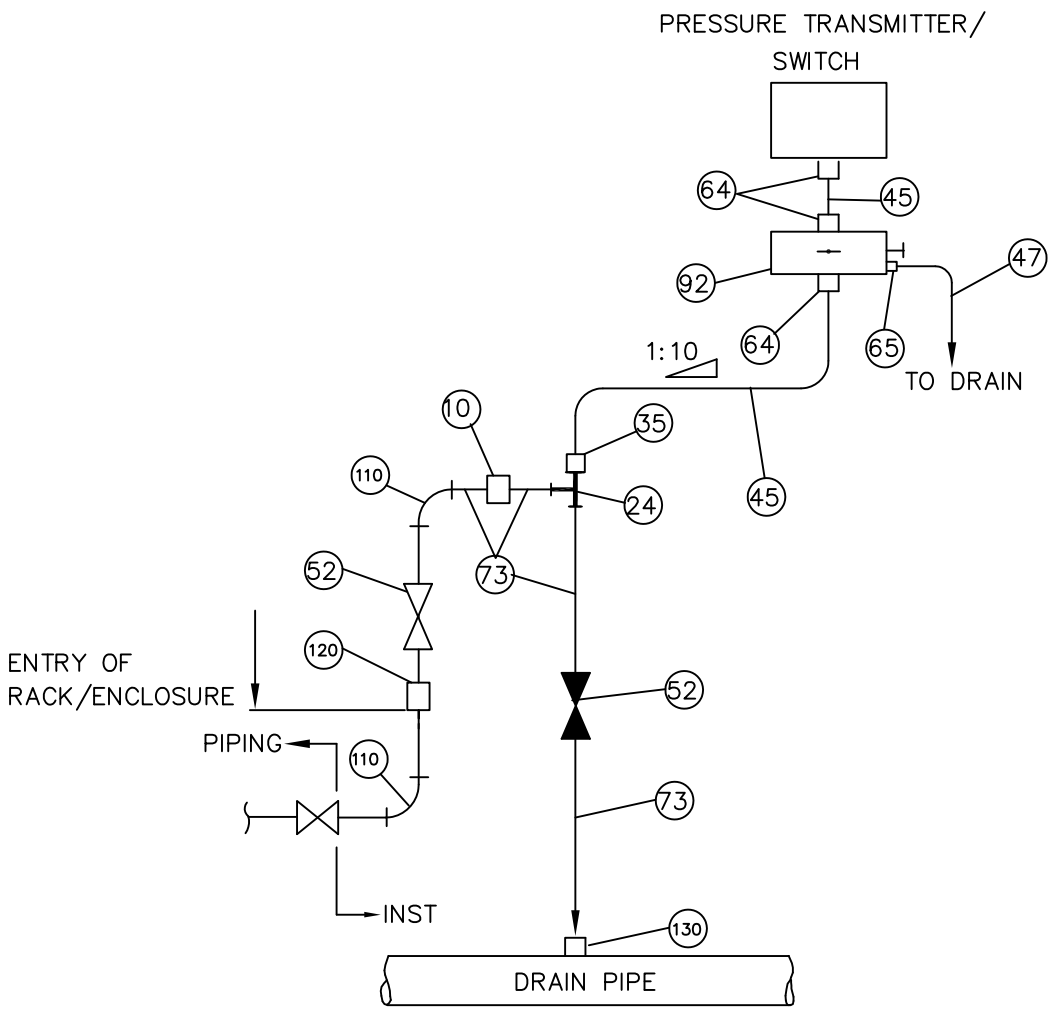
						TYPICAL INSTRUMENT INSTALLATION DIAGRAM
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)
GP	AT	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE	

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

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 2 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

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 3000l lbs
52	2	GLOBE VALVE 1/2" SW 600lbs
45	3Mtrs.	TUBE 1/2" OD 2.1 MM THICK
64	3	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 3000 lbs
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	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 3000 lbs
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.

PRELIMINARY
TENDER PURPOSE ONLY

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

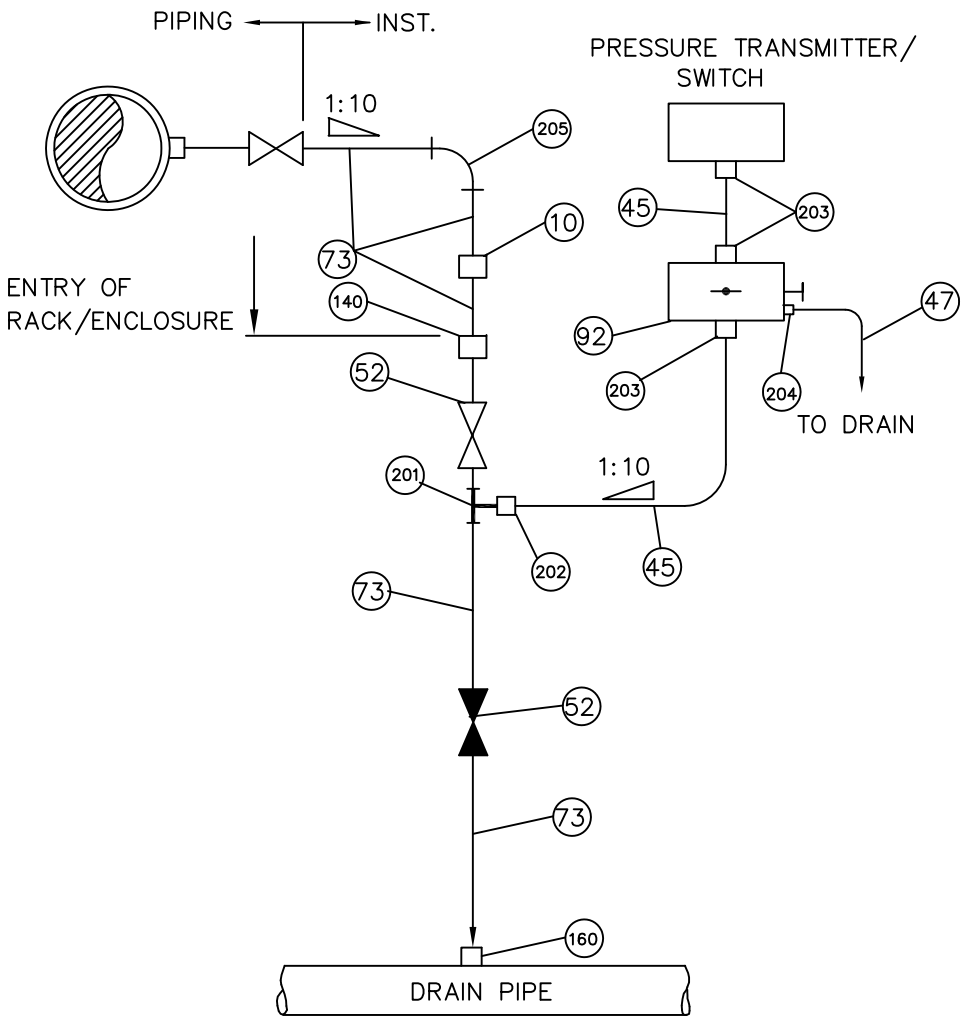
GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL-K9213R | SCALE NIL | SHT. 3 OF 20

DWG. NO. K9213R-DWG-I-0060 | REV. 0

PRESSURE TRANSMITTER/PRESSURE SWITCH MOUNTED BELOW SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
201	1	EQUAL TEE (FEMALE)1/2" SW 6000lbs
202	1	MALE CONNECTOR 1/2" PE 1/2" OD 6000 lbs
52	2	GLOBE VALVES 1/2" SW 600lbs
45	3 Mtrs	TUBE 1/2" OD 2.1 MM THICK
203	3	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 6000 lbs
73	15Mtrs.	IMPULSE PIPE 15 NB GR.B SCH 80
92	1	2 VALVES MANIFOLD 1/2" NPT(F)
10	1	FULL COUPLING 1/2" SW 6000lbs
47	0.15Mtrs.	TUBE 8 MM OD 1.0 MM THICK
204	1	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 6000 lbs
205	1	90° ELBOW 1/2" SW 6000lbs
140	1	BULK HEAD UNION/COUPLING CL:6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11
160	1	HALF COUPLING CL:6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

SERVICE : CONDENSATE, FEED WATER ETC.

PRELIMINARY
TENDER PURPOSE ONLY

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

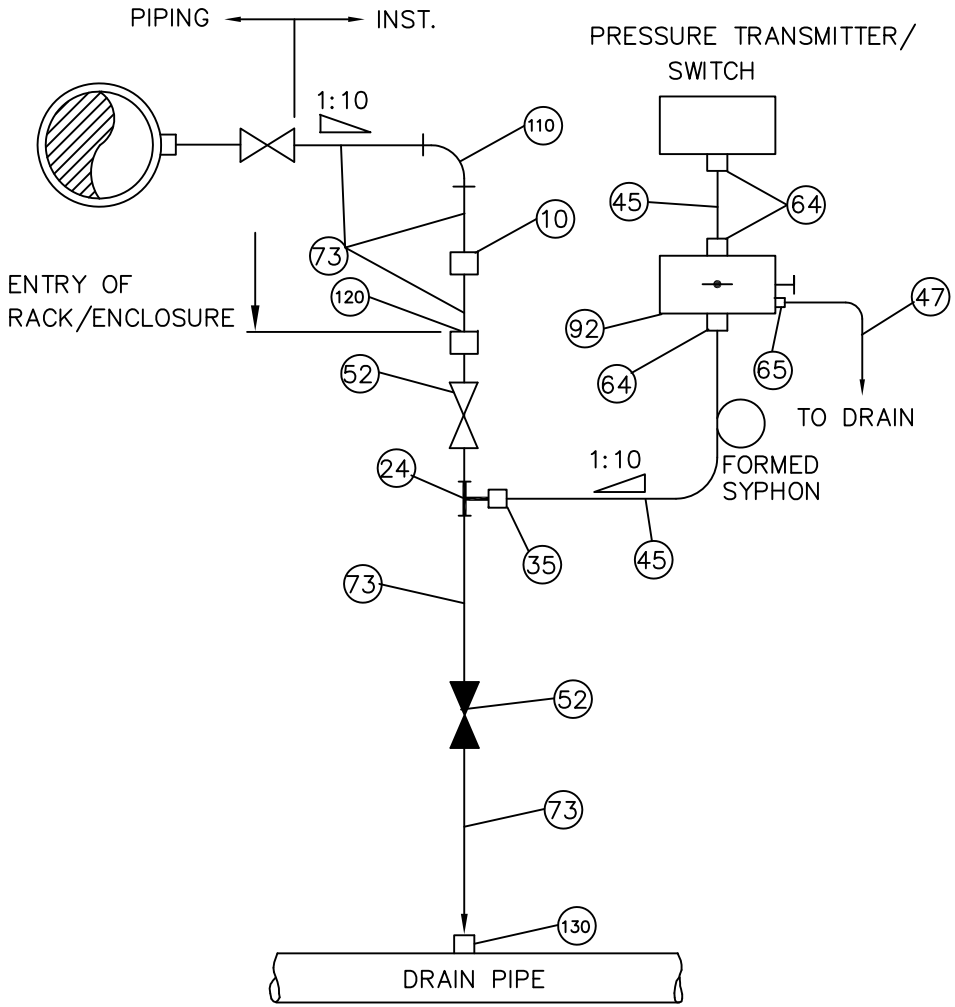
GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL-K9213R | SCALE NIL | SHT. 4 OF 20

DWG. NO. K9213R-DWG-I-0060 | 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	HALF COUPLING CL:3000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

SERVICE : LOW PRESSURE STEAM

PRELIMINARY
TENDER PURPOSE ONLY

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

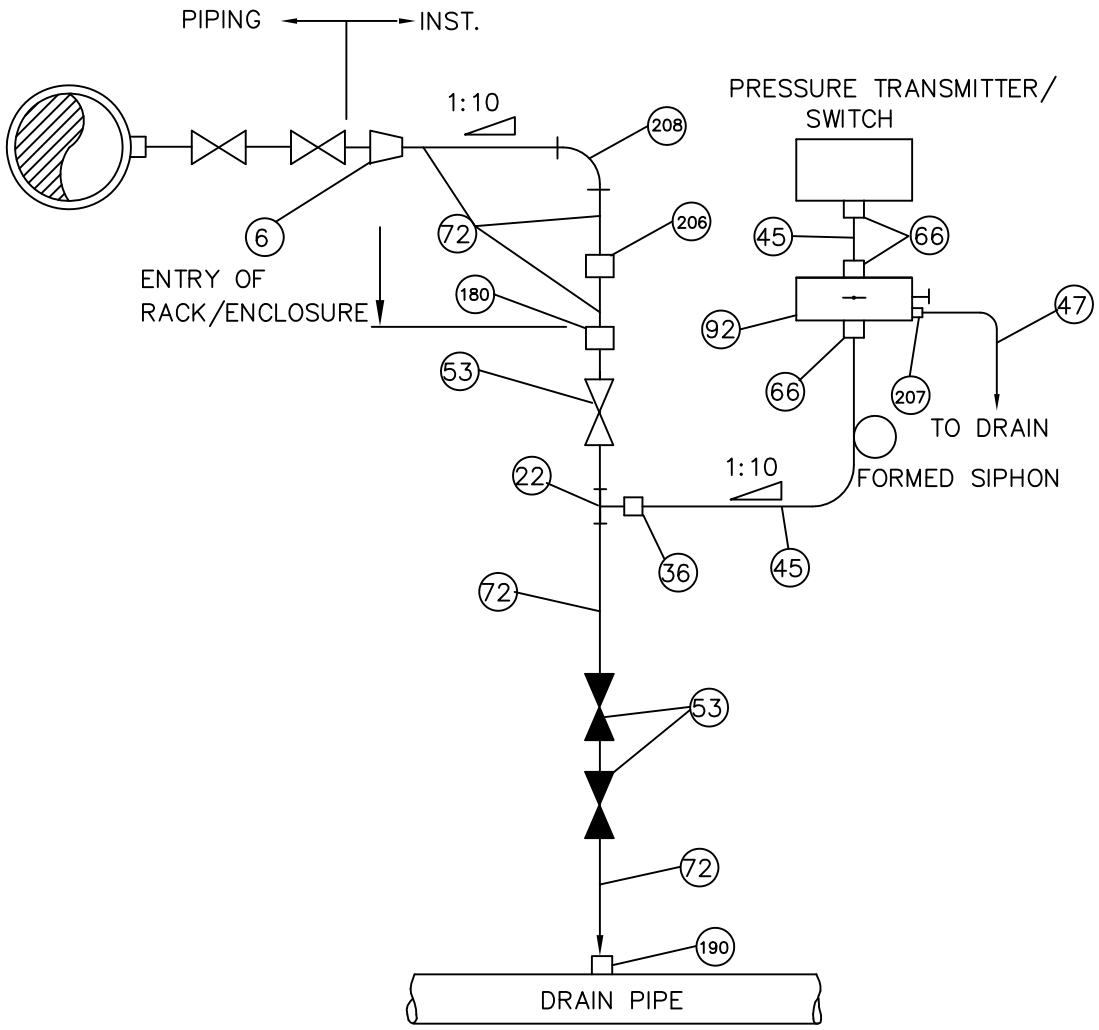
GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL-K9213R | SCALE NIL | SHT. 5 OF 20

DWG. NO. K9213R-DWG-I-0060 | REV. 0

PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED BELOW SOURCE POINT(WITH CONDENSATE POT)



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	HALF 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

PRELIMINARY
TENDER PURPOSE ONLY

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

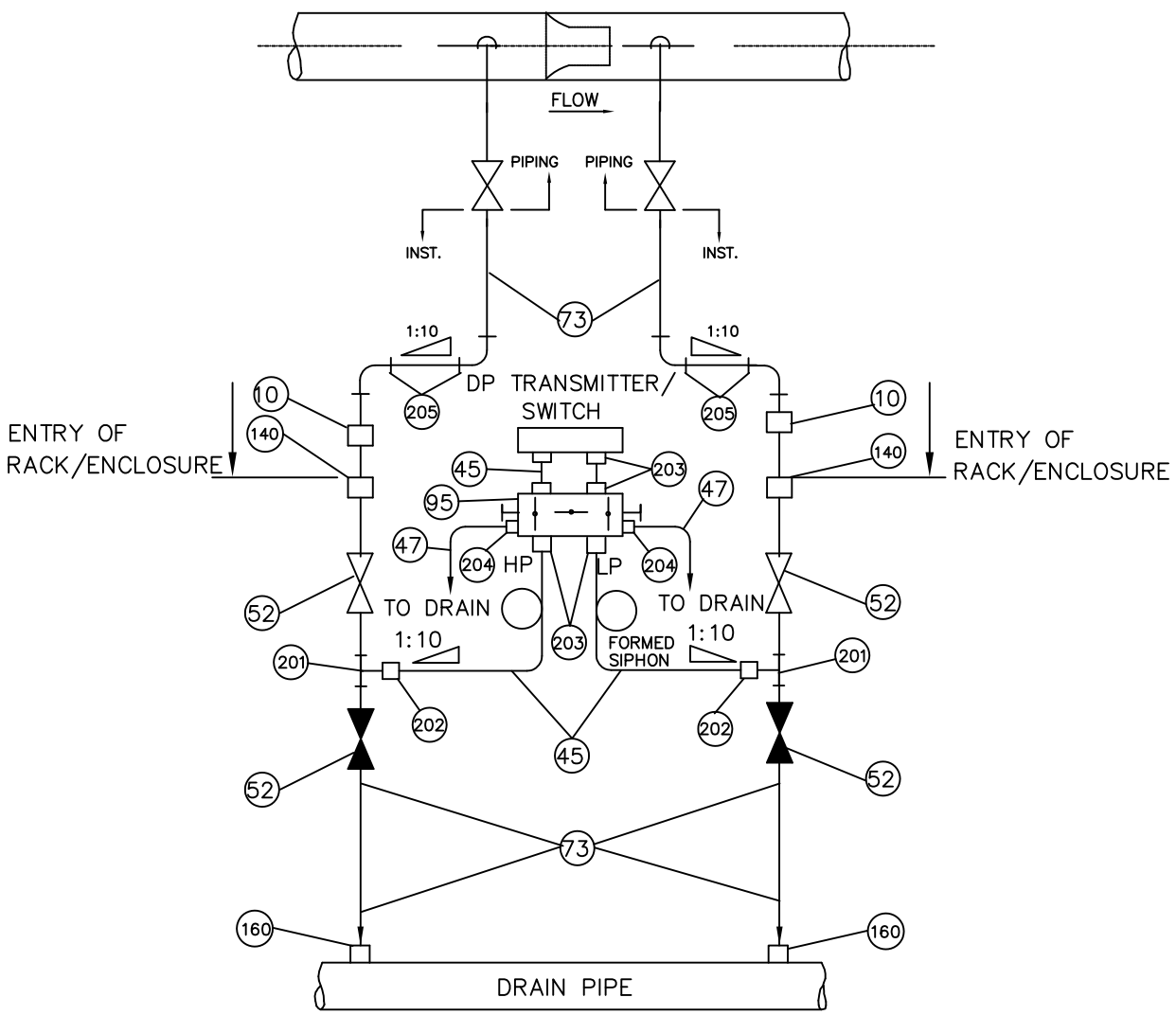
GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

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

DWG. NO. K9213R–DWG–I–0060 | REV. 0

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



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
201	2	EQUAL TEE (FEMALE)1/2" SW 6000lbs
202	2	MALE CONNECTOR 1/2" PE X 1/2" OD 6000 lbs
52	4	GLOBE VALVES 1/2" SW 600lbs
45	6 Mtrs	TUBE 1/2" OD 2.1 MM THICK
203	6	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 6000 lbs
73	30Mtrs	IMPULSE PIPE 15 NB GR.B SCH 80
95	1	5 VALVE MANIFOLD 1/2" NPT(F)
10	2	FULL COUPLING 1/2" SW 6000lbs
47	0.3Mtrs	TUBE 8 MM OD 1.0 MM THICK
204	2	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 6000 lbs
205	4	90° ELBOW 1/2" SW 6000lbs
140	2	BULK HEAD UNION/COUPLING CL:6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11
160	2	HALF COUPLING CL:6000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

SERVICE : CONDENSATE,FEED WATER ETC.

PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE

PRELIMINARY
TENDER PURPOSE ONLY

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

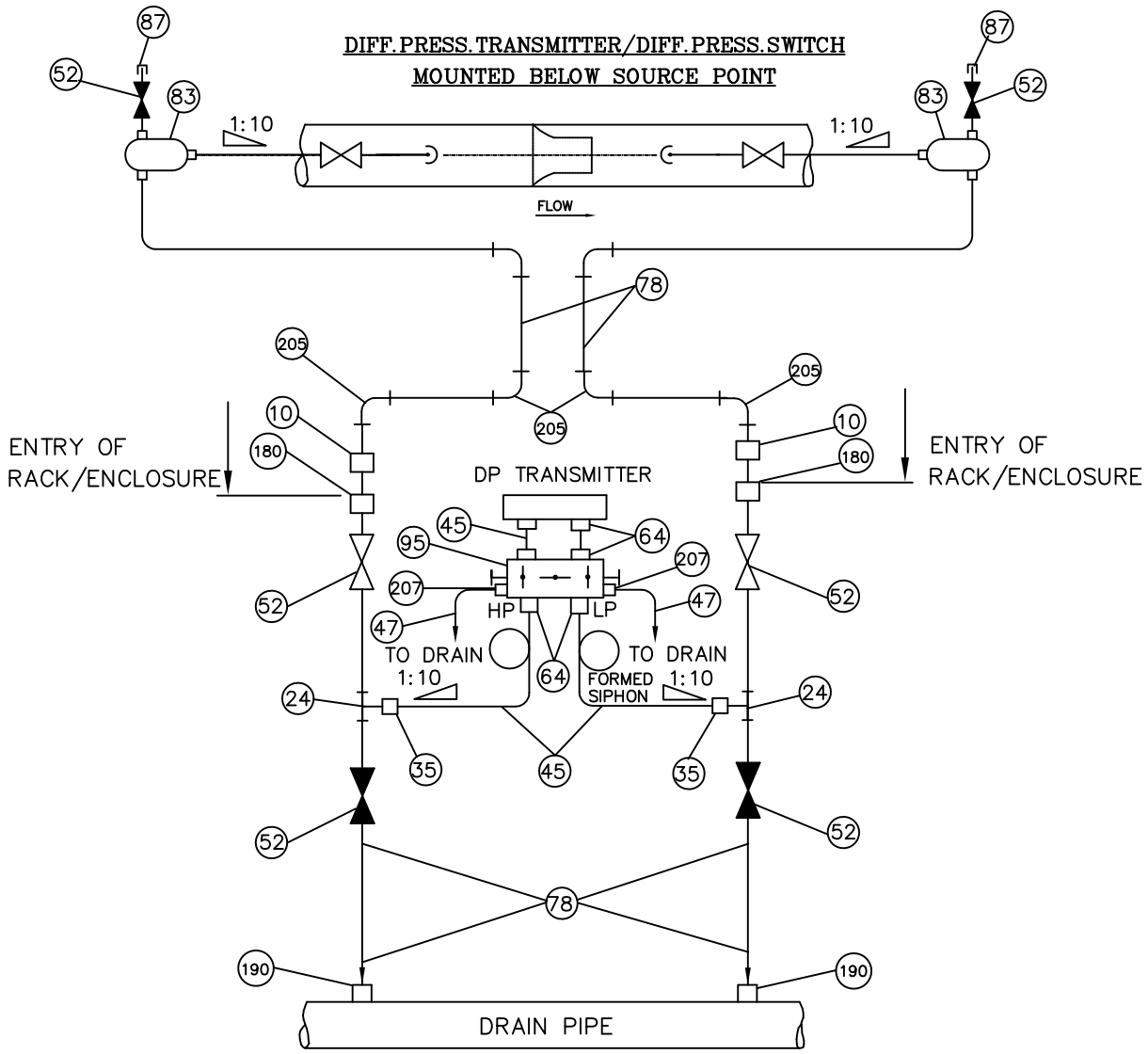
1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL-K9213R | SCALE NIL | SHT. 7 OF 20

DWG. NO. K9213R-DWG-I-0060 | REV. 0



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	2	EQUAL TEE (FEMALE)1/2" SW 9000lbs
35	2	MALE CONNECTOR 1/2" PE X 1/2" OD 9000 lbs
52	6	GLOBE VALVES 1/2" SW 600lbs
45	6Mtrs.	TUBE 1/2" OD 2.1 MM THICK
64	6	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 9000 lbs
78	30Mtrs	IMPULSE PIPE 15 NB SCH 80
95	1	5 VALVES MANIFOLD 1/2" NPT(F)
10	2	FULL COUPLING 1/2" SW 9000lbs
83	2	CONDENSATION POT 1/2" SW NPT(F) 9000 lbs
87	2	PLUG 1/2" NPT(F) 9000lbs
47	0.3Mtrs	TUBE 8 MM OD 1.0 MM THICK
207	2	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 9000 lbs
205	6	90° ELBOW 1/2" SW 9000lbs
180	2	BULK HEAD UNION/COUPLING CL:9000 LBS–AS PER ANSI B16.11,1/2" NB–SW
190	2	HALF COUPLING CL:9000 LBS/ 1/2" NB–SW AS PER ANSI B16.11

SERVICE : STEAM

PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE

PRELIMINARY
TENDER PURPOSE ONLY

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

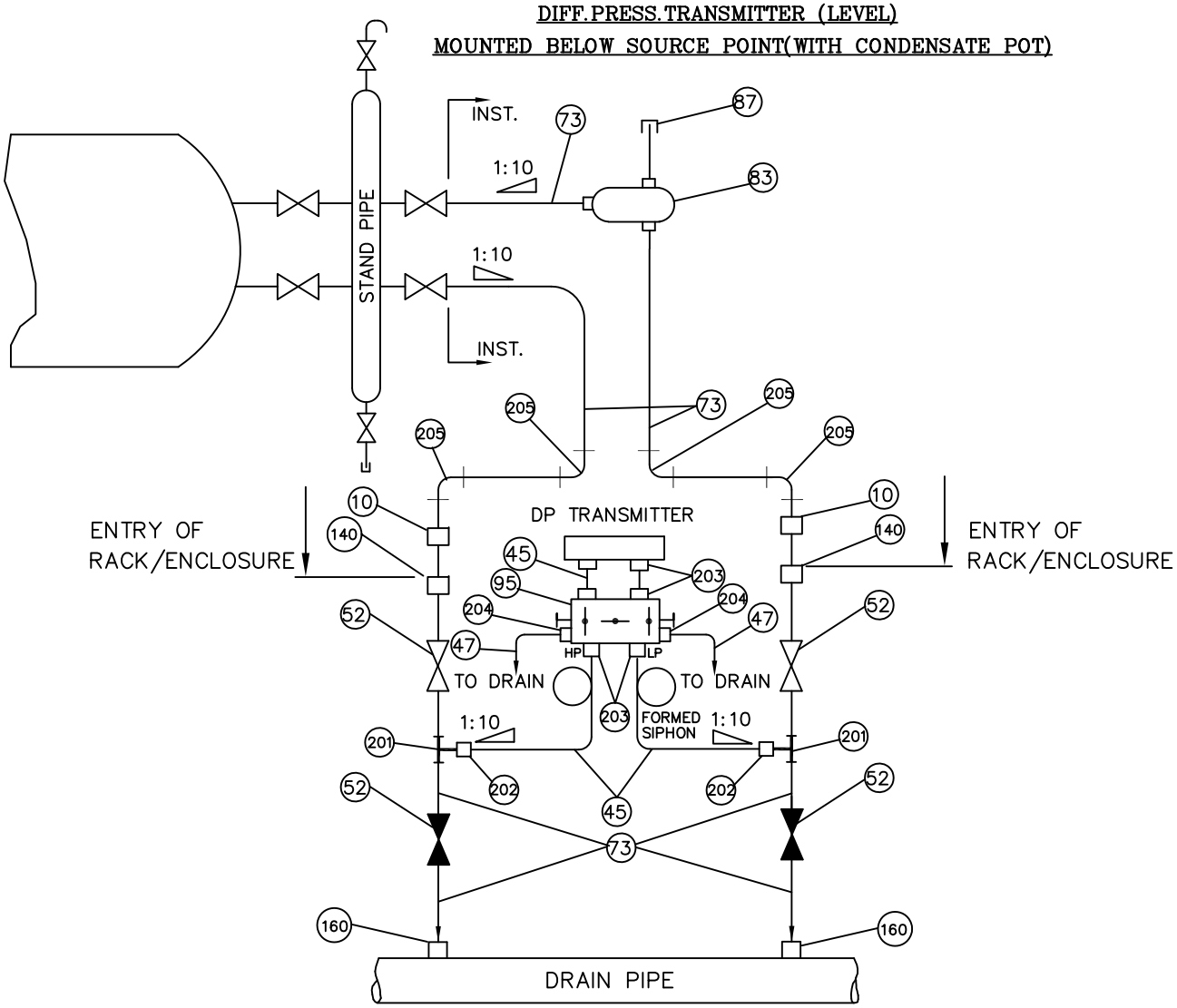
GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 8 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

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



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
201	2	EQUAL TEE (FEMALE)1/2" SW 6000lbs
202	2	MALE CONNECTOR 1/2" PE X 1/2" OD 6000 lbs
52	4	GLOBE VALVES 1/2" SW 600lbs
45	6Mtrs.	TUBE 1/2" OD 2.1 MM THICK
203	6	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 6000 lbs
73	30Mtrs	IMPULSE PIPE 15 NB SCH 80
95	1	5 VALVES MANIFOLD 1/2" NPT(F)
10	2	FULL COUPLING 1/2" SW 6000lbs
83	1	CONDENSATE POT 1/2" SW 6000lbs
87	1	PLUG 1/2" NPT(M) 6000lbs
205	4	90° ELBOW 1/2" SW 6000lbs
47	0.3Mtrs.	TUBE 8 MM OD 1.0 MM THICK
204	2	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 6000 lbs
140	2	BULK HEAD UNION/COUPLING CL:6000 LBS–AS PER ANSI B16.11,1/2" NB–SW
160	2	HALF COUPLING CL:6000 LBS/ 1/2" NB–SW AS PER ANSI B16.11

SERVICE : BOILER DRUM, DEAERATOR, HEATERS

PRELIMINARY
TENDER PURPOSE ONLY

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

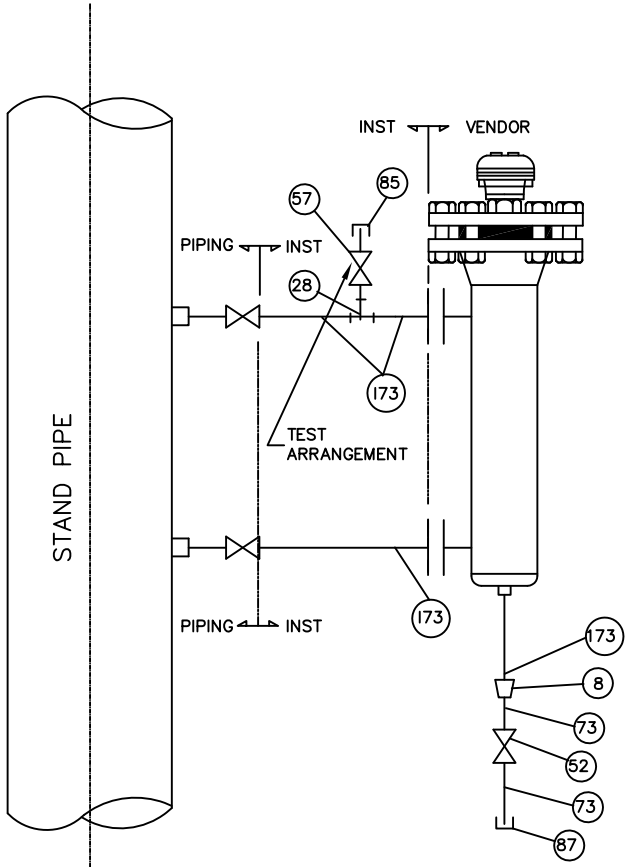
GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 9 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

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

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

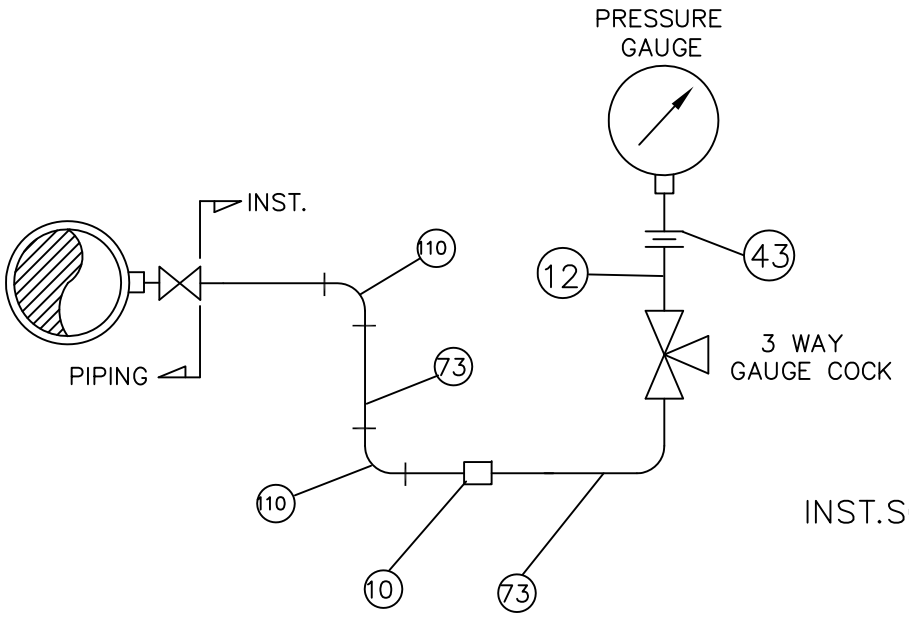
1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

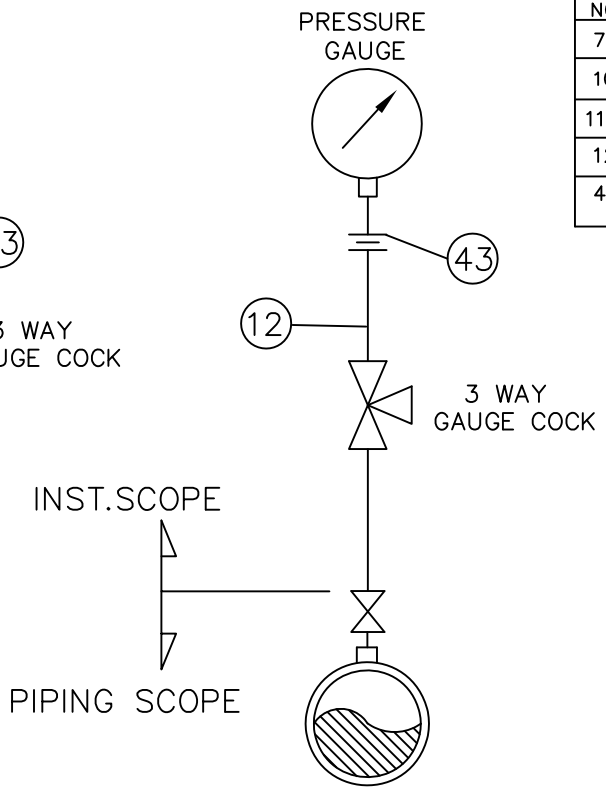
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 10 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0



REMOTE MOUNTING



ON TAP MOUNTING

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
73	15Mtrs	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

SERVICE : WATER, CONDENSATE ETC.

PRELIMINARY
TENDER PURPOSE ONLY

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

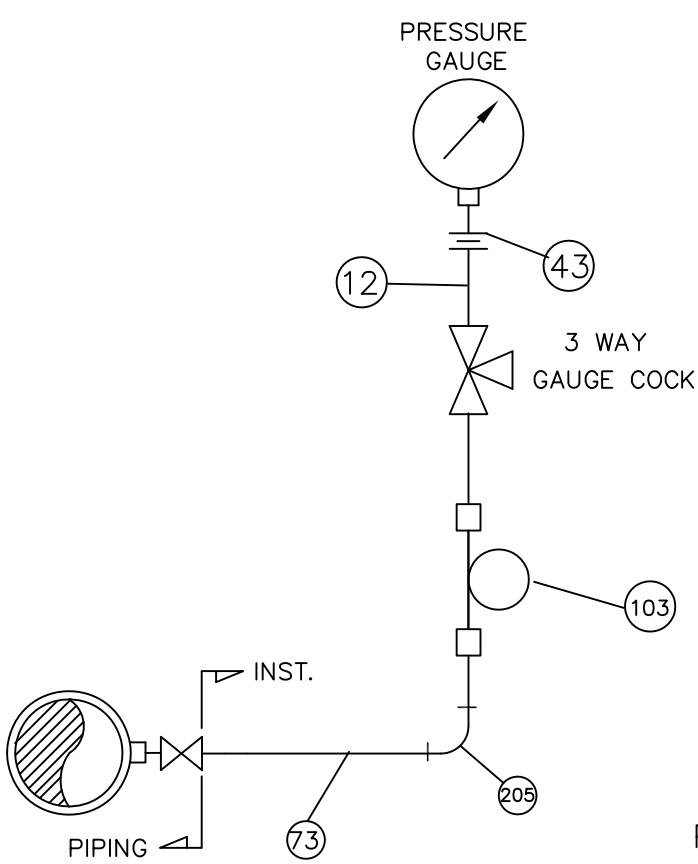
1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

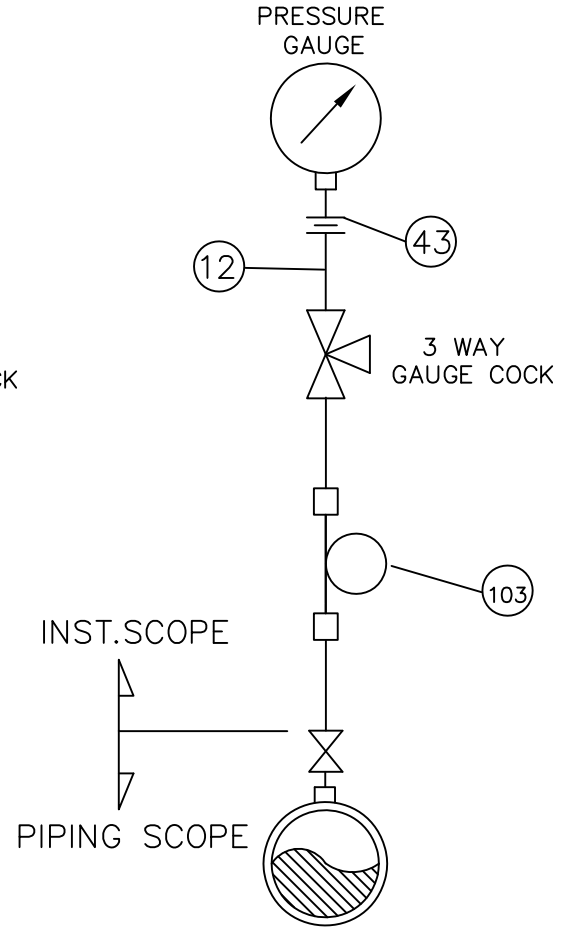
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 11 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0



REMOTE MOUNTING



ON TAP MOUNTING

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

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

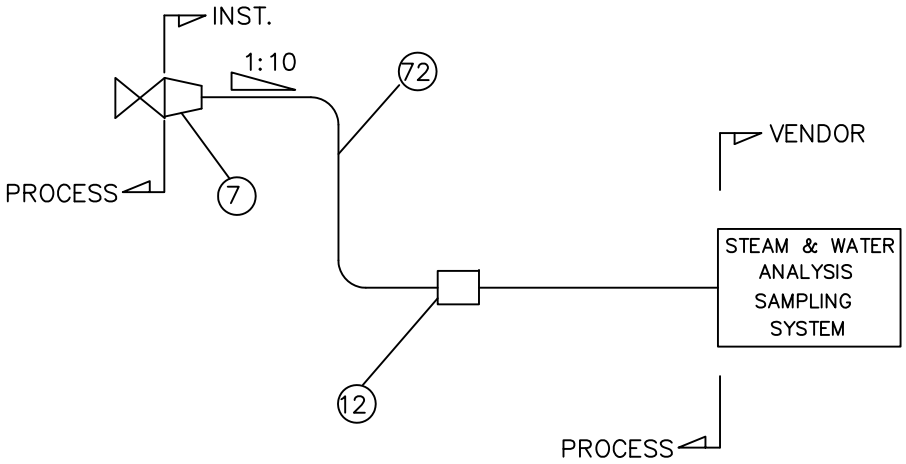
1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 12 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0



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

PRELIMINARY
TENDER PURPOSE ONLY

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

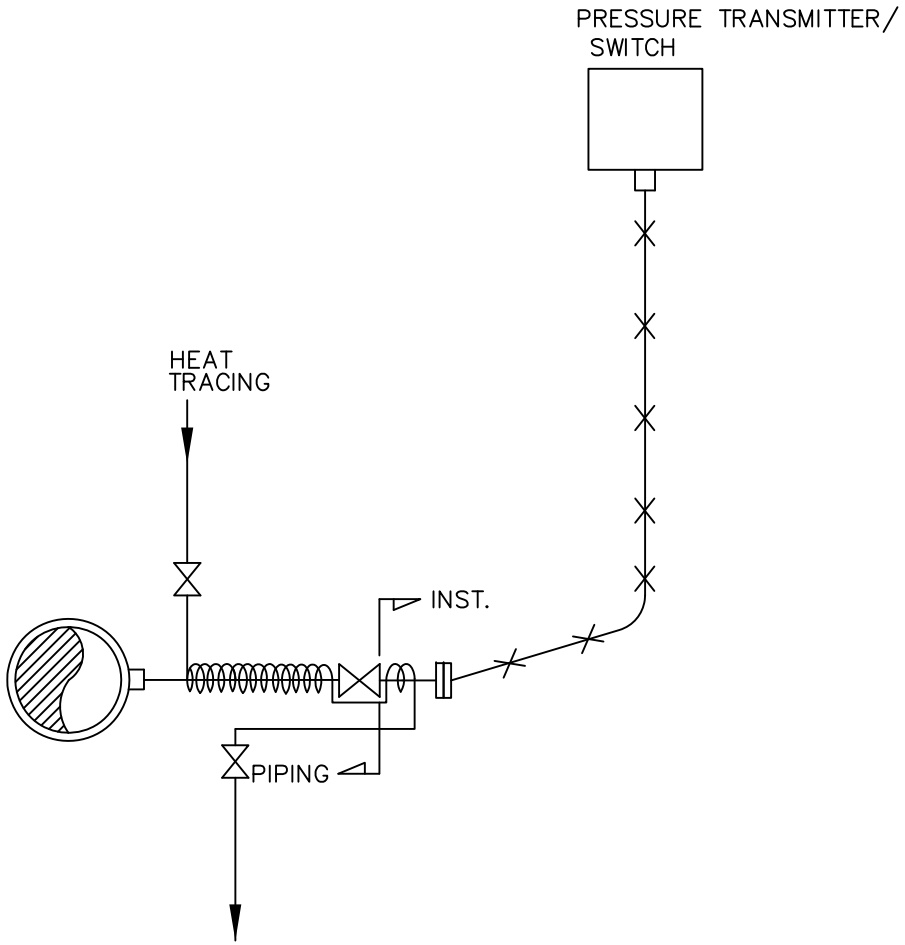
GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 13 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

PRESSURE TRANSMITTER/PRESSURE SWITCH
IN HFO SERVICE



PRELIMINARY
TENDER PURPOSE ONLY

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

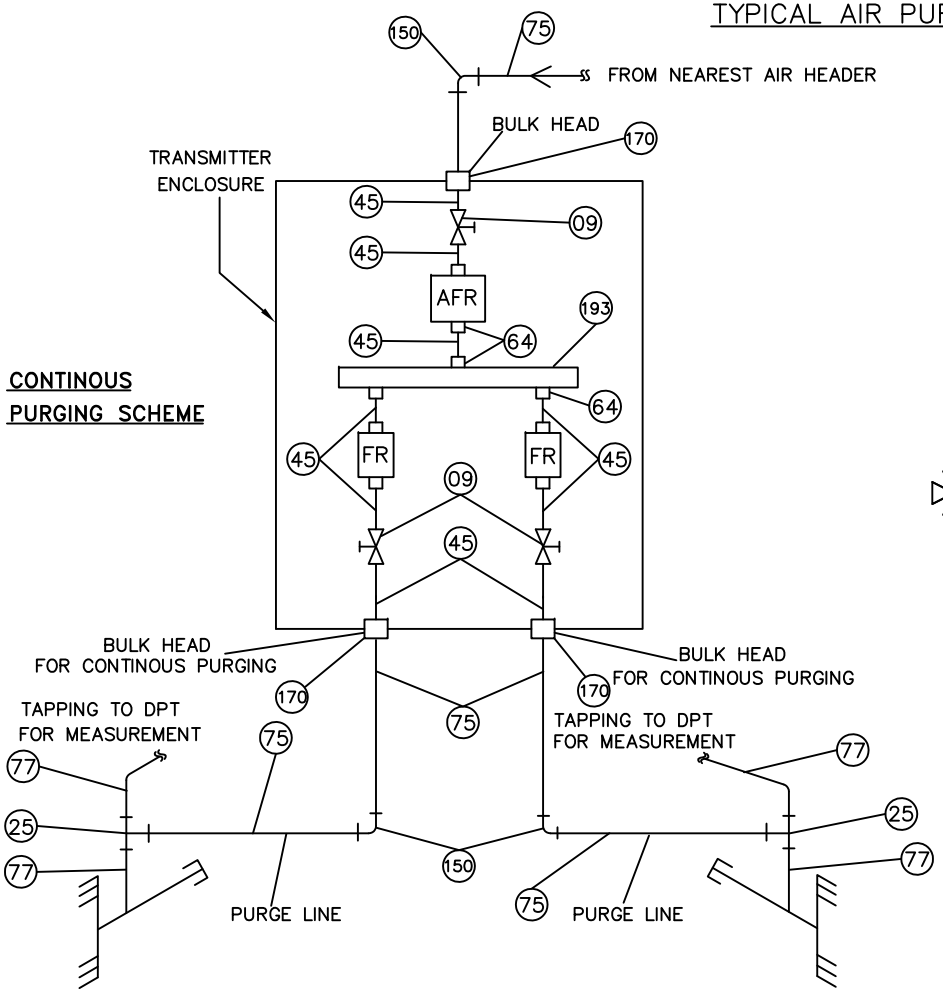
JOB NO. DCPL–K9213R | SCALE NIL | SHT. 14 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

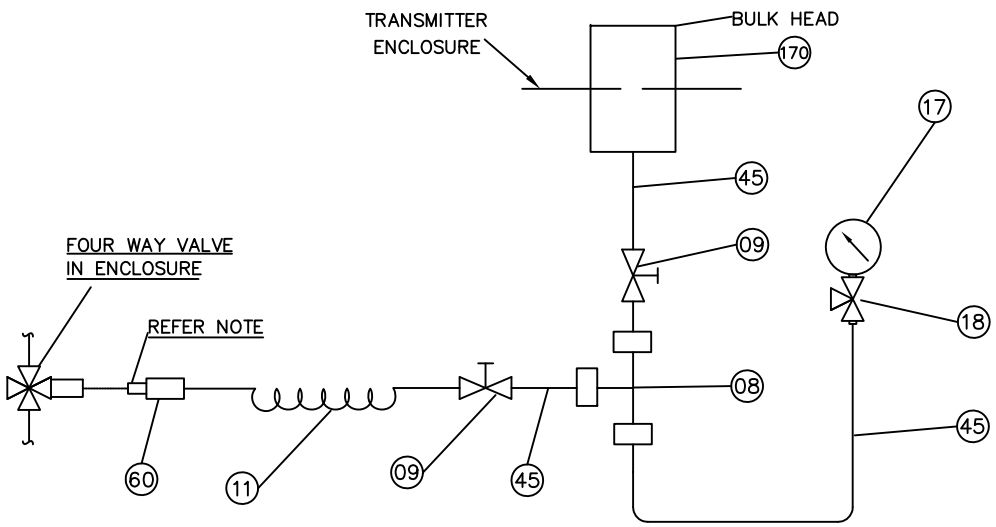
K9213-DWG-I-0060-14-20-REV-0

A4_H (08–'06) [297 x 210]

TYPICAL AIR PURGING SCHEMES



CONTINOUS PURGING SCHEME



INTERMITTENT PURGING SCHEME

NOTE:

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

FR–FLOW REGULATOR

CONTINUE TO SHT. NO. 16/20

PRELIMINARY
TENDER PURPOSE ONLY

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 15 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

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

PRELIMINARY
TENDER PURPOSE ONLY

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

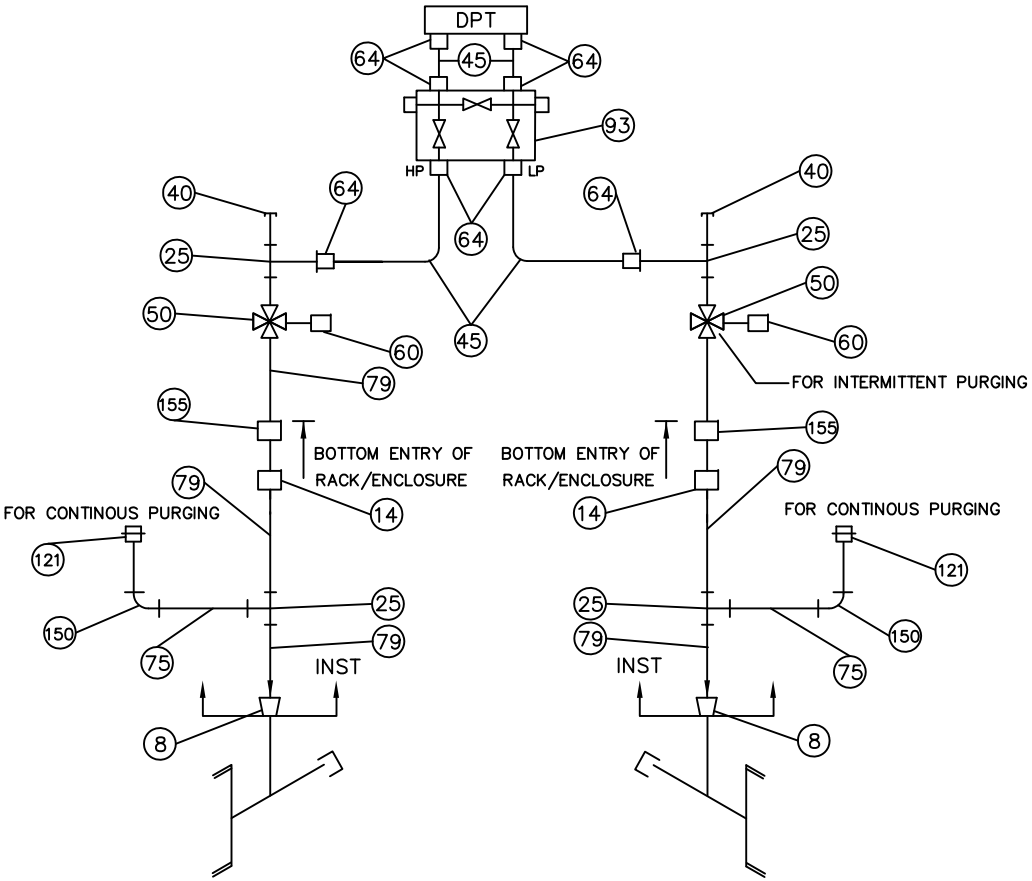
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 16 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

K9213-DWG-I-0060-16-20-REV-0

A4_H (08–'06) [297 x 210]



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
8	2	REDUCER 1" BSPF X 3/4" NB–SW CL 3000
14	2	FORGED COUPLING 3/4" SW CL 3000/AS PER ANSI B16.11
25	4	FORGED UNEQUAL TEE AS PER ANSI B16.11 SIZE : 2 X 3/4" NB–SW X 1/2" NPTF/CL3000
40	2	NIPPLE & CAP 3/4" NB–SCH 80/CAP–3/4" NPTF
45	6 Mtrs.	SEAMLESS TUBE 1/2" OD X 2.1 MM THK.
50	2	FOUR WAY VALVE SIZE :(2 X 3/4" NB–SW)X(2 X 1/2"NPTF) CL:800
60	2	QUICK DISCONNECTING FITTING SIZE:1/2"NPTM
64	8	MALE CONNECTOR 1/2" NPT(M) X TO SUIT 1/2" OD TUBE
79	30Mtrs	SEAMLESS PIPE/3/4" NB SCH 80
75	A/R	PIPE AS PER IS–1239 SIZE :1/2" NB–HEAVY GRADE
93	1	3 VALVE MANIFOLD 1/2" NPT(F)
150	2	GALVANISED ELBOW CL 3000 SIZE :1/2" NPTF
155	2	BULK HEAD COUPLING CL 3000 SIZE :3/4" NB SW /CL 3000/AS PER ANSI B16.11
121	2	BULK HEAD COUPLING CL 3000 SIZE :1/2" NPTF /AS PER ANSI B16.11

SERVICE : FLUE GAS, FURNACE ETC.

PRELIMINARY
TENDER PURPOSE ONLY

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

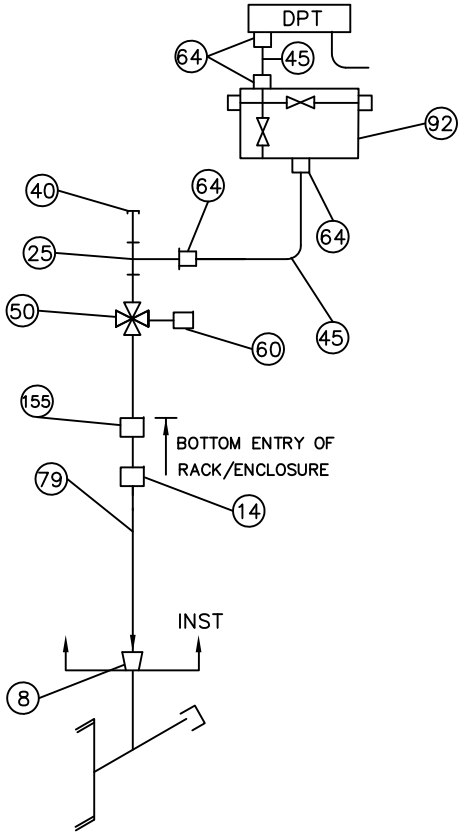
GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 17 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

DIFF. PRESSURE TRANSMITTER
MOUNTED ABOVE SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
8	1	REDUCER 1" BSPF X 3/4" NB–SW CL 3000
14	1	FORGED COUPLING 3/4" SW CL 3000/AS PER ANSI B16.11
25	1	FORGED UNEQUAL TEE AS PER ANSI B16.11 SIZE : 2 X 3/4" NB–SW X 1/2" NPTF/CL3000
40	1	NIPPLE & CAP 3/4" NB–SCH 80/CAP–3/4" NPTF
45	6 Mtrs.	SEAMLESS TUBE 1/2" OD X 2.1 MM THK.
50	1	FOUR WAY VALVE SIZE :(2 X 3/4" NB–SW)X(2 X 1/2"NPTF) CL:800
60	1	QUICK DISCONNECTING FITTING SIZE:1/2"NPTM
64	3	MALE CONNECTOR /SS 316 1/2" NPT(M) X TO SUIT 1/2" OD TUBE
79	30Mtrs	SEAMLESS PIPE/3/4" NB SCH 80
92	1	2 VALVE MANIFOLD 1/2" NPT(F)
155	1	BULK HEAD COUPLING CL 3000 SIZE :3/4" SW /CL 3000/AS PER ANSI B16.11

SERVICE : FLUE GAS, PRIMARY AIR, SECONDARY AIR ETC.

NOTE : AIR PURGING ARRANGEMENT SHALL BE INCLUDED.

PRELIMINARY
TENDER PURPOSE ONLY

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

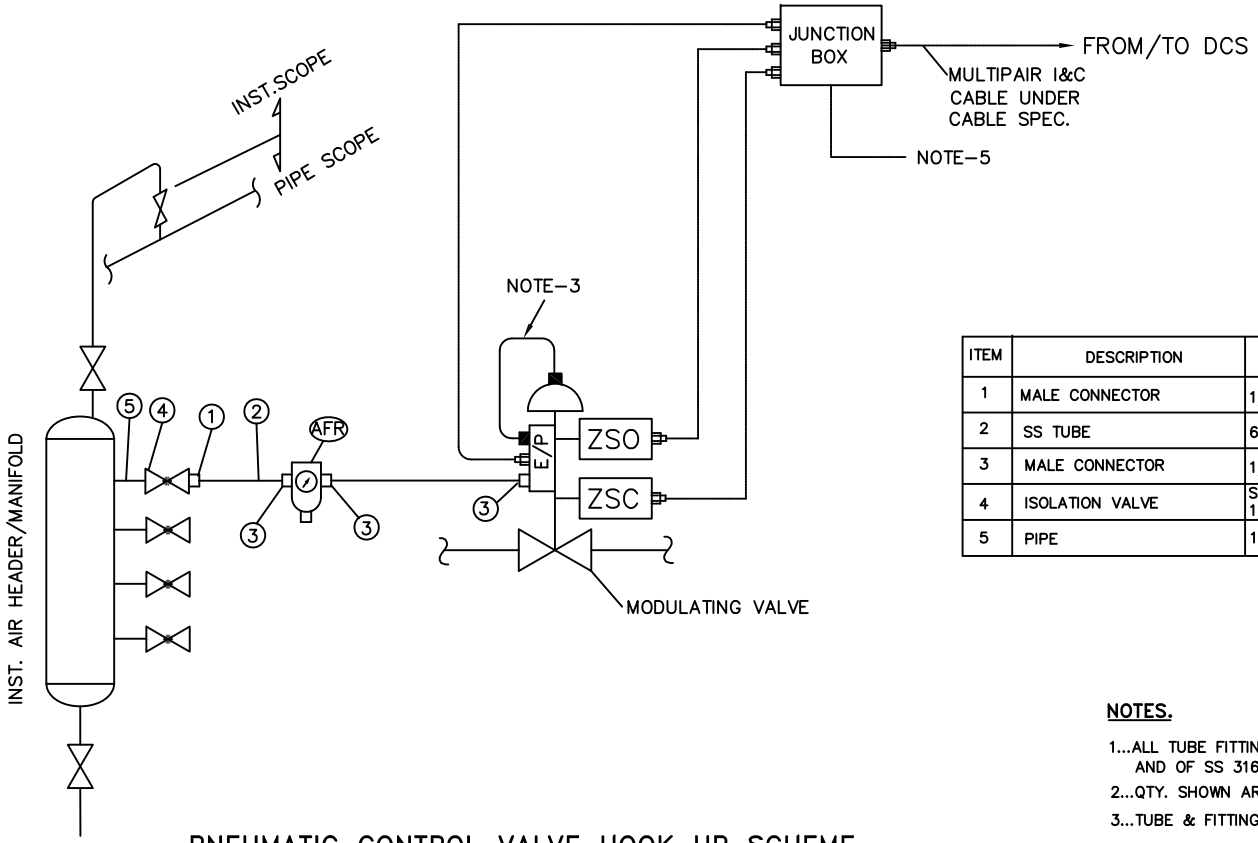
1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL–K9213R | SCALE NIL | SHT. 18 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0



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

PNEUMATIC CONTROL VALVE HOOK UP SCHEME

NOTES.

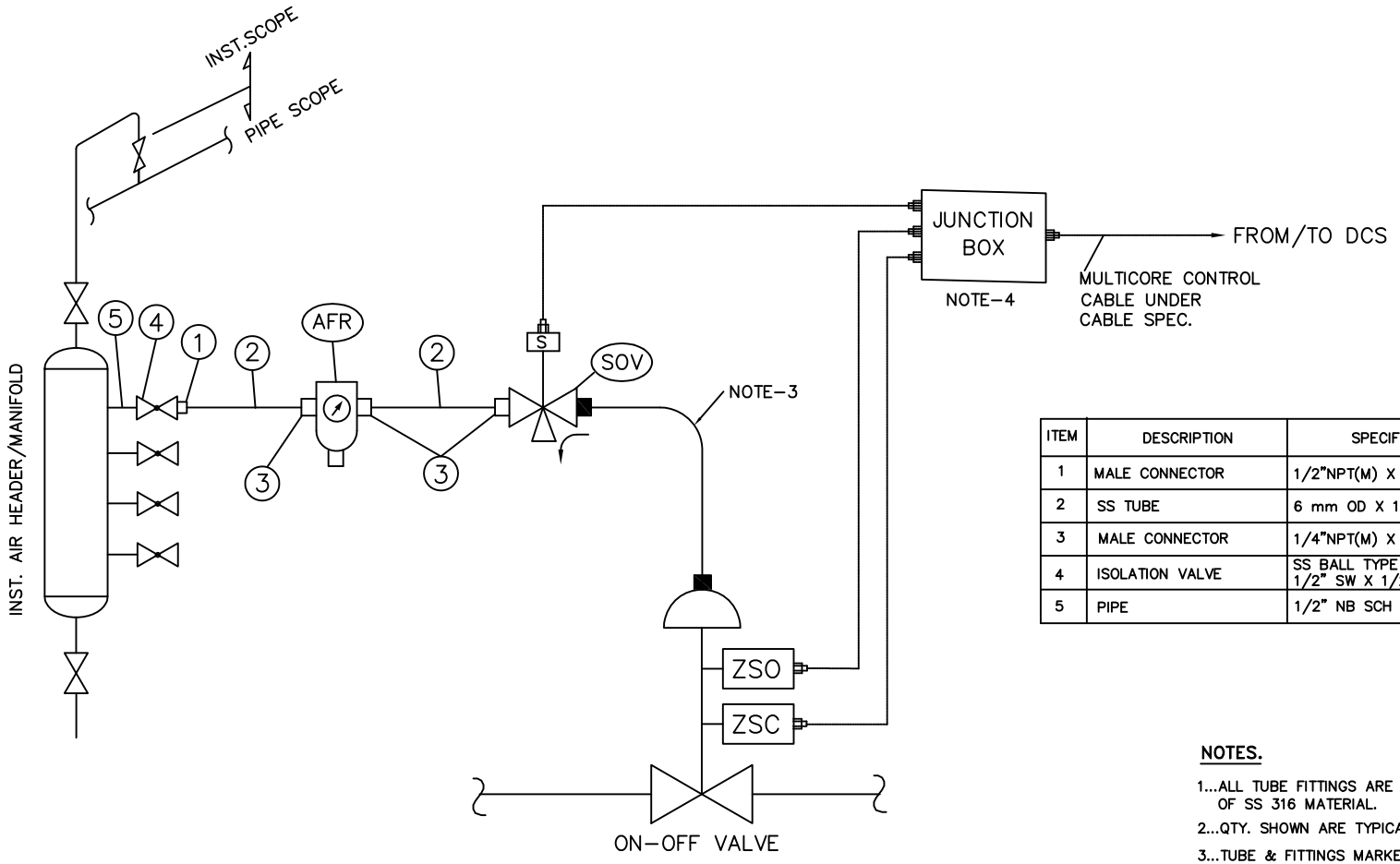
1...ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.
2...QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.
3...TUBE & FITTINGS MARKED ■ ARE INTEGRAL TO THE VALVE.
4...LIMIT SWITCHES WILL BE CONNECTED WHEREVER APPLICABLE.
5...JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.
6...ISOLATION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

PRELIMINARY
TENDER PURPOSE ONLY

						TYPICAL INSTRUMENT INSTALLATION DIAGRAM
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)
GP	AT	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE	

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

JOB NO. DCPL-K9213R | SCALE NIL | SHT. 19 OF 20
DWG. NO. K9213R-DWG-I-0060 | REV. 0



ITEM	DESCRIPTION	SPECIFICATION	QTY.	REMARKS
1	MALE CONNECTOR	1/2"NPT(M) X 6 mm OD COMPRN.	1	
2	SS TUBE	6 mm OD X 1.0 mm THK.	10 MTRS.	
3	MALE CONNECTOR	1/4"NPT(M) X 6 mm OD COMPRN.	3	
4	ISOLATION VALVE	SS BALL TYPE 600LBS 1/2" SW X 1/2" NPT(F)		
5	PIPE	1/2" NB SCH 40S	A/R	

PNEUMATIC SOV HOOK UP SCHEME

NOTES.

1...ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.

2...QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.

3...TUBE & FITTINGS MARKED ■ ARE INTEGRAL TO THE VALVE.

4...JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.

5...ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.

PRELIMINARY
TENDER PURPOSE ONLY

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

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

DWG. NO. K9213R-DWG-I-0060 | REV. 0

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

A4_H (08-'06) [297 x 210]

ANNEXURE-I

LIST OF MAKES OF SUB-VENDOR ITEMS

LIST OF SUB VENDORS (ANNEXURE-I)

SR No.	Items	Approved Vendor	Place / Location	Remarks
1.0	Horziontal/Vertical Centrifugal Pump	KBL	Kirolskarwadi	
		M&P	Pune	
		Flowmore	Ghaziabad	
		Sulzer pumps india ltd.	Navi mumbai	
		Worthington	Ghaziabad	
		Bharat pumps & compressors ltd	Allahabad	
		Flowserve India Controls Pvt. Ltd.	Coimbatore	
		Jyoti ltd.	Vadodara	
2.0	Vertical Centrifugal Pump	Kishore Pump	Pune	
		Sam Turbo	Coimbatore	
		KSB	Pune	
		Best and Crompton	Chennai	
		Voltas	Mumbai	
		V-Flo Pumps & Systems Co. Ltd.,	Beijing, China	
		Kishore Pump	Pune	
3.0	Strainers (Y-Type & Basket Type)	Multitetex Filtration Engg Ltd.	Noida	
		Sarojini Enterprises	Kolkata	
		Otoklin Filters	Mumbai	
		BHATIA ENGINEERING CO.	Delhi	
		JAYPEE INDUSTRIES PVT. LTD.	Delhi	
		FILTERATION ENGINEERS (I) PVT. LTD.	MUMBAI	
		OTOKLIN GLOBAL BUSINESS LIMITED	Mumbai	
		SUNGOV Engg. PVT. LTD.	Delhi	
		Grand Prix	Faridabad	
4.0	Fittings (metallic)	M.S. Fittings	Kolkata	
		Metal lloyds	Mumbai	
		True Forge	Faridabad	
		Tube Products	Baroda	
		NL Hazra	Kolkata	
		Gujrat Infra Pipes	Baroda	
		Edwards	USA	
		Pipefit Engineers	Baroda	
		Siddarth & Gautam	Faridabad	
		EBY	Mumbai	
		Reliance Forge	Mumbai	
5.0	MS/GI ERW Pipes	SAIL	Rourkela	
		Jindal	Ghazibad/ Hissar	Upto 300 NB ERW Pipes as per IS 1239/3589
		Surya Roshni	Bahadur Garh	Upto 400 NB ERW Pipes as per IS 1239/3589 and SAW as per IS 3589
		TATA Tube	Jamshedpur	Upto 150 NB ERW Pipes as per IS 1239
		PSL	Chennai/Vizag/Kutch/Daman	Spiral Weld SAW as per IS 3589
		Lalit Profile	Thane	Spiral Weld SAW as per IS 3589
		Samshi Pipes Industries	Vadodara	Spiral Weld SAW as per IS 3589
		Mukut Pipes	Rajpura	Longitudinal SAW (Single side weld) as per IS 3589
		Indus Tubes	G B Nagar	Upto 300 NB ERW Pipes as per IS 1239/3589
		Mann Ind	Indore	Spiral Weld SAW as per IS 3589
		Surendra Engg	Rajpura	Spiral Weld SAW as per IS 3589

		Pratibha Pipes & Structure Pvt Ltd	Thane	Spiral Weld SAW as per IS 3589
		JCO Gas Pipe	Chindwara	Spiral Weld SAW as per IS 3589
		Nukat Tanks and Vessels	Tarapur	Longitudinal SAW (Single side weld) as per IS 3589
		DADU Pipes	Sikrandrabad	Upto 300 NB ERW Pipes as per IS 1239/3589
		Good Luck Tubes	Sikandrabad	
		Advance Steel Tubes	Sahibabad	
		Bihar Tubes	Sikandrabad	
		Hi Tech Pipes	Sikandrabad	
		Ratnamani	Kutch/Ahmedabad/Chhatral	Upto 400 NB ERW Pipes as per IS 3589 and SAW as per IS 3589
		Maharashtra Seamless	Raigad	200-500 NB ERW Pipes as per IS 3589
		Welspun	Anjar/Bharuch	Upto 400 NB ERW Pipes as per IS 1239/ 3589 and SAW as per IS 3589
6.0	Seamless Pipes	ISMT	Ahmednagar/Baramati	
		Maharashtra Seamless	Raigad	
7.0	S.S. Pipes (For small Quantity 500 m)	REMI	Mumbai	
		Ratmani	Ahmedabad	
		Apex Tubes	Behror	
		Choksi	Ahmedabad	
8.0	CI Gate/ Globe/NRV/ SRV (Manual and motorized)	H.Sarkar	Howrah	SIZE UPTO 300NB
		A.V. VALVES LTD	Agra	
		Leader	Jalandhar	
		SURYA VALVES AND INSTRUMENTS MFG CO.	Chennai	FOR GV UPTO 450NB,GLV UPTO 300NB AND CHECK VALVES UPTO 350NB.
		ATAM VALVES PVT. LTD.	JALANDHAR	(1) CARBON IRON GATE VALVES: 65 NB TO 450 NB (UPTO PN-16.0) (2) CARBON IRON GLOBE VALVES & NON RETURN VALVES: 65 NB TO 150 NB (UPTO PN-16.0)
		FLUIDLINE VALVES COMPANY PVT.LTD.	Mumbai	1. CI Gate- CL125 & up to 900 NB, 2. CI Globe- CL125 & up to 450 NB, 3. CI SCNRV- CL125 & up to 600 NB.
		G.M. DALUI AND SONS PVT.LTD.	Howrah	
		KBL	Kondhapuri	Additionally approved for FM approved Gate valve 50-250 NB
		Bankim	Kolkata	
		VENUS PUMPS AND ENGG. WORKS	Kolkata	1) CI GATE VALVE SIZES 65NB-800NB ,2) CI GLOBE VALVE FOR SIZES 65NB-400 NB AND 3) CI SCNRV FOR SIZES 65 NB -600 NB.
9.0	GM valve	A.V. VALVES LTD	Agra	

		ATAM VALVES PVT. LTD.	Mumbai	GUN METAL GATE/GLOBE/NRV: 15 NB TO 50 NB (UPTO PN-16.0) & 15 NB TO 50 NB (UPTO #150)
		Leader	Jalandhar	
		VALTECH INDUSTRIES		GUN METAL SCREWED END TYPE , SCREWED IN BONNET , OUT SIDE SCREW & YOKE TPE , PN 16 , SIZES UPTO 50.
		SANT VALVES PVT. LTD.	Jalandhar	UP TO SIZE 100-NB ONLY.
10.0	Solenoid Valve	Rotex	Baroda	
		Avcon	Mumbai	
		Asco	Chennai	
		SMC	Noida	
		Nucon	Hyderabad	
		Rotex	Baroda	
		Avcon	Mumbai	
11.0	PLC Based Panels	SIEMENS	Nasik	
		SCHNEIDER	Nasik	
		ROCKWELL	Sahibabad	
		GE Intelligent Platform	BANGALORE	
		Honeywell Automation India Limited	Pune	
		ABB	Bangalore	
		SIEME	Nasik	
		SCHNEIDER	Nasik	
12.0	Battery (Ni Cd for PLC)	Amco saft	Bangalore	
		HBL Power System	Hyderabad	
		SAFT	France/Sweden	
13.0	Motor	Marathon,	kolkata	For HT and LT motor
		Crompton Greaves	Ahmednagar	For HT and LT motor
		NGEF	Bangalore	Upto 15 KW
		ABB	Bangalore/Faridabad	Upto 200 KW
		Siemens	Mumbai	For HT and LT motor
		Jyoti	Baroda	For LT motor only
		LHP	Solapur	Upto 120 KW
		BHEL	Bhopal	For HT motor only
		Bharat Electric (BHEL)		For LT motor only
		Bharat Bijlee	Mumbai	Upto 160 KW(For LT motor only)
		KEC	Bangalore/Hubli	Upto 90 KW
14.0	Battery (maintenance free for PLC/ Fire Alarm Panel)	EXIDE	Kolkata	
		HBL Power System	Hyderabad	
		AMAR RAJA	Tirupati	
15.0	Steel Plate, Structural Steel and section for Fire water storage tank	SAIL		
		Essar Steel		
		TISCO		
		RINL		
		Jindal		
		Lloyd		
		Ispat		
		Indian Iron & Steel Co. Ltd		
16.0	Pressure Gauge/DP Gauge	Gluck (I) Manufacturing Co	Mumbai,	
		H Guru	Rishra/Muzaffarpur/Bangalore	
		AN Instruments	Kolkata	
		ASHCROFT INDIA PVT LTD.	GIDC Chhatral Kalol	
		FORBES MARSHALL (HYD) LTD.	HYDERABAD	
		GAUGE BOURDON INDIA PVT. LTD.	Mumbai,	

		H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	BANGALORE	
		WIKA	Pune	
		Manometer India	Mumbai,	
		Baumer Technologies India Pvt. Ltd.	VAPI	
		GIC(Gauges Bourdon)	Panvel	
17.0	Pressure/DP/Vacuum Switch	Indfoss	Ghaziabad	
		SOR	USA	
		Dressor	USA	
		Delta control	UK	
		Trafag	Ranipet	
		GIC(Gauges Bourdon)	Panvel	
		ASHCROFT INDIA PVT LTD.	USA/GERMANY	
		Switzer	Chennai	
18.0	Level Switch (Float/Displacer)	DK Instruments	Kolkata	
		Levcon	Kolkata	
		Sigma	Mumbai	
		V-Automat	New Delhi	
		SBEM	Pune	
		Flow Star	Faridabad	
19.0	Level Indicator	Flow Star	Faridabad	
		Scientific Devices	Mumbai	
		Gauges Bourden	Panvel	
		SBEM	Pune	
		Pune Techtrol	Pune	
		Levcon	Kolkata	
		Sigma	Mumbai	
		V-Automat	New Delhi	
		DK Instruments	Kolkata	
20.0	OWS/PC	HP/Compaq /Dell/HCL/IBM/Lenovo		
21.0	Printer	HP/Cannon/Epson/Xeror/IBM/ Lexmark		
22.0	UPS	HITACHI-HIREL	Gandhinagar	
		APC	Bangalore	
		Delta	Gurgaon	
		Emerson	Mumbai	
		DB Power	Pune	
		Aplab	Mumbai	
23.0	Control / Power Cable	Cords Cable	Bhiwadi	
		Radiant Cables	Hyderabad	
		PolyCab	Daman	
		KEI	Bhiwadi	
		Nicco	Kolkata	
		Ravin Cables	Pune	
		Incab	Pune	
		HVPL	Faridabad	
		Torrent cable	Nadiad	
		Havells	Alwar	
		Paramount	Khushkhera	
		SRI Ram Cables	Bhiwadi	
		Thermocables	Hyderabad	
		Torrent cable	Nadiad	
		Universal Cables	SATNA	
		Gemscab	Bhiwadi	
		Delton	Faridabad	
24.0	Battery Charger for PLC/Diesel Engine	Chloride Power	Kolkata	
		Chabbi	Jalgaon	
		AMAR RAJA	Tirupati	
		Statcon	Noida	
		HBL Power System	Hyderabad	
		Dubas	Bangalore	
		Caldyne	Kolkata	
25.0	Fibre Optic Cable	Birla Ericsson	Rewa	
		Finolex	Pune/Goa	
		Aksh Fibre	Bhiwadi	
26.0	Pressure Transmitter and Diff. pressure Transmitter	Emerson	USA/Pawane	
		Laxons Automation	Daman	
		YIL	Bangalore	
		Siemens	Thane	

		Fuji	China	
		Yokogawa	Japan	
		Honeywell	USA/Pune	
27.0	Level Transmitter	ABB LIMITED		
		Endress + Hauser (India) Pvt. Ltd.,		
		Moore Industries International Inc.		
		NIVO CONTROLS PVT. LTD.		
		Pune Techtrol Pvt. Ltd.		
		EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.		
		SIEMENS LIMITED		
		SMART INSTRUMENTS LTD, BRAZIL		
		SBEM PVT. LTD.		
		Honeywell Automation India Limited		
		TOSHNIWAL INDUSTRIES PVT. LTD.,		
		V. AUTOMAT & INTRUMENTS (P) LTD.		
		YOKOGAWA INDIA LIMITED,		
28.0	AGITATOR	REMI	MUMBAI	
		FIBRE & FIBRE PRODUTS		
		STANDARD ENGINEERS	MUMBAI	
		CROMPTON GREAVES	AHAMADNAGAR	
29.0	ORIFICE PLATE	MICRO PRECISION	FARIDABAD	
		INSTRUMENTAION LTD	PALGHAT	
		CARLO DYNAMICS	HYDRABAD	
30.0	BUTTERFLY VALVE	ADVANCE VALVES PVT. LTD.	NOIDA	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		INSTRUMENTATION LTD.	PALAKKAD-KERALA	
		INTERVALVE (INDIA) LTD.	PUNE	
		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	
		SURYA VALVES AND INSTRUMENTS MFG CO.	CHENNAI	
		PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED	NAVI MUMBAI	
		UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED,	KOLKATA	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
31.0	DUAL PLATE CHECK VALVE	ADVANCE VALVES PVT. LTD.	NOIDA	
		ASIAN INDUSTRIAL VALVES & INSTRUMENTS.	CHENAI	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	
32.0	ELECTRICAL HOIST	ARMSEL MHE PVT. LTD	BANGALORE	
		ALPHA SERVICES	NEW DELHI	
		CONSOLIDATED HOISTS PVT LTD	PUNE	
		CENTURY CRANE ENGINEERS PVT. LTD.	FARIDABAD	
		EDDY CRANES PVT. LTD.	MUMBAI	
		GRIP ENGINEERS PVT. LTD.,	FARIDABAD	
		GLOBAL TECHNOLOGIES	HYDERABAD	
		HERCULES HOISTS LTD.	RAIGAD	
		LIFTING EQUIPMENTS AND ACCESSORIES	NEW DELHI	
		MANGLA HOISTS PVT LTD	NEW DELHI	
		REVA INDUSTRIES LTD.	FARIDABAD	
		ROCKWELL HOISTO CRANES PVT. LTD.	JHAJJAR-HARYANA	
		SAFEX ENERGY PVT. LTD.	AHMEDABAD	

		TUOBRO FURGUSON (INDIA) PVT LTD	KOLKATA-	
33.0	INSTRUMENT FITTING	AURA INCORPORATED	NEW DELHI	
		ASTEC VALVES & FITTINGS PVT. LTD.,	MUMBAI	
		ARYA CRAFTS & ENGINEERING PVT. LTD.	MUMBAI	
		COMFIT & VALVE PVT. LTD.	AHMEDABAD	
		FLUIDFIT ENGINEERS PVT. LTD.	MUMBAI	
		FLUID CONTROLS PVT. LTD.	MUMBAI	
		HP VALVES & FITTINGS INDIA PVT. LTD.	CHENNAI	
		PRECISION ENGINEERING INDUSTRIES	MUMBAI	
		PANAM ENGINEERS,	MUMBAI	
		PERFECT INSTRUMENTATION CONTROL (INDIA) PVT. LTD.	MUMBAI	
		VIKAS INDUSTRIAL PRODUCTS	NOIDA	
34.0	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	MUMBAI	
		FLEXPRO ELECTRICALS PVT. LTD.	GUJARAT	
		K.S.INSTRUMENTS PVT.LTD.	BANGLORE	
		SUCHITRA INDUSTRIES	BANGLORE	
		SHRENIK & COMPANY,	GUJARAT	
35.0	ROTAMETER	EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.	PUNE	
		FLOW STAR ENGINEERING PVT. LTD.,	FARIDABAD	
		FLOWTECH INSTRUMENTS SERVICRS	GUJARAT	
		INSTRUMENTATION ENGINEERS PVT LTD	HYDERABAD	
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	NAVI MUMBAI	
36.0	SIGHT FLOW INDICATORS	B.K.EQUIPMENTS PVT.LTD.	CHENNAI	
		BLISS ANAND PVT. LTD.	GURGAON	
		FLOWTECH INSTRUMENTS SERVICRS	GUJARAT	
		INSTRUMENTATION ENGINEERS PVT LTD	HYDERABAD	
		SIGMA INSTRUMENTS CO.	MUMBAI	
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	NAVI MUMBAI	
		TELACE EQUIPMENT PVT.LTD.	CHENNAI	
37.0	TEMPERATURE ELEMENT	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	GOA	
		DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	MUMBAI	
		PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	GOA	
		TECHNO INSTRUMENTS	GUJARAT	
		TEMPSENS INSTRUMENT (I) PVT LTD	UDAIPUR	
		TM TECNOMATIC SPA	ITALY	
		TOSHNIWAL INDUSTRIES PVT. LTD.,	AJMER	
		THERMAL INSTRUMENT INDIA PVT. LTD.	MUMBAI	
		BAUMER TECHNOLOGIES INDIA PVT. LTD.	MUMBAI	
38.0	**TEMPERATURE GAUGE**	A.N. INSTRUMENTS PVT. LTD.	KOLKATA	
		ASHCROFT INDIA PVT LTD.	GUJARAT	
		BUDENBERG GUAGE CO.LTD.	UK	
		FORBES MARSHALL (HYD) LTD.	HYDERABAD	
		GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	GOA	
		GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	GOA	
		GAUGE BOURDON INDIA PVT. LTD.	MUMBAI	

		H.GURU INDUSTRIES	KOLKATA	
		H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	BANGLORE	
		BAUMER TECHNOLOGIES INDIA PVT. LTD.	MUMBAI	
39.0	**BALL VALVE**	BDK	HUBLI	
		LEADER	JALANDHAR	
		BANKIM	KOLKATA	
		H SARKAR	KOLKATA	
		AV VALVES	AGRA	
		HAWA VALVES	MUMBAI	
		FLOW CHEM	AHMEDABAD	
		STEEL STRON VALVES	MUMBAI	
		AKAY VALVES LTD.	MUMBAI	
		AQUA VALVES PVT.LTD.	KARNATAKA	
		CRESCENT VALVES	MUMBAI	
		FISHER SANMAR LIMITED	CHENNAI	
		HABONIM VAAS AUTOMATION PVT LTD.,CHENNAI	CHENNAI	
		KIRLOSKAR BROTHERS LTD.	PUNE	
		KSB PUMPS LTD.	MUMBAI	
		MICROFINISH VALVES PVT LTD.	HUBLI	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
		PEC VALVES	MUMBAI	
40.0	SLUICE GATE	H SARKAR	KOLKATA	
		JASH ENGINEERING	INDORE	
		YASHWANT	MIRAJ	
		GLOBETECH	HOWRAH	
41.0	DIAPHRAGM VALVE	PROCON ENGINEERES	MUMBAI	
		HAWA VALVES	MUMBAI	
		BDK VALVES	HUBLI	
		FOURESS	BANALORE	
		INERVALVE	GUJRAT	
42.0	3 WAY VALVE	HI TECH	AHMEDABAD	
		ADVANCE VALVES PVT.LTD	NOIDA	
		BDK	HUBLI	
		FOURESS ENGG.INDIA LTD.	MUMBAI	
		FLUIDLINEVALVES COMPANY PRIVATE LTD.,	MUMBAI	
		INSTRUMENTATION LTD.	PALAKAD	
		KIRLOSKAR BROTHERS LTD.	PUNE	
		VENUS PUMP & ENGG. WORKS	KOLKATA	
		SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY	CHENNAI	
		STAFFORD CONTROLS LIMITED	PUNE	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
43.0	PLUG VALVE	FISHER SANMAR LIMITED	CHENNAI	
		BDK	HUBLI	
		LARSEN & TOUBRO LTD.	MUMBAI	
		LEADER	JALANDHAR	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
44.0	FLANGES (SS/CS)	BHARAT FORGE	PUNE	
		RELIANCE FORGE	MUMBAI	
		MS FITTINGS	KOLKATA	
45.0	POSITIVE DISPLACEMETN PUMP	MILTON ROY INIDA	CHENNAI	
		SWELLORE	AHMEDABAD	
		VK PUMP	NASIK	
		DENCIL PUMP	MUMBAI	
46.0	VALVES (GATE/GLOBE/NRV/ BALL)-CPVC/PVC/PP/ HDPE/PVDF	GEROGE FISHCHER IPING SYSTEMS PVT LTD	DELHI	
		ASTROL PLYTECHINC LTD	AHMEDABAD	
47.0	PIPE/FITTINGS/ FLANGES CPVC/PVC/ PP/HDPE/PFDF	GEROGE FISHCHER IPING SYSTEMS PVT LTD	DELHI	
		ASTROL PLYTECHINC LTD	AHMEDABAD	
48.0	RUBBER LINING FOR PIPES/TANKS	RISHI INDUTRIES	SONEPET	
		INDUSTRIAL LINING LTD	BARODA	
		MIL	CHENNAI	
49.0	NON METALIC PUMP (CENTRIFUGAL)	Anticorrosive Pumps	Mumbai	

		Rajedia Pumps	Gujrat	
		Price Pumps	Mumbai	
50.0	Blower	Everest	Delhi	
		Kay International	Haryana	
		Swam Pneumatics	Delhi	
		Kulkarni brothers	Mumbai	
51.0	TEMPERATURE SWITCH	INDFOSS (INDIA) LTD.	GAZIABAD	
		DRESSER INDUSTRIES INC.	USA	
		SWITZER INSTRUMENT LTD.	CHENNAI	
		SOR INC.	USA	
		TOSHNIWAL BROTHERS (P) LTD.	DELHI	
		VASU TECH LIMITED	DELHI	
52.0	HDPE TANK	SINTEX		
53.0	FRP TANK	TIANODE	CHENNAI	
		BHAVI PLAST	MUMBAI	
54.0	HYDROGEN DETECTOR	Detection Instruments	INDIA	
		HACH	USA	
		HONEYWELL	UK	
		ORBIT	INDIA	
55.0	RESIDUAL CHLORINE ANALYZER AND pH METER.	EMERSON		
		HACH		
56.0	LOCAL CONTROL PANEL	INDSUSTRIAL SWITCHGEAR & CONTROL	MUMBAI	
		POSITRONICS	BARODA	
		ECS	NOIDA	
		SWITCHING CIRCUIT	KOLKATA	
		CONTROL & SCHEMATICS	HYDRABAD	
		GE POWER	BANGLORE	
		SIEMENS	KOLKATA	
		C&S	NOIDA	
		PYROTECH	UDAIPUR	
		DELTA CONTROL	MUMBAI	
		L&T	MUMBAI	
57.0	PAINT	BERGER		
		ASIAN PAINTS		
		SHALIMAR		
		J&N		
		HIND RECTIFIER	NASIK	
58.0	Chain pulley block	INDEF		
		BRADY		
		Lifting Equipment		
		GRIP ENGG		
		Tractel tirfor		
		REVA		
		TECHNO INDUSTRIES		
59.0	HAND PUMP (MOTOR OPERATED BARREL PUMP)	JYOTI		
		SOLVACID		
		SLEEK		
		FLUDIYNE		
		Mach Powerpoint		
60.0	STRUCTURE STEEL	SAIL		
		TISCO		
		JINDAL		
		BHUSWAL		

Notes:-

a) All the finally selected sub vendors shall be subject to customer approval during detailed engineering without any delivery/ commercial implications to BHEL/ CUSTOMER.

b) This vendor list applicable for Mechanical, electrical and C&I items.

ANNEXURE-II

MANDATORY SPARE LIST

LIST OF MANDATORY SPARES ANNEXURE-II

SL. No.	Equipment / Package name	Qty.	Remarks (BHEL)
1	**Spares for Horizontal Centrifugal Pumps**		
1.1	Shaft	1 No.	
1.2	Shaft Sleeve	2 Nos.	
1.3	Impeller	1 No.	
1.4	Impeller locking nut and bolt	4 Nos.	
1.5	Impeller wear ring	4 Nos.	
1.6	Casing wear ring	4 Nos.	
1.7	Oil Seal	4 Nos.	
1.8	Oil Deflector	3 Nos.	
1.9	Oil Ring	3 Nos.	
1.10	Gland Packing	400%	
1.11	Lantern Ring	3 Nos.	
1.12	Mech Seal Assembly	1 No.	
1.13	Stationary/Carbon Packing and "O" Ring for Mechanical Seal	3 Sets	
1.14	Oil Level Gauge	3 Nos.	
1.15	Coupling	2 Nos.	
1.16	Rubber Bush for Coupling	2 Nos.	
1.17	"O" Rings	2 Sets	
1.18	Suction Strainers Element	3 Nos.	
1.19	Bearing for Pump Motor	2 Sets	
2	**Spares for Agitators**		
2.1	Gear Box Unit Complete	1 No.	Not applicable.
2.2	Bearing for Gear Box Unit	1 Set	Not applicable.
2.3	Coupling complete (Motor/Gear box and gear box/agitator)	1 Set	Not applicable.
2.4	Coupling Bolts	1 Set	Not applicable.
2.5	Coupling shim pack (if applicable)	4 Sets	Not applicable.
2.6	Oil seals	4 Sets	Not applicable.
3	**Spares for Valves**		
3.1	i) Manual Diaphragm valves	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.	
	ii) Auto Diaphragm valves	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.	Not applicable.
	iii) Spare Diaphragm for above	10% of total quantity used for each type and size with minimum no. two (2) for each type and	

		size.	
	iv) Diaphragm	10% of total quantity used for each type and size with minimum no. one (1) for each type and size.	
3.2	i) Non return valves (NRV)	2 nos. of each size & type	
	ii) Flaps for above NRV	2 nos. of each size	
3.3	Gate/Globe/Ballvalves/plug valve/needle valve		
	i) Upto 4”	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.	
	ii) Above 4”	1 no. each type and size.	Not applicable.
3.4	Butter fly valve		
	i) Upto 4”	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.	
	ii) Above 4””	1 no. each type and size	Not applicable.
4	**Spares for Air Blowers**		
4.1	Impeller with shaft	1 Set	Not applicable.
4.2	Bearings	1 Set	Not applicable.
4.3	Oil seals	5 Sets	Not applicable.
4.4	Filter	1 Set	Not applicable.
5	**Pneumatic Control Valve**		
5.1	Pneumatic Diaghragm for Diaghragm actuated valve	2 Nos. for each type of Actuator	Not applicable.
5.3	Gland Packing	1 set for each type of Control Valve	Not applicable.
5.4	Plug, Seat, Cage, Stem etc.	1 set for each type of Control Valve	Not applicable.
5.5	Retainer Ring, Seal Ring etc.	1 set for each type of Control Valve	Not applicable.
5.6	Gasket	2 Sets. for each type of Control Valve	Not applicable.
5.7	Position Transmitter complete set	10% of total quantity used in the system for each type and model.	Not applicable.
5.8	Control Valve E/P Positioner complete Set	10% of total quantity used in the system for each type and model.	Not applicable.
5.9	Complete Set of Solenoid Valve for Pneumatic type On/Off Valve	2 Nos. for each type & ratings	Not applicable.
5.10	Solenoid Coil for Pneumatic type On/Off Valve	5 Nos. for each type & ratings	Not applicable.
5.11	Position Limit Switch for Pneumatic type On/Off Valve	10 Nos. for each type & ratings	Not applicable.
6.0	**415 Volt Motor (Upto 30KW Rating)**		
6.1	Driving End & Non-Driving End Bearing	3Set for each type and rating of Motor	
6.2	Cooling Fan	2No. for each type and	

		rating of Motor	
6.3	Motor Terminal Block	5No. for each type and rating of Motor	
6.4	Complete Set of Coupling	1Set for each Application	
7.0	**Field Instruments (Transmitters/temperature elements (TC / RTD) / Gauges / Switches etc. along with relevant accessories)**		
7.1	10 (ten) percent of total of each type or at least one (whichever is higher) of each type along with accessories.		
8.0	**Control System (DCS, PLC etc.)**		
8.1	2 (two) numbers each of keyboard and cursor control devices.		
8.2	2 (two) numbers of LCD TFT (24") Monitors.		
8.3	10 (ten) sets of spare interface cables with connecting plugs for each type of peripherals & I / O hardware.		
8.4	10 (ten) percent of power supply modules of the total qty. offered for each type or 4 (four) numbers, whichever is higher.		
8.5	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.		
8.6	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.		
8.7	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.		
9.0	**Control Panel/Desk Mounted Items**		
9.1	Push Button		
9.1.1	Complete assembly	5Nos for each colour	
9.1.2	Contact Element (1NO + 1NC) Block	20Nos.	
9.2	Selector Switch	10Nos. for each type and rating	
9.3	Meter (Analog or Digital)		
9.3.1	Ammeter	10% for each type and range or minimum one (1) no. whichever is more	
9.3.2	Voltmeter	10% for each type and range or minimum one (1) no. whichever is more	
9.3.3	Frequency	10% for each type and range or minimum one (1) no. whichever is more	
9.3.4	MW	10% for each type and range or minimum one (1) no. whichever is more	
9.3.5	MVAR	10% for each type and range or minimum one (1) no. whichever is more	
9.3.6	Power Factor	10% for each type and range or minimum one (1) no. whichever is more	
9.3.7	Synchroscope	10% for each type and	

		range or minimum one (1) no. whichever is more	
9.4	Indicating Lamps complete assembly	10Nos. for each Colour and type	
9.5	Mimic Lamps	10Nos. for each Colour and type	
9.6	MCB	2Nos. for each type and rating	
9.7	Door Limit Switch	2Nos.	
9.8	Annunciation system		
9.8.1	Lamp Box with Facia & Lamps (LED type)	25Nos.	
9.8.2	Hooter	1No.	
9.8.3	Each type of PCB (for non-PLC driven system)	1(one) no.	
10.0	**UPS (For BOP systems)**		
10.1	Fuse	3 (Three) times of total quantity of each type of fuses used in the system (for all BOP systems).	
10.2	SCR	10% of total quantity of each type used in the system or minimum 2(two) nos. whichever is more.	
10.3	Diode	10% of total quantity of each type used in the system or minimum 2(two) nos. whichever is more.	
10.4	IGBT	2 (two) nos.	
10.5	Electronic Module/ PCB		
10.5.1	Static Switch	1 (one) no. each type of Electronic Card/ PCB/ modules used in the system	
10.5.2	Inverter	1 (one) no. each type of Electronic Card/ PCB/ modules used in the system	
10.5.3	Static voltage Regulator	1 (one) no. each type of Electronic Card/ PCB/ modules used in the system	
10.5.4	Charger	1 (one) no. each type of Electronic Card/ PCB/ modules used in the system	
10.5.5	UPS of 2 KVA rating or below.	One Complete set.	
10.5.6	Selector Switch	1 (one) no. each type	
10.5.7	Digital Voltage/ Current Indicator (LCD type)	1 (one) no. each type	
10.5.8	Indication Lamp- Complete assembly (Red/ Green colour)	1 (one) no. each type	
10.5.9	Cooling Fan - 240 VAC supply	1 (one) no. each type	
10.6	UPS Battery		
10.6.1	Battery Cell (Uncharged, Dry)	10% of total quantity of each BOP UPS.	

10.6.2	Inter connecting cell strips	10 nos.	
10.6.3	Rubber gloves	1 pair	
10.6.4	Voltmeter for measuring cell voltage (Center zero type)	1 no.	
10.6.5	Appron & Goggles	1 set	
10.6.6	Cell lifting puller	1 no.	
10.6.7	Insulated socket spanner with handle	1 no.	
10.6.8	Terminal screw with bellaville washer	10% of total quantity used	
10.6.9	Thermometer	1 no.	

Note: **Only applicable items shall be considered. Applicable items are those which are installed in the system.**

ANNEXURE-III

PAINTING & COLOUR SCHEME (REFER SECTION C2 B)

ANNEXURE-IV

LIST OF TOOLS & TACKLES

Bidder to consider necessary tools and tackles for mechanical, electrical and control & instrument as per their system requirement. In addition bidder to adhere relevant clauses of tender specification also. List of tools and tackles to be furnish by bidder during bid submission.

ANNEXURE-V

CLARIFIED WATER ANALYSIS

(REFER SECTION-C1)

ANNEXURE-VI

DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE

DRAWING/DOCUMENT SUBMISSION PROCEDURE (ANNEXURE-VI)

SL NO	DESCRIPTION	GSECL BARODA	GSECL WANAKBORI	DCPL KOLKATA	BHEL SITE	BHEL PEM
1	Correspondence-Technical					
	Vendor to BHEL	3+SC	3+SC	3+SC	3+SC	3+SC
2	Correspondence-Commercial					
	Vendor to BHEL	3+SC	3+SC	3+SC	3+SC	3+SC
3	Drawing/Document for approval					
	Vendor to BHEL	3+SC	3+SC	3+SC	--	5+SC
4	Drawing/Document (approved)					
	Vendor to BHEL	3+SC	3+SC	3+SC	3+SC	1+SC
5	Inspection/Test report					
	Vendor to BHEL	1+SC	1+SC	1+SC	1+SC	1+SC
6	O&M Manual					
	Vendor to BHEL	3+SC+CD	2+SC+CD	2+SC+CD	5+SC+CD	1+SC+CD
7	Final approved drawing/document (as built)	3+SC+CD	2+SC+CD	2+SC+CD	5+SC+CD	1+SC+CD

Note-1: SC: Soft copy, CD-Compact Disc.
Note-2: All soft copy (Autocad/EXCEL/Microsoft Word/Stad/etc) document shall be submitted by bidder whenever required by BHEL/Customer/Consultant.

ANNEXURE-VII

QUALITY PLAN

Items / Components \ Tests		Material Test	WPS/PQR/Welder Qualification	DPT/MPI	UT	RT	Hydraulic / Water Fill	Balancing	Type test	Performance Test	All test as per relevant Std/ Appd. Data Sheets	Visual & Dimension
A	**Centrifugal pumps**											
I	Casing	Y2	-	Y[3]	-	-	Y	-	-	-	-	Y
II	Impeller	Y2	-	Y[3]	-	-	-	Y	-	-	-	Y
III	Shaft	Y2	-	Y[3]	Y[5]	-	-	-	-	-	-	Y
IV	Fabricated components	Y	Y	Y[3]	-	-	Y	-	-	-	-	Y
V	Assembled Pumps	-	-	-	-	-	-	-	-	Y8	-	-
B	**Tanks & vessels**	Y	Y	Y[4]	Y[6]	Y[10]	Y	-	-	-	Y	Y
C	**R&W pipes**	Y	Y	Y[4]	-	Y[7]	Y	-	-	-	Y	Y
D	**RE joint**	Y	-	-	-	-	Y	-	-	Y		Y
E	**Rubber lining**	Y	-	-	-	-	-	-	-	-	Y	Y
F	**Pipes & Fittings**	Y[2]	Y	-	-	-	Y	-	-	-		Y[12]
G	**Gear box**	Y	-	Y	Y	-		-		Y	Y	Y
H	**Gate/Globe/ Check valve**	Y	-	Y	-	-	Y[11]	-	-	-	Y	Y

NOTE-1: - The above are minimum quality checks to be carried out at manufacturers works. The detailed quality plan based on above is to be developed by the main vendor incorporating witness stage for approval by BHEL/Customer.

NOTE-2: Butt welds, if any on-dished ends, shall be radio graphed after dishing. All dished ends for pressure vessels shall be stress relieved after dishing.

NOTE-3: Also refer data sheet-A for inspection for testing.

Remarks

LEGENDS:

1 As per AWWA C 504
2 One per heat/heat treatment batch.
3 On machined surface only.
4 Only DPT on root run after back gauging and finish weld.
5 For shaft ≥ 50 mm
6 For plates ≥ 25mm
7 For pipes weld thickness ≥20mm
8 As per HIS, USA
9 Void
10 On welds for dished ends manufactured with plates having weld joint. On vessel/tank as per design code.
11 Seat leakage test for actuator-operated valves shall be checked for seat leakage by closing the valve with actuator.
12 Pipes and fittings for rubber lining shall be free from internal weld bead.

ANNEXURE-VIII

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION

SL. No	DOCUMENT / DRAWING NO.	DRAWING / DOCUMENT TITLE	SCHEDULE OF SUBMISSION FROM LOI (WEEKS)	SIZE
		CW TREATMENT		
1	PE-V0-408-156-A010	TECHNICAL DATA SHEET FOR METERING PUMPS OF CW TREATMENT PLANT	10	A4
2	PE-V0-408-156-A013	INSTRUMENT SCHEDULE OF CW TREATMENT PLANT	10	A4
3	PE-V0-408-156-A024	CABLE SCHEDULE FOR CW TREATMENT PLANT	12	A4
4	PE-V0-408-156-A025	ERECTION PROCEDURE OF CW TREATMENT PLANT	14	A4
5	PE-V0-408-156-A003	EQUIPMENT LAYOUT OF CW TREATMENT PLANT	4	A1
6	PE-V0-408-156-A021	LIST OF DRIVES AND, I/O LIST	12	A4
7	PE-V0-408-156-A023	CABLE TRAY / TRENCH LAYOUT & CONDUIT ROUTING DRG. ALONG WITH EARTHING LAYOUT FOR CW TREATMENT PLANT	12	A1
8	PE-V0-408-156-A022	HMI PICTURE/ PLANT SCHEMATICS	12	A3
9	PE-V0-408-156-A016	PIPING LAYOUT FOR CW TREATMENT PLANT	10	A1
10	PE-V0-408-156-A002	P&I DIAGRAM OF CW TREATMENT PLANT	4	A1
11	PE-V0-408-156-A015	GA & WIRING DIAGRAM FOR CONTROL PANEL OF CW TREATMENT PLANT	12	A4
12	PE-V0-408-156-A008	GA DRAWING OF ALL TANKS/ VESSELS OF CW TREATMENT PLANT	8	A3
13	PE-V0-408-156-A014	VALVE SCHEDULE OF CW TREATMENT PLANT	10	A4
14	PE-V0-408-156-A017	O&M MANUAL OF CW TREATMENT PLANT	24	A4
15	PE-V0-408-156-A019	Electrical load data OF CW TREATMENT PLANT	8	A4
16	PE-V0-408-156-A007	PG test procedure for CWTP	20	A4
17	PE-V0-408-156-A011	DATA SHEET OF HORIZONTAL CENTRIFUGAL PUMPS OF CW TREATMENT PLANT	10	A4
18	PE-V0-408-156-A020	Cable schedule OF CW TREATMENT PLANT	12	A4
19	PE-V0-408-156-A006	Manufacturing quality plan for dosing pumps with motor OF CW TREATMENT PLANT	10	A4
20	PE-V0-408-156-A004	QAP FOR TANKS/ VESSELS OF CW TREATMENT PLANT	8	A4
21	PE-V0-408-156-A018	DATA SHEET OF MOTOR OF CW TREATMENT PLANT	10	A4
22	PE-V0-408-156-A012	DATA SHEET FOR INSTRUMENTS OF CW TREATMENT PLANT	10	A4
23	PE-V0-408-156-A005	Manufacturing quality plan for horizontal centrifugal pumps with motor OF CW TREATMENT PLANT	10	A4
24	PE-V0-408-156-A026	ENGINEERING BOQ OF CW TREATMENT PLANT	20	A4
25	PE-V0-408-156-A009	JUNCTION BOX DETAILS	12	A4
26	PE-V0-408-156-A027	PLC DOCUMENTS FOR PT PLANT--PLC CONFIGURATION DIAGRAM, DATA SHEET FOR PLC, GA & WIRING DETAILS FOR PLC PANEL, I/O LIST, BOM, MIMIC DIAGRAM, SCADA SCREEN, LIST FOR SIGNALS EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE IN BHEL.	16	A4
27	PE-V0-408-156-A028	UPS AND BATTERY SIZING CALCULATION, DATA SHEET AND GA FOR UPS	16	A4
28	PE-V0-408-156-A029	QAP FOR UPS	16	A4
29	PE-V0-408-156-A030	QAP / CHECK LIST FOR ALL INSTRUMENTS	16	A4
30	PE-V0-408-156-A031	QAP AND FAT FOR PLC	16	A4

1. A= APPROVAL. I = INFORMATION.
2. Any additional drawings-documents required during detailed engineering stage shall be provided by bidder without any commercial, technical and delivery implication to BHEL and customer.

3. Bidder to note that the successful bidder, during detail engineering, will submit the drg/doc through web based Document Management System in addition to hard copies to be submitted as per the Annexure IV of this specification. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.

- Internet explorer version – Minimum Internet Explorer 7
- Internet speed – 2 mbps (Minimum preferred)
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked
- Vendor's internal proxy setting should not block DMS application's link (http://124.124.36.198/wrenchwebaccess/login.aspx)"
- DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.
- For quick access bidder may refer the link http://bhelpem.com/DMSManuals/DMSManuals.html

4. Re-submission of drawing/document shall be done within 10 days by vendor.

ANNEXURE-IX

FORMAT FOR OPERATION AND MAINTENANCE MANUAL

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				

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**				

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**				

ANNEXURE-X

SITE STORAGE AND PRESERVATION

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHNANICAL BOPs

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

PROJECT ENGINEERING MANAGEMENT, POWER SECTOR

BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

1. SCOPE OF THE DOCUMENT

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

2. PURPOSE OF STORAGE & PRESERVATION

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

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

a) GENERAL STORAGE REQUIREMENTS

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

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

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

b) GENERAL PRESERVATION REQUIREMENTS

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

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.

11. Following preservatives/preservation methods can be used depending upon type of equipment

    a. Rust preventive fluid (RPF)

    b. Rust protective paints

    c. Tarpaulin covers, in case of outdoor storage

    d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –

    - Ingress of moisture and corrosion damages.
    - Damage to protective coating.
    - Open ends in pipes, vessels and equipment -
        - In case any open ends are noticed, same shall be capped.

2. Any damages to equipment / materials.

    - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
    - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

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

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

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

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

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

iii Open storage (O)

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

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

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

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

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

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
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_2SO_4)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

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

Sl. No.	**Description of the equipment**	**Type of Storage**	**Check for**	**Remarks**
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
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.

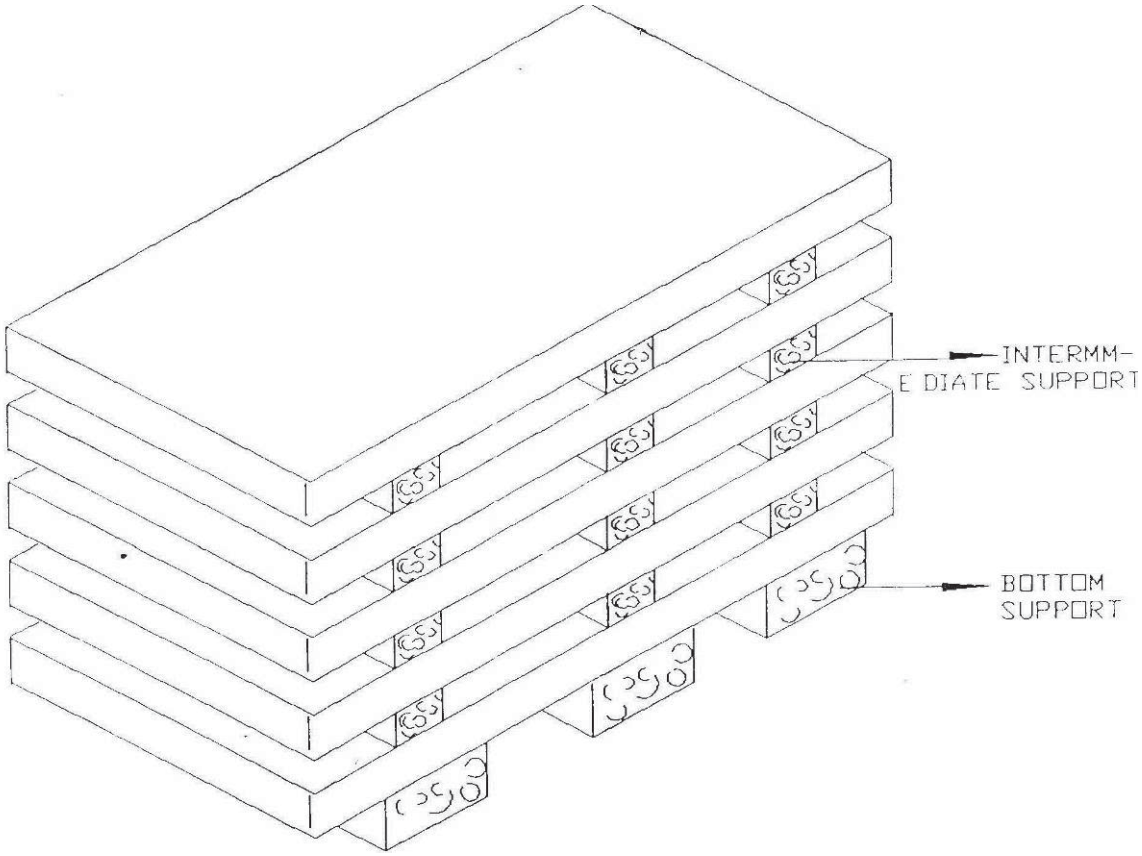


Figure – 1 – PLATE STACKING ARRANGEMENT

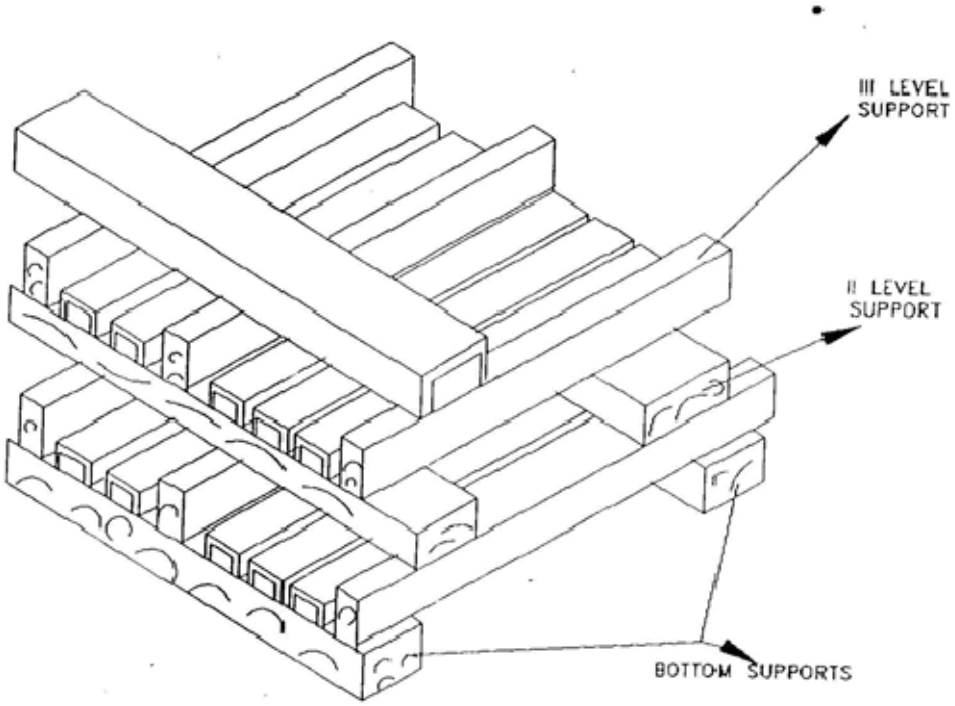


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

ANNEXURE-XI

PACKING PROCEDURE
(COVERED UNDER SECTION C 2B)

KKS PHILOSOPHY

FORM No. PEM - 6100 -0

DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY

KKS NUMBERING PHILOSOPHY

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

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

X	X	X	A	A	Y			Y B B	B

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

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

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

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

DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY

ANNEXURE-1

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

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

ANNEXURE-2

Standard Equipment Codes:

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

Standard Apparatus Codes:

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

Standard Measuring Circuits Codes:

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

ANNEXURE-3

Numerical Keys

A) Numerical Keys at System Code Level

i) Use 10, 20, 30, ……. To distinguish between main systems having same Alpha Codes. Examples:

a) Main Steam (Left) and Main Steam (Right)

b) BFP – A/B/C

c) ID Fan – A/B, FD Fan A/B, AH – A/B

ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.

iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.

B) Numerical keys at Equipment Code level:

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

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

N1 N2 N3

Motorised *(on/off duty)*	-	*0*	*01 to 50*
Motorised (inching duty)	-	*0*	*51 to 99*
Pneumatic (Control)	-	*1*	*01 to 50*
Motorised (thyrestor Control)	-	*1*	*51 to 99*
Sol. Operated	-	2	01 to 99
(Open / Close duty (Valves, NRVs, Gate)			
Hydraulic	-	3	01 to 99
NRV (Without actuation)	-	4	01 to 99
Manual	-	5	01 to 99
Manual	-	6	01 to 99
Relief & Safety Valves	-	7	01 to 99
Reserve	-	8	01 to 99
Reserve	-	9	01 to 99

ii) Field Instruments

Field Transmitters & Analog Signals	-	0	01 to 99
Field Switches & Binary Signals	-	1	00 to 99
PG Test Point	-	4	00 to 99
Gauges	-	5	00 to 99
Automatic Turbine Tester (ATT)-HWR	-	2	00 to 99
(Reserved for protection Signals used by Hardwar)			

Example of Numerical Key Usage:

In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, ……. Where system code is same.

VOLUME III

BIDDER SHOULD SUBMIT THE SIGNED AND STAMPED COPY OF THE FOLLOWING DOCUMENTS WITH BID:

1. Deviation if any strictly in the enclosed Schedule of deviation with cost of withdrawal only with mention of specification clause for which deviation is being asked. (Stamped & Signed)
2. Compliance certificate.(Stamped & Signed)
3. Schedule of Declaration. (Stamped & Signed)
4. Electrical Load data in BHEL format (Stamped & Signed)
5. Un Price Schedule duly filled in. (Stamped & Signed)
6. List of Start-up & commissioning spares if any. (Stamped & Signed)
7. List of Recommended spares if any. (Stamped & Signed).
8. ~~Guaranteed auxiliary power consumption in the enclosed format. (Stamped & Signed) in sealed envelope.~~

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

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.

SCHEDULE OF PRE-BID CLARIFICATION

All clarification from the Technical Specification shall be filled in by the BIDDER clause by clause in this format only.

VOLUME	SECTION	CLAUSE NO.	PAGE NO.	SPECIFICATION REQUIREMENT	CLARIFICATION	REASONS FOR CLARIFICATION

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL

DEVIATION SHEET (COST OF WITHDRAWL)

PROJECT:-1x800 MW WANAKBORI STPP
TECHNICAL SPECIFICATION FOR CW TREATMENT PLANT
PACKAGE:- CW TREATMENT PLANT [SECTION-4, VOLUME-III]

TENDER ENQUIRY REFERENCE:-

NAME OF BIDDER:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	**DESIGNATIONS**	**SIGN & DATE**	

NOTES:

1. For self manufactured items of bidder, cost of withdrawl of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. For directly dispatchable items, cost of withdrawl of deviation will be applicable on the basic price including taxes, duties & freight.
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawl of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
6. Bidder shall furnish price copy of above format along with price bid.
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawl of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawl of deviation shall be taken as NIL.
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
12. Cost of withdrawl is to be given seperately for each deviation. In no event bidder should club cost of withdrawl of more than one deviation else cost of withdrawl of such deviations which have been clubbed together shall be considered as NIL.
13. In case nature of cost of withdrawl (positive/negative) is not specified it shall be assumed as positive.
14. In case of descrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

SUGGESTIVE PRICE FORMAT FOR CW TREATMENT PLANT FOR 1X800 MW WANAKBORI STPP.

Sl. No.	DESCRIPTION OF EQUIPMENT / ITEM	TOTAL PRICE FOR "FOR" SITE
(1)	(2)	(3)
1.0	Total lump sum firm price on FOR site basis for design, engineering, manufacture, inspection, testing at manufacturer's works, supply/delivery duly packed at site including freight, unloading, storage and handling at site, erection and commissioning, trial run at site , PG test , supervision, plant handing over to customer etc. inclusive of all prevailing taxes, duties and other levies of CW Treatment Plant complete with all accessories, start up and commissioning spares as required, mandatory spares for the total scope defined as per BHEL Technical specification - PE-TS-408-156-A008 as required for safe and trouble free smooth operation.	
	NOTES:	
a	Bidder to note that total price indicated above at 1.0 shall be considered for evaluation and hence should be complete in all respect for the full scope defined and considering all terms and conditions agreed.	
b	In case, price indicated above does not match with item wise break-up given at 2.0, the highest price so calculated shall be considered for evaluation but in case of order, the same shall be placed at the lowest price.	
2.0	**BREAK-UP OF PRICES GIVEN IN 1.0 ABOVE**	
2.1	Total lump sum price on Design, engineering, manufacture, assembly, tests at manufacturer's works, forwarding, transportation, delivery of entire CW Treatment Plant to the site including Start up and commissioning spares as required , as defined subsequently complete with all accessories, auxiliaries as specified in Technical specification No. PE-TS-408-156-A008 as required for safe and trouble free smooth operation.	
2.2	Total lump sum price for supply/delivery of mandatory spares as specified in Technical specification No. PE-TS-408-156-A008.	
2.3	Total lump sum price on unloading, handling, storage, and in plant transportation at site, erection, commissioning trial run the entire CW Treatment Plant, as defined subsequently complete with all accessories, auxiliaries as specified in Technical specification No. PE-TS-408-156-A008 as required for safe and trouble free smooth operation.	
2.4	Total lump sum price on performance guarantee test, super vision as indicated in technical specification and handing over to Purchaser the entire CW Treatment Plant, as defined subsequently the CW treatment system and ancillaries as specified in Technical specification No. PE-TS-408-156-A008 as required for safe and trouble free smooth operation.	
2.5	Total lump sum price on supply of all water treatment chemicals for CW treatment Plant as specified in Technical specification No. PE-TS-408-156-A008. (bidder to give break-ups in separate sheet).	

ELECTRICAL LOAD DATA

(REFER SCETION C3)

DRAWING NO. PE-DG-408-156-A001

COOLING TOWER

CW FOREBAY

TO CONDENSER

pH pH

TO CWTP PLC

BHEL TO DCS

CWTP VENDOR

25NB

WATER TAP OFF FROM SERVICE WATER PE-DG-408-172-N003

CWTP VENDOR

BHEL

FILLING CONNECTION (TYP)

OVER FLOW

TO NEUTRA PIT

SCALE INHIBITOR TANK (CAP: 3000 LITER (EACH)).

CORROSION INHIBITOR TANK (CAP: 3000 LITER (EACH)).

BIOCIDE STORAGE TANK (CAP: 3000 LITER (EACH)).

2x100% 'Y'STRAINER

ANTI SCALANT DOSING PUMP (2X100 %). (CAP: 10 LPH).

CORROSION INHIBITOR DOSING PUMP (2X100 %). (CAP: 10 LPH).

BIOCIDE DOSING PUMP (2X100 %). (CAP: 300 LPH).

H2SO4 DOSING PUMP (2X100 %). (CAP: 150 LPH).

TO NEAREST DRAIN

80 NB SCH 10. CPVC

(ONLY PIT IS BY BHEL CIVIL)

NEUTRALIZATION PIT (60 CuM)

NEUTRALIZATION PIT DEWATERING PUMP (CAP: 15 CuM/Hr).

BULK H2SO4 STORAGE TANK (2X100 %). (CAP: 25000 LITER (EACH)).

H2SO4 DAY TANK (CAP: 3500 LITER).

80 NB

SULPHURIC ACID INLET MANIFOLD

H2SO4 UNLOADING PUMP (2X100 %). (CAP: 10 CuM/Hr (EACH)).

NOT A PART OF CW TREATMENT PACKAGE.

LEGEND

	GATE VALVE NORMALLY OPEN
	GATE VALVE NORMALLY CLOSED
	NON RETURN VALVE
	GLOBE VALVE NORMALLY CLOSED
	BALL VALVE
	PRESSURE RELIEF VALVE
	VENT TO ATMOSPHERE
	FUNNEL
PG	PRESSURE GAUGE
LG	LEVEL GAUGE
M	MOTOR OPERATED (AC)
LT	LEVEL TRANSMITTER
	Y TYPE STRAINER
C	CENTRIFUGAL PUMP.
	METERING PUMP.
pH	pH METER
	PLUG VALVE
LL/L/H	LOW LOW/LOW/HIGH
A	ALARM
I	INTERLOCK
	SILICA GEL BREATHER

NOTE-1: WRAPPING/COATING/PROTECTION OF ALL BURRIED CS PIPE SHALL BE AS PER IS 10221 OR AWWA C 203.

NOTE-2: THE INSTRUMENTS, VALVES, PIPE SIZE, ETC SHOWN IN FLOW DIAGRAM ARE TENTATIVE AND MINIMUM, MAY VARY BASED ON SUPPLIER RECOMMENDATION DURING DETAILED ENGINEERING.

NOTE-3: ALL OVERFLOW/DRAINS OF TANK SHALL BE CONNECTED TO NEUTRALIZATION PIT THROUGH RCC CHANNEL.

REV	DATE	ALTD	CHD		REV	DATE	ALTD	CHD		REV	DATE	ALTD	CHD	APPD

JOB NO. 408
STATUS CONTRACT
DISTRIBUTION
TO
No.OFF

1x800 MW SUPERCRITICAL THERMAL POWER PLANT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GSECL GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

DEVELOPMENT CONSULTANTS PVT LTD.

BHARAT HEAVY ELECTRICALS LTD
POWER GROUP
PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

DEPT CODE		NAME	SIGN	DATE
MAX	DRN	FS		
	DESN	FS		
	CHD	JP		
	APPD	KK/PK		

TITLE
P&ID FOR CW TREATMENT PLANT

DEPT. SCALE
SIGN
DATE

DRAWING NO.
PE-DG-408-156-A001

SHEET 1 OF 1 REV 4

SIZE -A1

Pipe Sizes for carbon Steel Pipes

01

NB	OD (mm)	THICK. (mm)
150	168.3	5.4
200	219.1	6.0
250	273.0	6.0
300	323.9	6.0
350	355.6	6.0
400	406.4	6.0
450	457.0	6.0
500	508.0	6.0
600	610.0	6.0
700	711	7.0
800	813	8.0
900	914	10
1000	1016	12
1100	1118	12
1600	1626	16
2200	2235	18
2600	2640	20
2700	2740	20
3700	3740	20

LEGEND

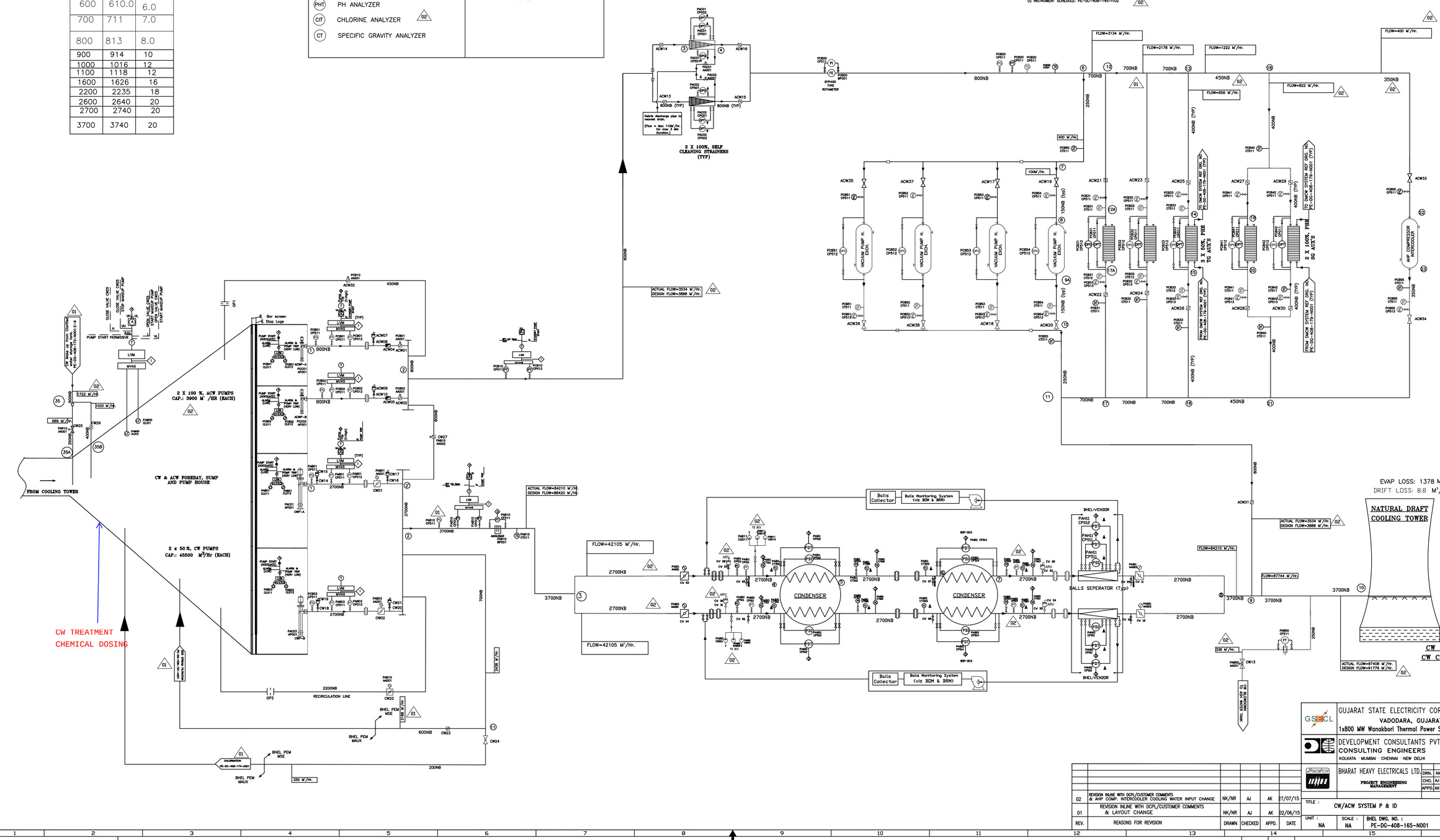
- MOTOR OPERATED GATE VALVE
- MOTOR OPERATED BUTTERFLY VALVE
- MANUAL BUTTERFLY VALVE
- NON RETURN VALVE
- GLOBE VALVE
- AIR RELEASE VALVE
- (PG) PRESSURE GAUGE
- (PS) PRESSURE SWITCH
- (PT) PRESSURE TRANSMITTER
- (DPG) DIFFERENTIAL PRESS. GAUGE
- (DPS) DIFFERENTIAL PRESS. SWITCH
- (DPT) DIFFERENTIAL PRESS. TRANSMITTER
- (LT) LEVEL TRANSMITTER
- (FT) (FE) BYPASS/ ONLINE ROTAMETER
- (TE) TEMPERATURE ELEMENT
- (TG) TEMPERATURE GAUGE
- (PHT) PH ANALYZER
- (CIT) CHLORINE ANALYZER 02
- (CT) SPECIFIC GRAVITY ANALYZER
- DCS
- ALARM
- ORIFICE PLATE
- R.E. JOINT (STD.)
- VERTICAL PUMP
- ANNUBAR
- LVM – LIMIT VALUE MONITOR
- MVAS– MEAN VALUE AUTO SELECTION
- INDICATION
- TYP – TYPICAL

01

S.NO.	EQUIPMENT	NOS. WORK. + STANDBY	CW REQD. PER COOLER CUB.M/Hr.	CW REQD. PER UNIT CUB.M/Hr	PRESS. DROP MWC	TEMP. RISE °C	REMARKS
1	CONDENSER	2 + 0	84210	84210	5.72	9.4	
2	VACUUM PUMPS	2 + 2	100	400	3.5	2.0	
3	PHE'S (TG AUX)	2 + 1	956	1911	7.0	8.6	
4	PHE'S (SG AUX)	1 + 1	822 02	822 02	7.0	7.0 02	
5	AHP COMPRESSOR INTERCOOLER	1 + 0	400 02	400 02	10	10	

NOTES:

1. DESIGN PRESSURE : 5.0 Kg/sq.cm (g) FOR C.W.SYSTEM, 02
   DESIGN PRESSURE : 7.5 Kg/sq.cm (g) FOR A.C.W.SYSTEM.
   DESIGN CW INLET TEMP. TO CONDENSER & VACUUM PUMP HEAT EXCH. = 33 °C
   DESIGN ACW INLET TEMP. TO PHE'S = 36 °C
   DESIGN MECHANICAL TEMPERATURE : 60 °C
2. MATERIALS OF CONSTRUCTION :
   A). PIPING UPTO AND INCLUDING 150NB SHALL BE CARBON STEEL ERW, IS:1239 (HEAVY GRADE)
   B). PIPING > 150NB SHALL BE CARBON STEEL (IS:2062), ROLLED AND WELDED CONFORMING TO IS:3589
3. ALL PRESSURE TAPPINGS & ROOT VALVES TO BE OF 15 Nb.
4. CW SYSTEM : 150 NB SIZE DRAIN & VENT VALVES SHALL BE PROVIDED AS REQD. AS PER LAYOUT.
   ACW SYSTEM : 50 NB SIZE DRAIN & VENT VALVES SHALL BE PROVIDED FOR PIPE SIZES 400 NB & ABOVE, 25 NB DRAIN & VENT VALVES SHALL BE PROVIDED FOR PIPE SIZES UPTO 350 NB AS PER LAYOUT REQUIREMENTS.
5. INSTRUMENTS MARKED ◇ THUS SHALL BE SUPPLIED ALONGWITH THE EQUIPMENTS.
6. ADDITIONAL AIR RELEASE VALVES (150 Nb) SHALL BE PROVIDED, IF REQUIRED AS PER SURGE STUDIES.
7. PAINTING/PROTECTION – PIPES:
   7.1 INTERNAL SURFACE (FOR PIPE DIA 1000NB AND ABOVE) 01
   A). SURFACE CLEANING BY WIRE BRUSH.
   B). APPLICATION OF ONE COAT OF EPOXY RESIN BASED RED OXIDE PRIMER FOLLOWED BY ADEQUATE NO. (2 to 3) OF FINISH COATS OF COAL TAR EPOXY PAINT TO ACHIEVE TOTAL DRY FILM THICKNESS OF 150–200 MICRONS.
   7.2 EXTERNAL SURFACE – OVERGROUND PIPING
   A) SURFACE CLEANING BY WIRE BRUSH.
   B). APPLICATION OF ONE COAT OF RED LEAD PRIMER FOLLOWED BY ADEQUATE NO.(2 to 3) OF FINISH COATS OF SYNTHETIC ENAMEL PAINT TO ACHIEVE TOTAL DRY FILM THICKNES OF 150–200 MICRONS. 01
   C). UNDERGROUND PROTECTION SHALL BE AS "ONE COAT OF COAL TAR PRIMER (MIN. 2 MM) OF APPROVED QUALITY FOLLOWED BY A FINAL COATING OF EPOXY RESIN & COAL TAR BLEND (MIN 1 MM) AND THEN TWO LAYERS, EACH 2MM THICK OF COAL TAR TAPE AS OUTER WRAP".
   D) CW PIPE BURIED PORTION COMING UNDER RAIL OR ROAD SHALL BE CONCRETE ENCASED.
8. REFERENCE DRAWINGS/DOCS.
   A) DMCW SYSTEM PID: PE-DC-408-179-N001
   B) DMCW SYSTEM DESIGN PHILOSOPHY & SYSTEM WRITEUP: PE-DC-408-179-N002
   c) ANALOG CONTROL SYSTEM: PE-DC-408-145-I002
   D) INSTRUMENT SCHEDULE: PE-SC-408-145-I102 02



REV.	REASONS FOR REVISION	DRAWN	CHECKED	APPD.	DATE
02	REVISION INLINE WITH DCPL/CUSTOMER COMMENTS & AHP COMP. INTERCOOLER COOLING WATER INPUT CHANGE	NK/NR	AJ	AK	27/07/15
01	REVISION INLINE WITH DCPL/CUSTOMER COMMENTS & LAYOUT CHANGE	NK/NR	AJ	AK	02/06/15

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT
1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

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

BHARAT HEAVY ELECTRICALS LTD.
PROJECT ENGINEERING MANAGEMENT

	NAME	SIGN	DATE
DRN.	NK/NR	-SD/-	27/07/15
CHD.	AJ	-SD/-	27/07/15
APPD.	AK	-SD/-	27/07/15

TITLE : CW/ACW SYSTEM P & ID

UNIT : NA | SCALE : NA | BHEL DWG. NO. : PE-DG-408-165-N001 | REV. 02

E 337.600
N 192.000

PUMP HOUSE

E 410.400
N 243.800

N=255.000

E=350.000
N=245.000

PRE-
TREATMENT
PLANT

28

REGENERATION
AREA

14

541.0E
246.5N

549.9E

16

CST

13

15

DM TANKS

1) Inlet water Taping point: 600 NB pipe as per CW/ACW p&Id.
2) Taping point for Service water and potable water (50 NB)

516.7E
217.9N

SW TANK
(RCC)

208.5N

373.5E
183.5N

CLARIFIED
WATER
RESERVOIR

30

32

23

25

CW TREATMENT PLANT

4 NOS DOSING PIPE
(BURIED)

496.0E
200.5N

36

436.0E
200.5N

503.0E
200.5N

516.0E
169.2N

22

ROAD

PEM/PC

446.0E
116.0N

21

45°

VENDOR

525.0E
108.0N

24

12

549.9E

PIPE RACK

50.0N

373.0E
90.0N

RL. 72.00M.

KEY PLAN FOR CW
TREATMENT PLANT
DRG NO. PE-DG-408-156-A004

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

AS INFORMED BY BHEL SITE, PROPOSED SPACE FOR FABRICATION YARD WILL BE BETWEEN GRID 200S TO 400N & 800E TO 1000E.

LEGEND

1. STG BUILDING (1x800MW UNIT)
2. BOILER
3. ELECTROSTATIC PRECIPITATOR
4. E.S.P. CONTROL ROOM
5. CHIMNEY
6. TRANSFORMER YARD
7. SWITCH YARD (GIS)
8. SWITCH YARD CONT. ROOM
9. SERVICE & TECHNICAL BUILDING
10. IA/SA/MRS COMPRESSOR BUILDING
11. DG SET
12. PIPE RACK
13. SPACE FOR CST
14. SPACE FOR DM PLANT, CHEM. HOUSE & CPU REGENERATION AREA
15. SPACE FOR DM PUMPS AND CST PUMP
16. DMW STG.TANKS
17. CLARIFIED CUM FIRE WATER STORAGE TANK (WITH EXISTING CLARIFIER)
18. SPACE FOR CLARIFIED WATER PUMPS
19. LFO / HFO DAY TANK
20. FO PRESSURIZING PUMP HOUSE
21. ND COOLING TOWER
22. CW & ACW PUMP HOUSE
23. CW CHLORINATION PLANT
24. SIDE STREAM FILTER
25. CW TREATMENT PLANT
26. STORES
27. AUXILIARY BOILER
28. PRE TREATMENT PLANT INCLUDING CLARIFIER
29. HYDROGEN CYLINDER STORAGE SPACE
30. CLARIFIED WATER RESERVOIR (WITH NEW CLARIFIER)
31. SPACE FOR FIRE WATER PUMPS
32. SPACE FOR SERVICE WATER PUMPS & NEW CLARIFIER PUMPS
33a SITE OFFICE
33b CANTEEN
34. NEW JACK WELL PUMP HOUSE
35. PIPE CUM PASSAGE TO JACKWELL
36. CW PIPE CORRIDOR
37. EQUIPMENT LAYDOWN SPACE
38. RETAINING WALL
39. FO TRANSFER PUMP HOUSE
40. LDO / HFO PIPE CORRIDOR
41. WATCH TOWER
42. PROPOSED SPACE FOR FGD
43a 43b PREASSEMBLY LAYDOWN SPACE
44A EFFLUENT TREATMENT PLANT
44B GUARD POND
45. BOILER DRAIN PIT
46A B.A. SLURRY PIT & PUMP HOUSE
46B ASH WATER PUMP HOUSE
47. AHP COMPRESSOR CUM VACUUM PUMP HOUSE
48. ASH HANDLING PLANT MCC-1 CUM CONTROL ROOM
49. AHP CLARIFIER
50. CHEMICAL HOUSE
51. FLY ASH SILO
52. SILO UTILITY / HCSD SHED / MCC ROOM
53. ASH PIPE CORRIDOR
54. MCC ROOM CUM ASH WATER RECOVERY SYSTEM PUMP HOUSE
55. WAGON TIPPLER
56. TRANSFER POINT
57. PENT HOUSE
58. CRUSHER HOUSE
59. STACKER/RECLAIMER
60. CRUSHED COAL STOCK PILE
61. COAL CONVEYOR
62. CHP MAIN CONTROL ROOM CUM S/S
63. ROAD FROM ASH SILO UNIT#8 TO EXISTING BRICK PLANT
64. WEIGH BRIDGE
65. FLY ASH EXTRACTION TOWER

FACILITIES FROM SL. No. (46) TO (65) PERTAIN TO ISG (AHP & CHP).

LEGEND

FENCING
EXISTING FACILITIES
PROPOSED FACILITIES
RAILWAY TRACK
PIPE RACK (ENGG. BY PEM)
PIPE RACK (ISG)
ROAD
DIVERTED ROAD
ROAD BY ISG
PIPE PEDESTAL
AHP PIPE CORRIDOR

NOTE:-

1. ALL DIMENSIONS AND CO-ORDINATES ARE IN METRES UNLESS NOTED OTHERWISE.
2. THE FINISHED GRADE LEVEL OF POWER BLOCK AREA IS RL. 72.00M.
3. THE FINISHED FLOOR LEVEL OF POWER HOUSE GROUND FLOOR EL. 0.00M WHICH CORRESPONDS TO RL. 72.3M
4. EXISTING FACILITIES WITHIN 800 MW PLANT AREA SHALL BE RE-LOCATED TO SUIT AT SITE CONDITION.
5. ANY BUILDING/ HEAVY STRUCTURE SHALL NOT BE LOCATED WITHIN 200.00M OF MAHI RIVER BANK AS PER CITATION NORMS.
6. READ THIS DRAWING IN CONJUNCTION WITH CUSTOMER DWG. NO.- WTPS: SEC.19.

REFERENCE DWG.

1.	PLOT PLAN	9213R-DWG-M-002 REV-05 (CUST.)
2.	MAIN PLANT EQUIPMENT LAYOUT PLAN AT EL 0.00M	PE-DG-408-100-M002
3.	LAYOUT PLAN & CROSS SECTION DWG FOR EXTENSION SWITCHYARD	TB-3-375-510-060

PROGRESSIVE PRINT 05.06.2015

CUSTOMER: GUJARAT STATE ELECTRICITY CORPORATION LTD
VADODARA, GUJARAT
1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

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

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

JOB NO. 408
STATUS CONTRACT
DISTRIBUTION

DEPT CODE		NAME	SIGN	DATE
M	DRN	VK SAH	-Sd-	26.12.2014
	DESN	RASHMI PRASAD	-Sd-	26.12.2014
	CHD	BK AGARWAL	-Sd-	26.12.2014
	APPD	JACOB JAMES	-Sd-	26.12.2014

REV.	DATE	ALTD	CHD	APPD
01	13.05.2015	VKS	RP	BKA

1. DRAWING REVISED IN LINE WITH CUSTOMER COMMENTS.
2. CHP & AHP AREA UPDATED IN LINE WITH THE REVISED DWG. RECEIVED FROM ISG AFTER SITE SURVEY DATED 12.02.2015.
3. WATER SYSTEM AREA RE-ARRANGED BASED ON INPUTS RECEIVED FROM VARIOUS AGENCIES.
4. EXTENSION SWITCH YARD SHOWN.
5. LDO/HFO PIPE CORRIDOR UPDATED.
6. STORE LAYOUT UPDATED.

TITLE: PLOT PLAN

DEPT. SCALE 1:3000
DRAWING NO. PE-DG-408-100-M001
SHEET 1 OF 1 REV. 01
SIZE-A0