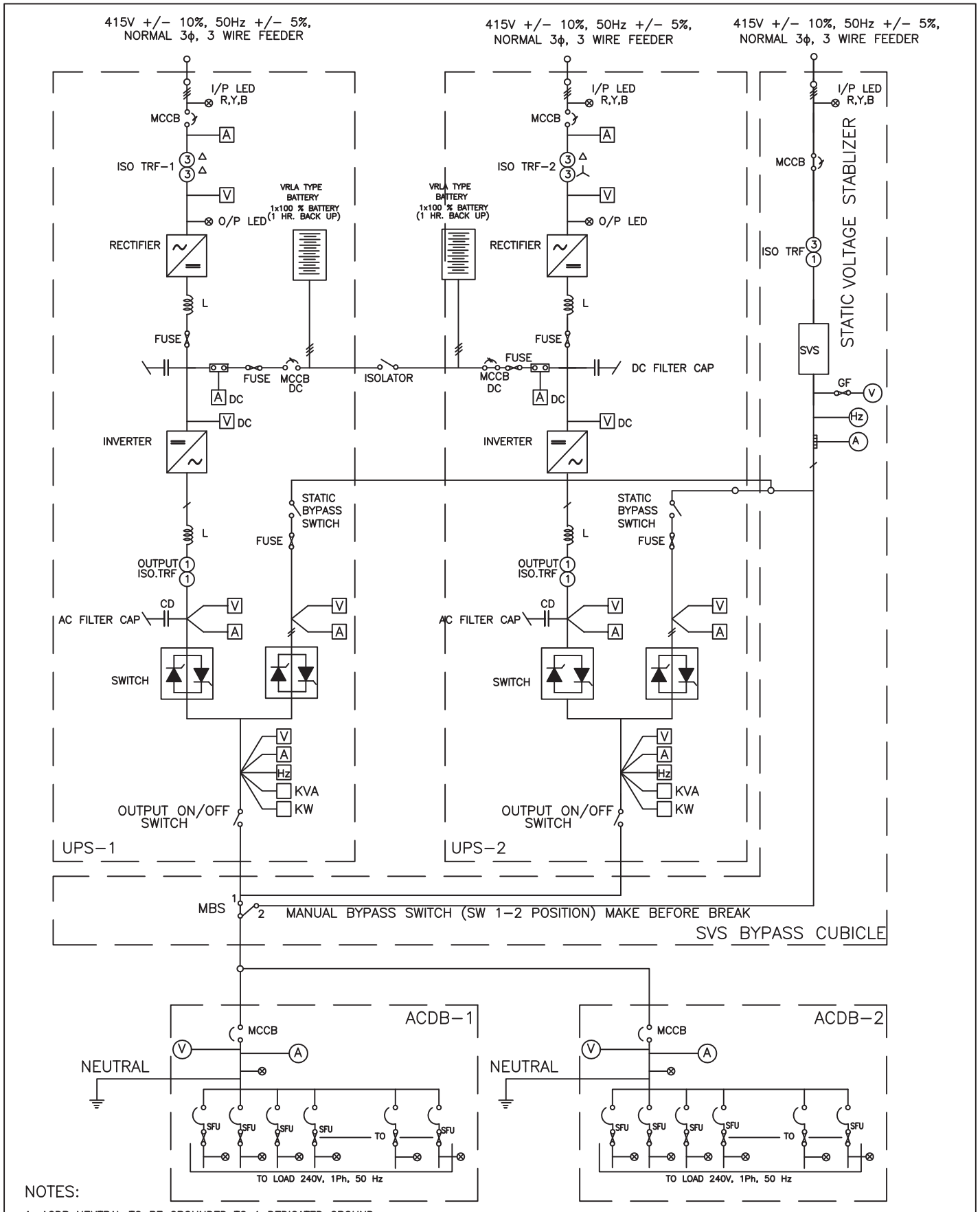
UPS SPECIFICATION



NOTES:

1. ACDB 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. PLC BASED SYSTEM WHICH ARE LOCATED IN TG BUILDING SHALL BE POWERED FROM MAIN PLANT UPS.

BHEL		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)	:	± 1.5%
	b) Transient voltage (On application or removal of 100% load)	:	± 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.

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

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

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

1 - BHEL; 2 - Vendor; 3 - Sub-vendor

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		3. Conductor a) Resistance b) Size c) Sheet colour	 MA MA MA	 Electrical Measurement Visual	 100% 100% 100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type	CR	Visual	Sample	BHEL Spec. and BOM	BHEL Spec. and BOM	Log Book	2	---	---	
		2. Verification of Test Certificates	CR	Scrutiny of Type / Routine T.Cs.	100%	Relevant IS	Relevant IS	Log Book	2	---	---	
		3. Operation / Functional check	CR	Electrical	Sample+ 100%@	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	+ for relay & contactors only
		4. I.R.	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	@ for all components except relays & contactors.
		5. H.V.	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	
		6. Calibration	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	1	
		7. Pick up / Drop off Voltage	MA	Electrical	100%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Log Book	2	---	---	

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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	
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
	IN PROCESS											
6.0	Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Surface defects after bending	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---	
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
	ASSEMBLY											
8.0	Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	

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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	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	

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REV. NO.	01 DATE: 22-02-2008
SHEET	5 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
	FINAL											
12.	Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

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

PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	6 OF 7

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

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

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PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

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

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	3	---	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant IS.	BHEL approved spec., drg., BOM & relevant IS.	Test Report	2	1	1	
15	FUCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		2. Instrument Calibratio	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant IS.	BHEL approved spec/drg & relevant IS.	Inspection Report	2	1	1	

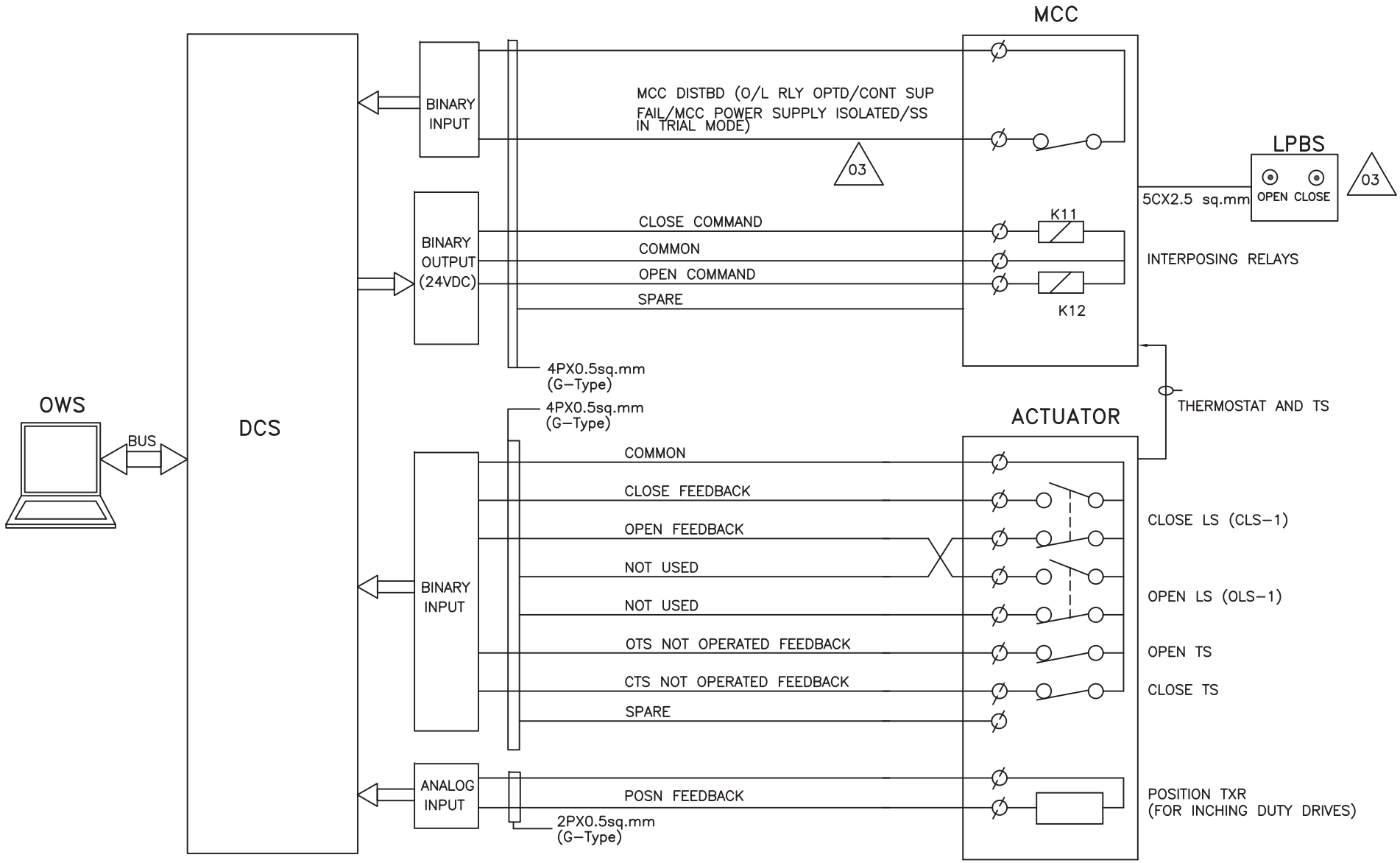
LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics

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

1 - BHEL; 2 - Vendor; 3 - Sub-vendor

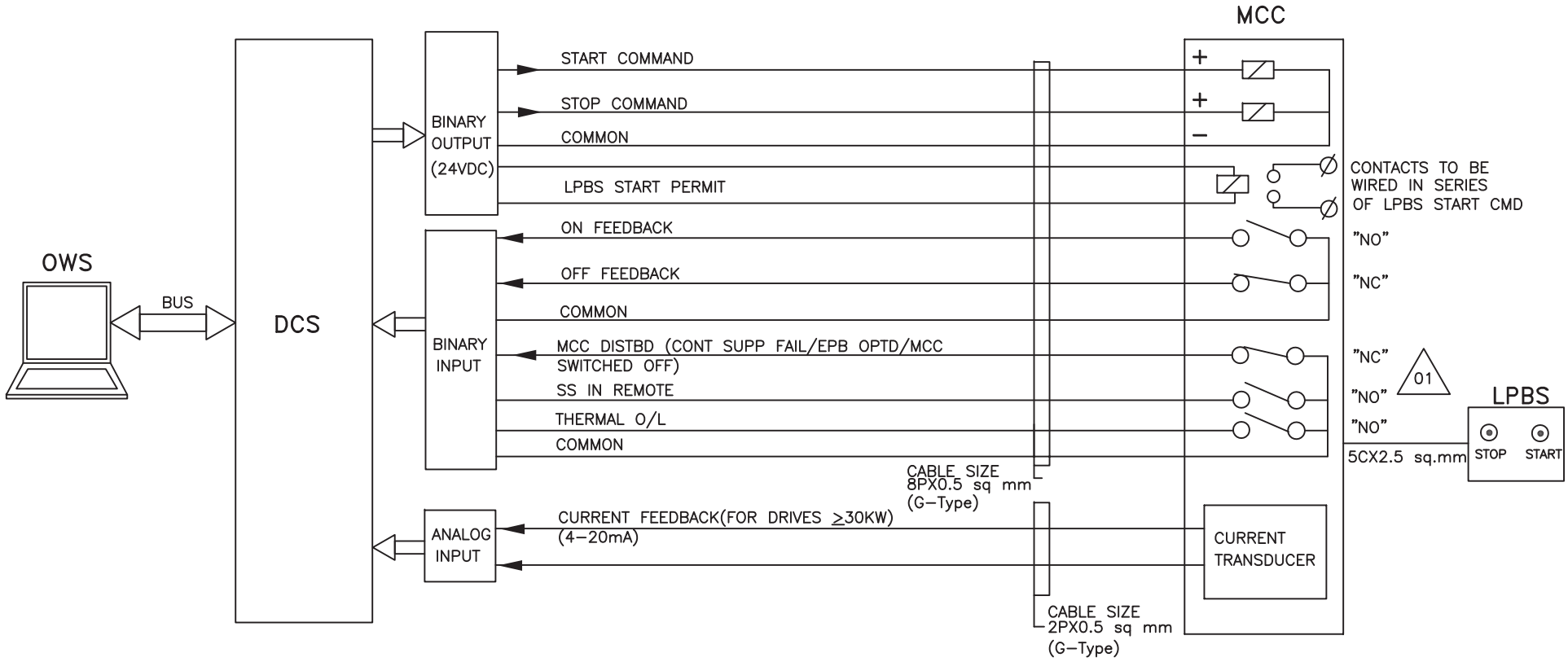
DRIVE CONTROL PHILOSOPHY

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH MCC)



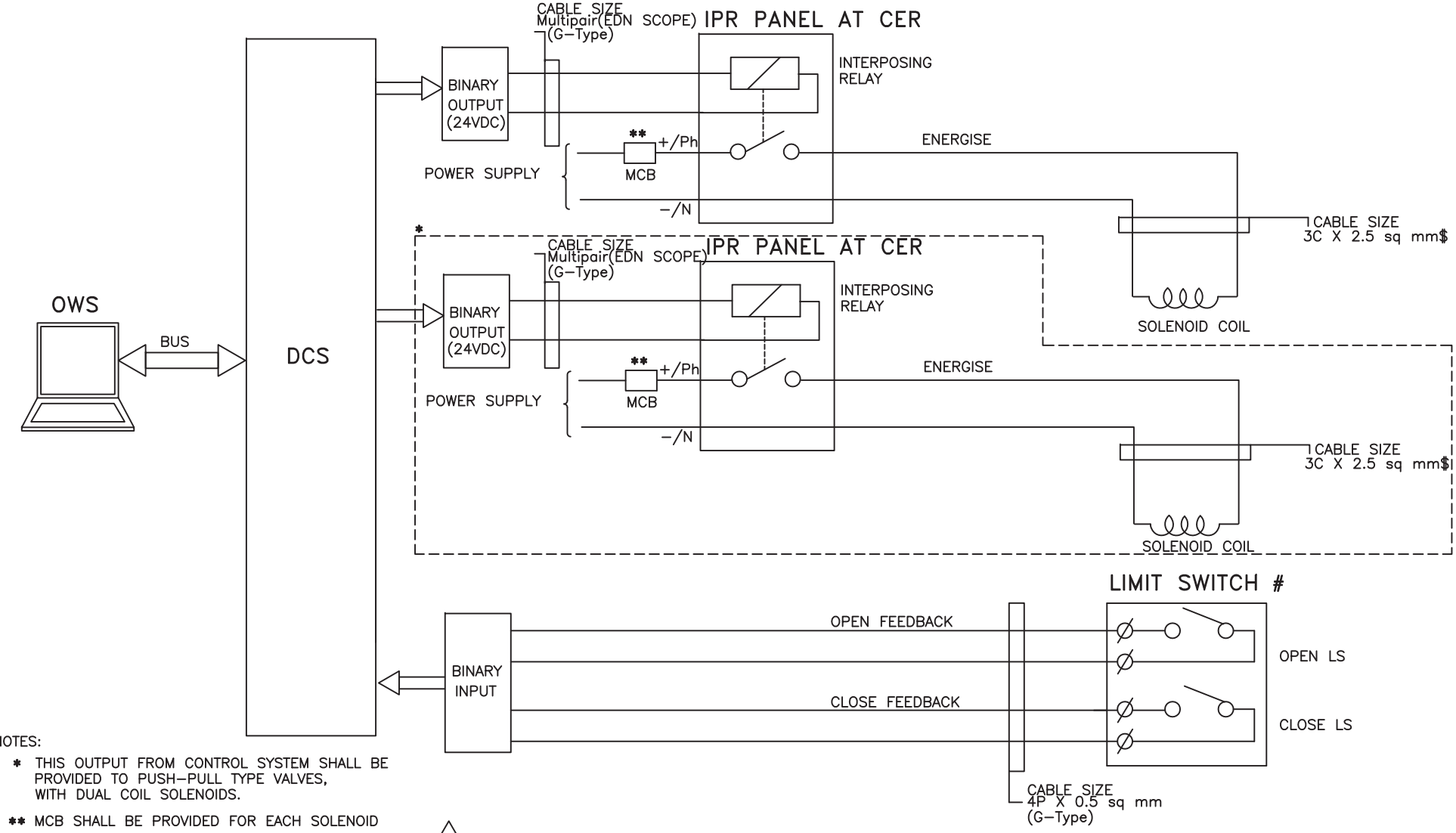
BHEL	PROJECT: 1X800MW WANAKBORI THERMAL POWER STN. EXTN. UNIT–8	DRG.NO.	PE–DM–408–145–I002
		DATE	15.06.15
	TITLE : 01 DCS INTERFACE FOR BIDIRECTIONAL DRIVE	REV.NO.	03
		SHT	8 OF 12

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE



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

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



NOTES:

* THIS OUTPUT FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH–PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.

** MCB SHALL BE PROVIDED FOR EACH SOLENOID

\# FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.

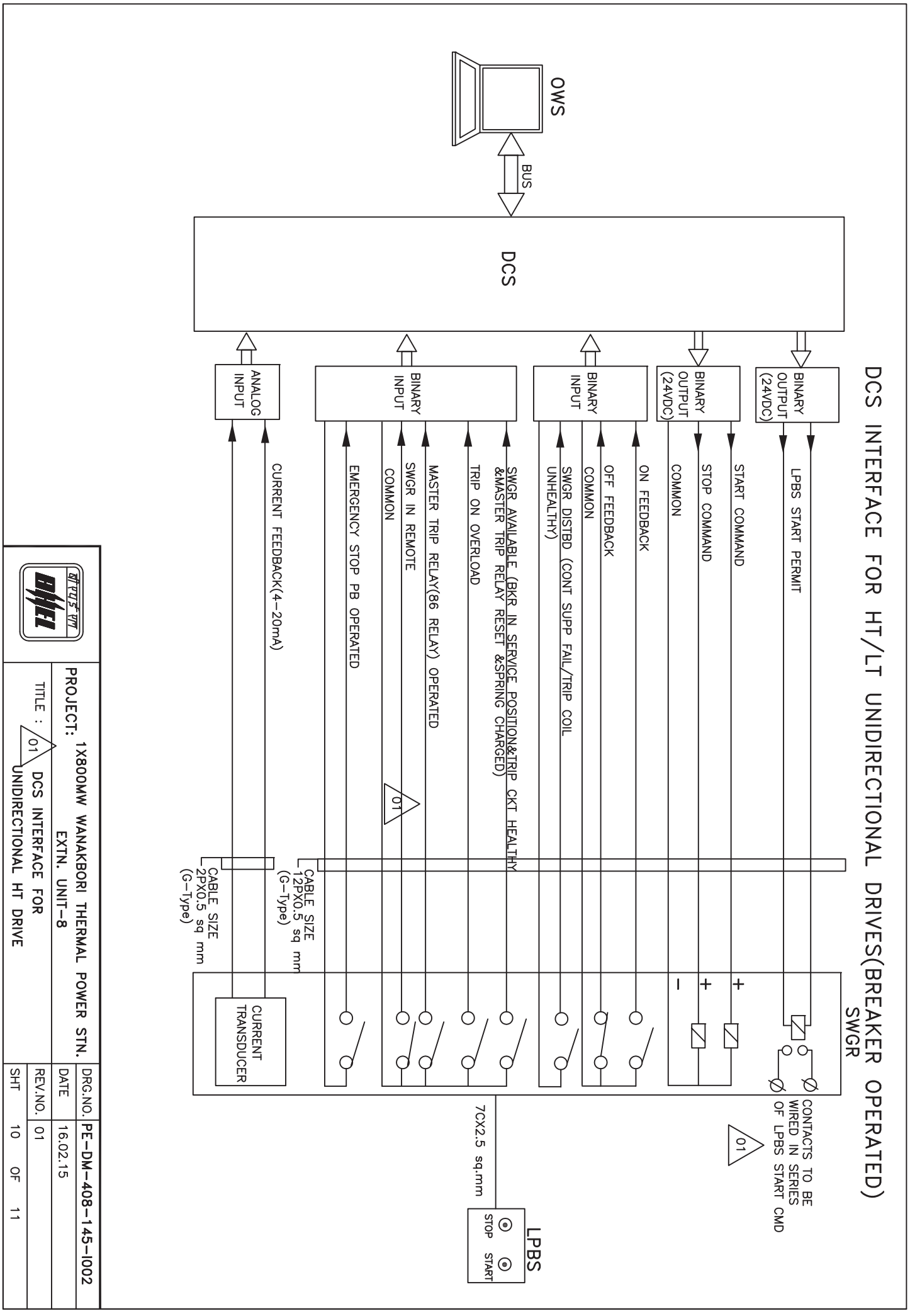
CER:–CONTROL EQUIPMENT ROOM

IPR:–INTER POSING RELAY

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

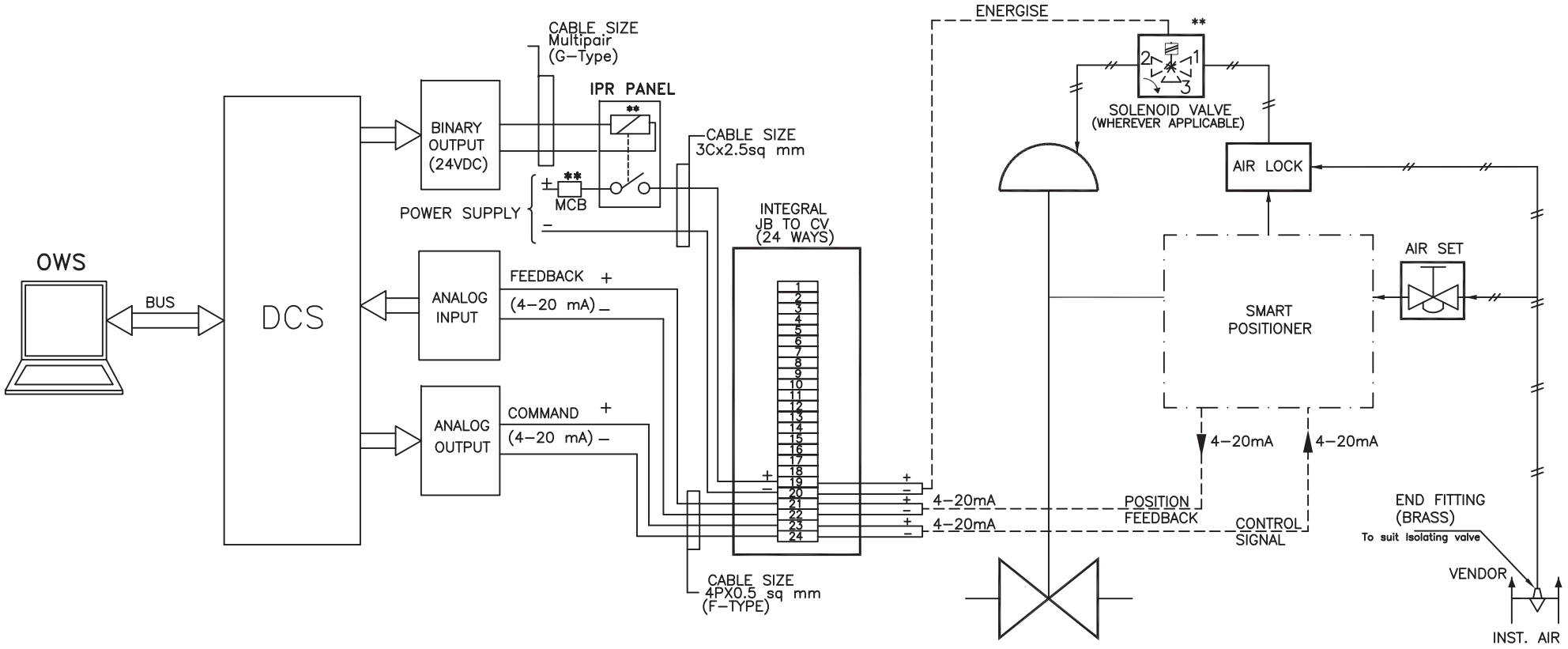
01

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



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)

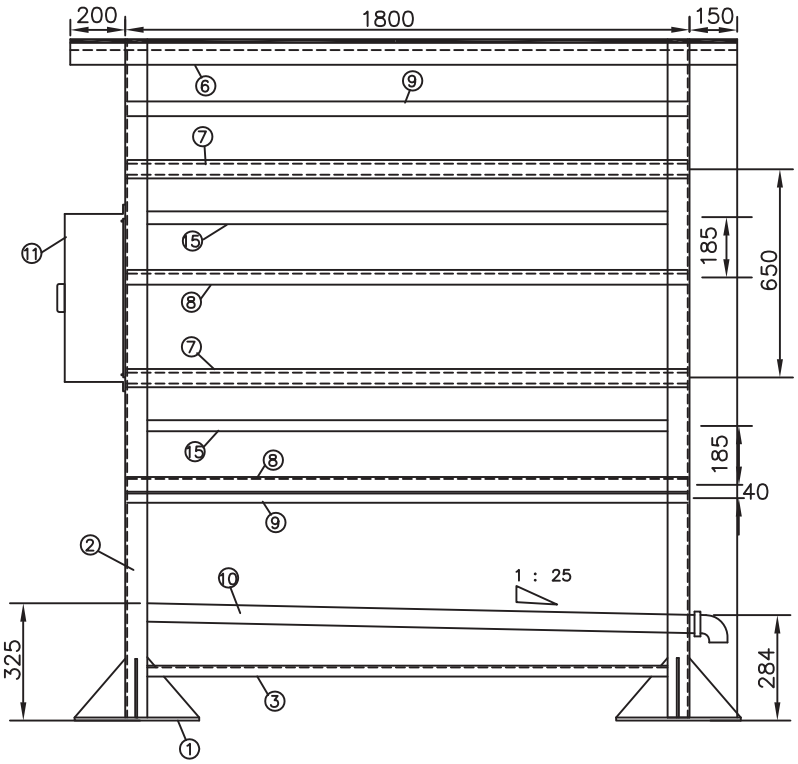
GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

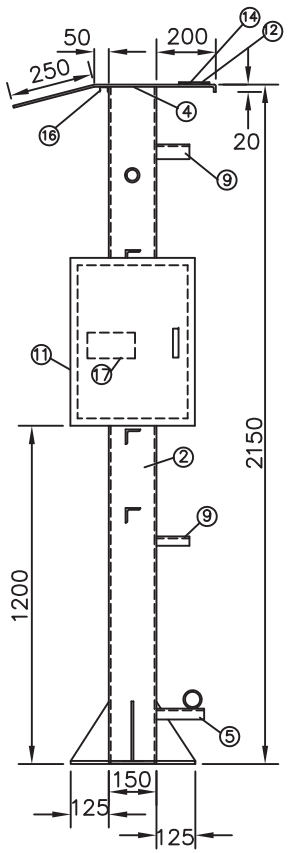
JOB NO. DCPL–K9213R | SCALE NIL | SHT. 1 OF 10

DWG. NO. K9213R–DWG–I–0200 | REV. 0

K9213-DWG-I-0200-1-10



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

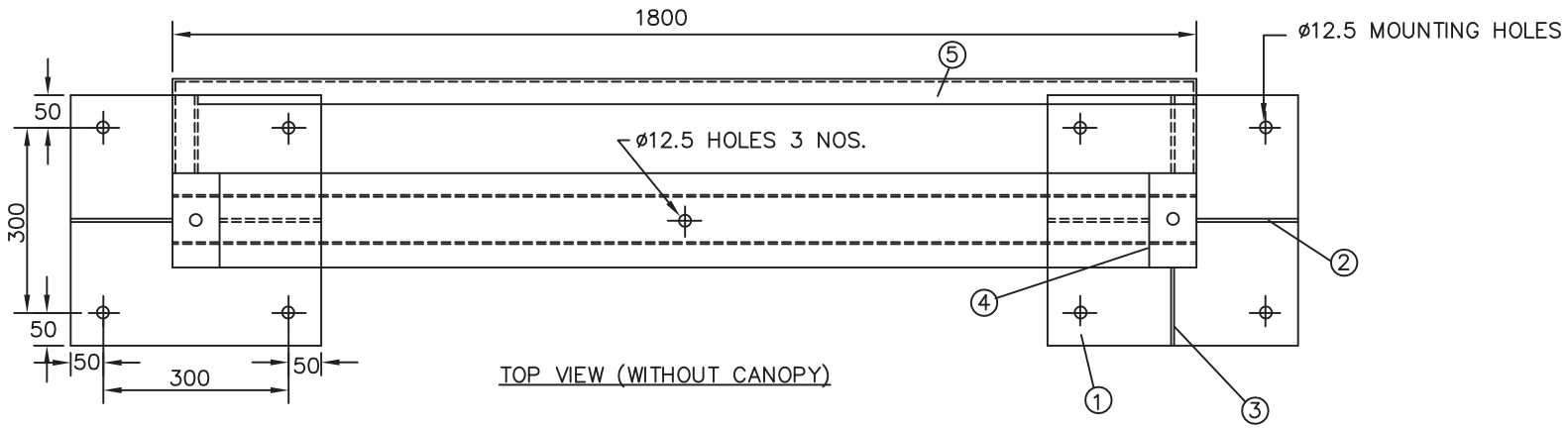
G.A.DRAWING FOR LOCAL INSTRUMENT RACK

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)

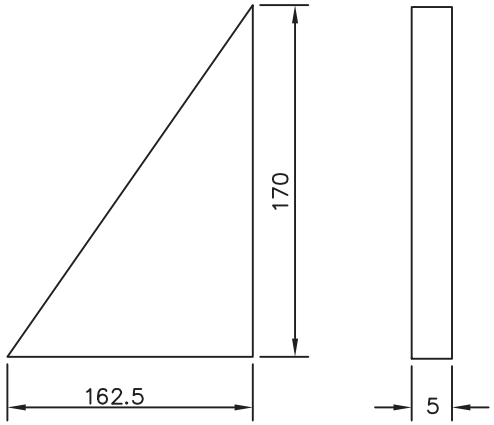
GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

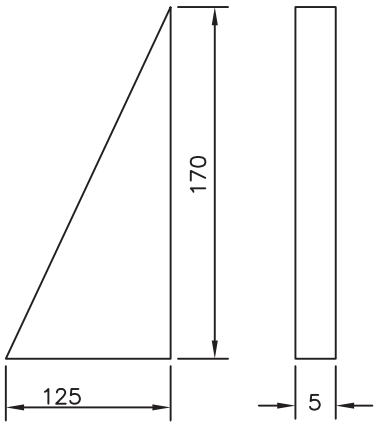
JOB NO. DCPL-K9213R | SCALE NIL | SHT. 3 OF 10

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

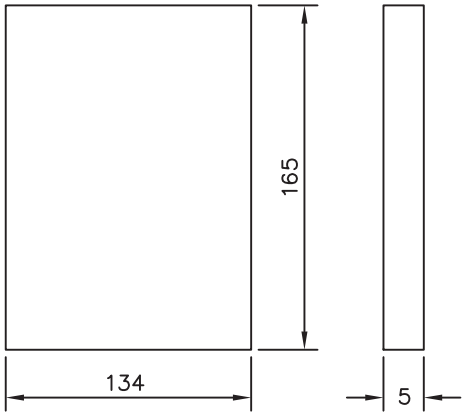
K9213-DWG-I-0200-3-10



DETAIL OF–1



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

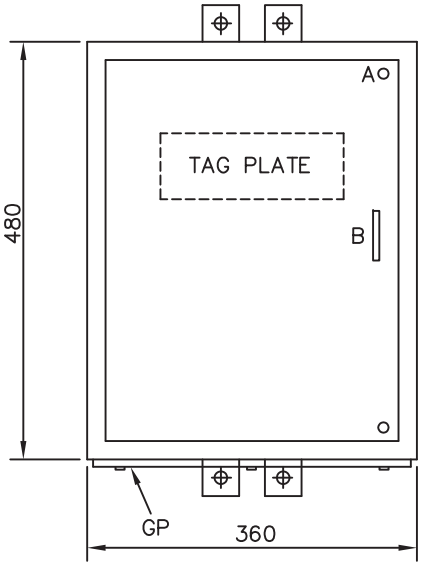
1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

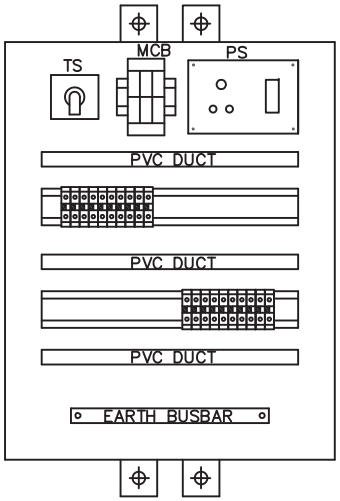
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

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

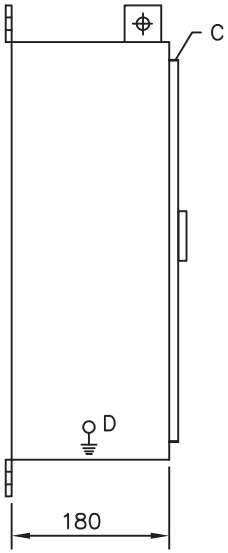
DWG. NO. K9213R–DWG–I–0200 | REV. 0



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)

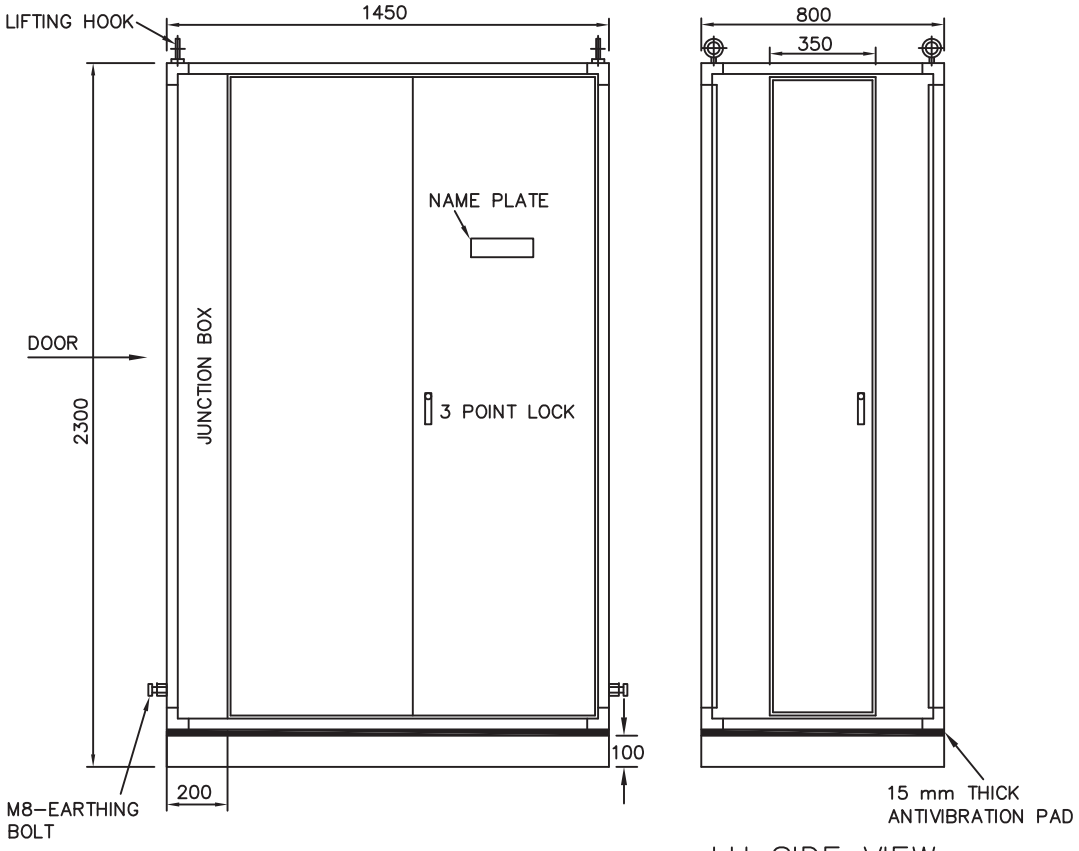
GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT

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

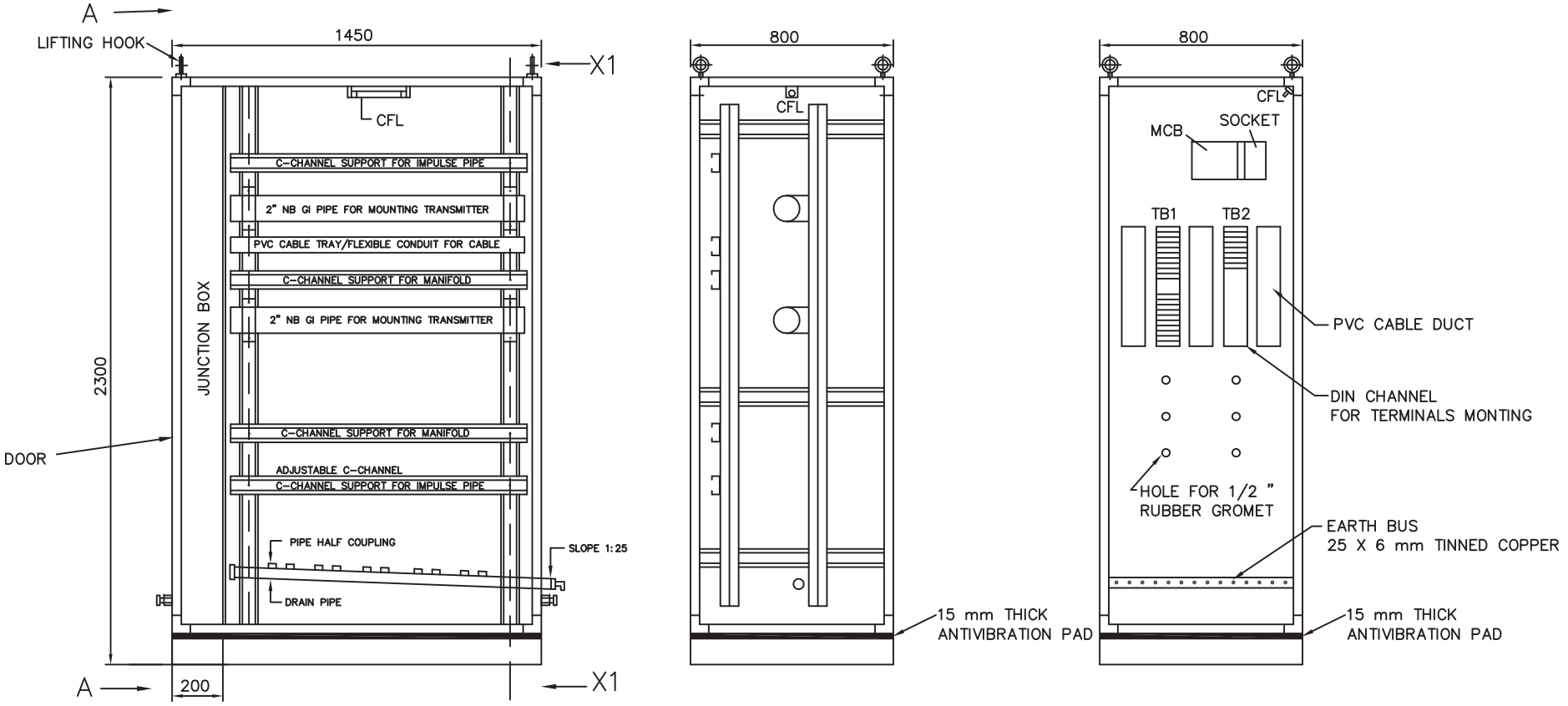
1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

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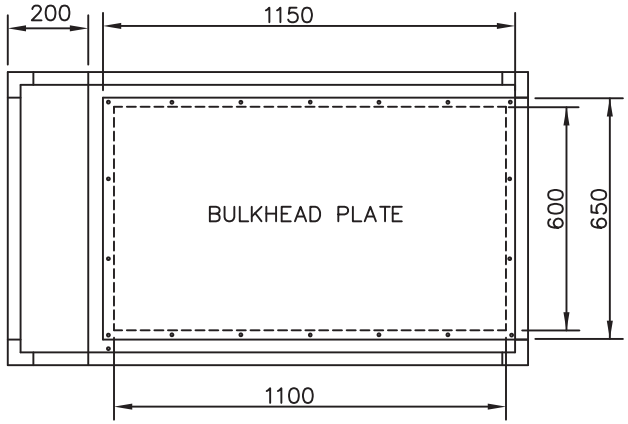
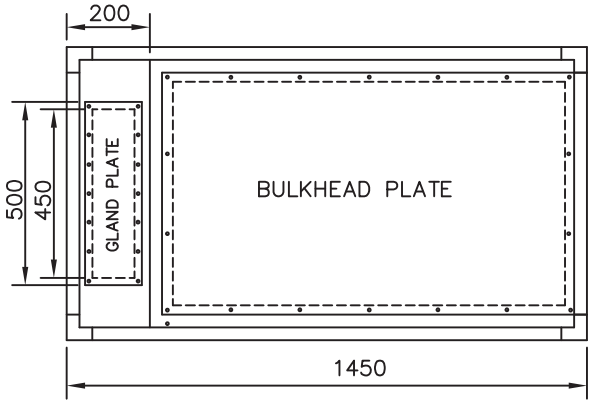
JOB NO. DCPL–K9213R | SCALE NIL | SHT. 7 OF 10

DWG. NO. K9213R–DWG–I–0200 | REV. 0

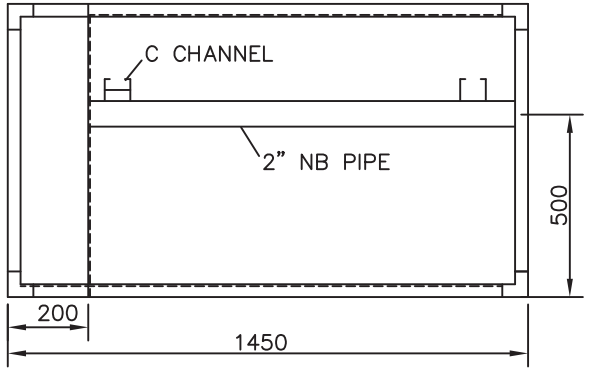
K9213-DWG-I-0200-7-10



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)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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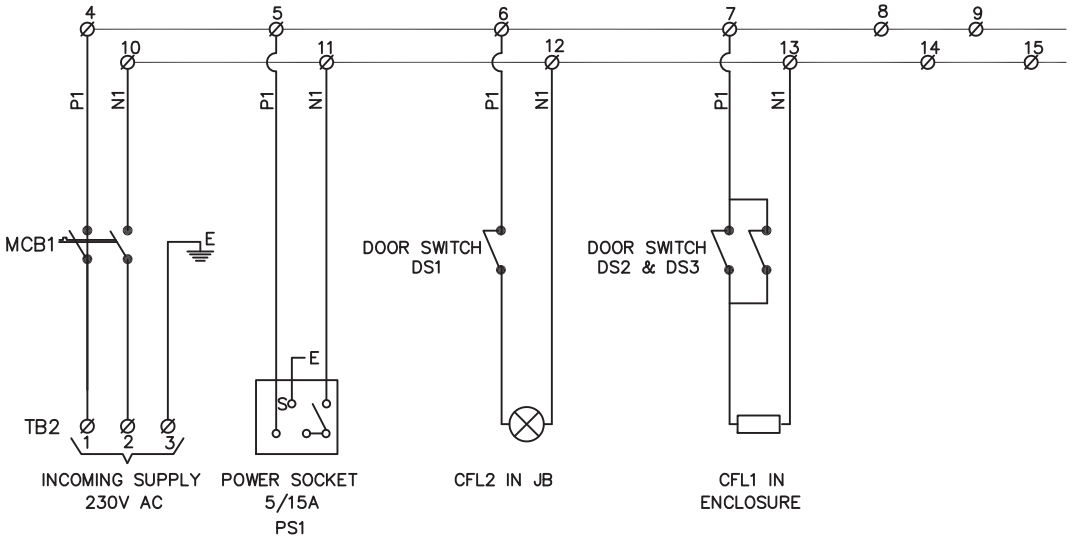
JOB NO. DCPL-K9213R | SCALE NIL | SHT. 8 OF 10

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

K9213-DWG-I-0200-8-10

POWER WIRING CIRCUIT

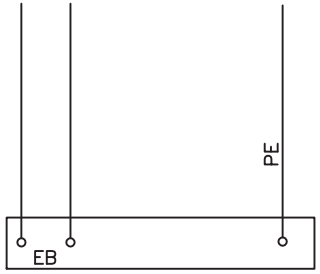


NOTES :

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)

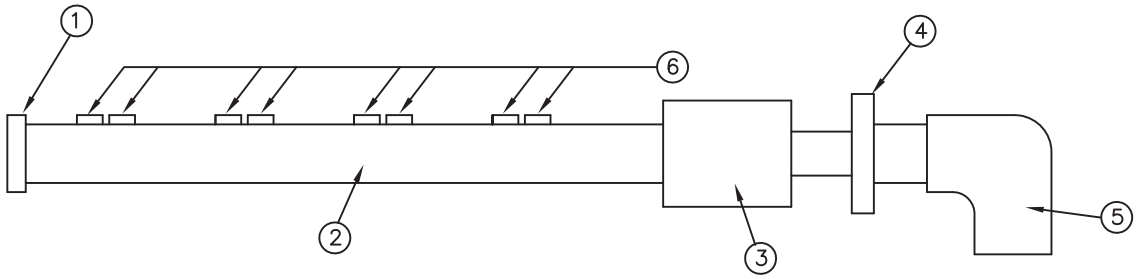
GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT

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



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

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

DRAIN HEADER DETAILS FOR
LOCAL INSTRUMENT ENCLOSURE

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

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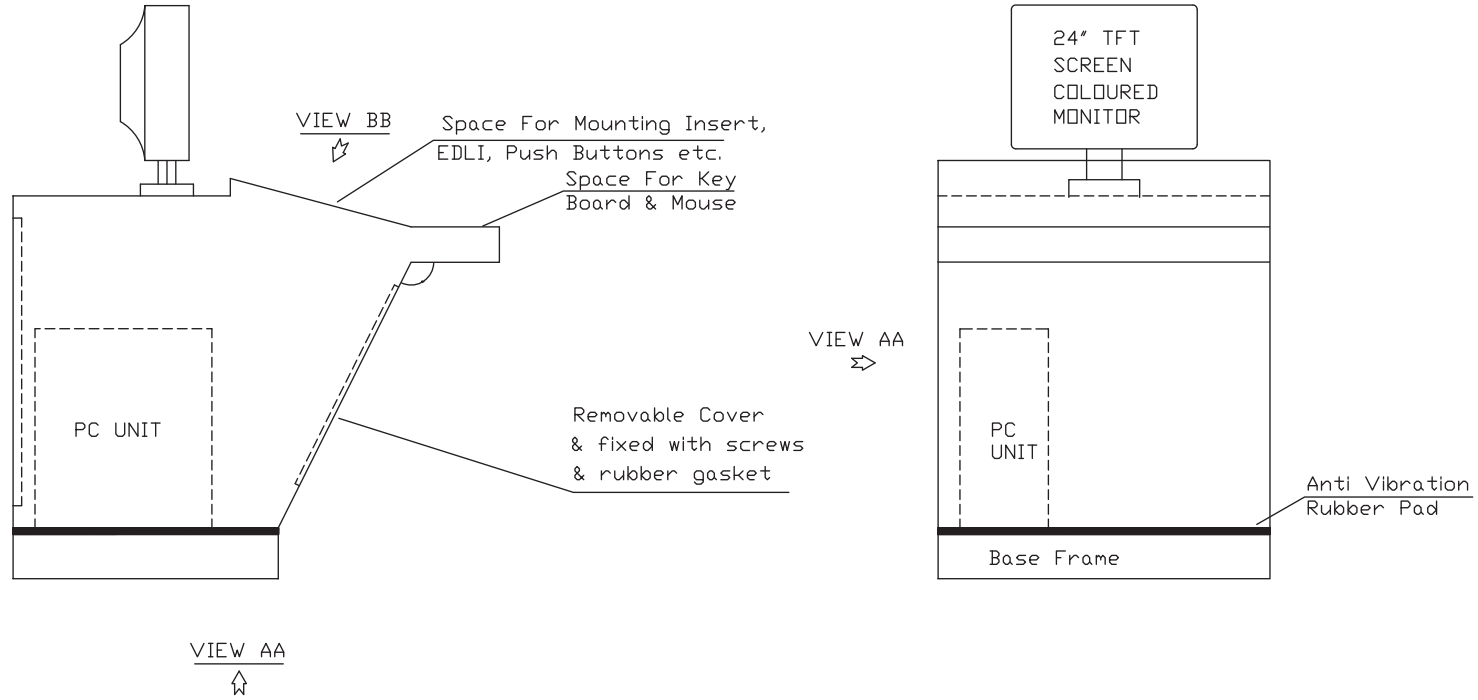
JOB NO. DCPL–K9213R | SCALE NIL | SHT. 10 OF 10

DWG. NO. K9213R–DWG–I–0200 | REV. 0

K9213-DWG-I-0200-10-10

A4_H (08–'06) [297 x 210]



THIS IS A PART OF TECHNICAL SPECIFICATION NO.-PE-TS-408-155-A001

NOTES:

1. THIS DRAWING IS FOR DESIGN CONCEPT AND DETAIL OF FABRICATIONS SHALL BE VENDOR'S RESPONSIBILITY SUBJECT TO USER'S APPROVAL.
2. DESK PORTION i.e. SPACE FOR KEY BOARD SHALL BE FABRICATED FROM STAINLESS STEEL SHEET. REMAINING PARTS FROM CRCA SHEET STEEL. SHEET THICKNESS SUBJECT TO USER'S APPROVAL.
3. SUITABLE LOUVERS (WITH WIREMESH 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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

TITLE: OPERATING STATION DESK PROFILE

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

JOB NO. K9213R | SCALE : NONE

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

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A3 (9-96) [420x297]

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

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

DWG. NO. K9213R–DWG–I–0060 | REV. 0

K9213-DWG-I-0060-2-20-REV-0