DC. Filtering on the input of the inverters shall be furnished is required to operate within the output ripple of the chargers furnished by the Bidder. Each inverter shall include equipment necessary to protect itself from damage resulting from excursios, loss, or restoration of DC input voltage and synchrnising voltage. The inverter output voltage shall be 230 V AC , 50 Hz, Single phase.

7.03.04 OVER LOADS, SHORT CIRCUITS AND LOAD LOSS PROECTION

1. The inverters shall be provided with suitable fuses at the input and output which will permit proper co-ordination with other protective devices and at the same time protect the inverter against damage due to internal faults. All necessary equipment shall be provided to protect the inverters against over loads, short circuits and 100% loss of load. The inverter shall be self protecting against damage if energized with full load connected.

2. The inverter shall be provided with current limiting circuitry which will limit the output current to a value which will not damage the inverter or blow its fuses.

3. The inverter shall have sufficient $I^2 t$ capability to prevent damage to itself until short circuit conditions on the output are cleared.

4. Each inverter shall be capable of operation with nonlinear loads. For bidders loads bidder shall detail the nature of non linearity. For loads provided by owner, bidder may assure a non linear wave form with a current crest factor of 3.0 occuring coincident with voltage peak. With nonlinearity consisting of third, fifth and seventh order harmonics. Output waveform of the inverter(s) shall remain within specified limits when operating with nonlinear loads at 100 per cent rated load.

5. The inverters shall be self protecting against all AC and DC transients, voltage surges and steady state abnormal voltages and current likely to be encountered in utility power station.

7.03.05 Automatic Synchronisation

Inverter equipment shall include stable solid state oscillator devices designed to automatically maintain the inverter output in phase and in synchronization with the standby AC source. The frequency regulation shall be automatic within $\pm$ 0.1 Hz of all conditions of inputs, loads and temperature occurring simultaneously or in any combination.

Facility shall be provided for automatic transfer to internal oscillator operation when the standby source frequency is not within the synchronization limits.

Provision shall be made for step less adjustment of synch disconnect frequency range from 50 Hz +/- 0.5 Hz to 50 Hz +/- 2 Hz.

Automatic adjustment of phase relationship between inverter output and standby AC source shall be gradual, at a controlled slew rate, which shall not exceed 0.1 Hz per second.

The inverter shall normally work on the internal oscillator with either of the two inverters as master synchronizer and the other following it. Suitable selector facility shall be provided to select the master. When any one inverter fails the healthy inverter gets the synchronizing signal from the standby AC source.

The DC inputcurrent shall never exceed the full load current except for a short circuit within the inverter. The limitation applies to transient as well as steady state currents and includes in rush currents upto initial energisation of the UPS, load energisation, short circuits external to the inverter etc. For any value of the load and load power factor drawn by the equipment served, the inverter shall not impose on DC source any voltage oscillations in excess of 5 volts (RMS total, all frequencies) or any current oscillations in excess of 3 %(RMS total, all frequencies) of the DC current at full load.

7.03.06 The inverter shall meet the following specifications in addition to other requirements stated herein :-

1.	Voltage input (Battery output)	:	As per system requirement
2.	Nominal voltage output:		240V, 50Hz, single phase
3.	Inverter capacity (output KVA)	:	As per clause 7.03.02
4.	Voltage regulation	:	
	a) Steady state (0-100% load at all input voltages & all power factors)	:	$\pm$ 1 %
	b) Transient voltage regulation (on application or removal of 100% load)	:	$\pm$ 5%
	c) Time to recover from transient to normal voltage with $\pm$ 1% of steady state (on application or removal of 100% load)	:	<50 milli second
5.	Wave Form		
	a) Nominal Frequency	:	50 Hz
	b) Frequency regulation for all conditions of input supplies, loads and temperature occurring simultaneously or in any combination (automatically controlled)	:	$\pm$ 0.1Hz

c)	Synchronization limits (for maintenance & synchronism between the inverter and standby AC source).	:	48 Hz to 52 Hz (factory test)
d)	Field adjustment range for (c) above	:	50 $\pm$ 0.5 Hz to 50 $\pm$ 2 Hz
e)	Total harmonic content	:	<4% max.
f)	Harmonic content max.for any single harmonic	:	<2.5%

6. Rated output current at rated output voltage with current limit not operating :

a)	Current	:	200%
b)	Duration	:	10 seconds

7. Overload capacity at 100% voltage :

a)	For 4 ms (fuse clearing):		App. 300%
b)	For 10 seconds	:	200%
c)	For 10 minutes		: 125%
d)	The proposed inverter has the capacity to clear largest acting fuse in 5 milli second & without entering into current limiting mode	:	---

8. Efficiency (watt output/watt input)

a)	at 100% load 1.0 P.F. / 0.8 P.F:		>91%/ 91%
b)	at 75% load 1.0. P.F. / 0.8 P.F.	:	>90% / 90%
c)	at 50% load 1.0 P.F. / 0.8 P.F.	:	>89% /89 %

9. Duty : Continuous

10. Cooling : Natural convection or forced cooling using redundant fans.

    Equipment to be designed for operation with full load even without cooling availability.

11. Ambient temperature : 50 deg C, maximum

12. SCR derating from : 50%

peak voltage and peak ratings.

7.03.06 STATIC INVERTER AUXILIARY EQUIPMENT

In addition to the inverter equipment specified above, auxiliary equipment shall be furnished with each static inverter as follows:

1) Equipment and material furnished, mounted and wired on the front panel of the inverter enclosures :

ITEM	QUANTITY
Output ammeter, AC, indicating, Scale-0 to 150 percent of rated continuous full load inverter output current, 1 percent accuracy.	1
Output voltmeter, AC, indicating 0-300 volt scale, 1 percent accuracy.	1
Output KVA, AC indicating scale 0-150 percent of Rated capacity, 1 percent accuracy.	1
Input voltmeter DC, indicating 0-300 volts scale, 1 percent accuracy.	1
Frequency meter, 45-55 hertz, 1 percent accuracy.	1
Power factor meter, (0-1. 0-0), 1 percent accuracy	
Inverter ON-OFF switch	1
Alarm Reset Push Button	1

2) Indicating lights listed below with proper actuating devices, circuitry and legend shall be furnished on front of the Ups panels. For these abnormal conditions which could be of a momentary nature, the indicating lights shall remain energized and the contract remain closed until cleared by a reset push button furnished on the panel. The indicating lights shall be of make subject to Owner's approval.

The following indications shall be provided as a minimum :

a) DC voltage to the Inverter - Low
b) DC voltage to the Inverter - High
c) Loss of DC input to the inverter
d) Inverter output voltage - High
e) Inverter output voltage – Low (after a time delay to avoid unnecessary alarm due to low voltage on load in rush etc.)
f) Inverter A failure / Inverter B failure
g) Standby AC source failure
h) Inverter A / Inverter B not synchronized with AC source
i) Automatic transfer to AC source. Blown Fuse or Tripped Breaker.
j) Inverter A/ Inverter B feeding 100% UPS Load
k) Standby source feeding 100% UPS loads
l) Redundant fan failure and temperature high (if provided)

7.04.00 STATIC TRANSFER SWITCHES AND AUXILIARY EQUIPMENT

7.04.01 The static transfer switches shall be provided to perform the following functions

1) To transfer the load automatically without any break between the inverter to the standby inverter as required to maintain the continuity of power supply to UPS connection loads. The load shall be automatically transferred from "Inverter" to the inverter source upon any malfunction of one inverter.

2) To transfer UPS load under manual control from standby AC source to inverter when placing the UPS System in service and from inverter to standby AC source when taking the UPS out of service.

7.04.02 The static transfer switches shall have two modes of operation namely automatic and manual.

7.04.03 The static transfer switches shall use silicon controlled rectifiers and other static devices required for automatic transfer of load from "Inverter" to Standby" source and vice versa.

The static switches shall conform to the requirements specified herein including the following:

1. Capacity (continuous) : Equal to the continuous full load capacity of the inverter.
2. Capacity (overload) : 200% for 10 seconds, 150% of continuous for 60 seconds and 125% of continuous rating for 10 minutes and 300% of continuous rating for 4 msec.
3. Capacity (Peak) : 1000 % of continuous rating for 5 cycles.
4. Transfer Time : < 4 msec. The transition shall be "make before break", voltage failure shall be sensed at the output of the static switch.
5. Voltage Rating (Nominal) : 240 Volts, 50 Hz. Single phase.
6. Transient Voltage Tolerance : 340 Volts peak above the normal line voltage.
7. Ambient temperature : 50 deg C max.
8. Cooling : Natural or forced circulation , using redundant fans.
9. Duty : Continuous

7.04.05 **TRANSFER INITIATION**

1) The transfer of static switch from normal "Inverter" position to "Stand-by" position shall be initiated by one of the following causes :

   a) Inverter failure and UPS System trouble
   b) Inverter output voltage failure
   c) Over current
   d) Manual push button operation
   e) Static Output voltage failure.

2) 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 static transfer switch.

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

4) UPS bus current shall be continuously monitored by a current monitoring detector. This detector shall operate the static transfer switch when the load current exceeds the overload rating of any inverter. The detector shall rest when the load current falls below the rated current of the inverter resulting in retransfer of static switch with inverter position.

5) Over current transfer limit shall be continuously adjustable from inverter continuous rating to inverter current limit rating.

7.04.06 TRANSFER INHIBIT

The transfer of static switch shall be inhibited under the following conditions:

1) Automatic or manual transfer of load from inverter to stand-by AC source or vice versa, shall be inhibited when the inverter frequency is not synchronized to the alternative source.

2) Transfer resulting from overload shall be inhibited when the standby AC source is not available. In this case the load fed by the inverter shall be automatically disconnected

7.04.07 RETRANSFER TO NORMAL

1) The retransfer to normal shall be manual in all cases.

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

7.04.08 Static transfer switches shall be provided with necessary protective devices (circuit breakers / current limiting fuses) both in “Normal” as well as “Stand-by” position.

7.04.09 The static transfer switches shall be provided duly mounted and wired in enclosures furnished by the bidder.

7.04.10 The static switches shall be furnished with contacts to alarm failure of the alternate source or opening of any fuse protecting the static switches.

7.05.00 MANUAL BY-PASS SWITCH

7.05.01 The manual by-pass switch will be used to isolate any static switch from its load and stand-by power supply and to take the static switch out of service without power interruption to the load. In doing so the manual by-pass switch shall connect both load buses to a single inverter. The manual by-pass switch shall also provide the facility for by- passing the entire UPS system during start up at the option of the operator.

7.05.02 The manual bypass switch shall have make before break contacts to ensure continuous supply to UPS loads during the operation of this by-pass switch.

7.05.03 The manual by-pass switch shall be rated for 600 Volts, 50 Hz, single phase operation. It shall have continuous load carrying capacity equal to full load inverter current and necessary short term load carrying and interrupting capacity to meet the requirements of the UPS system.

7.05.04 All other by-pass and disconnect devices shall be provided by the Bidder as required for orderly start up and shut down and maintenance of UPS system and system components.

7.05.05 The Bidder shall provide potential free contacts, one closed in each position, for use in DDCMIS & PLC system.

7.05.06 The manual by-pass switch and required disconnect devices shall be furnished duly mounted and wired in enclosure, furnished by the Bidder.

7.06.00 FLOAT-CUM-BOOST CHARGERS AND AUXILIARY EQUIPMENT

Two no. 100% capacity SCR based fully controlled 12 pulse float cum boost chargers shall be furnished for main BTG UPS system and Two no. 100% capacity SCR based fully controlled 6 pulse float cum boost chargers shall be furnished for BOP packages UPS system. Each charger shall confirm to the following requirements.

7.06.01 CHARGER CAPACITY

Each charger furnished for UPS system shall be adequately rated to ensure that any one shall meet full DC load of UP system operating at 100% rating plus recharge the fully discharged UPS battery within 8 hours.

The Bidder shall furnish the charger rating calculations to the Owner to satisfy that this requirement is met. The charger shall be furnished as per rating approved by the Owner during engineering stage.

7.06.02 The chargers shall be supplied from a 415 volt, 50 Hz. 3 phase system. The chargers shall maintain the output voltage within plus and minus 0.5 percent from no load to full load with an input power supply deviation in voltage level of plus or minus 10 percent and input power supply deviation in frequency of plus or minus 5 per cent and with both deviations present in any combination.

7.06.03 In addition to supplying DC power for inverters, the chargers shall be designed to charge a fully discharged battery without over loading or causing over voltage or without causing interrupting operation of AC or DC circuit breakers for the entire range of intended operating regimes. Suitable solid state electronic circuits shall be provided to ensure that the charging current is voltage regulated and current limited. After the battery is recharged the charger shall maintain the battery at full charge until the next emergency operation when the UPS battery is again required to provide DC power.

7.06.04 Float and equalizing controls shall have an adjustment range of $\pm$ 5% continuous (without steps).

7.06.05 The chargers shall be self-regulating, solid state, silicon controlled, full-wave rectifier type designed for single and parallel operation with the battery specified under clause 7.07.00. The chargers shall be designed for automatic load sharing during parallel operation.

7.06.06 The charger shall be current limited at 125% of full load to reduce output voltage for charger circuit protection and for protection of battery from overcharge. The current limit shall be continuously adjustable from 80% to 125%.

7.06.07 All necessary equipment and devices shall be provided to protect the charger from short circuits, transient voltage surges, load and supply fluctuation including sudden loss of input or load.

7.06.08 The charger shall have a slow walk-in circuit which shall prevent application of full load DC current in less than 10 seconds after AC power is energized.

7.06.09 The minimum full load efficiency at nominal input and float output shall be 96 %.The output regulation, ripple content and power factor shall meet the requirements of UPS system as well as the inverters furnished by the Bidder as per clause 7.03.00.

7.06.10 Chargers and auxiliary equipment shall be mounted in free standing cabinets furnished by the Bidder. Charger cabinets shall be folded steel construction with top, front, back and sides fabricated from not less than 3 mm thick sheet steel. The cabinet front, back, end sides shall extend to the floor to present a finished appearance. Cabinet door shall be provided to permit easy access to all components for maintenance or replacement. Doors shall have concealed hinges and three-point latches. Louvers shall be provided for ventilation as required for operation at the specified ambient but the cabinet top shall be solid. All louver openings shall be covered with corrosion resistant fine screen coverings.

7.06.11 **GROUND DETECTOR SYSTEM**

a) Each charger shall be furnished with a ground detector system consisting of a relay and a center tapped resistor. The resistor shall be connected between the positive bus and the negative bus.

The relay coil shall be connected between the centre tap of the resistor and ground. The relay shall be furnished with one normally open and one normally closed contact wired to terminal blocks for connection to external circuits.

7.06.12 **UPS Signal interfacing with DDCMIS/DCS & PLC**

a) The bidder shall provide alarms and status indications, current, voltage ,frequency, PF etc through serial link with MODBUS or another compatible protocol .

b) The Bidder shall furnish 4-20 mA signals to DDCMIS/PLC for the following:

i) Inverter A & B output voltages
ii) Inverter A & B output currents
iii) Inverter A&B output frequency

c) List of alarms (min.) to DDCMIS through potential free contacts shall be as follows:-

i. Rectifier – 1 Trip.
ii. Inverter – 1 Trip.
iii. UPS battery low.
iv. Rectifier – 2 Trip.
v. Inverter – 2 Trip.
vi. Load on static Bypass.
vii. Static Bypass failure
viii. ACDB – 1 Incomer Tripped.
ix. ACDB – 2 Incomer Tripped.
x. UPS – 1 Fan Tripped.
xi. UPS – 2 Fan Tripped.

7.07.00 UPS/24 V DC System BATTERY AND ACCESSORIES

The UPS/24 V DC system batteries shall be heavy duty *Ni-Cd type* as specified below:

i. Expected service life is greater than 20 years when operated on float or trickle charge.
ii. Low maintenance – minimal topping up frequency and self - discharge.
iii. Capable of rapid recharging.
iv. Transparent containers for ease of inspection and maintenance.
v. Battery racks provided for battery shall be 2 tier made from heavy teak wood to bear 150% over load, anti acid paint etc.
vi. One no. 2 sided Folding Aluminium ladder (height 180 cm) for maintenance & removal of battery cells and mounting bracket for ladder shall be provided by bidder with each battery set.

The batteries shall be **heavy duty Nickel-cadmium Fiber plated type** and shall be sized for an hour of full load operation during non-availability of AC supply / chargers. The Ni-Cd batteries shall conform to IS:10918. For sizing calculation, design margin of 120%, an aging factor of 0.8 and a temperature correction factor (Based on temperature characteristics curve to be submitted by the Bidder and at a temperature of 4 deg. C). Capacity factor shall be taken into consideration, and ambient temperature shall be considered as the electrolytic temperature. The sizing of the battery shall be as approved by Owner during detailed engineering. However, Bidder shall consider a suitable voltage drop from battery room to UPS and UPS to load, while sizing the battery. The system shall also be suitably designed to overcome any over voltage that may arise during low-load operation of the charger. The bidder shall clearly bring out in his offer how the same is being implemented.

The battery size shall be calculated taking UPS/24 V DC system capacities as base load. Bidder shall also consider voltage drop from battery room to UPS/24 V DC systems, while sizing the battery. For Plant UPS & plant 24 V DC system, battery back up time shall be 2 hours and for BOP packages UPS & BOP 24 V DC system, the back up time shall be for 1 hour.

For Fire alarm panels, batteries shall be provided with min. 10 hours backup.

7.07.01 In order to monitor the batteries, **online battery health monitoring system** shall be employed. It is a battery management system based on monitoring the voltage of individual battery cell, which provide the information/details about battery health status to end user/owner. Complete hardware like detector units, Battery clips, cables, monitor (power control unit) and other accessories etc as required to complete the system shall be provided by bidder. LED indication shall be provided on detector units for power, alarm and RUN indication etc. Data from Online Battery Health Monitoring System shall be communicate/transferred to DDCMIS for Monitoring and analysis using different protocol like RS485 Modbus/OPC etc.

7.07.02 One complete set of all accessories and devices required for maintenance and testing of batteries shall be supplied for each set of the batteries of each unit/plant auxiliary system. Each set include at least the following:

a)	Hydrometer	5 Nos
b)	Set of hydrometer syringes suitable for the vent holes in different cells	5 Nos
c)	Thermometer for measuring electrolyte temperature	5 Nos
d)	Specific gravity correction chart	5 Nos
e)	Wall mounting type holder made of teak woodfor hydrometer & thermometer	5 Nos
f)	cell testing voltmeter(3-0-3 V)	5 Nos
g)	Alkali mixing jar	5 Nos
h)	Rubber aprons	5 Nos
i)	Pair of rubber gloves	5 Nos
j)	Set of spanners	5 Nos
k)	No smoking notice for each battery room	2 Nos
l)	Goggles (industrial)	5 Nos
m)	Instruction card	10 Nos
n)	Minimum and maximum temperature indicator for battery room	1 No.
o)	Cell lifting facility	1 Set
p)	Vent Caps	2 set
q)	Terminal Bolts & Washers	1 Set
r)	Plastic Filling Bottles	10 Nos.
s)	Alkali resistant funnel & Mugs	10 Nos.

7.07.03 Cell booster charger shall be provided with main plant UPS & 24 V DC batteries set to charge the new & sick cell for revival of cell. The cell booster shall be built in separate portable panel. Resistive load discharge bank shall also be provided with main plant UPS & 24 V DC batteries set to discharge the batteries in case of over charged batteries.

7.08.00 VOLTAGE STATIC STABILISER

7.08.01 One 415 Volt, 3 phase to 240 Volt, single phase transformer along with associated static voltage stabilizer shall be furnished with each UPS set.

This transformer and stabilizer combination shall convert 415 Volt $\pm$ 10% plant auxiliary AC supply to 240V $\pm$ 1% single phase standby AC Power which will serve as UPS system back up supply source.

7.08.02 The transformer and stabilizer shall be sized for 100 percent UPS load and shall coordinate with the largest branch circuit protection device for feeder short circuit current without sacrificing voltage regulation. The voltage stabilizer shall employ silicon solid state circuitry and shall maintain the specified output voltage for 0-100% load with input voltage variations as indicated above. Class of insulation of wound components like transformers etc shall be class H with temp rating up to class B.

7.08.03 The stabilizer shall meet the following characteristics as a minimum
- Fast rate of correction - within 5 cycles
- Output distortion - less than 5% under worst conditions
- Efficiency - better than 95%
- Overload Capacity – 300% for 200 mSec.

The make and rating shall be subjected to Owners approval.

~~7.09.00 24 V DC CONTROL POWER SUPPLY SYSTEM FOR MAIN PLANT~~

~~7.09.01 The bidder shall offer a completely separate parallel redundant system with 50 % load sharing on each charger to cater to 24 V DC requirements for control, protection interlock & sequencing systems for BTG (Turbine protection, MFT & solenoid valves etc.). 24V DC system shall consist of~~

~~1.~~	~~100% capacity 12 Pulse float cum booster charger~~	~~2 nos. charger in parallel redundant configuration~~
~~2.~~	~~Battery Bank for 100 % load~~	~~2 Bank (100% capacity) each for 120 minutes back up~~
~~3.~~	~~DCDB (including 20 % spare feeders on each panel with 2 nos. minimum spare feeder of each rating)~~	~~2 set, (Quantities of feeders shall be as on required basis).~~
~~4.~~	~~Armored FR LS S T2 (inner & outer sheath), PVC type Cu insulated stranded copper conductor Cables. For emergency trip push buttons, Fire alarm system, safety critical circuit, trip protection circuit and for other services specified elsewhere in the specification shall be fire survival power cable conforming to IEC 60331, BS6387 (CWZ), BS6207 standard and this specification.~~	~~Complete power cables for 24 V DC system with battery, DCDB and loads.~~
~~5.~~	~~MCCB (At input, output, battery side, & DCDB side etc) with ON, OFF & Trip indication.~~	~~1 no. each~~

~~Input for 24 V DC systems shall be from 3 phase MCC system. 24VDC power supply to load will be through MCCB, MCB, and redundant feeders DCDB – 1 and DCDB – 2. Grounding cubicle for 24 V DC system shall be included in scope of supply.~~

~~SLD of 24 V DC charger system as per NIT drawing # 114-17-0200 shall also be referred by bidder~~.

~~7.09.03.06~~ ~~The charger shall be current limited at 125% of full load to reduce output voltage for charger circuit protection and for protection of battery from overcharge. The current limit shall be continuously adjustable from 80% to 125%.~~

~~7.09.03.07~~ ~~The chargers shall have a slow walk-in circuit which shall prevent application of full load DC current in less than 10 seconds after AC power is energised.~~

~~7.09.03.08~~ ~~The chargers shall be fed from 415V AC, 50 HZ, 3 phase. The Bidder shall provide all required power cables from 415 V AC power supply system to his power supply system.~~

~~7.09.03.09~~ ~~The minimum full load efficiency at nominal input and output shall be 70%.~~

~~7.09.03.10~~ ~~Charger design shall ensure that there is no component failure due to fluctuations of input supply or loss of supply and restoration. This feature shall be demonstrated during factory testing at various loads.~~

~~7.09.03.11~~ ~~Bidder shall furnish the equipment complete in all respects along with charger rating & voltage drop calculations, supporting curves/data etc.~~

~~7.09.03.12~~ ~~24 V DC Charger sizing calculation shall be submitted for approval) at 50 deg. C ambient. Each Individual parallel redundant 24 V DC charger system shall be designed considering 20% design margin.~~

~~**7.09.04**~~ ~~**Batteries And Accessories**~~

~~The 24 V DC system batteries shall be Two (2) set of **heavy duty Nickel-cadmium Fiber plated type** as specified at clause no. 7.07.00. Battery sizing calculation shall also be submitted for approval as per factors specified at clause no. 7.07.00. All other items shall also be furnished by bidder as specified at clause no. 7.07.01 & 7.07.02, 7.07.03.~~

~~In order to monitor the batteries, **online battery health monitoring system** shall be~~ employed.

7.10.00 AC & DC Power supply for BOP packages

7.10.01 The UPS system shall be separate for each BoP/offsie package. The UPS shall be designed as specified at clause no. 7.02.00 to 7.08.00.

7.10.02 Parallel redundant 240 V AC to 24 V DC convertor with 50% sharing & 125 % capacity shall be provided for 24 V DC power supply in each cubicle separately as per requirements for BOP/Offsite package's PLC control system and microprocessor based control system.
The UPS power supply shall be extended to Parallel redundant 240 V AC to 24 V DC convertor thru redundant UPS feeders.

AC to DC convertor shall be SMPS based and shall have wide range of AC/DC input voltage (85-264 V AC & 90-350 VDC). It shall have the necessary diagnostic functions like indications for DC OK, automatic overload monitoring etc. The MTBF for the power supplies shall not be less than 500,000 hours (in Accordance with (IEC – 1709) with operating temp. from –25deg. C to 70 deg. C.

7.11.00 CONSTRUCTIONAL FEATURES FOR CABINETS/ENCLOSURES

The Construction details for UPS & 24 V DC charger system cabinets/enclosure shall conform to the requirements indicated in chapter 6.

7.11.01 Grounding

Normal, AC power supply will be grounded at the source. For grounding other than this, I/P and O/P isolation transformers shall be furnished with the UPS.

7.11.02 All the transformers used any where in UPS & 24 V DC charger circuitry shall be copper wire winded with class H insulation.

7.12.00 DC DISTRIBUTION BOARD PANEL

7.12.01 Distribution board shall be furnished with components, devices and materials meeting the requirements specified herein.

7.12.02 Each DC distribution board shall be constructed for 2 wire DC distribution .All bus bars shall be of solid copper. Each panel shall have four double pole 800 amps MCCB and properly sized fuses for three incoming feeders (two from chargers and one from battery) and two double pole 800 amps Moulded case circuit breakers with thermal over current relays and electromagnetic over current relays for two out going feeders to inverters. Isolators and circuit breakers shall open and close with snap action. Fuses of appropriate capacity shall be provided for incoming feeder from battery. All switches, fuses, circuit breakers and buses shall be rated for DC system fault level, which shall be indicated by the bidder in his proposal. Circuit identification cards mounted in card holders shall be provided on the hinged panel board front. The number of feeders (WITH 20% spare feeders) and rating of each feeder shall be to suit the individual load keeping in view the fuse clearance capability of UPS system already stipulated and shall be as finalised during engineering. No price implication is admissible for the number ratings of feeders as decided during engineering and owners decision in this shall be final. Each feeder shall have fast acting semi conductor fuse, MCB & LED indication for ON status.

7.13.00 AC DISTRIBUTION BOARDS PANEL

7.13.01 Panel boards for distribution of continuous AC power to essential loads shall be dead - front type panel boards rated for 600/1100 V, AC service. The hinged panel board front shall cover the fuses and wiring gutter but not the switch handles. The hinged front and switch handles shall be covered by the enclosure door.

7.13.02 Each panel board shall be constructed for 2 wire, single- phase distribution with a solid neutral bar. Phase and neutral bars shall be of copper. Rating of the main lugs shall be equal to the rated continuous full load current of each inverter.

7.13.03 Each panel board shall have one fused disconnect switch & MCCB of adequate rating for incoming feeder for A C Bus and requisite double pole, suitably rated ampere fused, disconnect switch branch circuit devices (MCB). Fused switches shall be equipped with arc quenchers, visible blades, and quick-make quick-break operating mechanisms. Maximum size fuse which branch circuit fuse holders will accept shall be rated at 60 amperes. As each UPS fed load will be provided with two hot

redundant 100% rated feeders. Main feeders to ACDB shall be provided with digital type Ammeter, Voltmeter, Frequency meter, PF meter, Watt meter & VA meter. One from ACDB-A and other from ACDB-B, boards with feeders shall be constructed in line. The number of feeders (WITH 20% spare feeders) and rating of each feeder shall be to suit the individual load keeping in view the fuse clearance capability of UPS system already stipulated and shall be as finalised during engineering. No price implication is admissible for the number ratings of feeders as decided during engineering and owners decision in this shall be final. Each feeder shall have fast acting semi conductor fuse, MCB & LED indication for ON status.

7.14.00 FACTORY TESTS

7.14.01 The UPS system & 24 V DC system shall be factory tested under various stages of manufacture and upon full completion as per Owner approved quality Assurance plan, the tests shall include, but shall not be limited to the following:

7.14.02 Type and Routine Tests

Type and routine tests for various components and sub assemblies in accordance with IS and/or NEMA, TEE Test Standards.

7.14.03 Functional Tests

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 inverters for synchronisation with range of adjustments; transfer and retransfer of static switches under influence of under voltage and over current, tests on charges, batteries and other system components to confirm compliance with specification.

7.14.03.1 UPS (Factory Acceptance Test)

i) Power Efficiency (IEC 146-2, IEC 146) at 100% load, 50% load.
ii) Load test (Approved Procedure) load regulation test
iii) Audible noise test (IEC 146-2)
iv) Fuse clearing capability (Approved Procedure)
v) Relative harmonic content (IEC 146-2)
vi) Synchronous transfer & synchronization test (IEC 146-4)
vii) Temperature rise test without redundant fans (IEC 146-2)
viii) Input voltage variation test (Approved Procedure)
ix) Overload test on inverter & charger (Approved Procedure)
x) Insulation test (IEC 146)
xi) Restart test (IEC 146-2)
xii) Short circuit current capability (IEC 146-2 clause 5.10)
xiii) Output voltage & frequency tolerance (IEC 146-2)
xiv) Voltage current division (IEC 146-2)
xv) Relative harmonic content (IEC 146-2)
xvi) Parallel redundancy (* Simulation of Parallel redundant fault (IEC 146-4)
xvii) Overload test (final acceptance test)
xviii) Any other required as per national international standard or QAP

DOCUMENT FOR LCP

~~G.~~ SPECIFICATION

FOR

CONTROL PANELS

CHAPTER-6

SUPERVISORY CONTROL PANELS, SUPERVISORY CONTROL DESKS, EQUIPMENT PANELS

6.00.00 PANEL AND DESKS

6.01.00 GENERAL REQUIREMENTS

All DDCMIS/PLC/any other control system's electronic modules, power supply components, other control devices (except field mounted sensors/transmitters) and required for completeness of the system shall be housed in cabinets furnished by the Bidder. All equipment and dedicated cabinets required for termination, marshalling and proper interface within Bidder's system and also with other systems shall also be provided by the Bidder.

The cabinet mounted equipments shall be fully assembled, installed in mounting racks, wired and fully tested as per specification requirements and Owner approved drawings in the manufacturing works of a qualified manufacturer prior to shipment to the project site. The Bidder shall ensure that the cabinets are complete and ready for installation before dispatch from manufacturing works. The installation work at project site for these cabinets should only involve connections through multi pair cables from marshalling cabinets (wherever provided) to system cabinets and inter-cabinet/cabinet to UCD/UCP/BUP.
The Control cabinets shall house all types of modules / hardware to achieve all functions of Control System including signal conditioning modules, controller modules, I/O modules, communication controller modules, and all other requisite hardware for a complete system.

6.02.00 SUPERVISORY CONTROL PANELS AND DESKS

6.02.01 Control Desks & Other Furnitures

Supervisory control desks for DDCMIS and other systems shall be supplied for mounting the required operating station as specified else where in the specification. Also control desk will be provided for balance work stations – located in computer room, supervisor room etc. All furniture including chairs and tables for printers etc. shall also be provided by the bidder.
Also control desk & complete furniture will be provided for work stations & printers – located in respective control room for BOP packages.

Industry standard Cushioned revolving, wheel, independently, adjustable seat and back chairs with provision for adjustment of height shall be provided for the operator & unit in charge & other personnel in central control room area & BOP's control rooms, simulator rooms, Conference room, meeting room, documentation room, staff room, CAAQMS shelters, CAAQMS room etc. These shall be designed for sitting for long duration such that these are comfortable for the back. The exact details shall be finalised & approved by Owner during detailed engg.

The actual nos., placement and profile of the main plant control room desk shall be decided during the detailed Engineering.

The tentative layout of central control desk, LVS & consoles are shown in the Drg. No. 114-05-0108, 0105 & 0111.

Control D esk for pr ogrammer's, M aintenance E ngineer's, E WS, Serves, P C & diagnostic OWSs: -

Required numbers of control desks for accommodating programmer's/main-tenance engineer's/diagnostic etc shall be su pplied. T hese sh all pr eferably hav e t he sa me dimension as that of supervisory control desks. Also required nos. of control desk will be provided f or w ork s tations & pr inters – located i n r espective co ntrol room for B OP packages.

Desks for accommodating printer:

Adequate number of table/desks/stands for accommodating printers in bidder's scope shall be supplied. Each printer shall be on a separate table / stand.

Care shall be taken to ensure ergonomically aspects so as to create ergonomically ideal work pl ace co nsidering phy sical asp ects such as an av erage I ndian per son's size and reach, physiological aspects such as line of sight and field of vision and cognitive factors such as concentration and perceptivity. Extreme care shall be taken to design the desks with correct angles and dimensions.

Glass top t eak wood o ffie table w ith l ockable dr awers shall be pr ovided f or C hief Enginner room and all other executive rooms.

6.02.02 Supervisory Panel Unit Control Panel

In addi tion to the LV S a nd O WS, a l imited oper ation from bac kup uni t control panel i s envisaged for emergency operation and to provide safe shut down of plant. The U nit control panel shall housed Conventional Push-button (ILPB) stations, Console inserts (for SG, TG & Generator like FSSS, HPBP, SADC, APRDS, ATRS, ATT, DEHC, LPBP etc), Trip Push Buttons, EWLI, Ammeters, chartless recorders, & min. 15 nos. programmable digital display units for Boiler, Turbine & Generator's parameters. The mosaic grid shall be heat resistant, flame retardant, self extinguishing, and shrinkage free, non reflecting type. Finish of mosaic grid shall be m at type with out flaring. Hard wired emergency trip pushbuttons shall be arranged on operator station desk & in parallel on UCP.

Unit control Panel (UCP), shall be located suitably in the CCR.

In addition to above, 21 nos. Programmable digital display units common for both units showing total MW shall be pr ovided by bidder at different locations of plant. The data to this DDU will be fed from DDCMIS through MOD BUS/PROFI BUS /RS 485 protocol and not hard wired. The **digit size** of the display unit will be **300 mm for 6 Nos**. and **200 mm for 15 Nos.** The placements/locations shall be decided during detailed Engineering.

Control panel cum desk with HW annunciation windows, ILPBs, Ammeters, Annunciation & desk PBs, mimic, lamps, Indicators, recorders, etc. shall be pr ovided as per Annexure A – Control System Philosophy for BOP packages.

(Exact service & quantities will be worked out & approved during detailed engineering by owner).

6.02.03 Two (2) nos. vertical Steel Almirahs shall be provided for keeping documents in each BOP package's control room. Glass doors for each rack shall be provided such that the documents are visible from outside. Size of the rack shall be sufficient to easily fit technical manuals. The exact details shall be approved by Owner during detailed engg.

Suitable lockers (min. 24 nos. per unit) shall be provided in the room adjacent to the each central unit control room for storing of personal articles of control room personnel. Similarly suitable lockers (min. 8 nos in each control room) shall be provided in BOP package control rooms for storing of personal articles of control room personnel. Also, vertical steel almirahs (min. 4 nos. per unit) shall be provided in Documentation Room for storing of documents.

Vertical Steel Almirahs shall also be provided for the following rooms, wherein final quantity may be decided by owner during detailed engineering

a. Maintenance room – 6 nos. min. (per Unit)
b. ERP room – 2 nos. min (Common for both unit).
c. PADO Room – One (1) no. min.(per unit)
d. Station In charge room – One (1) no. min (common for both unit).
e. Simulator room – 4 nos. min. (per Unit)

Thickness of steel almirah sheet shall be 18 gauges.

In addition to above, All industry grade furniture including chairs, control tables, tables for printers etc. & Almirahs for storage of consumables/catalogues/manuals shall also be provided by the bidder as on required basis and finalized by owner any where in power plant. Details shall be finalised and approved by Owner during detailed engineering.

6.02.04 Control panels for service system like C.W. Pumps etc. will be located in the respective control room. In addition, some local panels will be provided near respective system/equipment such as Boiler Feed Pump, Hydrogen seal oil system, Electrostatic precipitator etc.

6.03.00 TERMINATION/Marshalling CABINETS & Interposing Relay Panel

Marshalling/Termination cabinets for the control system shall be supplied for terminating all cables originating from the field, MCC/SWGR or any other source of signal and for distributing the signals to different functional panels, MCC/SWGR and control cubicles.

Incoming cables from the field, MCC/SWGR or any other source of signal shall be terminated in suitable terminal blocks in logical sequence.

Prefabricated cables with plug in connectors at both ends shall be used for extending the signals to the functional panels. Matching plug sockets shall be provided in the termination cabinets for terminating the plugs.

Interposing relay panels for the system shall be supplied for mounting interposing relays & terminating all cables originating from the DO cards in case of solenoid valves, and other required services etc. IPR panels shall be placed in CER and LCR.

Interposing relay shall be mounted in respective SWGR/MCC/integral starter required for commands signals of HT/LT unidirectional drives and bidirectional drives, breakers, isolators & bus couplers etc from DDCMIS/DCS/PLC or any control system.

Terminal blocks shall be located inside the cabinets on support wings fabricated of metal plates.

The plug socket shall be mounted on hinged plates to provide an access to the rear pins of the plugs.

General features of termination cabinets and accessories shall conform to the general design and construction specification of panels. Terminal blocks shall be Rail mounted Terminal blocks (Screw less cage clamp type) with markers.

6.04.00 CONSTRUCTIONAL FEATURES OF PANELS, CONSOLES, CONTROL DESK, CUBICLES & ENCLOSURES

All panels, cubicles, consoles, SOV panels and enclosures furnished as per this specification shall be of free standing type and shall be constructed of specified gauge of steel plates. The panel sheet thickness shall be not less than 2 mm unless otherwise specified herein.

The panels, consoles/desks shall be reinforced as required to ensure true surfaces and adequate support for instruments mounted thereon. All instrument cutouts, mounting studs, and support brackets shall be accurately located. All welds on the exposed panel surfaces shall be ground smooth. Finished panel surfaces shall be free from waves, bellies, or other imperfections. Unless specified, otherwise, panel doors shall be 4 points hinged and shall have turned back edges and additional bracing where required to ensure rigidity. Door hinges shall be of the concealed type. Door latches shall be of the three-point type to ensure tight closing. Door locks shall be furnished which will allow actuation of all locks by a single master key. All panels shall have removable lifting eyebolts for safe lifting from top during storage and installation handling.

Cabinet doors shall be hinged and shall have turned back edges and additional braking where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three/four-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is equal or more than 800 mm, double doors shall be provided.

All panels shall be mounted on vibration dampers, which are secured to channels mounted on the floor. The channels shall be field welded to steel plates set into the concrete flooring. The steel plates shall be located such as to approximate the outline of panel bases. The exact mounting details shall be as approved by the owner during detailed engineering stage. All panels shall be provided with adequate ventilation and packaging density of components shall be restricted so as to limit the temperature rise

above ambient to 10° C under the worst conditions. All panels shall have auto on/off switch for internal lighting. All the power supply circuit for control panels shall be provided with auto changeover circuitry.

In each panel /cabinet, a 24 VDC Voltmeter digital type shall be provided to check the Field Interrogation voltage.

Exhaust Fans with louvers & filters shall be provided on door's (front & Rear) upper side to remove hot air in all consoles, control desk and panels.

Fire/Smoke detectors shall be provided inside the Control room mounted system/control cabinets.

UPS, 24 V DC & non UPS's Feeder failure/ healthy indication shall be provided in each cabinet & remote indication shall be hooked up to DDCMIS/ PLC/annunciation & suitably grouped.

All the panels shall be equipped with Anti vibration pad of min. 15 mm size. Cable gland plate thickness shall be 3 mm.

Doors shall be provided with neoprene/polyurethene gasket only.

All the cable entries shall be at the bottom of electronic cubicles/control panels.

Protection class of panels shall be as specified at Vol. V, chapter 2.

6.04.01 Operator Control Desk

6.04.01.1 In CCR, Operator work station consoles/desk shall be of granite top of curved nature with powder coated frame. OWS consoles shall be provided with the facility for locating the CPU, document etc with all required utilities.

Unit In charge desk/consoles shall be of granite top of curved nature with powder coated frame. OWS consoles shall be provided with the facility for locating the CPU, document etc with all required utilities.

Station In charge desk/consoles shall be of granite top of curved nature with powder coated frame. OWS consoles shall be provided with the facility for locating the CPU, document etc with all required utilities.

6.04.01.2 Engineer work station and all other consoles/desk shall be ergonomically designed industrial grade type with swivel chairs for use at the various Programming stations and all other plant locations. All the equipment like Programmers stations, PC's, various peripherals & similar devices shall be complete with desks and they shall be of industrial grade stands and other mounting accessories and the same shall be completely erected & commissioned by the bidder. Details for other operating and enginering stations shall be as below:

i. Operator Control desk shall be free standing table top type with doors at the back and shall be constructed of 3 mm thick CRCA steel plates. It shall have concealed cable & wire way management system. The top surface of control

desk shall be 30mm thick with the top 12mm of acrylic solid surface and the remaining 18mm of laminated medium density fibre board. Control desk shall consist of vertical, horizontal and base supports with their coverings for work surface, keyboard trays, Mouse pads, Monitor shelf and concealed cable and wire way management, perforated trays with covers in both horizontal & vertical directions.

ii. To achieve durable & water resistant finish, a sheet of "plastic PVC membrane" on the surface of control desks shall be provided. Final paint finish with proper smoothening is to be ensured. Final finish of CD should be in line with relevant International standards. For more durability, the membrane sheet of the Control desk should extend 200 mm more into the underside of the desk. The cabling / wiring between OWS & CPU's, power supply cables etc. shall be aesthetically routed and concealed from view.

iii. All the control desk shall be equipped with Anti vibration pad of min. 15 mm size. Cable gland plate thickness shall be 3 mm.

iv. Doors shall be provided with neoprene/polyurethene gasket only.

6.05.00 SURFACE PREPARATION AND PAINTING

All panel exterior steel surfaces shall be ground smooth, and painted as specified below:

Suitable filler shall be applied to all pits, blemishes and voids in the surfaces. The filler shall be sand blasted so that surfaces are level and flat, corners are smooth and even. Exposed raw metal edges shall be ground burr free. The entire panel surface shall be sand blasted to remove rust and scale and all other residue due to the fabrication operation. Oil grease and salts etc. shall be removed from the panels by one or more solvent cleaning methods. Alternatively 7 tank process shall be followed.

Two spray coats of inhibitive epoxy primer – surface 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 colour (Catalysed epoxy finish) shall be applied to all surfaces of dry film thickness 2.0 mil. The finish colours for exterior and interior surfaces shall conform to the following shades:

a) Exterior - RAL 7032/RAL 7035.

b) Interior - Glossy white two coats/RAL 7035 with fire resistant paint

One uniform colour shade as finalized shall be applicable for complete plant.

Paint films, which show sags, checks, blisters teardrops, fat edges or other painting imperfections, shall not be acceptable and if any such defects appear, they shall be repaired by and at the expenses of the Bidder.

6.06.00 PANEL WIRING

Interconnecting wiring shall be provided between all electrical devices mounted in the panels, and between the devices and terminal blocks if the devices are to be connected

to equipment outside the panels by cabling and through pre-fabricated plug in cables. All alarm contacts located within a panel shall be wired to terminal blocks. Thermocouple and other special circuits shall be field wires direct to instrument terminal blocks without the use of panel wiring.

All control and instrument wiring used within the panels shall confirm to NEC and NEMA standards and shall be factory installed and tested at the works of a qualified manufacturer. All interior wiring shall be installed neatly and carefully, and shall be terminated at suitable terminal blocks. Sufficient clearance shall be provided for all control and instrumentation leads, and all incoming and outgoing leads shall be connected to terminal blocks suitably located for connecting external circuits.

All panel wiring shall have appropriate ferruling for clear identification. Interior wiring shall be so arranged that the external connections can be made with only one wire per terminal point. Any common connections shall be made internal side of the terminal blocks. Common connections shall be limited to two wires per terminal. Instrumentation cable shield wires shall be connected to separate terminal at the terminal block. Signal circuit shields shall be grounded separately.

All internal wiring (except low level instrument wiring) shall be National Electric Code Type SIS, Polymetric/Elastomeric insulated, tinned copper stranded conductor, switchboard wire, or owner approved equal.

Panel wiring shall have a flame resistant insulation with adequately sized 650/1100 V grade tinned copper stranded conductor based on current carrying capacities as etc forth by the National Electric Code.

Wire sizes shall be as specified herein and suitable for intended applications.

Wiring to door mounted devices shall be provided with (49 strand minimum) adequate loop lengths of hinge wire so that multiple door openings will not cause fatigue braking of the conductor.

Wiring shall be arranged to enable instruments or devices to be removed and/or serviced without unduly disturbing the wiring. No wire shall be routed cross 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.

Panel wires shall be identified with wire number and each termination by means of Action craft products split sleeve or Borden Chemical Co. indelible tubing markers or owner approved equal. Corrections and modifications of all panel wiring shall be Bidder's sole responsibility. Any corrections/modifications required at site for successful commissioning shall be done by the Bidder without any additional costs. Terminal lugs furnished must be of the compression, insulated sleeve, half ring tongue type. Open-ended terminal lugs will not be accepted. Wires shall not be looped around the terminal screws or studs.

Wires shall not be tapped or spliced between terminal points.

Panels, cabinets, consoles/desks will be provided with removable, gasketed cable gland plates and cable glands, for all floor slots used for cable entrance. Split type grommets shall be used for prefab cables.

Internal wiring in factory prewired electronic systems cabinets may be installed according to the Bidder's standard as to wire size, insulation, and method of termination on internal equipment except that insulation for all wiring power supply wiring, and interconnecting cables between devices shall pass the following tests.

a) Flammability test IEEE 383/1974
b) When tested under UITPP test method or ASTM 2893/77 light transmittance of 80%
c) When tested under IEC 754-1 maximum acid gas generation shall be 2% by weight
d) Oxygen index not less than 30 as per ASTM D 2863.

All terminations for intra panel wiring inter panel cabling and connecting the Bidders panels, PB stations, control stations etc. shall be with cage clamp Screwed less connections. Soldered connections are not acceptable. All field side or external input connections shall also preferably of Cage clamp/Spring Clamp/ Screwed less connection.

Conductor Clamping shall also confirm to Standard IEC – 60947-1 & IEC-60947-7-1.

Identification of conductors may be done by insulation colour coding identified on drawings or by printed wiring lists. Terminal blocks for connection of external circuits in to factory prewired electronic system cabinets shall meet all the requirements as described elsewhere in the specification. For all multicore cables, the outer sheath shall satisfy the properties identified above. However, for panel wiring, the wiring insulation shall also satisfy the properties identified above. The internal wiring shall be done in coloured wiring.

6.06.01 Following Wire size shall be utilized for internal wiring:

a.	Current (4-20 mA) Low voltage signals (AI/AO & DI signals)	: :	0.75 sq.mm
b.	DO signals, Ammeter/ voltmeter circuit,control switches, indicator,recorder	:	1.5 sq.mm
c.	Internal Illumination	:	2.5 sq.mm

d. Size of Power supply cables shall be as below:-

i. 1 to 16 Amp. - 2.5 sq. mm
ii. 17 to 20 Amp. – 4 sq. mm
iii. 21 to 32 Amp. - 6 sq. mm
iv. 33 to 40 Amp. - 10 sq. mm.
v. 41 to 60 Amp. - 16 sq. mm
vi. Power earth - 4 sq. mm

6.07.00 INSTRUMENTS MOUNTING

6.07.01 Instruments and relays mounted on the panels shall be easily accessible for repair and replacement without disturbing other equipment their connected wiring. No special tools shall be needed for the purpose.

6.08.00 PANEL ILLUMINATION

Panels shall be provided with LED based illuminating lamps with door switch and six (6) point 6/ 16A, 240V A C universal type power sockets with switch for maintenance purposes. These switches shall be with quick make and break mechanism. 100 % spare LED lamps shall be provided with each panel, these are in additional to mandatory spares.

6.09.00 FUSE BLOCKS

Where fuse blocks rated 30 amp. 250 Volts are required by the specifications or the manufacturer's design, they shall be modular type with bakelite frame and reinforced retaining clips. Blocks shall be class H.2 pole, screw terminal fuse blocks. Blocks for other current and voltage ratings shall be similar in construction.

6.10.00 FUSES & MCB

All fuses shall be fast acting semiconductor types for AC supply and compatible to the UPS fuses. For all DCP owered devices, similarly the fuses shall be fast acting compatible to DCDB fuse provisions. All the AC power supplies shall be provided with the protection of Fast acting semi conductor fuses & 2 P thermomegnetic type MCB. Make of Fuses shall be GE or Siemens. For all the DC power supply circuits, electronic type DC MCB shall be used only. Make of DC MCB shall be Siemens, Phoenix contacts, Murr, Weidmuller, or Lutze.
50 % spare fuses shall be provided with each panel, these are in additional to mandatory spares.

6.11.00 MOULDED CASE CIRCUIT BREAKERS

Moulded case circuit breakers used in equipment covered under these specifications shall have not less than 5000 amp. Interrupting capacity at 220 Volts DC 10,000 Amp. Symmetrical interrupting capacity at 240 Volts AC. MCCB shall be provided at each main feeder line like ACDB & DCDB main feeders, PLC main feeder, control panels, UPS circuits etc.

6.12.00 GROUNDING

All panels and cabinets shall be provided with a continuous bare copper ground bus of minimum 6 mm x 25/50 mm cross section. The ground bus shall be bolted to the panel structure and effectively ground the entire structure. Each Ground bus shall have provision at each end for connection of ground leaks (6 mm x 50 mm GI Flats) by suitable bolting. All system cabinets shall be brought to a common system ground by the bidder. Electronic earthing resistance shall be < 0.5 ohms.

Each circuit requiring grounding shall be individually and directly connected to the panel ground bus by ring tongue type compression lugs. For electronic system cabinets the system ground bus shall be insulated from the cabinet enclosure and shall be separately

connected to the system ground. All system cabinets shall be brought to a common system ground by the bidder.

The Bidder shall furnish his recommendations regarding grounding requirements for all equipment/systems and shall specifically indicate the deviations if any from the above requirements as a part of his proposal.

6.13.00 TERMINAL BLOCKS

For all inputs to the system emanating from the field or other systems, the bidder shall furnish terminals suitable for correct size of field cables.

6.13.01 All outputs going to MCC/SWGR terminal blocks, shall be rated 600 volts minimum and shall have strap screw less terminals suitable for connection of wires with ring tongue type lugs. Standard terminal blocks shall be screw less cage clamps type. Terminal blocks shall be approximately sized for larger wire size of higher voltage insulated incoming conductors as necessary. All the TBs used shall be 6.6 polymide to withstand corrosion and the metallic portion shall be coated against rust /corrosion. All metal parts should be non –ferrous in nature.

6.13.02 Terminal blocks shall be provided with white marking strips and re permitted by the safety codes and standards shall be without covers.

6.13.03 Fuses shall not be mounted on terminal blocks. Neither step type terminal blocks nor angle mounting of terminal blocks will be acceptable.

6.13.04 At least 20 per cent spare unused fully wired terminals shall be provided on each terminal block for circuit modifications and for termination of all conductors in a multi-conductor control cable with each panel, enclosure, cubicle, SOV Boxes etc.

6.14.00 NAME PLATES AND LABELS

Name plates of adequate size shall be provided for each panel on front and rear of the panel. Instruments/other accessories mounted inside the panels shall have identification marking clearly visible from inside.

Devices to be mounted on the panels shall also be labeled on the panels shall also be labeled on the outside of the panel. Name plates shall be of polyamide sheets with black letters on white background. Name plates shall be attached to the boards by means of stainless steel panhead screws. Fuses provided for protection of various boxes shall be accessible for replacement. Fuse boxes shall be provided with circuit label and fuse rated current and voltage.

Markings/Labels

All markers/labels shall be made of halogen & silicon free polyamide material with inflammability class V2 as per UL 94, ensuring scratch proof printing with the use of environment friendly solvent free ink & latest BLUEMARK UV technology so as to comply the WIPE RESISITANCE according to DIN EN 61010-1/VDE 0411-1.

DRIVE CONTROL PHILOSOPHY

H.DRIVE

CONTROL

PHILOSOPHY

FOR

ANALOG
&

BINARY

DRIVES

A. DRIVE CONTROL PHILOSOPHY

The control philosophy for different type of Drives is detailed below:

1 Bi-directional drives with Integral Starter(Open/Close duty and inching/regulating duty)

a) All bi-directional drives shall have integral starter. These drives shall be operable from Remote i.e. from Central Control Room (CCR). Local operation facility is provided for initial testing/commissioning only. (1)

b) Remote manual operation of all drives shall be done from Operator Works Station (OWS/LVS).

c) Remote control commands i.e. open/close generated from DDCMIS shall be issued to Integral Starter through interposing relays, mounted in Integral Starter. For open/close duty bi-directional drives Start & stop command shall be latched at integral starter end, except for inching duty bi-directional drives where latching is not required. (4)

d) Necessary electrical protections shall be realized at Integral Starter, whereas process interlocks and protection shall be realised in DDCMIS.

e) Following signal exchange shall take place between Integral Starter & DDCMIS.

- Open & close command
- Integral Starter Disturbed (Loss of power supply/Loss of control supply/ Motor thermostat trip/ Thermal O/L /Local/off/Remote S/S in Local or Off mode/Stop PB optd/Torque open/close cutoff). (4)
- Actuator in Remote Mode.
- Valve status feedback by means of limit switches (open/close).
- Valve position feedback (4-20mA) for inching duty drives.

f) The Control & Operation from Backup Control Desk/UCP shall be envisaged for critical Drives. (3)

g) For Bidirectional drives of >=15 KW, CURRENT TRANSDUCER shall be located in MCC. (4)

The above signal exchanges are diagrammatically represented in sheet no. 7.

2 Unidirectional LT Drives (Contactor Operated)

a. Unidirectional LT drives shall be operable from Remote i.e. from Central Control Room (CCR). Drives shall be provided with Local Emergency Stop Push Button (EPB). Local start operation of the drive can also be done through the start push button provided near the drive when the drive is in local mode.

b. Remote manual operation of all drives shall be done from OWS/LVS and Local/remote selection of drives shall be done in DDCMIS. Back (1)

up remote operation from PB station mounted on UCP is provided for some essential drives for safe shutdown of plant.

c. Control commands i.e. start/stop, shall be generated from DDCMIS and shall be issued to MCC through interposing relays located in respective MCC. DDCMIS output command shall be latched in MCC. EPB (stay put type), in MCC supplier's scope, shall be wired directly to MCC to stop the motor irrespective of motor being in remote/local mode. The EPB shall be provided with press to lock and turn to release type, keyless mechanism. Under its locked position, the drive operation shall be inhibited. The local start push button shall be wired to the DDCMIS to ensure interlock/protection requirement. 1

d. Necessary electrical protections for the drives shall be realised at MCC, whereas process interlocks and protections shall be realised in DDCMIS.

e. Following signal exchange shall take place between MCC & DDCMIS

i. Drive Start & Stop commands.
ii. Drive ON & OFF feedback.
iii. MCC disturbed (Thermal O/L /Control supply fail/ MCC switched off).
iv. MCC available(In Remote)
v. EPB operated

3

f. Current transducers, 4-20mA types (in MCC suppliers scope), shall be mounted in the MCC for monitoring the current in DDCMIS for all drives ≥ 15 KW and for important drives <15 KW. Auxiliary power supply to these transducers shall be provided from the control power supply of the respective MCC. 1

g. The Control & Operation from Backup Control Desk/UCP shall be envisaged for critical Drives. 3

h. Start & Stop command shall be latched at MCC end.

The above signal exchanges are diagrammatically represented in sheet no. 8.

3 <u>Solenoid Operated Drives (24V DC/220V DC/240V AC)</u> 2

a. Solenoid operated drives shall be operable from remote i.e. CCR only.

b. Remote manual operation of all drives shall be done from OWS.

c. Remote control commands i.e. open/close shall be generated from DDCMIS and shall be issued to the respective solenoid through interposing relays located in Interposing Relay panels.

d. Necessary process interlocks shall be realized in DDCMIS.

e. Following signal exchange shall take place between solenoid operated drive & DDCMIS (1)

i. Valve open & close command.

ii. Valve status feedback by means of limit switches (open/close), wherever available or from relay contact of interposing relays if limit switches are not provided. 1No. contact for single coil & 2 No. contact for dual coil (open Limit switch & closed limit switch) shall be provided. (2) (3)

f. BHEL will take care of de-energize to trip philosophy for fail safe control system (wherever required). (4)

g. UCP/backup interface shall be provided for critical solenoid drives.

The above signal exchanges are diagrammatically represented in sh. no. 9.

4 HT/LT Unidirectional Drives (Breaker operated)

a. Remote manual operation of Breaker operated drives shall be normally from remote i.e. Station DDCMIS in main Control Room through OWS/LVS and Local/remote selection of drives shall also be done in DDCMIS. Back up remote operation from PB station mounted on UCP is provided for some essential drives for safe shutdown of plant. (1)

b. Remote/Switchgear (SWGR) selection shall be realized from SWGR mounted R/S selector switch.

c. Following are the operational combinations for breaker operated drives:

-SERVICE POSITION – Drive Operation (Start/Stop) shall be from CCR with R/S (Remote/SWGR) selector switch in Remote position.

-TEST POSITION – SWGR Testing (Start/Stop) from SWGR.

Switchgear mounted ‘Trip/Neutral/Close’ switch shall be provided for testing of switchgear when ‘R/S’ selector switch is selected as ‘SWGR’ and SWGR is in test position.

d. Remote control commands i.e. start/stop, pulse type, shall be generated from DDCMIS and shall be issued to Switchgear through interposing relays located in respective Switchgear. Further there is Local/remote selection in DDCMIS. Local selection in DDCMIS means, command from local PB, provided near the drive, will be executed through DDCMIS whereas in case of remote mode of selection in DDCMIS, the command from OWS will be processed, not through local PB.

e. The EPB shall be wired directly to switchgear to stop the motor irrespective of motor being in remote/local mode. The EPB (stay put type), in SWGR supplier's scope, shall be provided with press to lock and turn to release type, keyless mechanism. Under its locked position, the drive operation shall be inhibited. The local start push button shall be wired to the DDCMIS to ensure interlock/protection requirement.

1

f. Necessary electrical protections for the drive shall be realised at Switchgear, whereas process interlocks and protections are realized in DDCMIS.

g. Following signal exchange shall take place between switchgear and DDCMIS: -

i. Drive Start & Stop commands.
ii. Drive ON & OFF status feedback.
iii. Switchgear Disturbed (Control power supply fail/Trip coil Unhealthy/Master trip relay operated).
iv. Switchgear Available (Breaker in Service & Trip ckt Healthy & Master Trip Relay Reset & Spring Charged)
v. Master Trip Relay (86 Relay) operated.
vi. Emergency Stop PB operated.
vii. Local start Push Button shall be wired to DCS from LPBS near Drive.

2

h. Current transducers, 4-20mA types (in SWGR suppliers scope), shall be mounted in the SWGR for monitoring the current in DDCMIS. Auxiliary power supply to these transducers shall be provided from the control power supply of the respective switchgear.

3

i. The Control & Operation from Backup Control Desk/UCP shall be envisaged for critical Drives.

The above signal exchanges are diagrammatically represented in sh. no. 10.

B. ANALOG DRIVE CONTROL PHILOSOPHY

Analog Drives Control

1.1 A drive control function residing in Distributed Processing Units (DPUs) is used to position the pneumatically operated control valves/Dampers through SMART positioner (conventional positioner for Burner Tilt). Interlock and protection Open/Close Commands, originating from field or generated internally in Control Logics (ACS), are interfaced with the drive control function residing in processors.

1.2 Control Valve actuator design shall take care of fail safe condition i.e. bringing valve to full open/full close or stay put mode, on signal (pneumatic/electric) failure.

1.3 Auto/Manual operator control and display for various control loops shall be provided through OWS, using Analog Displays.

1.4 Analog Displays have following functionality:

- Auto/Manual selection with control device “Raise/Lower Buttons”
- Set point indication with “Raise/Lower Buttons”
- Indication for deviation between set point and measured value
- Measured value indication
- Final control element portion indicators

3 1.5 The Control & Operation from Backup Control Desk/UCP shall be envisaged for critical Drives.

The above signal exchanges with DDCMIS are diagrammatically represented in sh.no. 11.

C. CABLE

3 For interconnection of analog signals (4-20mA) to DDCMIS, in general “armoured” 0.5sq mm color coded individually and over all screened twisted pair shall be used (F Type). However for position feedback signals of bidirectional drives and current feedback signals of HT/LT drives 2P, F type cable shall be used.

For interconnection of binary signals (24V DC) to DDCMIS, “armoured” 0.5sq mm color coded over all screened twisted pair cable shall be used (G Type).

2 **D.IO REDUNDANCY**

(1) IO redundancy shall be as per specification requirement.
(2) Start command/stop command/trip command towards safety of process or process equipment shall be hardwired parallel from two different cards.
3 (3) In case of redundant/multi Pumps/Drives for same service, all related Inputs & outputs of main pump/drive shall be in separate I/O cards and similarly all related Inputs & outputs of respective standby pump/drive shall be in separate I/O cards. Inputs/outputs of any two same services pumps/drives shall not be mixed in one common I/O car

3 **Notes**: **1) (a)** Drive Control Philosophy will be generally used for total project except for few cases where OEM recommendations prevail.
(b) This scheme shall be applicable for PLC as well as DDCMIS based Offsite packages.

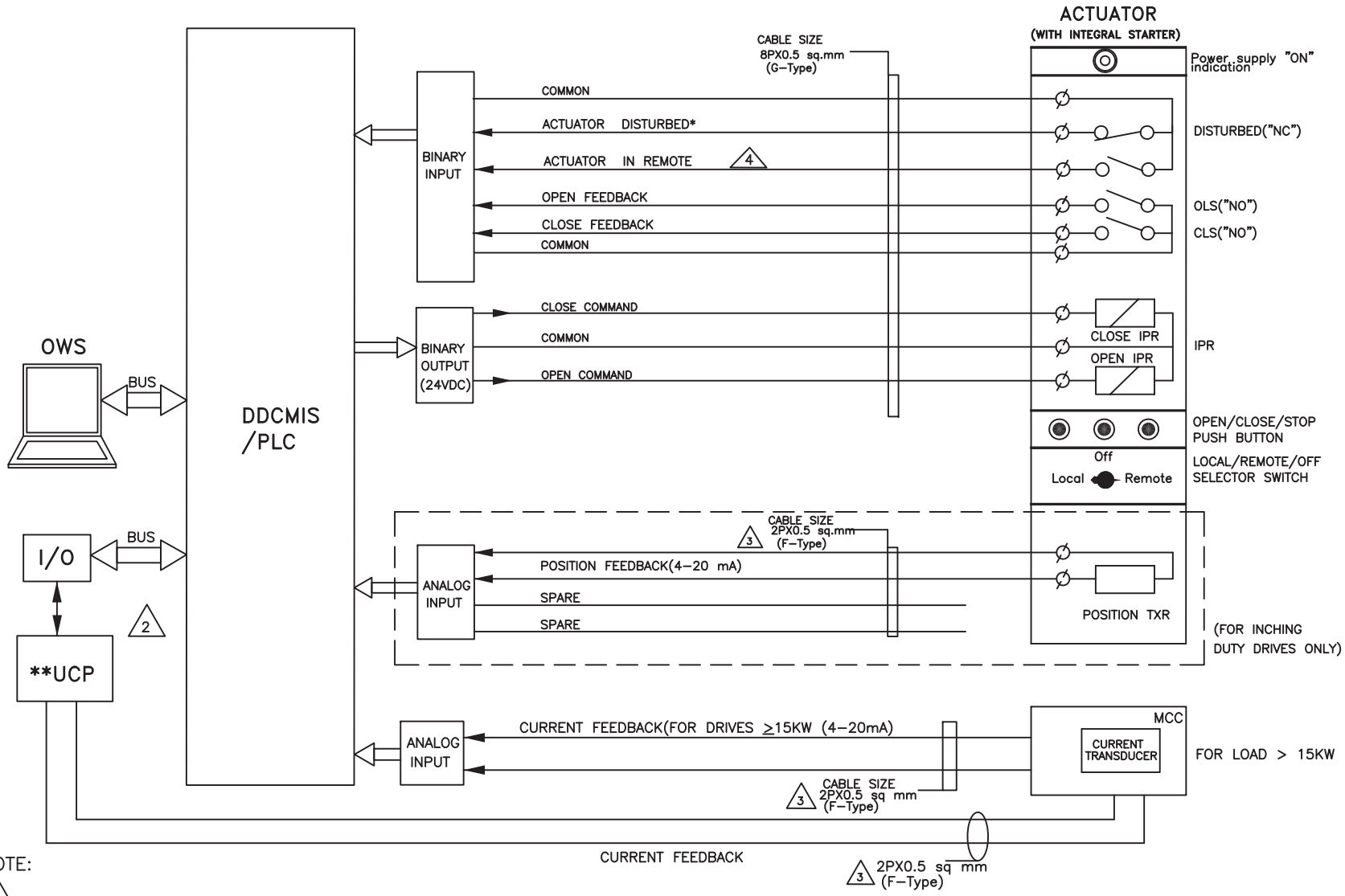
4 **2) Email/Message alert**
Intimation through message/E-mail shall be provided for tripping for all HT drives & critical LT drives.

3) Drives with VFD will have the following signal exchange:-

4

a) Speed Input AI
b) Speed Output AO
c) VFD Mode/Bypass Mode selection DI
d) VFD Mode/Bypass Mode command DO

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)



NOTE:

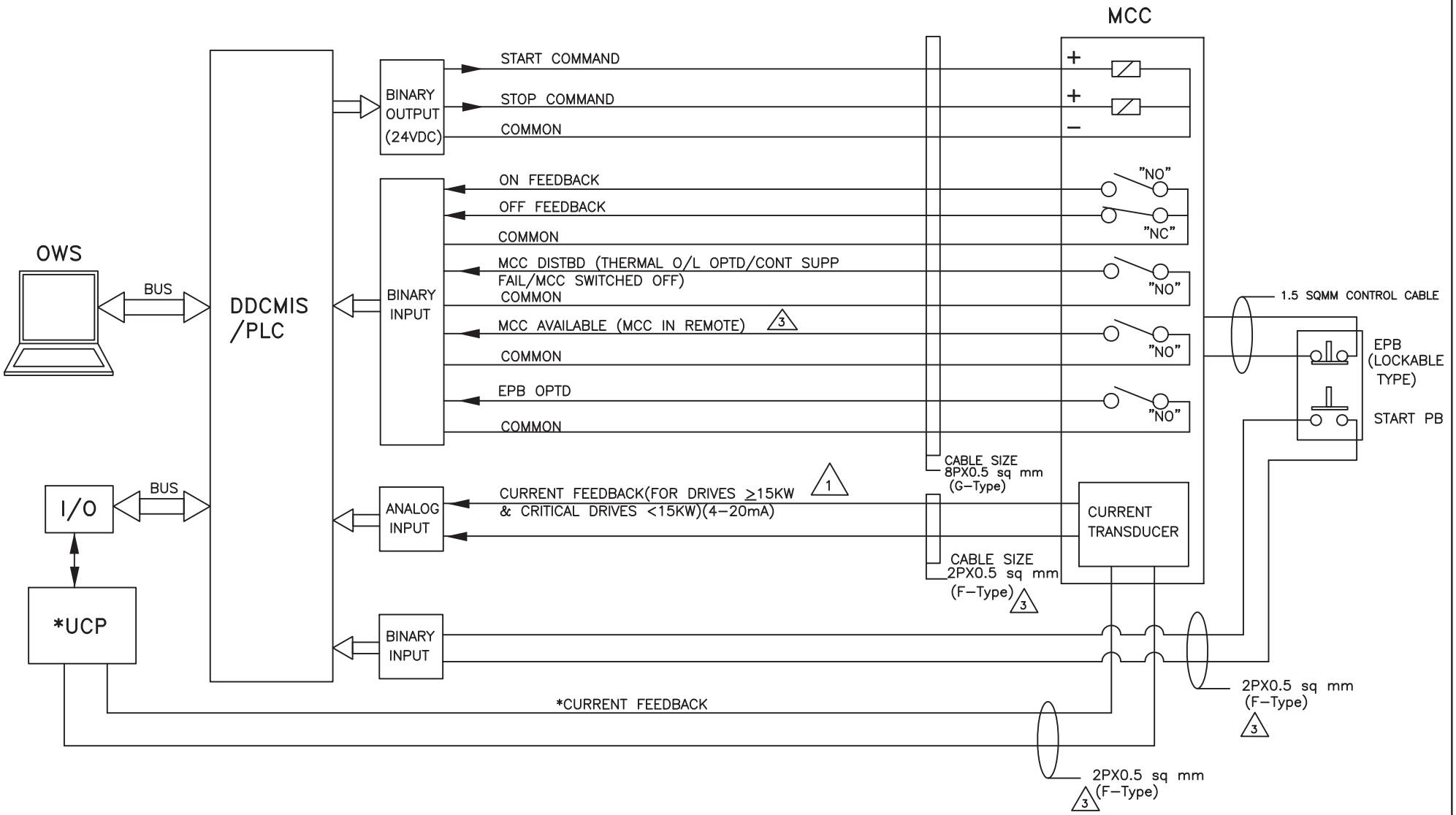
4 REDUNDANCY OF IO SHALL BE AS PER CUSTOMER SPECIFICATION.

* DISTURBED= Loss of Power supply (1 Phase/3 Phase)/ Loss of control supply/ Motor thermostat trip/Thermal over load/Torque open/close cutoff Local/Off/Remote Sel. switch in local or off mode/Stop PB optd.

2 ** AS APPLICABLE.

BHEL	PROJECT: 2X660 MW ENNORE SEZ STPP	DRG.NO.	PE–DM–412–145–I002
		DATE	10.08.2015
	TITLE DDCMIS INTERFACE FOR BIDIRECTIONAL DRIVE	REV.NO.	04
		SHT	8 OF 12

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE

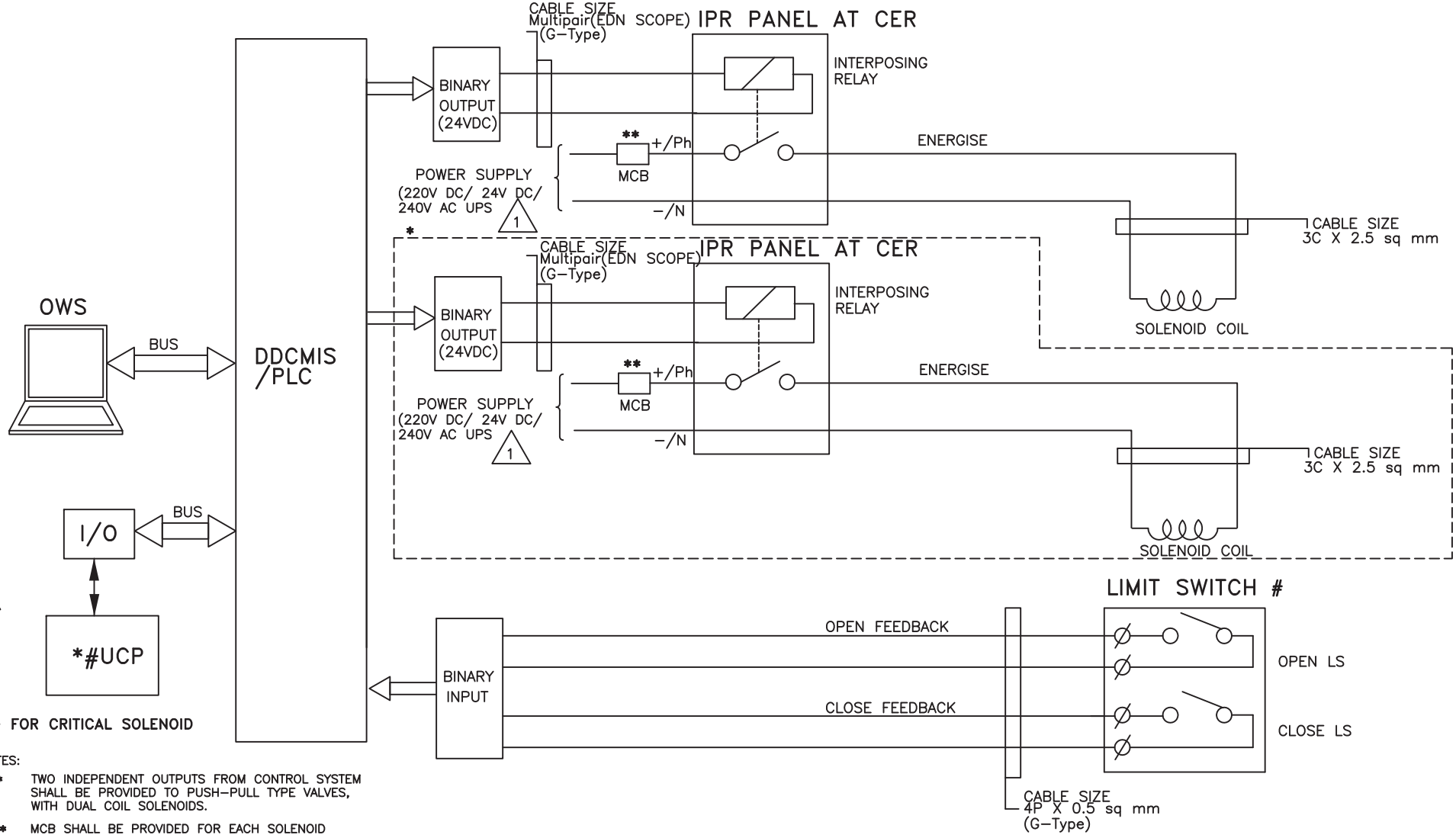


NOTE:

* CURRENT FEEDBACK IN DDCMIS SHALL BE PROVIDED FOR ALL DRIVES > 15 KW AND FOR IMPORTANT DRIVES <15 KW.
4 I/O REDUNDANCY SHALL BE AS PER SPECIFICATION REQUIREMENTS.

BHEL	PROJECT: 2X660 MW ENNORE SEZ STPP	DRG.NO.	PE–DM–412–145–I002
		DATE	10.08.2015
	TITLE DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE	REV.NO.	04
		SHT	9 OF 12

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



NOTES:

* TWO INDEPENDENT OUTPUTS FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH–PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.

** MCB SHALL BE PROVIDED FOR EACH SOLENOID

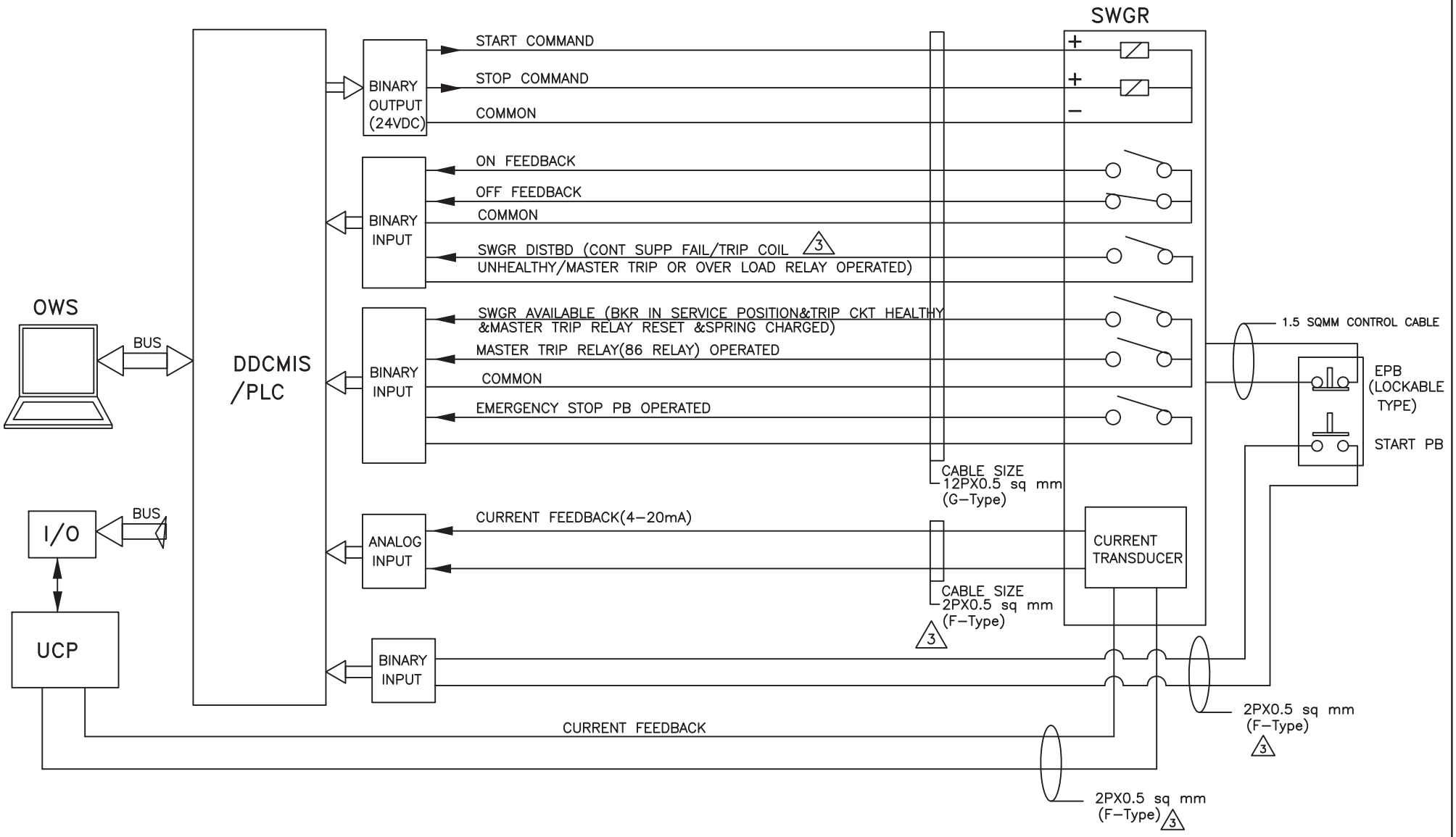
\# FOR ON/OFF TYPE, SOLENOID ACTUATED VALVE. RELAY CONTACTS SHALL BE WIRED AS FEEDBACK WHEREVER LIMIT SWITCH FEEDBACKS ARE NOT AVAILABLE. 1 CONTACT FOR SINGLE COIL & 2 CONTACT FOR DUAL COIL (OPEN LIMIT SWITCH & CLOSED LIMIT SWITCH.

*** BHEL WILL TAKE CARE OF DE–ENERGISE TO TRIP PHILOSOPHY FOR FAIL SAFE CONTROL SYSTEM (WHEREVER REQUIRED)

I/O REDUNDANCY SHALL BE AS PER SPECIFICATION REQUIREMENTS.

BHEL	PROJECT: 2X660 MW ENNORE SEZ STPP	DRG.NO.	PE–DM–412–145–I002
		DATE	10.08.2015
	TITLE DDCMIS INTERFACE FOR SOLENOID DRIVE	REV.NO.	04
		SHT	10 OF 12

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



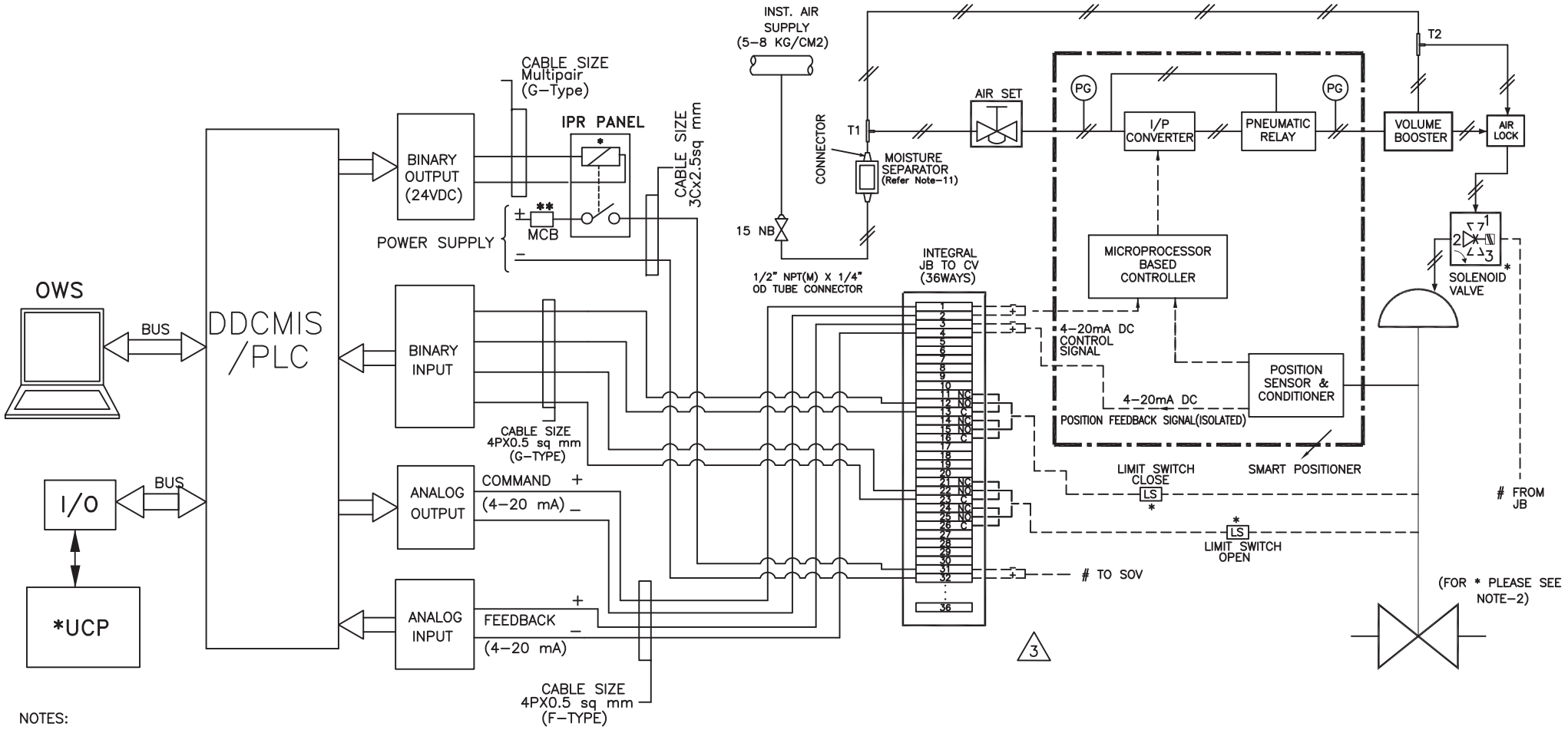
NOTE:

VIBRATION, WINDING & BEARING SIGNALS SHALL BE INTERFACED WITH DDCMIS AND INCLUDED IN EDN'S DOCUMENT.

I/O REDUNDANCY SHALL BE AS PER SPECIFICATION REQUIREMENTS. 3

BHEL	PROJECT: 2X660 MW ENNORE SEZ STPP	DRG.NO.	PE–DM–412–145–I002
		DATE	10.08.2015
	TITLE: DDCMIS INTERFACE FOR UNIDIRECTIONAL HT DRIVE	REV.NO.	04
		SHT	11 OF 12

DCS INTERFACE FOR ANALOG DRIVE (WITH SMART POSITIONER)



NOTES:

* WHEREVER APPLICABLE.

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

3 I/O REDUNDANCY SHALL BE AS PER SPECIFICATION REQUIREMENTS.

4 ALL REQUIRED ACCESSORIES i.e. SOLENOID OR ANY OTHER HARDWARE REQUIRED TO ACHIEVE THE STAYPUT POSITION AT CONTROLLER SIGNAL FAILURE SHALL BE PROVIDED.

DI FOR FAULT SIGNAL OF THE SMART POSITIONER SHALL BE PROVIDED.

BHEL	PROJECT: 2X660 MW ENNORE SEZ STPP	DRG.NO.	PE-DM-412-145-I002
		DATE	10.08.2015
	TITLE: TYPICAL HOOK-UP DIAGRAM ANALOG DRIVE (WITH SMART POSITIONER)	REV.NO.	04
		SHT	12 OF 12

QAP FOR C&I ITEMS AND FAT

I.SPECIFICATION

FOR

QUALITY ASSURANCE

&

TESTING

CHAPTER-14

QUALITY ASSURANCE AND TESTING AND GUARANTEES

14.01.00 GENERAL REQUIREMENT

14.01.01 All equipment furnished under this specification shall be subject to test by authorized quality assurance personnel of the Bidder, representatives of the Owner during manufacture, erection and on completion. Bidder'' quality assurance personnel for these shop and site tests shall be identified in advance and shall be acceptable to the Owner. The approval of the Owner or passing of such inspection of tests will not, however, prejudice the right of the owner to reject the equipment if it does not comply with the specifications when erected or fails to give complete satisfaction in service.

14.01.02 The Bidder shall furnish details of shop and site tests proposed to be conducted by him at various stages to meet the specification requirements for each type of instrument/system along with his proposal. Bidder shall also furnish details of his proposed shop and site quality assurance organization for this contract

14.01.03 Bidder shall prepare a detailed shop and site 'Quality Assurance Programme' to meet the requirements of these specifications for Owner's approval. This document shall also contain the formats for reports and maintenance of test records specification of test equipment to be used for site tests.

14.01.04 All equipment and systems furnished under this specification shall be subjected to shop & site tests in accordance with the Quality Assurance Program approved by the Owner and shall be adequate to ensure full compliance with these specification, all applicable codes & standards and detailed engineering drawings and documents approved by the Owner.

14.01.05 The Bidder shall provide all required test equipment and simulation devices for performing all shop and site tests. All tests equipment shall be of reputed make, required accuracy class and shall be recently calibrated. The record of calibration of test equipment shall be made available to the Owner on demand.

14.01.06 The cost of all tests as per the requirements of this specification and approved quality assurance programme shall be included in Bidder's lump sum price for this package and no extra price shall be payable by the Owner for conducting any test as per the intent and requirements of this specification.

14.01.07 All approval/Inspection are to be carried out by the Owner only.

14.02.00 SHOP TESTS

14.02.01 General Requirement

14.02.01.00 Shop tests shall include all tests to be carried out at Bidder's works at of this sub-bidder and at works where raw materials used for manufacture of equipment is produced.

14.02.01.01 Individual components, instruments and devices furnished in accordance with specification sheets, and I&C device list enclosed with these specifications shall be shop tested by manufacturer prior to shipment. The manufacturer shall conduct these tests for certifying compliance with published specifications for the equipment and provide test results to the Owner in writing. These tests and test certificates shall be in accordance with the agreed 'QA' programme for major systems/equipments. However, manufacturer's standard methods shall be followed if details of tests for any equipment are not covered under this agreed 'QA Programme'.

14.02.01.02 Whenever tested quality material is specified and wherever called upon by Indian Boilers Regulations or by the design code, the test pieces are to be prepared and tested to Owner's satisfaction.

14.02.01.03 In the event of Owner being furnished with certified particulars of tests, which have been carried out by the suppliers of material, the Owner may, at his discretion, dispense with these tests.

14.02.02 Material Tests

14.02.02.01 Whenever tested quality material specified and whenever called upon by Indian Boilers Regulations or by design code, the test pieces, are to be prepared and tested to Owner's satisfaction.

14.02.02.02 In the event of Owner being furnished with certified particulars of tests, which have been carried out by the suppliers of material, the Owner may, at his discretion, dispense with these tests.

14.02.03 Test at Manufacturer's Works

14.02.03.01 Works tests are to include electrical, mechanical performance and hydraulic tests in accordance with relevant IS, IBR or any other approved standard or any other tests called for by the Owner under these specifications to ensure that the equipment being supplied fulfills the requirements of these specifications. For equipments not covered by any IS or other approved standards, the tests to be carried out shall be in accordance with Bidders' quality assurance programme approved by the Owner.

14.02.03.02 Control systems, monitoring systems ,control panels instrument enclosures ,and power supply systems shall be shop tested according to unique requirements specified in the applicable section of these specifications for each item and quality assurance program approved by the owner.

14.02.03.03 All shop tests shall be performed prior to shipment and the Owner shall be given the opportunity to witness these tests. The Bidder shall notify the Owner regarding readiness for shop test at least 10 days before the scheduled date if the tests to be conducted within Indian and at least 60 days before the schedule date if the test is to be conducted abroad.

14.02.04 Factory Tests

14.02.04.01 Automatic Control and Monitoring system (DDCMIS, PLC & any other microprocessor based control system) including alarm annunciation system furnished as per this specification shall be subject to shop and site tests as per the requirements of this specification, applicable codes and Owner approved Quantity Assurance Program so as to demonstrate to the Owner that the equipment furnished by the Bidder meets the intent and requirement of this specification. These tests shall include but shall not be limited to the tests indicated in the subsequent clauses.

14.02.04.02 **Surge Protection Test for Solid State Equipment**

All solid state equipment shall be able to withstand the noise and surge inherent in a Power House, and shall strictly comply with SWC tests ANSI C 37.90A, 1974 for IEEE-472 (1974). Complete details of the features incorporated in electronic system to meet this requirement, the relevant test carried out, and the test certificates shall be submitted along with the proposal.

14.02.04.03 **Burn-in and Elevated Temperature Test**

All solid state electronic equipment shall be tested as a complete system/equipment with all devices connected for a minimum of 168 hours continuously under energized conditions prior to shipment from manufacturer's works, as per the following cycle :-

During the first 48 hours of testing the ambient temperature shall be maintained at 50 deg.C and relative humidity at 95%. The equipment shall be interconnected with all devices, which will cause it to repeatedly perform all operations; it is supposed to perform in actual service, with load on various components being equal to those, which will be experienced in actual service.

The 48 hours tests period shall be continuous but shall be divided into four 12 hours segments. The input voltage during each 12-hour segment shall be nominal voltage for 11 hours, followed by 110% of normal voltage for 30 minutes followed by 90 percent of nominal voltage for 30 minutes.

The 48 hours elevated temp test shall be followed by 120 hours of burn in test as specified in the above paragraphs except that the temperature is reduced to ambient temperature prevalent at that time. Alternatively copy of type test certificate for burn-in test shall be submitted.

14.02.04.04 The Bidder shall furnish full details regarding shop tests and site tests, as per good engineering practices. The Owner shall approve all such tests and the supplier shall conduct all such tests without calling for additional price.

The tests shall cover factory tests, burn-in and elevated temperature tests, simulation and functional tests, insulation tests as applicable, the rating of the contact devices and components, surge withstand capability test, conformity of interconnection cables, testing and checking of other conditions deemed to be necessary with the system/equipment items.

14.02.04.05 All instruments and control equipment supplied against this contract shall be factory calibrated at least at five (5) points throughout the range and checked for their

functional/performance requirements. The instruments shall also be calibrated at site prior to commissioning.

14.02.04.06 All panels, instruments enclosures, junction boxes, etc. shall be type tested for degree of protection and applicable in accordance with IS: 2147. 8.02.04

14.02.04.07 Type, routine and acceptance testing of all equipments, supplied under this contract, shall be in accordance with relevant NEEA/IS/IEC/ANSI/BS/ISA standards, in addition to the requirements of Owner approved Quality Plans. Six (6) copies of test reports shall be submitted to the Owner for approval prior to dispatch of respective equipment

14.02.04.08 The representative of Owner shall be given opportunity to witness the factory tests which shall be mutually finalized during the progress of the contract.

14.02.04.09 All control systems to be furnished for this project, shall be factory tested for circuit continuity and direction of response. The Components to be tested shall include all controllers, HAND/AUTO station, other system modules, alarm contactors and multi-conductor interconnecting cables. The tests shall be performed with all of the system components supplied by the Bidder connected to form a complete system with the sole exception of transmitters. The tests shall include a means of confirming the mathematical design response of the control system by simulating changes in system input. The tests shall be a qualitative functional test of each component of control system, which simulates dynamic inputs and monitors system outputs.

14.02.04.10 Certain control loops shall be factory tested using closed loop mathematical simulation techniques. Control loops to be tested by closed loop methods are broadly as under. However, owner has discretion to test and all control loops during simulation testing.

ii) Firing rate control (fuel and air flow control)
iii) Furnace draft control
iv) Boiler separator level control

(d) **Response time for Turbine Control System.**

The input simulation equipment shall be designed to produce effects from control system outputs based on mathematical model of the predicted performance and process dynamics of the main unit equipment. The control constants of various control loop components shall be adjusted to produce a stable and optimum control adjusted to produce a stable and optimum control when connected to the simulation equipment.

14.02.04.11 Simulation data including factory adjustment of control system constants, and simulation equations shall be tabulated and shall be made available by the Bidder for owner's use during field check out and the start up of the control system.

14.02.04.12 Availability of a simulated type test for automatic control loops specified with a detailed description of testing methods utilized, shall be indicated.

14.02.04.13 The availability of facilities for carrying out the model test for the control systems shall be indicated by the bidder. Also details of test procedures and copies of test results conducted for a similar fossil fuel fired unit shall be furnished. The data required from Boiler and Turbo generator supplies shall also be furnished by the Bidder.

14.02.04.14 Brief description of all tests proposed to be conducted on each control system components during various stages of manufacture, installation and commissioning shall be f urnished. C opies of t est dat a acc umulated dur ing t he t ests shall be submitted to the mutually agreed formats.

14.02.04.15 The owner shall witness the factory tests which shall be performed at a time mutually agreeable to the Bidder and the owner.

14.02.04.16 **Factory Acceptance Tests for DDCMIS, DCS, Simulator & PLC**

GENERAL	1	FACTORY ACCEPTENCE TEST (FAT): REF NOTE-1	✓
	2	FACTORY ACCEPTENCE TEST (FAT) PROCEDURE: REF.NOTE -2	✓
	3		
	4		
	5		
TEST REQUIREMENTS	6	TEST SHALL BE PERFORMED WITH THE COMPLETELY ASSEMBLED SYSTEM AND ALSO WITH COMPLETE	✓
	7	I&C SOFTWARE AND PERFORMING ALL FUNCTIONS EXPECTED OUT WHILE IN ACTUAL SERVICE AND	
	8	WITH STSTEM CONFIGURATION AS FINALISED.	
	9	PROCESS INPUT/OUTPUT CONDITIONS AND OTHER LOAD ON THE SYSTEM TO BE STIMULATED	✓
	10	EITHER BY HARDWARE/SOFTWARE.	
	11	ALL SYSTEM SOFTWARE and APPLICATION SOFTWARE TO BE LOADED AND OPERATIONAL ON THE	✓
	12	SYSTEM PRIOR TO FAT	
	13	FAT TO BE CONDUCTED AT ELEVATED TEMP. OF 45 DEG C FOR MINIMUM 48 HOURES	✓
	14	FAT UNDER FOUR CYLES OF VOLTAGE FLUCATIONS VIZ NOMINAL AT 110 % OF RATED VOLTAGE	✓
	15	PERFORMANCE TEST:	✓
	16	-	
	17	-	
TEST DOCUMENTS DRAWINGS	18	TOTAL SYSTEM CONFIGARATION DRAWINGS	
	19	FAT PROCEDURE CONSITING OF:	
	20	(i) TEST EQUIPMENT	
	21	(ii) TEST ENVIRONMENT	
	22	(iii) TEST CONFIGURATION	✓
	23	(iv) TEST PROCEDURE	
	24	(v) TEST SCHEDULE	
	25	(vi) TEST VENUE	
	26	(vii) TEST REPORTS- SPECIMEN COPIES	
	27	FUNCTION DESIGN SPECIFICATION FOR EACH EQIPMENT / SYSTEM	
	28	-	
	29	-	
PRELIMINARY CHECKS	30	GENERAL APPEARENCE CHECK and BILL OF MATERIALS CHECK	✓
	31	CONSTRUCTION CHECK AS PER OVER ALL GENERAL ARRANGEMENT DRAWINGS	✓
	32	DIMENSIONAL CHECK	✓
	33	LABELLING, TERMINAL ARRANGEMENT AND EQUIPMENT IDENTIFICATION CHECK	✓
	34	POWER SUPPLY VOLTAGE LEVEL CHECK and POWER 'LEDs -ON CHECK	✓
	35	COOLING FAN OPERATION CHECK	✓
	36	GROUNDING NETWORK CHECK	✓
TEM	1	POWER SUPPLY UNDER VOLTAGE AND OVER VOLTAGE CHECK (± 10%)	✓
	2	PROCESSOR and MAIN DATA BUS NETWORK REDUNDANCY CHECK, IF APPLICABLE	✓
	3	COMMUNICATION COUPLER IF APPLICABLE REDUNDANCY CHECK	✓
	4	COMMUNICATION MODULE OF THE CONTROLLER TO NETWORK REDUNDANCY CHECK, IF APPLICABLE	✓
	5	POWER SUPPLY REDUNDANCY CHECK	✓
	6	HARDWARE ON-LINE MAINTAINABILITY CHECK,	✓
	7	-	
	8	-	
CONTROLLER ENGINEERING	9	CLOSED LOOP CONTROL SIMULATION CHECK	✓
	10	OPEN LOOP CONTROL SIMULATION CHECK	✓
	11	CONTROL LOOP RESPONSE CHECK	✓
	12	BUMPLESS AUTO MANUAL TRANSFER CHECK	✓
	13	OPERATING STATION – GRAPHIC OVERVIEW CHECK	✓
	14	OPERATING STATION- TREND CHECK	✓
	15	OPERATING STATION- REAL TIME TREND CHECK	✓
	16	OPERATING STATION- MIMICS CHECK	✓
	17	OPERATING STATION- CHECK FOR OPERATING CONTROL DIRECTLY FROM MIMICS	✓
	18	OPERATING STATION- FUNCTION KEYS CHECK	✓
	19	OPERATING STATION- TOUCH SCREEN FUNCTION CHECK	✓
	20	OPERATING STATION- ANALOG CONTROL DISPLAY CHECK	✓
	21	OPERATING STATION- SEQUENCE CONTROL DISPLAY CHECK	✓
	22	OPERATING STATION- OPERATOR GUIDENCE MESSAGE CHECK	✓
	23	OPERATING STATION- ALARM MANAGEMENT FUNCTION CHECK	✓

	24	OPERATING STATION LOGGING FUNCTION CHECK	✓
	25	OPERATING STATION / RESPONSE / UPDATING CHECK	✓
	26	KEYBOARD LOCK FUNCTION CHECK	✓
	27	OPERATING STATION INTERCHANGEBILITY and ASSIGNABILITY CHECK	✓
	28	PRINTER ASSIGNABILITY and BACK-UP FUNCTION CHECK	✓
	29	FLOPPY DISK/ STD / OPTICAL DISK UNIT STORAGE and RETRIEVAL CHECK	✓
	30	OPERATING STATION ASSIGNABILITY CHECK FOR HARD COPIER FUNCTION	✓
	31	PLANT PERFORMANCE CALCULATION CHECK	✓
	32	COMMUNICATION INTERFACE TO OTHER'S SYSTEM SIMULATION CHECK	✓
	33	-	
	34	DATA BUS DISTANCE BUILDING CHECK (REFER NOTE- 3)	✓
	35	GRAPHIC DISPLAY BUILDING FUNCTION CHECK	✓
MAINTENANCE	36	CLOSED LOOP CONTROL SYSTEM MODIFICATION CHECK	✓
	37	OPEN LOOP CONTROL SYSTEM MODIFICATION CHECK	✓
	38	ALARM DISPLAY PRIORITISATION CHECK	✓
	39	SYSTEM SECURITY CHECK	✓
	40	SYSTEM ALARM CHECK	✓
	41	SYSTEM DIAGNOSTIC FUNCTION CHECK	✓
	42	POINT DETAIL CONFIGURATION CHECK	✓
	43	CONTROL LOOP TUNING CHECK	✓
	44	SYSTEM SELF DOCUMENTATION CHECK	✓
NOTES	1. THE INTENT OF THE FAT IS TO DEMONSTRATE AND ENSURE THAT THE I&C SYSTEM MEETS ALL THE FUNCTIONAL REQUIREMENTS AS INTENDED IN THE SPECIFICATION / CONTRACT. A COMPLETED INTEGRATED TEST OF THE SYSTEM SHALL BE CARRIED OUT AT VENDOR'S WORKS IN THE PRESENCE OF OWNER, ON COMPLETION OF INTEGRATION/MANUFACTURING OF THE SYSTEM. THE SHIPMENT OF I&C EQUIPMENT TO SITE WILL BE EFFECTED ONLY AFTER THE FAT HAS BEEN ACCEPTED BY THE OWNER.		
	2. FAT PROCEDURE SHALL BE PREPARED BY VENDOR AND TO BE SUBMITTED FOR OWNER'S/ APPROVAL WELL IN ADVANCE PRIOR TO THE COMMENCEMENT OF FAT		
	3. FAT SHALL BE CONDUCTED WITH THE DISTANCE BETWEEN THE PROCESSOR AND OTHER SUPPORTING PERIPHERIALS AS PER THE FINAL LAYOUT IN THE CONTROL ROOM.		
	4. ALL THE RELEVANT APPROVED DOCUMENTS REQUIRED FOR FAT SHALL BE SUBMITTED BY THE BIDDER IN ADVANCE PRIOR TO COMMENCEMENT OF FAT.		

14.02.04.17 **Tests to be performed during FAT of PLC system**

Following minimum tests shall be performed during FAT at manufacturer's place of PLC system:

1) Hardware Inspection of PLC Sub System
   - i) Heat run test
   - ii) Hardware check / physical software package check
   - iii) I/O loading specification
   - iv) PLC start-up and power fail restart
   - v) PLC processor back-up function
   - vi) Communication redundancy

2) Application Inspection for Logic Functions
   - i) Ladder logic functional check and graphic screen check

3) Application Inspection for PLC Panels
   - i) General arrangement
   - ii) Appearance and construction
   - iii) Panel wiring
   - iv) Panel functional check
   - v) Power supply redundancy check

4) PLC System Checks

i) PLC Scan time functional test
ii) PLC/IO panel/Engineering station functions
iii) Diagnostic and process alarm test
iv) Controller redundancy test
v. I/O cards redundancy test.
vi) Controller loading test

In addition to above test, Bidder shall also perform other tests as per approved QAP & FAT procedure. Also bidder shall submit "Type Test" report as per IEC – 61131.2 along with FAT report for PLC.

14.02.04.19 FACTORY ACCEPTANCE TEST FOR SIMULATOR

Factory Acceptance Test (FAT) shall include all required tests to fully demonstrate to Owner's satisfaction that each equipment/sub-system/system software modules etc. furnished as per this specification, as well as Simulator as a whole, fully meets the functional, parametric and other requirements of this specification and Owner's approved drawings/documents under all operating regimes.

Bidder to note that FAT procedure given below in subsequent clauses are only indicative in order to help the Bidder in understanding the requirements and help him in submitting a detailed procedure based on these guidelines meeting all the specification requirements.

The Bidder shall also carry out the tests included in subsequent clause as pre FAT and submit its results before inviting Owner for FAT.

The Factory Acceptance Test (FAT) shall include all reasonable exercises, which the combination of equipment and software can be expected to perform. These tests shall be divided into, as a minimum, but not limited to the following categories:

i. Pre power on checks
ii. Power on check
iii. Hardware tests
iv. Functional tests
v. Parametric tests
vi. Specific tests on Electronic hardware

14.02.04.19.1 The major Functional Tests shall include but not limited to the following:

a) Verification of individual modules in line with approved documents.

b) Verification of adherence to parameters for various plant configurations at different initial conditions.

c) **Functional test for C&I Model**

Verification of proper realization of Control and Logic functions as per input documents and approved functional design specification (FDS).

d) **Functional tests for HMIPIS**

i. Verification of all types of displays, logs including their formats, bar graphs, X-Y plots etc. Verification of all function keys on keyboards and availability of all operator functions.

ii. Verification of event generation and handling capabilities of HMIPIS processors by simulating various types of events / data and observing associated event sequence display and alarm signaling boxes.

iii. Calculations:

All calculations shall be tested to demonstrate that these are in accordance with the specification and I/O schedule. The Bidder shall prepare all tests cases for calculations (3 for each calculation at low, mid and upper ranges of inputs) and submit them for the owner's approval. Test cases shall include performance calculations, flow and level calculations, pressure and temperature compensations, etc.

iv. Checking historical storage and retrieval functions including long-term storage.

v. Checking healthiness of processor, main memory. Testing of initialization and loading of configuration data, etc.

vi. Verification of all programmers' stations functions for HMIPIS and Control System, as well as for documentation facility as specified.

vii. Various display response time / System accuracy etc.

viii. Display update time on OWS

e) Functional test for networking & communication devices

i. Verification of various features as per approved documents.

ii. Verification of throughput after creating high communication traffic.

f) Instructor's workstation Functions

Verification of all features of instructor functions like malfunction, initial conditions, snapshots, trainee exercises etc. in line with specification & approved documentation.

g) Programming and Documentation functions

i. Verification of all programming function like, modification of application software, da tabase, a dministrator's function et c. i n l ine w ith specification and approved documents.

ii. Verification of all documentation functions in line with specification and approved documents.

14.02.04.19.2 FAT Procedure

The B idder shall su bmit a de tailed FA T p rocedure for ow ner's approval dur ing detailed engineering stage based on the above guidelines. The FAT procedure to be submitted by the Bidder shall be det ailed and exh austive enough such that owner is satisfied t hat al l t he S imulator S ystem sp ecification r equirements and f eatures are being tested and the system meets these requirements.

14.02.04.20 **Tests to be performed during FAT of Peripherals & other control system**

1. Colour Graphic Video Display Unit (OWS)

   i. Functional tests (As per FAT procedure. Note-1)
   ii. Test for capabilities of OWS including error detection for the complete system (Both hardware & software) simulating worst conditions
   iii. Noise test
   iv. Surge withstanding capacity as per IEEE or equivalent
   v. Quality assurance as governed by BS 5750 or equivalent
   vi. Design, construction, components, finishes and testing of electronic equipment as per EES-1980 (General specification of electronic equipment) or equivalent

   Note-1: Test to be witnessed by Owner.

2. Keyboard

   i. Test for satisfactory operation of keyboard controls, push buttons and all associated functions (As per FAT procedure. Note-1)
   ii. Quality assu rance as governed by BS 5750 or e quivalent for functional test for the complete system simulating worst conditions
   iii. Design, construction, components, finishes and testing of electronic equipment as per EES-1980 (General specification of electronic equipment) or equivalent

   Note-1: Test to be witnessed by Owner.

3. Printers

   i. Noise level test for the printer
   ii. Test of interlock performance and error detection feature.
   iii. Quality assurance as governed by BS 5750 or equivalent
   iv. Design, construction, components, finishes and testing of electronic equipment as per E ES-1980 (General sp ecification o f el ectronic equipment) or equivalent

4. Floppy / Tape Drive Unit / Bulk Memory Unit / DVD, CD drive Unit / DAT Drive

   i. Noise test
   ii. Surge withstanding capacity as per IEEE or equivalent
   iii. Quality assurance as governed by BS 5750 or equivalent
   iv. Design, construction, components, finishes and testing of electronic equipment as per ES-1980 (General specification of electronic equipment) or equivalent
   v. Test of Control unit and drive for all features, date checking features.

5. Vibration Monitoring & Analysis System

   i. Simulated functional test (Note-1)
   ii. Tests for server, LED monitor, Printer, Keyboard

   Note-1: Test to be witnessed by Owner.

6. PADO (Performance & Optimization System)

   i. Simulated functional test (Note-1)
   ii. Tests for server, LED monitor, Printer, Keyboard

   Note-1: Test to be witnessed by Owner.

7. ERP System

   i. Simulated functional test (Note-1)
   ii. Tests for server, LED monitor, Printer, Keyboard

   Note-1: Test to be witnessed by Owner.

8. MIS System

   i. Simulated functional test (Note-1)
   ii. Tests for server, LED monitor, Printer, Keyboard

   Note-1: Test to be witnessed by Owner.

9. HMS System

   i. Simulated functional test (Note-1)
   ii. Tests for server, LED monitor, Printer, Keyboard

   Note-1: Test to be witnessed by Owner.

NOTES:

1. The intent of the FAT is to demonstrate and ensure that the I &C system meets all the functional requirements as intended in the specification / contract. A completed integrated test of the system shall be carried out at vendor's works in the presence of Owner or Owner's representative, on

completion of integration / manufacturing of the system. The shipment of I&C equipment to site will be effected only after the FAT has been accepted by Owner.

2. FAT procedure shall be prepared by vendor and to be submitted for Owners approval well in advance prior to the commencement of FAT.

14.02.04.21 **Calibration of Instruments**

The Bidder shall carry out the calibration of instruments as indicated below by submitting the test procedure and quality assurance plan for the Owner's approval. Bidder shall also prepare detailed checklist/calibration sheets for each of the systems/equipment clearly indicating the step-by-step procedures to be carried out for calibration pre commissioning, loop checking, powering and commissioning.
The calibration of all instruments shall be checked and calibration records prepared for the Owner's use. If the instruments require recalibration, Bidder shall recalibrate the instruments and revise the calibration records and submit to the Owner.

i TESTS TO BE PERFORMED FOR FIELD INSTRUMENTS

1.	Pressure Gauges
	Calibration Hydro test (1.5 times max. pr.)
2.	Pressure switches
	Calibration test / Hydro test / Contact rating test / Accuracy test / Repeatability
3.	Differential Pressure Gauges
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
4.	Differential Pressure Switches
	Calibration test / Hydro test / Contact rating test / Leak test / Accuracy test / Repeatability test.
5.	Thermometers
	Calibration / Material test / Accuracy test / Bore concentricity : $\pm$ 5% of wall thickness / Hydrostatic test for TW (1.5 times max. pr.)
6.	Temperature switch
	Calibration / Material test / Accuracy test / Bore concentricity : 1.5% of wall thickness / Hydrostatic test for TW (1.5 times max. pr.) / Contact rating test.
7.	Resistance temperature detector assembly.
	Calibration / Material test / Bore concentricity test / Insulation test ($\leq$ 500 MΩ at 500V DC) as per ISA, Hydro test for TW. Bore concentricity: $\pm$ 5% of wall thickness, Accuracy test.
8.	Thermocouple assembly
	Calibration / Material test, Insulation test ($\geq$ 500 Ω at 500 V, DC) as per ISA, Hydro static test (1.5 times max. pr.), Bore concentricity : $\pm$ 5% of wall thickness.
9.	Thermowells
	Material test / Bore concentricity : $\pm$ 5% of wall thickness / Hydrostatic test for TW (1.5 times max. pr.)

10.	Level Guages
	Hydrostatic test / Material test / Seat leakage test / Ball check test.
11.	Level switches (Magnetic)
	Material test / Contact rating test / Hydro test / Calibration test.
12.	Flow Switch
	Material test / Hydro static test (1.5 times max. pr.) / function test.
13.	Flow glasses
	Material test / Hydrostatic test (1.5 times max. pr.) / function test.
14.	Variable area flow meters
	Calibration test / Material test / Hydrostatic test (1.5 times max. pr.)
15.	Flow element
	100% Radiography test / Hydro test / Calibration test, IBR Certificate.
	Calibration test for flow element shall be witnessed by Owner.
16.	Control valves/Pneumatic block valve/Pressure regulating valve – Refer chapter 11.
17.	Position transmitters
	Calibration / hysteresis and Accuracy test
18.	Electro Pneumatic Convertors
	Calibration test / Accuracy test
19.	Solenoid valves
	Hydrotest / Seat leakage test / CV test / Coil insulation test
20.	Air filter regulators
	Calibration test / Accuracy test
21.	Junction Boxes
	Test for degree of protection / Material test
22.	Tests for terminal blocks
	Test for moulding for flame resistant, Non-hygroscopic and Decarbonised / Insulation test between terminals / Insulation between terminal block and frame.
23.	Thermocouple extension cable
	Thermo-emf characteristic / Continuity test / Measurement on capacitance, inductance and loop resistance / Insulation resistance / High voltage test as per latest IS / Tensile and elongation test / Oxygen index test / Any other test applicable.
24.	Mass flow meter
	Performance test / Calibration test / Hydrostatic test.
25.	Boiler Level Gauge
	Hydrostatic test / Material test / Seat leakage test / IBR Certificate
26.	pH/Conductivity measurement / Silica / Dissolved oxygen analysers:
	Calibration test, Accuracy test
27.	Sample cooler :

	Hydro test, IBR Certificate
28.	Sampling racks :
	Hydro test, IBR Certificate for tubes and fittings.
29.	S02 / Nox analyser / SPM analyser:
	Calibration test, accuracy test
30.	Interposing relay
	Functional test, temperature rise test, H.V test, Insulation test
31.	Transmitter Racks :
	Hydro test, air leak test for piping / tubing and fittings. IBR certification as required for tubing / piping and fittings.
32.	Pressure Transmitter
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
33.	Differential pressure transmitter
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
34.	Temperature Transmitter
	Calibration test / Accuracy test /Ambient temperature error test
35	Pneumatic Block Valves
	a) IBR certificate form III C b) Hydrostatic test : ANSI B 16.34 c) Seat leakage test : As per ANSI B 16-104 d) CV test: As per ISA procedure e) Magnetic particle test ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) g) Radiography test: ANSI B 16.34 special class h) Calibration and Hysteresis test i) Actuator leakage test
36.	Pressure Regulating Valve

	a) IBR certificate form III C b) Hydrostatic test : ANSI B 16.34 c) Seat leakage test : As per ANSI B 16-104 d) CV test: As per ISA procedure e) Magnetic particle test ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) g) Radiography test: ANSI B 16.34 special class h) Calibration and Hysteresis test i) Actuator leakage test
37.	Local Panels : Visual inspection, wiring & continuity check, H.V. and I.R. tests on panels, checking of bill of materials, functional tests.
38	Wiring Termination & Accessories
	Routine test: Conductor resistance test/High voltage test/Impulse dielectric test/insulation test/Humidity test/Temperature rise test on power circuits/short time current test on power circuits.
	Type test:Annealing test/Test for insulation and sheath/ Flame retardance test - a) Oxygen index, b) Flammability / Test for acid gas generation/test for water absorption/wet dielectric test
39	Marshalling/System cabinets
	Verification of degree of protection/Electrical tests as detailed under wiring Termination& accessories/Type test and routine test as per relevant Indian standards.
	Notes:
	1. Test Certificates in addition to inspection at manufacturers works shall be furnished for all the instruments for Owner's review. 2. Above Test to be witnessed shall be finalized by Owner.
	3. In addition to above test, test as per approved QAP shall also be witnessed by owner.

17.02.05 TYPE TESTING

The BIDDER shall furnish the Type test reports of all type tests as per relevant standards and codes. As well as other specifics test indicated in the specification. A list of such test are given for various equipment in table titled, TYPE TEST REQUIREMENT FOR C&I SYSTEM and under the item special requirement for solid state requirements/systems. For the balance equipments/instruments. type test may be conducted as per manufacturer standards or if required by relevant standards.

A. Out of these test listed , the bidder /subvendor/manufacturer is required

to conduct certain type test specifically for this contract (and witnessed by employer or his authorized representative). Even if the same have been conducted earlier as clearly indicated subsequently such tests.

B. For the rest, submission of type test, results, and certificates shall be acceptable provided following points

i. The same have been carried out by the bidder/ subvendor on exactly the same model/rating of equipment. (For control valves this shall be same size, type & design).
ii. There has been no change in the components from the offered equipments and tested equipments.
iii. The test has been carried out as per the latest standards along with amendemends as on the date of bid opening.

C. In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the bidder/sub-vendor within the quoted price and no extra cost will be payable by the owner on this account.

17.02.05.1 As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main bidder or his authorized representative and balanced have to be approved by the employer.

The schedule of conduction of type test/submission of reports shall be submitted and finalized during pre award discussion.

17.02.05.2 For the type test to be conducted, bidder shall submit detailed test procedure for approval by owner. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable)., recording of different parameters, intervals of recording precaution to be taken etc. for the test to be carried out.

17.02.05.3 **SPECIAL REQUIREMENTS FOR SOLID STATE EQUIPEMNTS /SYSTEMS**

The minimum type test report, over and above the requirements of above clause which are to be submitted for each of the major C&I systems like DDCMIS, DCS, PLC etc shall be as indicated below:

i. Surge Withstand Capability (SWC) for solid state equipments/equipments

All solid state systems/equipments shall be able to withstand the electrical noise and the surges as encountered in actual service conditions and inherent in the power plant . All the solid states systems /equipments shall be provided with all required protection that needs the surge withstand capability as defined in ANSI 37. 90.1/IEEE 472. Hence, all front end cards which receive external signals like analog input and output modules, Binary input and output modules etc including power supply , data highway, data links shall be provided with protection that meets the surge withstand capability as

defined in ANSI 37.90.1/IEEE 472. Complete details of the features incorporated in the electronic system to meet this requirement the relevant test carried out, the test certificates ,etc shall be submitted along with the proposal. As an alternative to the above, suitable class of EN 61000-4-12 which is equivalent to ANSI 37.90.1/IEEE 472 may also be adapted for SWC test.

ii. The dry heat test as per IEC-68-2-2 or equivalent
iii. Damp heat test as per IEC 68-2-3 or equivalent
iv. Vibration test as per IEC 68-2-6 or equivalent
v. Electrostatic Discharge test as per EN 61000-4-2 or equivalent
vi. Radio frequency immunity test as per EN 61000-4-6 or equivalent
vii. Electromagnetic Field Immunity test as per EN 61000-4-3 or equivalent

Test listed at Item no v , vi, vii above are applicable for electronic cards only as defined under item no. (i) above

17.02.05.4 TYPE TEST REQUIREMENTS FOR C&I SYSTEMS

S.No.	Item	Test requirement	Standard	Test to be specifically conducted	Owner's Approval required on Test Certificate
1	Electrical metering instruments	As per standards	IS 1248	No	Yes
2	Thermocouple	Degree of Protection Test	IS - 13947	No	No.
3	Junction Box	Degree of Protection Test	IS - 13947	Yes	Yes
4	RTD	As per standards	IEC-60751	No	No
5	Electronic Transmitter	As per standards	BS 6447/ IEC 60770	No	Yes
6	E/P convertor	As per standards	Manufacturing standard	No	Yes
7	Instrumentation cable (Twisted and shielded) (Refer Vol. V, Chapter 9)				
8	Battery	As per standard	IS 10918	Yes	YES
9.	Voltage stabiliser	Over load test	Approved procedure	No	YES
		Temp. rise test without redundant fans	Approved procedure	No	YES
		Input voltage variation test	Approved procedure	No	YES
10	**DDCMIS**				
	CLCS	Model Test	Approved	No	No

	system		procedure		
	BMS & MFT	Safety requirement	VDE 0116, SEC 8.7	No	YES
11	Conductivity type level switch	Degree of protection test	IS 13947	No	No
12	Local gauges	Degree of protection test	IS 13947	No	No
13	Process actuated switches	Degree of protection test	IS 13947	No	No
14	Control valves	CV test	ISA 75.02	No	YES
15	PLCs	As per Standard	IEC 1131	No	YES
16	LIE/LIR	Degree of protection test	IS 13947	YES	YES
17	Flue gas O2 analyser, other Fl ue gas Analysers	Degree of protection test	IS 13947	No	YES
18	Flow nozz les & O rifice plates	calibration	ASME PT C BS 1042	YES	YES

Note:
Type test are to be conducted only for the items, which are being supplied as part of this package.

A. For batteries with electric power supply system of main plant C&I, the bidder shall submit for owner's approval the reports of all the type tests as per IS-10918 carried out within last 5 years from the date of bid opening and the test should have been either conducted at an i ndependent l aboratory or sh ould hav e b een w itnessed by a o wner/client. The complete type test report shall be for any rating of battery in a particular group, based on plate dimensions being manufactured by supplier.

For batteries with electric power system of auxiliary plants, type test reports for batteries shall be as per standard –practice of manufacturer.

14.02.06 Testing at Site [Prior to commercial operation]

a. All equipment shall be checked thoroughly in respect of the following:

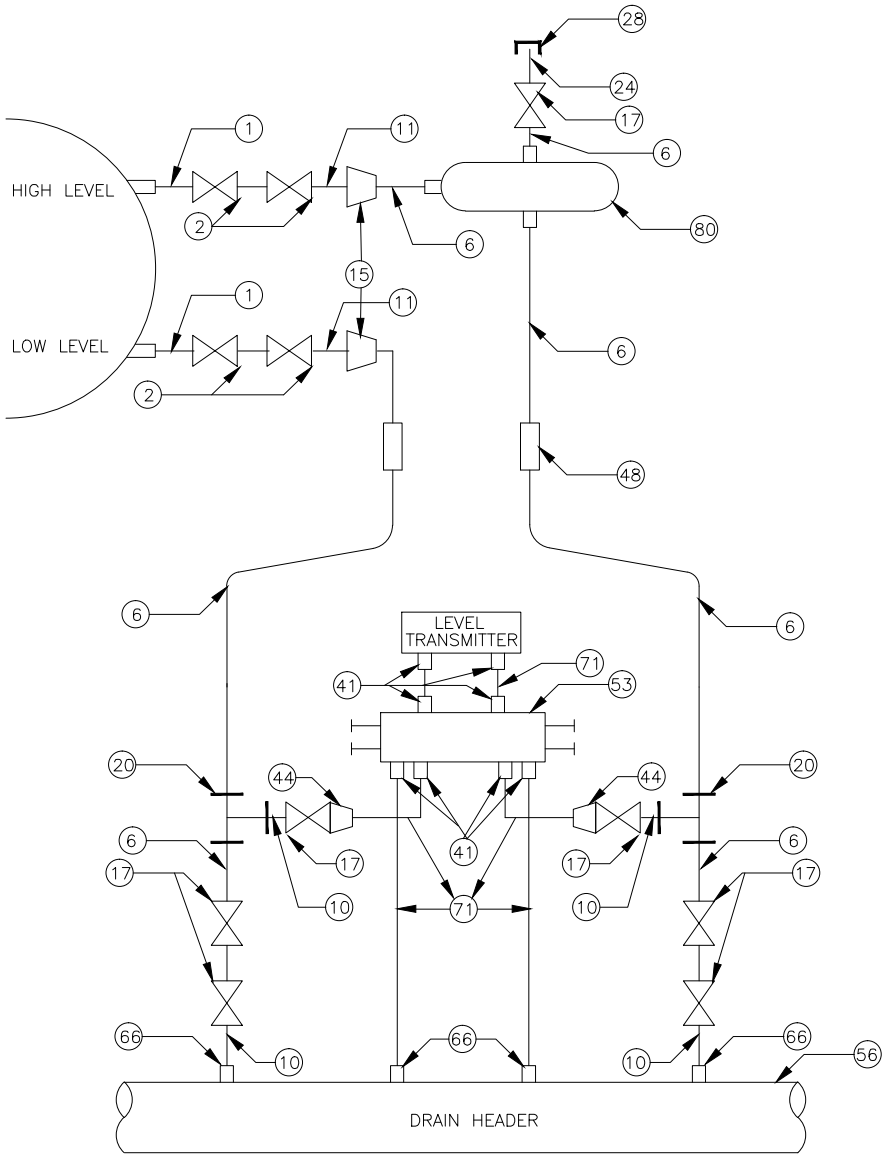
i. Visual and mechanical testing

ii. Complete system configuration loading functions; system diagnostics; system proper operation specified power supply specifications.

HOOK UP DRAWING

INSTRUMENT HOOK UP

L.DRAWINGS



TRANSMITTER MOUNTED BELOW INST. SOURCE POINT

TAG NO.	DESCRIPTION	BOM
80	CONDENSATION CHAMBER	1
71	1/2"OD IMPULSE TUBE, SS-316	AS REQD.
66	1/2" GI SOCKET / FUNNEL	4
56	2"NB GI DRAIN HEADER	AS REQD.
53	5-VALVE MANIFOLD, SS-316	1
48	1/2" SW, CS/AS BULK HEAD PIPE UNION	2
44	1/2"BWX1/2"OD COMPRESSION TUBE FITTING,SS-316	2
41	1/2"NPT(M)X1/2"OD TUBE COMPRESSION FITTING,SS-316	8
28	1/2" NPT (F) CS CAP	1
24	1/2" NPS SCH-80/160X1/2"NPT(M) CS/AS NIPPLE	1
20	1/2" SOCKET WELDED EQUAL TEE CS/AS	2
17	1/2" SOCKET WELDED CS GLOBE VALVE	7
15	1"TO 1/2" SOCKET WELD REDUCER	2
11	1" NPS SCH 80/160 CS/AS NIPPLE	2
10	1/2" NPS SCH 80/160,CS/AS NIPPLE	4
6	1/2" NPS SCH 80/160 CS/AS PIPE	AS REQD.
2	1/2"/3/4"/1" SOCKET WELDED GLOBE VLV/ROOT VLV.	4
1	1/2" NPS SCH 80 NIPPLES OF MATERIAL SAME AS MAIN PIPE WITH NECESSARY ATTACH TO FLANGES	AS REQD.

NOTE:-
1. FOR HIGH TEMP. SERVICE (MORE THAN 80°C) A 'U' TUBE(REF. DWG NO. 114-04-0100) SHALL BE PROVIDED BETWEEN THE MANIFOLD AND THE TRANSMITTER
2. FOR HIGH PR.(MORE THAN 40kg/sqcm) ONE NO. OF ISOLATING VLV. IS PROVIDED IN EACH LINE BETWEEN VLV. MANIFOLD AND 1/2"SW EQUAL TEE AND 2NO. DRAIN VLV. ARE ALSO

REFERENCE DRAWINGS.

NOTES

1. DO NOT SCALE, ASK WHEN IN DOUBT.
2. ALL DIMENSIONS ARE IN MILIMETRES UNLESS NOTED OTHERWISE.
3. BULK HEAD FITTING SW TYPE SHALL BE PROVIDED AT LIE/LIR
4. ABOVE DRWING IS FOR BASIC GUIDE LINE TO BE MEET BY BIDDER, ANY FURTHER IMPROVEMENT DURING DETAILED ENGINEERING SHALL ALSO BE CONFIRMED/PROVIDED BY CONTRACTOR.
5. QUANTITIES OF INSTRUMENTS/ ERECTION HARDWARE SHALL BE AS PER NIT AND AS FINALISED DURING DETAIL ENGINEERING
6. FOR DM PLANT MATERIAL OF ERECTION HARDWARE SHALL BE SS 316 ONLY.

NOTICE

ZONE	MARK	REVISIONS	DATE	CIVIL	MECH.	ELEC.	C&I	H.O.D.
	A	PRELIMINARY	25.04.13				SLN	
	0							
	1							
	2							
	3							
	4							
	5							
	6							

APPROVED

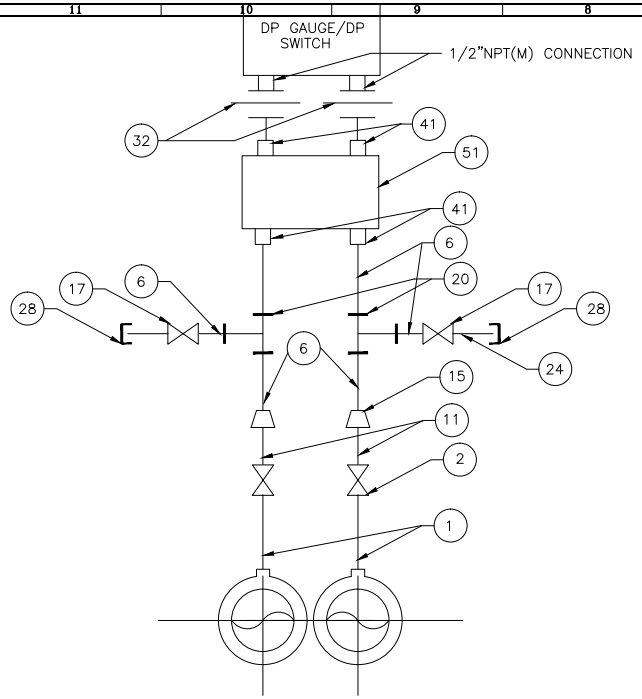
FOR BID PURPOSE ONLY:

DESEIN
CONSULTING ENGINEERS
NEW DELHI - INDIA

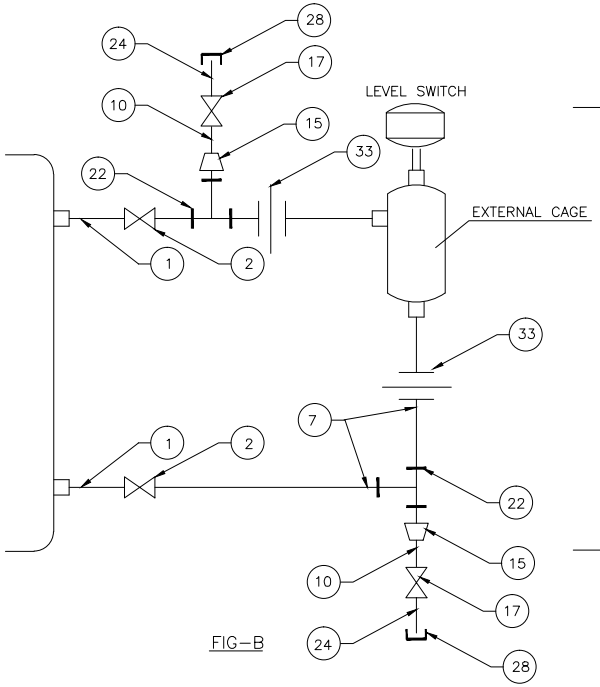
CLIENT: TAMILNADU GEN. & DIST. CORPORATION
PROJECT: 2x660MW ENNORE SEZ COAL BASED SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI.
TITLE :- INST. DRAWING FOR LEVEL TRANSMITTERS

	NAME	SIGN.	DATE
CAD/DRAWN	VIKAS		23.04.13
DESIGNED	SKM/SN		23.04.13
CHECKED	S.K.M.		24.04.13
SCALE	N.T.S.		

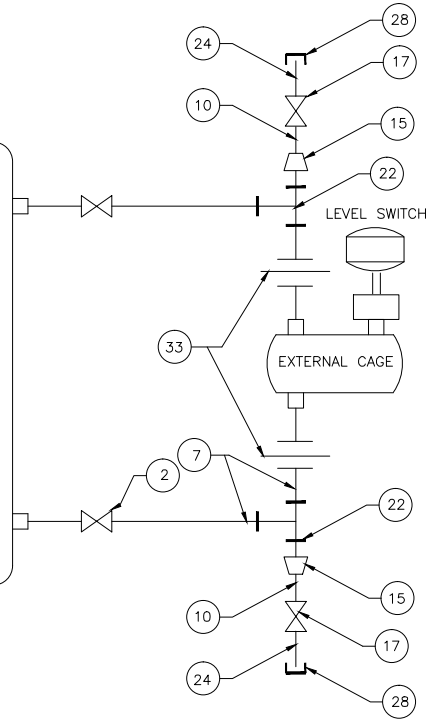
JOB. No. D-4027
DWG.No. 114-04-0110
REV. 0
Sheet No. 1 of 1



FIG–A



FIG–B



FIG–C

TAG NO.	DESCRIPTION	A	B	C
		QTY.		
78	1/2" NPT(F) X 1/2" NPT(M) SNUBBER/PULSATION DAMPNER	1	–	–
51	5 VALVE MANIFOLDS, SS–316	–	–	–
41	1/2" NPT(M) X 1/2" OD TUBE COMPRESSION FITTING,SS–316	–	–	–
38	3 WAY GAUGE VALVE 1/2"NB SW	1	–	–
33	1" SW EQUAL PIPE UNION	–	2	2
32	1/2" NPS,3 PIECE PIPE UNION 1/2" NPT(F) SCREWED AND 1/2" SW CONNECTION	1	–	–
28	1/2" NPT(F) CS. CAP	1	2	2
24	1/2" NPS,SCH 80/160 X 1/2" NPT(M) CS/AS NIPPLE	1	2	2
22	1" SW EQUAL TEE CS/AS	–	1	2
20	1/2"SW EQUAL TEE CS/AS	1	–	–
17	1/2" SW,CS/AS, GLOBE VALVE	1	2	2
15	1" TO 1/2" SOCKET WELD REDUCER	1	2	2
11	1"NPS SCH 80/160 CS/AS NIPPLE	1	–	–
10	1/2"NPS,SCH 80/160 CA/AS NIPPLE	–	2	2
6	1/2"NPS,SCH 80/160 CARBON/ALLOY STEEL PIPE	AS REQD.		
7	1" NPS,SCH 80/160 CS/AS STEEL PIPE	AS REQD.		
2	1/2"3/4"/1" ROOT VALVE – SW GLOBE VALVE	2	2	2
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL SAME AS THAT OF MAIN PIPE (AS PER PROCESS REQD.)	AS REQD.		

NOTE:–
WITH VALVE OF SIZE 1/2"SW NIPPLE PIECE IS NOT REQUIERED

REFERENCE DRAWINGS.

NOTES

1. DO NOT SCALE, ASK WHEN IN DOUBT.
2. ALL DIMENSIONS ARE IN MILIMETRES UNLESS NOTED OTHERWISE.
3. ABOVE DRWING IS FOR BASIC GUIDE LINE TO BE MEET BY BIDDER, ANY FURTHER IMPROVEMENT DURING DETAILED ENGINEERING SHALL ALSO BE CONFIRMED/PROVIDED BY CONTRACTOR.
4. QUANTITIES OF INSTRUMENTS/ ERECTION HARDWARE SHALL BE AS PER NIT AND AS FINALISED DURING DETAIL ENGINEERING
5. FOR DM PLANT MATERIAL OF ERECTION HARDWARE SHALL BE SS 316 ONLY.

NOTICE

ZONE	MARK	PARTICULARS	DATE	CIVIL	MECH.	ELEC.	C&I	H.O.D.
	A	PRELIMINARY	25.04.13				SLN	

REVISIONS | APPROVED

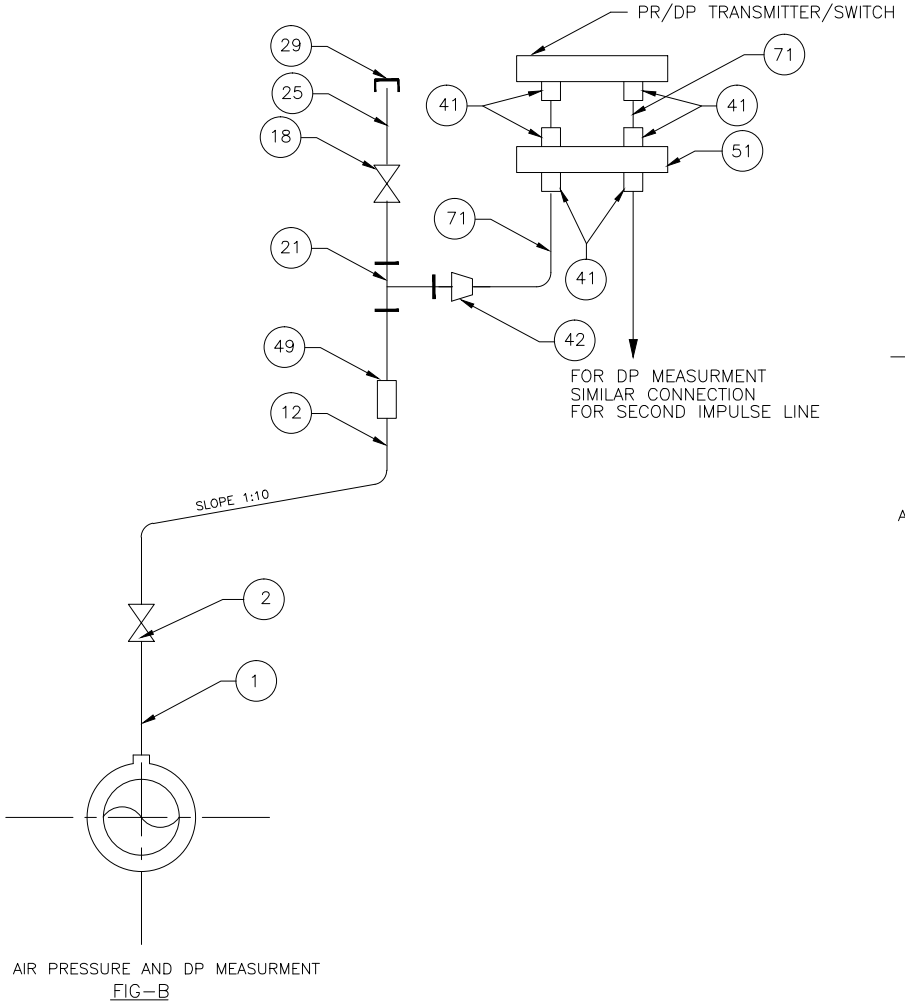
DESEIN
CONSULTING ENGINEERS
NEW DELHI – INDIA

CLIENT: TAMILNADU GEN. & DIST. CORPORATION
PROJECT: 2x660MW ENNORE SEZ COAL BASED SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI
TITLE :– INST. DRAWING FOR DIFF. PRESS. SWITCH/GAUGE/LEVEL SWITCHES
FOR BID PURPOSE ONLY

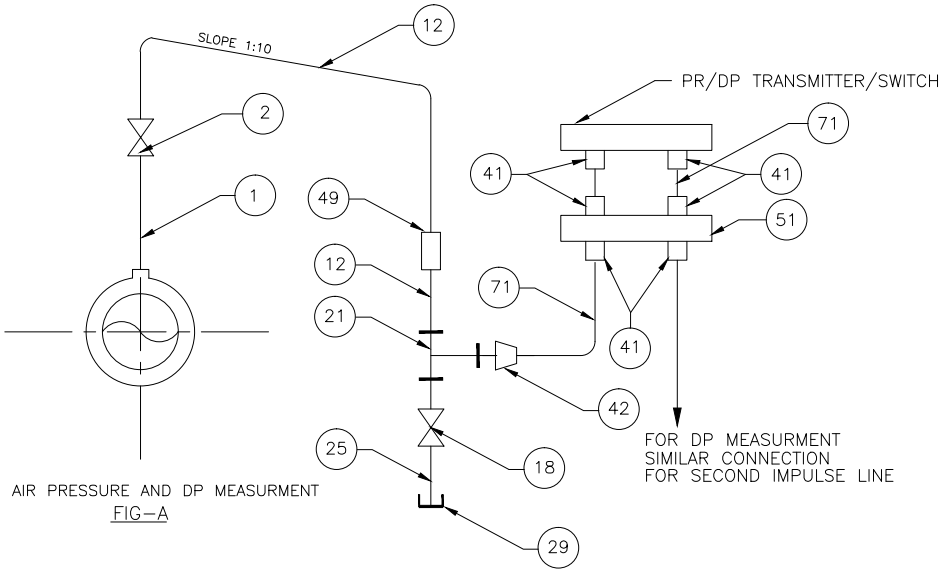
	NAME	SIGN.	DATE
CAD/DRAWN	VIKAS		23.04.13
DESIGNED	SKM/SN		23.04.13
CHECKED	S.K.M.		24.04.13
SCALE	N.T.S.		
JOB. No.	D–4027		
DWG.No.	114–04–0108		REV. 0

Sheet No. 11 of 19

PRINT DISTRIBUTION: SR. No. PARTY



AIR PRESSURE AND DP MEASURMENT
FIG–B



AIR PRESSURE AND DP MEASURMENT
FIG–A

TAG NO.	DESCRIPTION	A	B
		QTY.	
71	1/2"OD IMPULSE TUBE,SS–316	AS REQD.	
51	5/3/2–VALVE MANIFOLDS,SS–316	1	1
49	3/4"SW,CS/AS BULK HEAD PIPE UNION	1	1
42	3/4"BW X 1/2"OD TUBE FITTING,SS–316	1	1
41	1/2"NPT(M) X 1/2"00 TUBE COMPRESSION FITTING,SS–316	6	6
29	3/4"NPT(F) CS CAP	1	1
25	3/4"NPS,SCH–80 X 3/4"NPS(M)CS NIPPLE	1	1
21	3/4" EQUAL TEE,CS	1	1
18	3/4" SW,CS GLOBE VALVE	–	1
12	3/4" NPS. SCH–80 CARBON STEEL PIPE	AS REQD.	
2	1/2"/3/4"/1" ROOT VALVE – SW GLOBE VALVE	1	1
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PER PROCESS REQD.)	AS REQD.	

BILL OF MATERIAL

NOTE:–
QUANTITY IN COLUMN A&B TO BE DOUBLED
FOR DP TAPPING EXCEPT ITEM NO. 51

REFERENCE DRAWINGS.

NOTES

1. DO NOT SCALE, ASK WHEN IN DOUBT.
2. ALL DIMENSIONS ARE IN MILIMETRES UNLESS NOTED OTHERWISE.
3. ABOVE DRWING IS FOR BASIC GUIDE LINE TO BE MEET BY BIDDER, ANY FURTHER IMPROVEMENT DURING DETAILED ENGINEERING SHALL ALSO BE CONFIRMED/PROVIDED BY CONTRACTOR.
4. QUANTITIES OF INSTRUMENTS/ ERECTION HARDWARE SHALL BE AS PER NIT AND AS FINALISED DURING DETAIL ENGINEERING
5. FOR DM PLANT MATERIAL OF ERECTION HARDWARE SHALL BE SS 316 ONLY.

NOTICE

ZONE	MARK	PARTICULARS	DATE	CIVIL	MECH.	ELEC.	C&I	H.O.D.
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NEW DELHI – INDIA

CLIENT: TAMILNADU GEN. & DIST. CORPORATION

PROJECT: 2x660MW ENNORE SEZ COAL BASED SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI.

TITLE :– INST. DRAWING FOR PRESS. & DIFF. PRESS. TRANSMITTERS/SWITCH (AIR SERVICE)

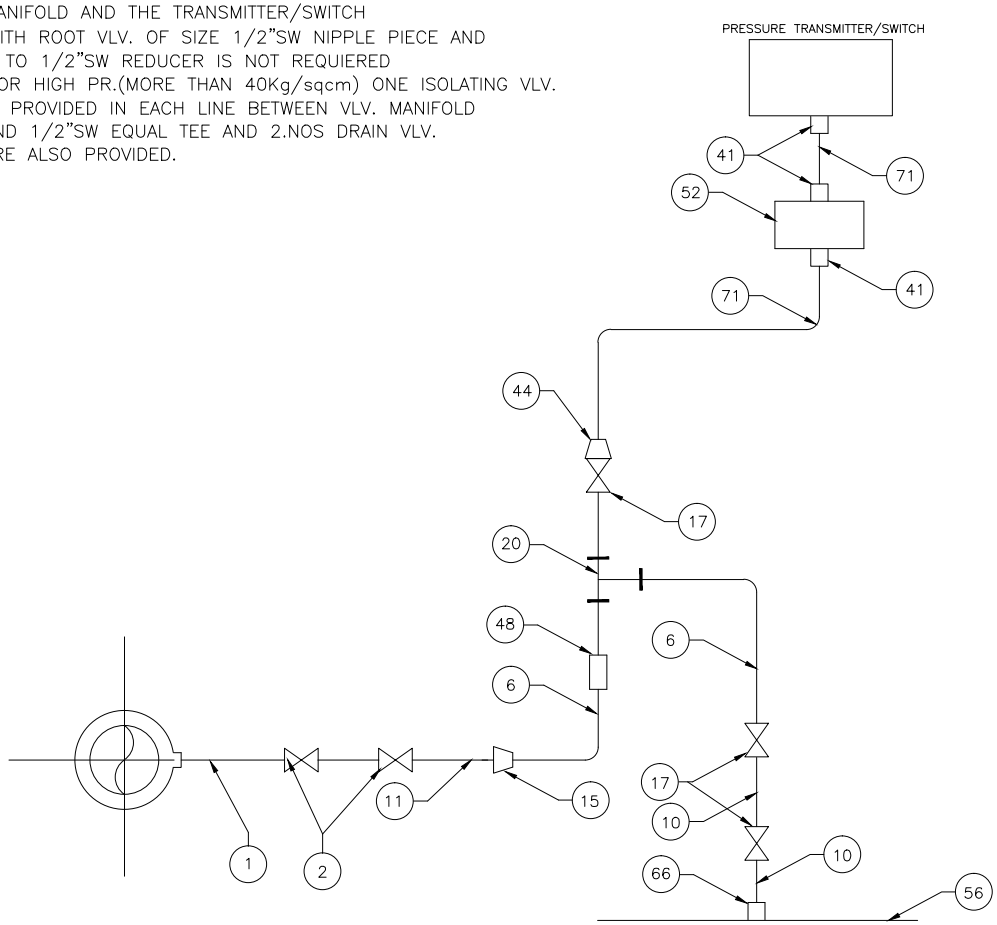
FOR BID PURPOSE ONLY:

	NAME	SIGN.	DATE
CAD/DRAWN	VIKAS		23.04.13
DESIGNED	SKM/SN		23.04.13
CHECKED	S.K.M.		24.04.13
SCALE	N.T.S.		
JOB. No.	D–4027		
DWG.No.	114–04–0103		REV. 0

Sheet No. 5 of 19

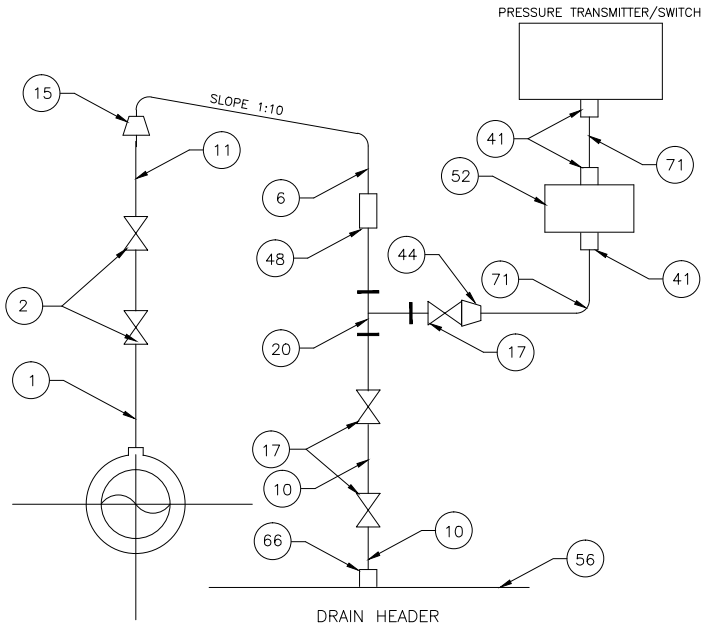
NOTE:–

1. FOR HIGH TEMP. SERVICE (MORE THAN °80C) A 'U'–TUBE / SYPHON (REF. DWG NO. IN–114–04–0100)SHALL BE PROVIDED BETWEEN THE MANIFOLD AND THE TRANSMITTER/SWITCH
2. WITH ROOT VLV. OF SIZE 1/2"SW NIPPLE PIECE AND 1 TO 1/2"SW REDUCER IS NOT REQUIERED
3. FOR HIGH PR.(MORE THAN 40Kg/sqcm) ONE ISOLATING VLV. IS PROVIDED IN EACH LINE BETWEEN VLV. MANIFOLD AND 1/2"SW EQUAL TEE AND 2.NOS DRAIN VLV. ARE ALSO PROVIDED.



TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

FIG–D



TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT

FIG–C

TAG NO.	DESCRIPTION	C	D
		QTY.	
71	1/2"OD IMPULSE TUBE,SS–316	AS REQD.	
66	1/2" GI SOCKET	1	1
56	2"NB GI DRAIN HEADER		
52	5/3/2–VALVE MANIFOLDS,SS–316	1	1
48	1/2"SW,CS/AS BULK HEAD PIPE UNION	1	1
44	1/2"BW X 1/2"OD COMRESSION TUBE FITTING,SS–316	1	1
41	1/2"NPT(M) X 1/2"00 TUBE COMPRESSION FITTING,SS–316	3	3
20	1/2"SW EQUAL TEE,CS	1	1
17	1/2" SW,CS GLOBE VALVE / NEEDLE VALVE	3	3
15	1" TO 1/2" SW REDUCER	1	1
11	1" NPS SCH–80 CS/AS NIPPLE	1	1
10	1/2" NPS,SCH 80/160, CS/AS NIPPLE	2	2
6	1/2" NPS. SCH–80/160 CS/ AS PIPE	AS REQD.	
2	1/2"/3/4"/1" ROOT VALVE	2	2
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PER PROCESS REQD.)	AS REQD.	

BILL OF MATERIAL

REFERENCE DRAWINGS.

NOTES

1. DO NOT SCALE, ASK WHEN IN DOUBT.
2. ALL DIMENSIONS ARE IN MILIMETRES UNLESS NOTED OTHERWISE.
3. BULK HEAD FITTING SW TYPE SHALL BE PROVIDED AT LIE/LIR
4. ABOVE DRWING IS FOR BASIC GUIDE LINE TO BE MEET BY BIDDER, ANY FURTHER IMPROVEMENT DURING DETAILED ENGINEERING SHALL ALSO BE CONFIRMED/PROVIDED BY CONTRACTOR.
5. QUANTITIES OF INSTRUMENTS,/ ERECTION HARDWARE SHALL BE AS PER NIT AND AS FINALISED DURING DETAIL ENGINEERING
6. FOR DM PLANT MATERIAL OF ERECTION HARDWARE SHALL BE SS 316 ONLY.

NOTICE

ZONE	MARK	PARTICULARS	DATE	CIVIL	MECH.	ELEC.	C&I	H.O.D.
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CLIENT: TAMILNADU GEN. & DIST. CORPORATION

PROJECT: 2x660MW ENNORE SEZ COAL BASED SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI.

TITLE :– INST. DRAWING FOR PRESS. & DIFF.PRESS. TRANSMITTERS/SWITCH (STEAM & LIQUID SERVICE)

	NAME	SIGN.	DATE
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DESIGNED	SKM/SN		23.04.13
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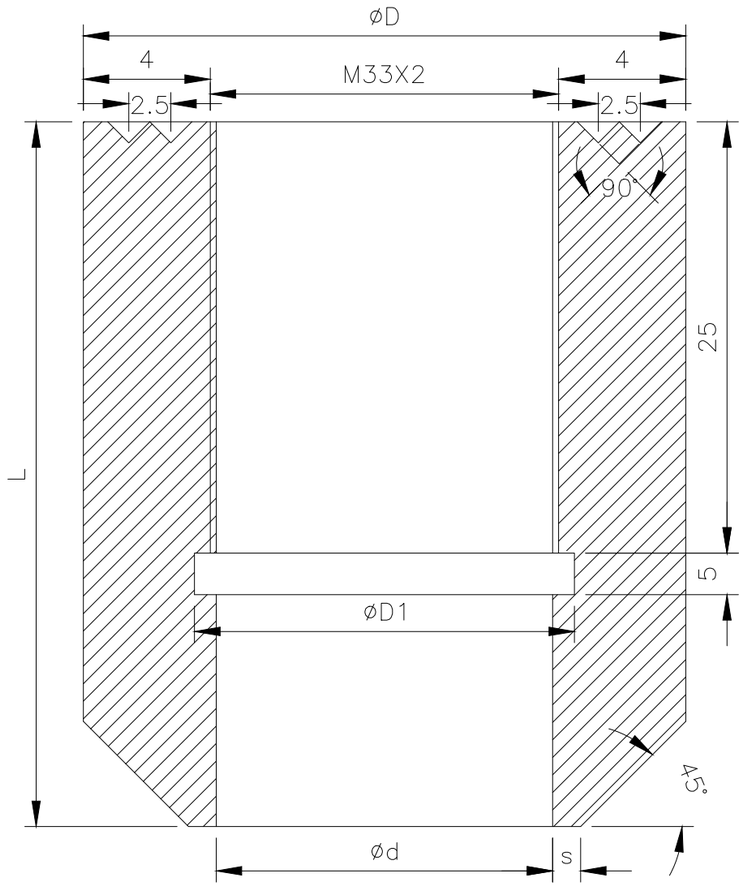
JOB. No. D–4027

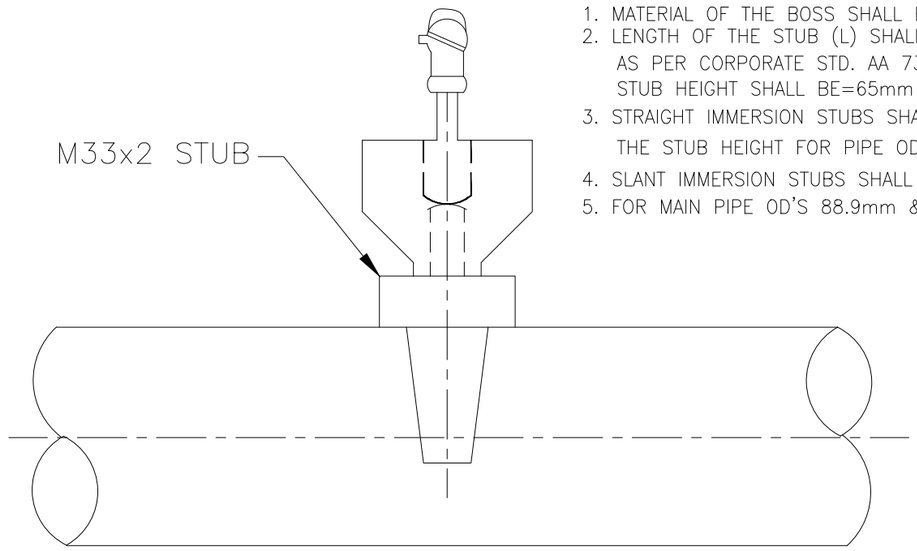
DWG.No. 114–04–0104 REV. 0

Sheet No. 7 of 19



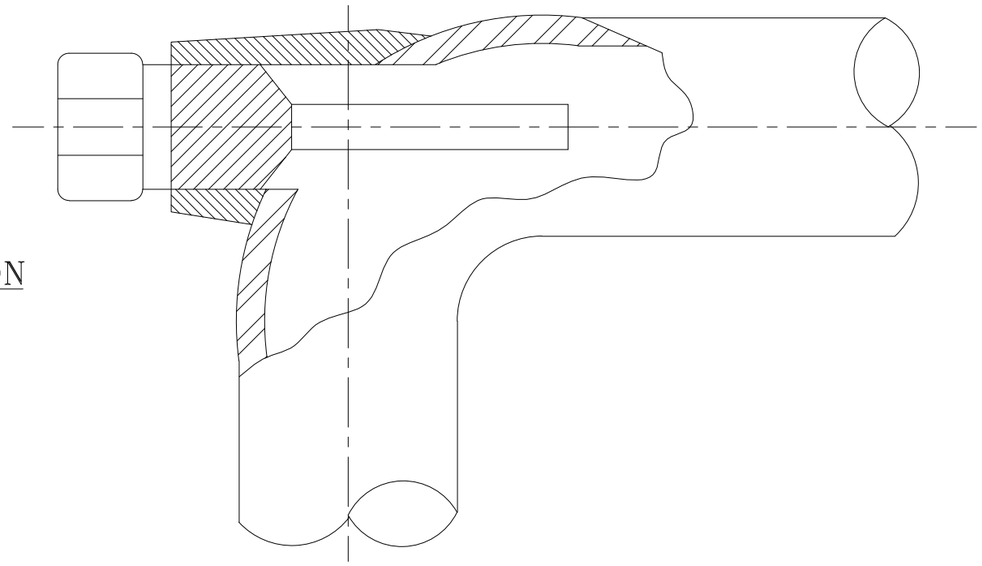
TEMPERATURE STUB FOR STRAIGHT IMMERSION

FOR PIPE OD BELOW 219.1mm	29	55	33.5	1.5	65
FOR PIPE OD 219.1mm & ABOVE	29	55	33.5	1.5	45
MAIN PIPE SIZES	d	D	D1	S	L



INSTALLATION TYPE-1

(FOR MAIN PIPE OD 168.3mm & ABOVE)



INSTALLATION TYPE-2

(FOR MAIN PIPE OD 88.9mm & BELOW)

NOTE :-

1. MATERIAL OF THE BOSS SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED.
2. LENGTH OF THE STUB (L) SHALL BE 65/45 mm DEPENDING UPON PIPE SIZE, AS PER CORPORATE STD. AA 7326102.(FOR PIPE OD 88.9mm TO 159mm STUB HEIGHT SHALL BE=65mm & FOR PIPE OD >219.1mm STUB HEIGHT SHALL BE=45mm)
3. STRAIGHT IMMERSION STUBS SHALL BE USED FOR PIPE OD'S 168.3mm & ABOVE. THE STUB HEIGHT FOR PIPE OD, 168.3mm TO <219.1mm SHALL BE 65mm.
4. SLANT IMMERSION STUBS SHALL BE USED FOR PIPE OD'S 88.9mm TO 159mm.
5. FOR MAIN PIPE OD'S 88.9mm & bELOW SUITABLE EXPANDER SHALL BE USED.

REFERENCE DRAWINGS.

NOTES

1. DO NOT SCALE, ASK WHEN IN DOUBT.
2. ALL DIMENSIONS ARE IN MILIMETRES UNLESS NOTED OTHERWISE.
3. BULK HEAD FITTING SW TYPE SHALL BE PROVIDED AT LIE/LIR
4. ABOVE DRWING IS FOR BASIC GUIDE LINE TO BE MEET BY BIDDER, ANY FURTHER IMPROVEMENT DURING DETAILED ENGINEERING SHALL ALSO BE CONFIRMED/PROVIDED BY CONTRACTOR.
5. QUANTITIES OF INSTRUMENTS/ ERECTION HARDWARE SHALL BE AS PER NIT AND AS FINALISED DURING DETAIL ENGINEERING
6. FOR DM PLANT MATERIAL OF ERECTION HARDWARE SHALL BE SS 316 ONLY.

NOTICE

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PROJECT: 2x660MW ENNORE SEZ COAL BASED SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI.

TITLE :- INST. DRAWING FOR TEMPERATURE STUB

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CAD/DRAWN	VIKAS		23.04.13
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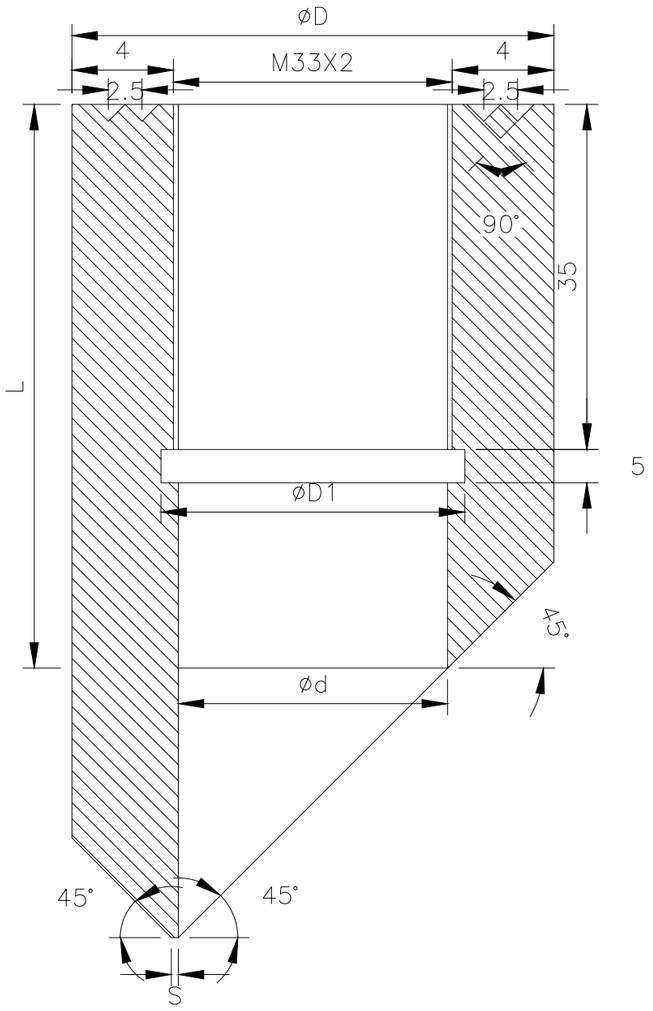
DWG.No. 114-04-0111 — REV. 0

Sheet No. 1 of 1

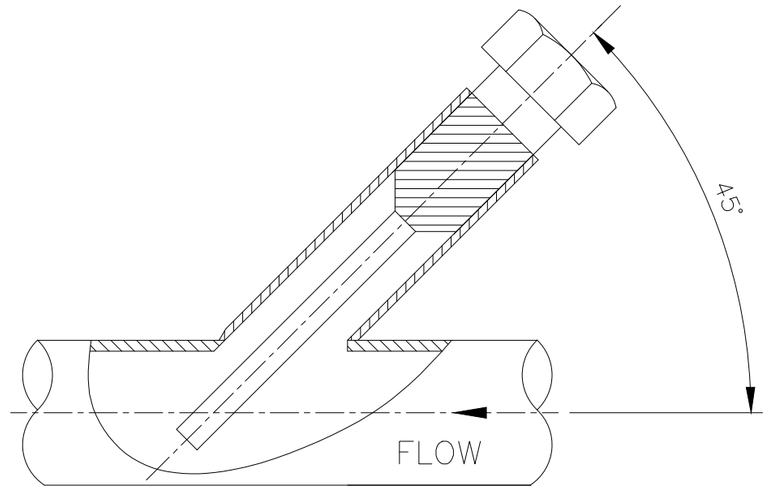


TEMPERATURE STUB FOR SLANT IMMERSION

FOR PIPE OD BELOW 219.1mm	29	55	33.5	1.5	65
FOR PIPE OD 219.1mm & ABOVE	29	55	33.5	1.5	45
MAIN PIPE SIZES	d	D	D1	S	L

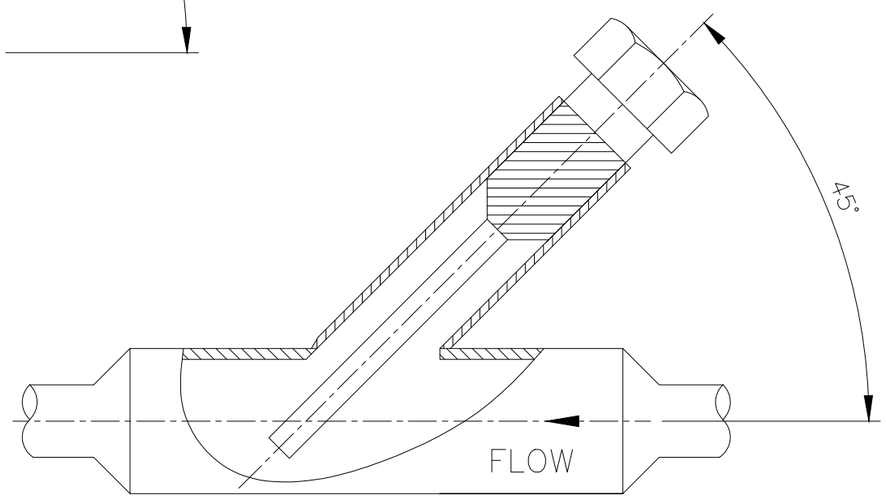
NOTE :–

1. MATERIAL OF THE BOSS SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED.
2. LENGTH OF THE STUB (L) SHALL BE 65/45 mm DEPENDING UPON PIPE SIZE, AS PER CORPORATE STD. AA 7326102.(FOR PIPE OD 88.9mm TO 159mm STUB HEIGHT SHALL BE=65mm & FOR PIPE OD >219.1mm STUB HEIGHT SHALL BE=45mm)
3. STRAIGHT IMMERSION STUBS SHALL BE USED FOR PIPE OD'S 168.3mm & ABOVE. THE STUB HEIGHT FOR PIPE OD, 168.3mm TO <219.1mm SHALL BE 65mm.
4. SLANT IMMERSION STUBS SHALL BE USED FOR PIPE OD'S 88.9mm TO 159mm.
5. FOR MAIN PIPE OD'S 88.9mm & bELOW SUITABLE EXPANDER SHALL BE USED.



INSTALLATION TYPE–3

(FOR MAIN PIPE OD 88.9mm TO 159mm)



INSTALLATION TYPE–4

(FOR MAIN PIPE OD 88.9mm & BELOW)

REFERENCE DRAWINGS.

NOTES

1. DO NOT SCALE, ASK WHEN IN DOUBT.
2. ALL DIMENSIONS ARE IN MILIMETRES UNLESS NOTED OTHERWISE.
3. BULK HEAD FITTING SW TYPE SHALL BE PROVIDED AT LIE/LIR
4. ABOVE DRWING IS FOR BASIC GUIDE LINE TO BE MEET BY BIDDER, ANY FURTHER IMPROVEMENT DURING DETAILED ENGINEERING SHALL ALSO BE CONFIRMED/PROVIDED BY CONTRACTOR.
5. QUANTITIES OF INSTRUMENTS/ ERECTION HARDWARE SHALL BE AS PER NIT AND AS FINALISED DURING DETAIL ENGINEERING
6. FOR DM PLANT MATERIAL OF ERECTION HARDWARE SHALL BE SS 316 ONLY.

NOTICE

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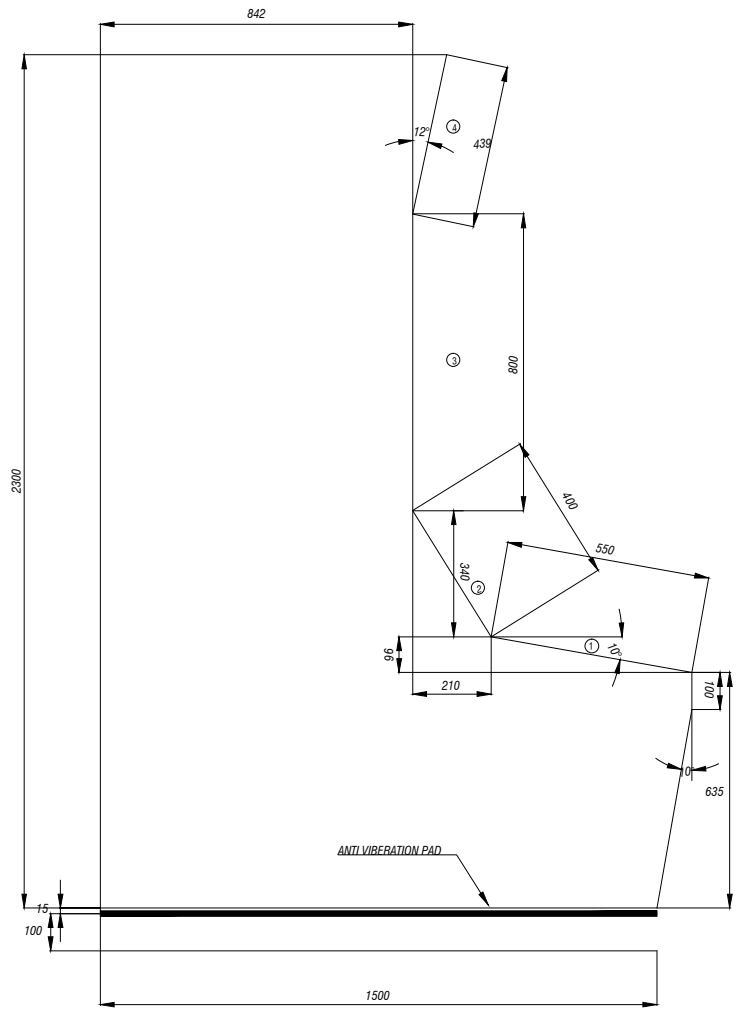
TITLE :– INST. DRAWING FOR TEMPERATURE STUB

FOR BID PURPOSE ONLY:

	NAME	SIGN.	DATE
CAD/DRAWN	VIKAS		23.04.13
DESIGNED	SKM/SN		23.04.13
CHECKED	S.K.M.		24.04.13
SCALE	N.T.S.		
JOB. No.	D–4027		
DWG.No.	114–04–0111	REV.	0

Sheet No. 15 of 18

FURNITURE DETAILS



NOTE:-

1 : Panel for Mounting annunciation P.B., Desk release PB, Emergency Trip P.B.

2 : Panel for Mounting ILPB for OLCS / Sequential Operation.

3 : Sheet metal panel for mounting MIMIC , Ammeters,Indicator, Totalizer, recorder etc.

4. Inclined Sheet metal panel for mounting Annunciation Facia windows.

NOTES

1. DO NOT SCALE, ASK WHEN IN DOUBT.
2. ALL DIMENSIONS ARE IN MILIMETRES UNLESS NOTED OTHERWISE.
3. DETAILS OF PANELS/ DESK SHALL BE AS PER SPECIFICATION.

NOTICE

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CLIENT– TAMILNADU GEN. & DIST. CORPORATION

PROJECT: 2x660MW ENNORE SEZ COAL BASED SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI.

TITLE :– GEN.ARRG.OF DESK CUM PANEL (TYP) FOR BOP PACKAGES

FOR BID PURPOSE | SHEET NO. 1 of 1

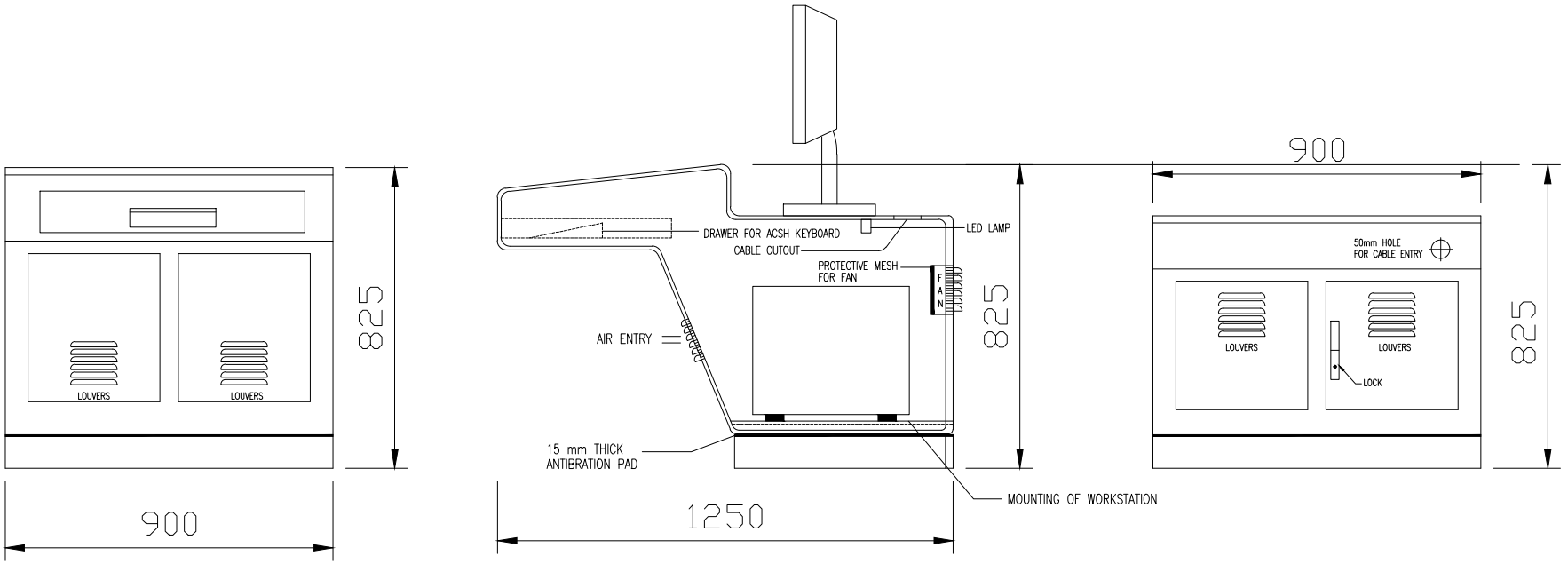
DRAWN	DESIGNED	CHECKED
VIKAS	SKM/SN	SKM
23.04.13	23.04.13	24.04.13

SCALE NTS

JOB NO. D–4027

DRG NO. 114–05–0105 | REV. 0

DRG. NO. 114-05-0108



FRONT VIEW

SIDE VIEW

REAR VIEW

NOTES

1. DO NOT SCALE, ASK WHEN IN DOUBT.
2. ALL DIMENSIONS ARE IN MILIMETRES UNLESS NOTED OTHERWISE.
3. DETAILS OF PANELS/CONSOLE/LVS SHALL BE AS PER SPECIFICATION.
4. DESK/CONSOLE FOR PA SYSTEM SHALL ALSO BE PROVIDED BY BIDDER.

ZONE	MARK	PARTICULARS	DATE	C&I	MECH.	ELEC.
	5					
	4					
	3					
	2					
	1					
	0					
	A	PRELIMINARY	25.04.13	SLN		

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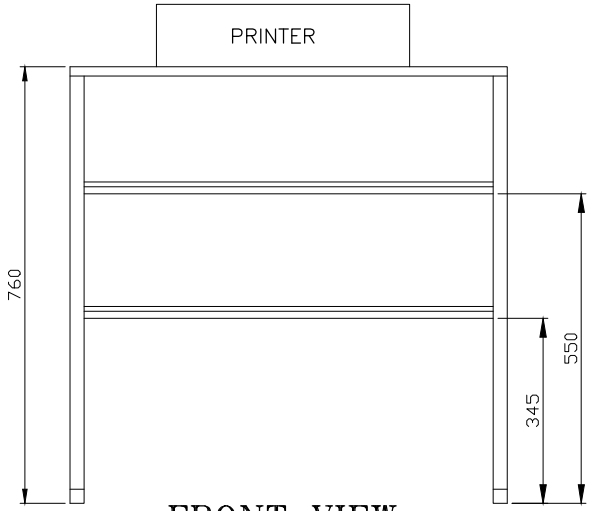
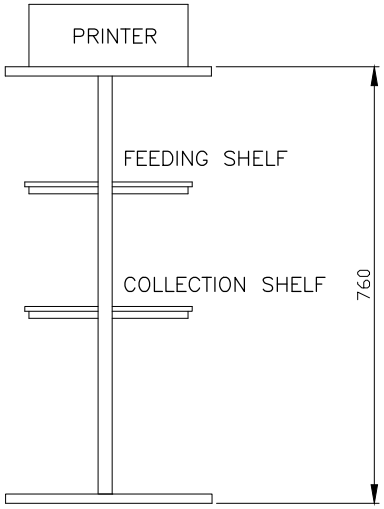
CLIENT–	TAMILNADU GEN. & DIST. CORPORATION
PROJECT–	2x660MW ENNORE SEZ COAL BASED SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI.
TITLE	OUTLINE GERENAL ARRANGEMENT (OGA) OF HMI SYSTEM
	FOR DDCMIS & PLC SYSTEM. SHEET NO. 3 of 4

DRAWN	DESIGNED	CHECKED
VIKAS	SKM/SN	SKM
23.04.13	23.04.13	24.04.13

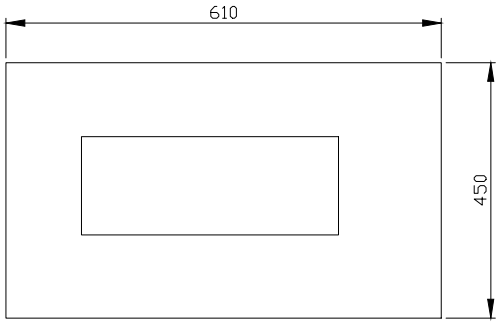
SCALE	N.T.S
JOB NO.	D–4027
DRG. NO.	114–05–0108
REV.	0



FRONT VIEW



SIDE VIEW



TOP VIEW

NOTES	NOTICE
1. DO NOT SCALE, ASK WHEN IN DOUBT. 2. ALL DIMENSIONS ARE IN MILIMETRES UNLESS NOTED OTHERWISE. 3. DESK/CONSOLE FOR PA SYSTEM SHALL ALSO BE PROVIDED BY BIDDER.	THIS DRAWING IS THE PROPERTY OF DESEIN CONSULTING ENGINEERS, NEW DELHI, AND IS LENT SUBJECT TO THE CONDITION THAT IT SHALL NOT BE REPRODUCED, COPIED, LENT OR OTHERWISE DISPOSED OF DIRECTLY OR INDIRECTLY. IT SHALL NOT BE USED TO FURNISH ANY INFORMATION FOR THE MAKING OF DRAWINGS, PRINTS OR APPARATUS OR PARTS THEREOF EXCEPT FOR THE PROJECT SPECIFICALLY PROVIDED FOR BY CONTRACT AGREEMENT WITH DESEIN.

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	5					
	4					
	3					
	2					
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	0					
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DRAWN	DESIGNED	CHECKED
VIKAS	SKM/SN	SKM
23.04.13	23.04.13	24.04.13

CLIENT– TAMILNADU GEN. & DIST. CORPORATION

SCALE N.T.S

PROJECT– 2x660MW ENNORE SEZ COAL BASED SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI.

JOB NO. D–4027

TITLE:– OGA–PRINTER TABLE FOR DDCMIS AND PLC SYSTEM

DRG. NO. 114–05–0108 | REV. 0

FOR BID PURPOSE | SHEET NO. 4 of 4

ERECTION HARDWARE

CHAPTER-9

ERECTION HARDWARE

9.00.00 PROCESS CONNECTION AND PIPING

9.00.01 General Requirements

This section covers the material requirement for instrument connection to process, instrument process, piping, tubing, supports, Instrumentation cables, control cables and power cables for connecting UPS, 24/48 V DC, unregulated power supply for cubicle illumination, compensating cables/Extension cables, transmitter racks and main accessories to be furnished under this specification and the requirements of installation and routing. Impulse lines, fittings and other accessories required for the erection of complete Instrumentation and Control System supplied under various packages of this specification shall be supplied on "as required' basis. Bidder shall offer all necessary items for this section based on his experience on similar plants, plant layout diagrams, installation drawings and other applicable sections of this specification. Based on the good engineering practices Bidder shall furnish installation drawings during the engineering of the system for Owner's review and approval .The installation of the drawings shall be suitable for his installation of his range of instrumentation.

The Bidder shall furnish and test all required erection hardware, which is necessary for proper installation and interconnection of the equipment/systems furnished by the Bidder and their integration with main equipment/systems as per the enclosed installation drawings and other applicable clause. The Bidder shall furnish all hardware and accessories to ensure that the equipment/systems furnished form a complete and operational system meeting the intent and requirement of this specification.

All materials, furnished shall conform to the latest editions of America National Standard Code for Pressure piping, Power piping, ANSI B311.1, ANSI B16.11, ASME Boiler and Pressure Vessel Codes, IBR and other applicable ASME, ANSI and Indian Standards. Schedule numbers, sizes and dimensions of all carbon steel, stainless steel and alloy seamless steel pipe shall confirm to ANSI B.36.10 and of stainless steel pipe shall confirm to ANSI B 36.19 unless otherwise specified.

All materials supplied under this section shall be suitable for intended service; process operating conditions and type of instruments used and shall fully conform to the requirements of this specification.

The Bidder is responsible for the performance of the equipment furnished on system basis any shortfall in erection material observed during erection stage shall be compensated by the Bidder at no extra cost. (Installation drawings # 114-04-0000, 0100 to 0113 shall also be referred by bidder).

9.01.00 GUIDLINE FOR INSTALLATION AND ROUTING OF INSTRUMENT PIPING

9.01.01 General Requirements

The following general erection guidelines have been enumerated here to enable the Bidder to estimate the requirement of instrument piping in plant:-

i) All instrument piping shall be in accordance with good engineering practice. It shall be finalized during engineering stage. Instrument piping shall be complete with fittings, valves and other required accessories.

ii) Instrument piping shall not be routed:-

a) Across equipment removal areas
b) Below mono-rails and cranes
c) Above or below removable gratings
d) Above or below cable trays.

iii) Primary Impulse Piping System:

a) The primary impulse piping system shall include the instrument piping and all required accessories from process tap off point (root valves onwards) up to the respective instruments. From the same source, Tee off for instruments are not allowed. Separate tapping shall be provided for each instrument. The Bidder shall provide the necessary fittings and accessories along with impulse pipes for completeness and arrangements as per the finalized Instrument Installation Diagrams. Special accessories such as reservoirs and other devices shall be installed as required for flow primary element connection as required by the design of instruments, in accordance with the instructions of the instrument manufacturer.

b) The Bidder shall prepare impulse pipe routing drawings.

c) Impulse piping shall include a blow-down line and shut-off valve adequate for the duty requirements and for withstanding continuous design pressure and temperature of process medium. For process pressure above 40 Kg/Cm^2g, double valves shall be used before connecting to the blow-down header (This arrangement shall be provided for installation for the new transmitter if the existing transmitter has the same arrangement.)

d) To assure a constant static head the connections from low pressure steam and low pressure liquid filled lines should preferably slope downward continuously towards the instrument as the instrument is mounted below the source point. If downward slope is not feasible or the instrument is mounted above the source point, the line should slope upward continuously and a “pigtail” installed at the instrument to assure a water seal for temperature protection. Upward sloping liquid lines should be used only if the process pressure is sufficient to assure a head of liquid at the instrument. Horizontal runs should have a slope of not less than 40 mm per meter and must be adequately supported to maintain a constant slope. Vacuum connections to the condenser should always slope upward to the instrument.

e) Primary process piping for steam flow, liquid flow and manometric level measurement systems should preferably slope downward from the primary element connections to the instrument. Primary piping for flue gas and air flow measurement systems should preferably slope upward from

the primary element connections to the instrument. If these requirements cannot be met, special venting or drain provisions will be required. Horizontal runs must have a slope of not less than 40 millimeters per meter and must be adequately supported to maintain a constant slope.

f) Primary process piping from the field which enters the instrument enclosure from the bottom shall extend into the enclosure approximately 150 millimeters and be equipped with a socket weld to flare less tubing coupling of stainless steel. This coupling shall be used to connect the field primary process line to the enclosure process line. The field primary process line shall be anchored to the enclosure angle with U-bolts. Holes for supporting U-bolts shall be field or drilled.

g) All impulse piping shall be supported rigidly at an interval not exceeding 1.5 meters so as to prevent excessive sag in piping. Process piping shall not be used for supporting impulse piping.

h) Impulse lines subject to severe sonic pulsations such as boiler feed pump discharge, shall be of sufficient length and of suitable configuration to scatter harmful sonic wave energy before it reaches the instrument.

i) Impulse piping shall be installed to permit thermal expansion without placing excessive stress on the piping and without affecting the gradient of slope. Long continuous straight runs of piping shall always be avoided. If required, expansion loops shall be provided at least every 2.5 meters to break the continuity.

j) All welded and screwed fittings shall conform to ANSI B16.11. Threads of piping components shall be taper pipe thread in accordance with ANSI B2.1. All threads shall be clean machine cut with all burrs and chips removed. Lubricants shall be of dry filc type. Any one of the following compounds may be used as a pipe thread sealer. Bidder shall supply adequate amount of his preferred sealer for erection purpose.

a) Permatex
b) Molycote
c) Neolube

(Teflon tape shall not be used as a pipe thread sealer).

9.01.02 <u>Impulse Piping System</u>

Impulse piping system consists of primary impulse pipes/tubes, valves, fittings, valve manifolds and other accessories between the source connection point (source shut-off valve onwards) and all instruments/devices. Impulse pipe span for supporting clamp shall be 1.5 mtr. This will also include all piping and valves etc. required for instrument drain and vent connections. The Bidder shall furnish and test all items required for completeness of this specification.

9.01.03 <u>AIR SUPPLY PIPING</u>

The piping for air supply shall be as specified below (However the Bidder shall supply the materials as required basis to complete the system in all respect)

i) Individual Supply Lines and Control Signal Lines:-

Air lines shall be ¼ inch size, connected by brass/SS316 flare less tubing fittings. Copper/SS316 tubing shall be light drawn tampered tubing conforming to ATM B75 except copper tubing in tubing cables shall be annealed soft temper tubing conforming to ASTM B68 or B75. Fittings on the branch line to facilitate connections to the individual supply line shall be cast brass screwed type.

ii) Flexible Hoses:-

Flexible hoses shall be ¼ inch SS flexible hose pipe and with Buna-N liner steel wire braid reinforcement complete with ¼ inch brass/SS316 fittings and shall have swivel male pipe threads. Each hose shall be done meter in length.

iii) Pipe Material Specification:-

The piping material shall be carbon steel hot-dipped galvanized inside and outside as per IS-1239 or the equivalent of these standard heavy quality with screwed ends. The piping threads shall be as per ASA B.2.1.

iv) Isolating Valves:-

Gate valves as per ASTM B62 inside screw rising stem screwed female ends as per ASA B.2.1 valve bonnet shall be union type and trim shall be stainless steel body rating 150 pounds ASA. Valves sizes shall be ½ inch to 2 inch.

v) Fittings:-

Forged cast steel A234 Gr. WPM galvanized inside and outside; screwed as per ASA B2.1 dimensions as per ASA B16.11, rating 2000 pounds, elbows and soft seats. The size of the fittings shall be ½ inch through 2 inch.

vi) Air Filter Regulator Set:-

An instrument Air Filter Regulator Set with mounting assembles shall be provided for each pneumatic device requiring air supply.

vii) Instrument Air Piping System:-

a) Instrument Air shall be made available by the bidder at 3.5 to 7.0 Kg/cm^2 pressure. The instrument air may be arranged as under:-

11. For the control valves and power cylinders in owner's scope but controlled by bidder's control system, the instrument air requirement for E/P converter shall be tapped from the nearby instrument air header laid by bidder / already laid existing piping with accessories available near the control valves or damper.

Complete hardware required for interfacing with Owner system shall be in bidder scope.

b) Air supply piping shall be installed at site always with a slope of over 1/100 to prevent accumulation of condensed water within the pipe.

c) All joints in the instrument air sub-header shall be of screwed type.

d) Instrument air line shall be separate for each individual instrument, equipment & drive with own isolation valve and other required hardware. Tee off of instrument line for two or more same/similar services instrument, equipment & drive are not acceptable.

e) Instrument air flushing/purging lines shall be provided for Bowl Mill DP, secondary air flow measurement instrument and other all flue gas services instruments etc.

viii) Signal / Control Air Tubing System:-

Necessary tubes with fittings and accessories for output signal from pneumatic instruments mounted in the field and control signals to final control elements shall be covered under this tubing system.

9.02.00 SPECIFICATION FOR ERECTION HARDWARE

The erection hardware shall meet the following specifications:-

	Item	**Specification**
9.02.01	**Impulse Piping**	
i)	High pressure and high temperature services (Medium: Steam & Water and furnace region)	Seamless Alloy Steel piping to ASTM A335 GR.P91/22 (schedule XXS/160 for high pressure & high temperature)
ii)	Low pressure and low temperature services (Medium: Steam & Water)	Seamless carbon steel piping to STM A106, Gr.C
iii)	Low pressure and low temperature services (Air, Flue gas)	ERW carbon steel piping to IS 1239:1973 Heavy class System)
iv)	Steam and water analysis system	Seamless stainless steel piping to ASTM A312 GR. TP-321
v)	Seamless copper tubing	ASTM B-75

9.02.02 **Fittings Double compression type**

i)	Material for socket weld fittings	ASTM A105 ASTM A182, Gr. F22 6000/3000 lbs
ii)	Dimensions of fittings	ANSI B16.11
iii)	Fittings for steam and water analysis.	Gr. F-321

9.02.03 **Valves**

i)	3 – way valves	SS body/forged CS body stellited internals and SW ends as per requirement for 2500 lb/800 lb ASA ratings.
ii)	5- valve manifolds	FAS body/FCS body 316SS stellited internals with NPT(F) SCRD ends for 3000/2500 lb/1500 lb/800 lb ASA ratings. Construction – Single block (Bar stock)
iii)	3-valve manifolds	FAS body/FCS body 316SS stellited internals with NPT(F) SCRD ends for 3000/2500 lb/1500 lb/800 lb ASA ratings. Construction – Single block (Bar stock)
iv)	2-valve manifolds	FCS body, 316SS stellited internals, NPT(F) SCRD ends. Construction – Single block (Bar stock)
v)	Isolation and drain valves	Globe valves with FAS body/FCS body, 316SS stellited internals SW ends for 3000/2500 lb/1500 lb/800 ASA ratings.

9.02.04	Condensation vessels	FAS/FCS body with NPT (F) SCRD connection and vent plugs for 3000/2500/1500/800 lb ASA ratings.
9.02.05	Racks and Associated Equipment	ANSI C83.9-1972
9.02.06	Code for pressure piping, welding and Hydrostatic testing	ANSI B-31.1

9.02.07	Flexible conduits with fittings	Lead coated, paper insulated, heat resistant flexible metallic conduits with necessary fittings.

9.02.08 3 Valve manifold shall be used, wherever Diff Pressure transmitter/switch have been used for pressure measurement.

9.02.09 5 Valve manifold shall be used for Diff. Pressure & Flow measurement Transmitters/Switches.

9.02.10 In addition to above, table # 9.1 shall also be followed for selection of specific erection hard ware as per process requirements.

9.03.00 TRANSMITTER & SWITCHES ENCLOSURES

In general, BTG process transmitters & switches installed at outdoor location and in areas where they are subjected to splashing oil, water, steam etc., shall be mounted in closed type transmitter rack. For other areas (indoor), open type racks may be used for installation of transmitters and process switches. However the actual requirement shall be finalized during detailed Engineering considering following:-

i) Transmitter/Switches enclosures shall be free standing, enclosed type offering protection against dust, moisture and vermin. Enclosures shall be suitable for outdoor installations, in thermal power plants.

ii) The enclosures shall comprise of Galvanized Sheet mounting plate internally. Also external-mounting brackets in Polyamide or Stainless Steel shall be available. Alternatively transmitter enclosures can be glass Fiber Reinforced Polyester (GRP) compression moulded and shall be weather proof.

iii) Instrument piping inside the enclosure shall conform to the specification and in line with typical installation drawings enclosed with the specification.

iv) Blow down header shall be provided inside the enclosure as called for.

v) Bulk head connection shall be provided to receive and terminate the impulse pipes from root valves.

vi) Instrument tubing, fittings and isolation, drain valves shall be to ANSI code for pressure piping. Piping/tubing shall be subject to hydrostatic tests at 1.5 times maximum system pressure.

vii) Support angles shall be provided for valve manifolds, wiring trays etc. Enclosures shall be complete with necessary bulk head fittings, junction boxes, drain header and other accessories as needed on the basis of approved hook up drawings.

viii) Sufficient spacing among adjacent transmitters shall be maintained to offer easy accessibility and operational convenience. The enclosure shall be designed with sizes to suit the grouping and to completely include all the hardware for hooking up

the transmitters to the process on the basis of approved installation diagrams. A maximum of five (5) transmitters are envisaged to be grouped in one enclosure.

x) A minimum of twenty (20) percent spare terminals shall be provided. Only one wire per terminal shall be used on the outgoing side of these blocks (for cable panel). Any common connections required shall be provided on the panel side of the block. All incoming power terminals are to be clearly identified in a manner distinctly different from all other terminals and grouped in a logical pattern.

xi) Chapter no. 6 of this volume shall also be referred for designing of Transmitter/Switches enclosures.

9.04.00 LOCAL INSTRUMENTS, LOCAL BOARDS AND TAPPING POINTS

i) All local gauges as well as sensors, Transmitters and switches any other instruments for parameters like pressure, temperature, level, flow etc for safe and efficient operation of equipment under the scope of specification, shall be provided by bidder as approved by Owner. Such equipment shall be listed by the Bidder detailing the items with the respective functions in service. All field mounted instruments shall be mounted in such a way as not to be affected by vibration & environmental conditions. Racks to mount these instruments shall be furnished by bidder complete with requisite erection hardware, tubings and junction boxes with all terminals of the instruments duly wired complete with cable glands. Groupings of instruments, actual number of racks for instruments and its construction shall be to Owners approval.

ii) Transmitters & Switches provided shall be mounted in transmitter/Switches enclosures to owner's approval. The junction box for electrical connections shall be outside the transmitter enclosures.

iii) All erection hardware required for complete installation/ implementation of entire instrumentation specified is included in bidders scope. Any change in size, type, rating or in quantity deemed necessary during engineering shall be supplied within package price with no additional financial implication to owner.

iv) Bidders scope includes providing counter flanges on pipe lines/ vessels to suit owner arranged flanged devices. Counter flanges shall be complete with gaskets, nuts, bolts and other requisite accessories for proper installation.

v) Separate and independent tapping on equipment/associated piping shall be provided to suit the philosophy of redundant primary sensors. Separate sensors for control and monitoring etc are as decided by Owner. This shall include application such as first stage pressure. Wherever the process value being measured needs to be compensated for temp, pressure variations, the tapping points for such compensating elements shall be provided in requisite number along with the tapping for the process value.

vi) Whereever transmitters & switches are provided, in addition Local gauges shall also be provided by bidder for local field monitoring.

vii) Local instruments and remote sensors & transmitters to be furnished with the equipment shall generally be as indicated herein and as per redundancy criteria indicated elsewhere but not be limited to the following: -

1. <u>Pressure Measurement</u>

i. **Pressure Gauge** for:

a) Shell pressures of all Deaerator, HP and LP heaters and other vessels.
b) Mercury manometers shall be provided during air outlet flows measurement.
c) Bleed steam pressure at extraction point for all turbine extractions and for pressure on drain lines.
d) Pressure gauges at inlets and outlets of condensate extraction pumps, main oil pump, each auxiliary oil pump, AC standby oil pump, DC Emergency oil pump, jacking oil pumps, DM makeup pumps, DMCW pumps, BFP, or any other pumps etc.
Pressure Gauge at outlet of each type of Fan.
e) Lube oil pressure before and after oil coolers, HPT & IPT front seal chamber leak off pressure.
f) MS pressure downstream of ESV, after HPT control valves and after HPT first stage, HRH steams pressure after IV, Gland steam header pressure, HPT exhaust etc.
g) Condensate pressure in condensate pump discharge header, and feed water pressure at inlet and outlet of each LP & HP heaters.
h) LP turbine exhaust pressure and condenser pressure
i) Relay/Lube/Control oil pressure, Drain oil lines pressure.
j) Pressure gauges for vacuum pumps and each pump discharge.
k) Pressure gauge at Instrument and service air header in compressor room and in the field at the main location of instrument/service air header, the pressure gauges shall be provided.
l) Pressure gauges at inlet and outlet of each heat exchanger and cooler.
m) Frame mounted Pressure Gauges (FMG) shall be provided for Main steam Pressure, Feed water pressure to economizer, CRH Steam Pressure, HRH Steam Pressure etc.
n) For condensate storage tank the pressure gauge in terms of 0-10000 mm wc or suitable range having **dial size of 300 mm or bigger size** shall be provided.
o) **U tube manometer with Hg filled for direct measurement of condenser vacuum** shall be provided in the fixed with isolation valve for local indications.
p) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering by owner.
q) Pressure gauge for all BoP packages as decided during detailed engineering by owner.

ii. **Pressure Switches**

a) Pressure switches at condensate Extraction Pump Discharge header, Boiler feed pump, seal water line or any other pumps for alarm (high & low) and interlock purpose.

b) Pressure switches for steam supply to LP/HP heaters.
c) Pressure switches for initiation of turning gear.
d) Pressure switches for control oil, jacking oil and lube oil pressure for all required alarms and interlocks.
e) Steam pressure downstream of ESV, steam pressure after first stage of HPT, gland steam header pressure and suction line from turbine glands to Gland cooler.
f) Pressure switches for condenser vacuum low, very low alarms & interlocks.
g) Condenser water box pressure for alarm interlocks.
h) Pressure switches (low & high) for individual pumps/blowers suction/discharge and discharge header – alarms, interlocks and protection
i) At the main location of instrument air header the pressure low switches shall be provided for alarms in DDCMIS
j) Pressure switches/any other process switch etc. for OLCS / Alarms / Interlocks / Protection. Pressure switches at inlet, outlet of individual pumps and discharge header of pumps for protection and auto start / stop & alarms.
k) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering as per redundancy criteria by owner.
l) Pressure switches for all BoP packages as decided during detailed engineering. by owner.

iii. **Differential Pressure Transmitters, Diff Pressure Switches & Diff. Pressure Gauges**

a) Pressure across strainers and filters.
b) Diff. Pressure Transmitters/switches/Gauges for all BoP packages as decided during detailed engineering by owner.
c) Diff. Pressure Transmitter across condenser on CW lines, Air pre heaters on air & flue gas lines, on PA lines, CEP suction strainers, Feed control station etc.
d) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering as per redundancy criteria by owner.

iv. Pressure Transmitters

a) For all services as mentioned for Pressure gauges & Pressure Switches.
b) Pressure Transmitters at condensate Extraction Pump individual Discharge and discharge header, Boiler feed pump individual Discharge and discharge header, seal water line or any other pumps/fans/HT/LT unidirectional drive for alarm (high & low) and interlock purpose.
c) Pressure transmitter for wind box (Left/Right) & pulverizer seal air fans discharge pressure.
d) Pressure Transmitters as on required basis for monitoring, interlocks & controls as per redundancy criteria and approved by owner.
e) Above are the minimum requirements, actual quantities shall be as decided during detailed engineering as per redundancy criteria and approved by owner.
f) Pressure Transmitters for all BoP packages as decided during detailed engineering by owner.

2. Temperature Measurments:-

The Bidder shall furnish all temperature sensing elements to be installed in their piping. The scope of supply shall include, but not limited to the following: -

i) Duplex RTDs for all bearing, drain oil from bearings, LPT exhaust steam, 3 no's of duplex RTDs each on left and right CW outlet of condenser etc.

ii) 6 no. duplex or 12 no. simplex Embedded temperature detectors for various motor stator windings and duplex RTDs for Motor/Pump bearing temp.

iii) Chromel-alumel surface/other thermocouples for turbine casings, ESV, IV bodies, superheated steam, hot reheat steam piping, steam of first stage HPT, inlet bowl of IPT, steam exhaust of HPT, down stream of ESV and IV, steam in ESVs and IVs, steam admission pipes metal temperatures, HPC, IPC flange metal temperature etc.

iv) For all HP heaters remote monitoring with redundant independent sensors of inlet/outlet temperatures of feed water and extraction steam shall be provided in addition to local gauges.

v) For all LP heaters remote monitoring with redundant independent sensors of inlet/outlet temperatures of feed water and extraction steam shall be provided in addition to local gauges.

iv) Temperature sensors for HP-LP bypass system for measurement as well as for control.

v) Adequate number of temperature Elements shall be furnished to provide initiating contacts for temperature interlocking and trip circuits. The temperature elements shall be provided, but not limited to the following: -

Steam temperature of HPT exhaust, steam temperature after ESV (L&R), IV (L&R), LPT exhaust hood steam, drain oil temperature of all journal bearings and thrust bearing & lube oil header temperatures, thrust bearing of each condensate extraction pump and vacuum pump protection, interlocks.

vi) Metal Temp measurement and steam temp measurement at each super heater & Reheater location.

vii) Temp. Element & Temp gauges at Feed water line to economizer inlet, economizer to steam separator, spray water lines to desuperheaters, Soot blower steam, Soot blower steam drain lines, steam drain lines, Flue gas & air lines etc

viii) Temp. Measurements (Local & remote) for all BoP packages as decided during detailed engineering.

ix) Thermocouples for Temp. above 200 deg C shall be provided by bidder.

x) For plate heat exchangers, spare thermowell provision shall be made at inlet & outlet of ACW & DMCW lines in addition to local & remote temperature monitoring points.

xi) Each ESP Hopper shall be provided with RTDs to control the temperature of ash through Hopper heater.

xii) Temperature gauges.

a) For bearing temperatures AC and DC lube oil pumps, LPT exhaust hood etc.

b) For condensate and feed water at inlet and outlet of HP heaters, Vacuum pumps, LP heaters etc.

c) Steam & water inlet/outlet of LP and HP heaters, steam and air mixture inlet to vacuum pumps, and drain lines etc.
d) Journal/thrust bearing drain oil, lube oil at inlet/outlet of oil coolers, cooling water at inlet and outlet of oil coolers etc.
e) Thrust bearing of each condensate extraction pump.
f) Temp. Gauges at inlet and outlet of each heat exchanger and cooler.
g) Frame mounted Temperature Gauges (FMG) shall be provided for Main steam Temperature, Feed water Temperature to economizer, CRH Steam Temperature, HRH Steam Temperature etc

xiii) Above are the min. requirements, actual quantities shall be as decided during detailed engineering by owner.

3. Level Measurement

i) Level gauges - level gauges for boiler separator, HP heaters, LP heaters, deaerator, drain cooler, gland steam cooler, vacuum tanks, condenser hot well CBD tank, stator water tank, Stator water expansion tank and other pressure vessels, main oil tank and all oil tanks in BTG & BOP package. The level gauges shall be mica shielded steel armoured transparent glass type. Level gauges for condenser hot well shall be provided on both sides.

ii) Level switches for HP/LP heaters, drain cooler, gland steam cooler, condenser hot well, deaerator, main oil tank and other pressure vessels, tanks, sumps etc. The separate switches for high, very high and low levels shall be provided as per interlocks and protection requirements.

External cage mounted magnetic level switches/ displacer type shall be employed for low pressure & low temp. services.

However conductivity type level switches shall be provided for high pressure & high temp services like HP heaters, CRH/HRH drain Pot, Turbine Drains etc.

iii) Level Transmitters (Type as per Owner approval) for open sump/tank/bunker/vessel/heaters.

iv) Level measurement for all BoP packages as decided during detailed engineering.

v) Level switches for OLCS / Alarms / Interlocks / Protection. Level switches for sump/tank level high/normal/ low/very low interlocks.

vi) Each ESP hopper must be provided with 3 nos. level switch (switches 2 nos. for high level and One no. for low level.)

vii) Above are the min. requirements, actual quantities shall be as decided during detailed engineering by owner.

4. Flow Measurements:-

a) Primary Elements: Flow nozzles shall be used for feed water flow and other critical measurements where weld-in construction is required. Flow nozzles shall be made of stainless steel, with three sets of pressure taps installed in the pipe wall where required. One no. spare set of pressure tap shall also be provided on flow nozzle,

wherever required. Installation of flow nozzles and pressure taps shall be made in the pipe fabricator's shop and shall be witnessed by a representative from the flow nozzle manufacturer.

b) Paddle type orifice plates shall be used for other flow measurements where flanged construction and higher pressure loss are acceptable. Orifice plates shall be made of stainless steel. Orifice flanges shall be of the raised face weld neck type with dual sets of taps.

c) Construction and installation of flow nozzles and orifices shall conform to the requirements of ASME Performance Test Code PTC-19.5, and discharge coefficients shall be predicted in accordance with data published in ASME Research Report on Fluid Meters.

d) Airfoil or venturi flow sections, shall be used for measuring boiler combustion airflow.

e) A special high accuracy flow nozzle pipe shall be provided to determine feed water flow to the economizer. This nozzle shall be hydraulically calibrated and utilized for feed water flow control and for turbine testing as described in ASME PTC 6 (latest revision).

f) Orifice plates shall be supplied with carrier rings as per process requirement.

g) Doppler effect type flow meters shall be used for sludge applications.

h) For Raw water, water treatment plant and effluent treatment plant, ultrasonic type flow meters to be used.

i) Secondary Elements: Secondary elements for differential type flow sensors shall be strain gauge or capacitance type differential pressure transmitters. Square root extraction required for the DP transmitters shall be performed electronically in the transmitter itself.

j) HFO/LDO flow meters shall be based on coriolis mass flow technology. Fuel Oil meters shall be provided for fuel oil unloading system and near boiler after day oil tank (at main supply & return lie).

k) Flow nozzles shall be provided for following services in main plant:-

i) Steam flow measurement for BFP Turbines.
ii) Feed water flow measurement
iii) Auxiliary steam flow measurements
iv) HP bypass flow measurements
v) BFP suction flow.
vi) Deaerator water flow measurement
vii) HP heaters drain Flow measurements.

Orifices shall be provided for following services:-

i) Spray water flow measurement

ii) Condensate flow measurements
iii) DM/hotwell makeup to condenser.
iv.) Condensate dump flow to CST
v) Gland Steam Condensate flow measurements

l) For DM water flow & Ash Slurry flows measurements online electromagnetic flow meter shall be used.

m) At CW & ACW pump discharge headers flow transmitters shall be provided (Non Contact ultrasonic Type are preferable). In addition flow measurement shall also be provided for CW water used any where except condenser service.

n) Instrument and Service Air - Vortex/Swirl type Flow meter

o) Flow transmitters for general applications shall be of the differential pressure type

.

p) Flow switches for OLCS / Alarms / Interlocks / Protection.

q) Lubricating oil Flow transmitter/meter with switch shall be provided for Bearing systems of APH, FD, PA, etc.,

r) Sight glasses flapper indication type shall be provided on lube oil cooling water piping as required to ensure indication of fluid flow.

s) On line Fuel flow & velocity measurement facility in each Pulverized Fuel (PF) pipe for each coal pulveriser shall be provided by bidder for accurate, absolute and simultaneous measurement of coal velocity, coal density, coal mass flow rate and air-to-fuel ratio. The equipments shall compromise of sensors working on micro wave technology.

t) In addition to the **conventional triple DP measurement techniques** involving venturi/Airfoil for secondary air flow measurement, One number **Flow measurement** system each on Left side and Right side shall be provided **as redundant/checking measurement for secondary air flow** which could be used in the optimization package.

On line secondary air flow & velocity measurement facility in each on left side & right side shall be provided by bidder for accurate, absolute and simultaneous measurement of air velocity & flow rate. The equipments shall compromise of sensors working on tribo-electric (Correlation technique) technology.

u) Any other flow element/meter required for system shall be finalised as per system requirement and as per approved drawings/documents by owner.

9.05.00 **Process Connections**

The type of instrument source connection shall depend upon the process parameters and the tapping size. The source connection drawings shall be finalised during the engineering stage.

Size of tapping point stub, number and size of root valves for different types of measurements are as follows:

Sl. No.	Quantity of root valves	Size of stub and root valve	Service Condition
Pressure and Differential Pressure Measurement			
(i)	2	25NB	≥ 40 bar(g) OR 425^{0}C
(ii)	1	15NB	< 40 bar(g) AND 425^{0}C.
Level Measurement			
(a)	**Level Gauge & Switch**		
(i)	2	25NB	≥ 40 bar(g) OR 425^{0}C
(ii)	1	25NB	< 40 bar(g) AND 425^{0}C
(b)	**Level transmitter (displacement type)**		
(i)	2	40NB	≥40 bar(g) OR 425^{0}C
(ii)	1	40NB	<40 bar(g) AND 425^{0}C
(c)	**Stand pipe for level measuring instrument**		
(i)	2	80 NB	≥40 bar(g) OR 425^{0}C
(ii)	1	80 NB	< 40 bar(g) AND 425^{0}C
Flow Measurement			
(i)	2	25NB	≥ 40bar(g) OR 425^{0}C
(ii)	1	25NB	< 40 bar(g) AND 425^{0}C
Sampling system measurement (Steam and Water Service)			
(i)	2	25 NB	≥40 bar(g) OR 425^{0}C
(ii)	1	25 NB	< 40 bar(g) AND 425^{0}C

Technical Specifications for C&I Systems-Table-No. 9.1

S.No.	System/Line Description	Piping Class	Impulse Pipe material	Schedule (Size)	Materials for fitting/ valve body	Valve steam material	Rating of Piping Fitting	Pressure Class of valve
1	Main steam, Up steam & down stream of HP bypass and up stream of auxiliary steam pressure reducing valve.	A	ASTM-A335 Gr.P-91/22 (Note-2)	XXS (½ Inch)	Note-3	Note-3	9000lb	3000 SPL
2	BFP discharge/ superheater attemperator/spray to PRDS	B	ASTM-A106 Gr. C	160 (½ Inch)	Note-3	ASTM-A-182 Gr.F6a	6000lb	2500 SPL
3	Reheater attemperator	C	ASTM-A106 Gr. C	160 (½ Inch)	ASTM-A-105	ASTM-A-182 Gr.F6a	6000lb	1500 SPL
4	Hot. Reheat/Down stream of Aux.Steam pressure reducing valve upto desuperheater/flash tank drain manifold, HRH upstream & down stream of LP Bypass valve.	D	ASTM-A335 Gr.P-91/22 (Note-2)	160 (½ Inch)	ASTM-A182 Gr.F-22	Note-3	3000lb	2500 SPL
5	Cold reheat upto Tee-off for HP bypass.	E	ASTM-A335 Gr.P-22	80 (½ Inch)	ASTM-A182 Gr.F-22	ASTM-A-182 Gr.F6a	3000lb	800
6	Cold reheat down steam of Tee-off (HP Bypass)	F	ASTM-A106 Gr. C	80 (½ Inch)	ASTM-A105	ASTM-A-182 Gr.F6a	3000lb	800

7	BFP suction/condensate system/Extraction to LPH/HPH and Extractions to BFPT, Desecrator, auxiliary steam.	G	ASTM-A106 Gr. C, ASTM-A335 Gr.P-11/22	80 (½ Inch)	ASTM-A105	ASTM-A-182 Gr.F6a	3000lb	800
8	Air/Flue gas outside furnace.	M	ASTM-A106 Gr.B/C	80 (3/4 Inch)	ASTM-A105	ASTM-A-182 Gr.F6a	3000lb	800
9	Air flue gas inside furnace	N	ASTM-A335 Gr.P-22	80 (3/4 Inch)	ASTM-A182 Gr.F-22	ASTM-A-182 Gr.F6a	3000lb	800
10.	Purge Air	O	ASTM-A106 Gr.C	80 (3/4 Inch)	ASTM-A105	SS316	3000lb	800
11.	DM Cooling water	P	ASTM-A312 TP 316	80/40 (1/2 Inch)	ASTM – A 182 F 316	SS316	3000lb	800
12.	CW & ACW	Q	ASTM-A106 Gr.C	80 (1/2 Inch)	ASTM-A105	SS316	3000lb	800

Note:-

1). Above requirements are minimum to be complied by bidder. Rating of piping / fittings / valves etc. is subjected to be approved by owner as per the final design pressure & temperature finalized during the detailed engineering, as per ANSI B 31.1.
2). In case temperature is more than 540 deg C, the material shall be P-91 only.
3). Material shall be compatible with that of the impulse pipe material and design parameter.
4). For DM Plant or DM water services, complete erection Hardware material shall be SS316 only.

LIST OF SUB VENDORS:

FOR ELECTRO MECHANICAL ITEMS			
SR No.	**Items**	**Approved Vendor**	**Place / Location**
1.0	Horziontal/Vertical Centrifugal Pump	KBL	Kirolskarwadi
		M&P	Pune
		Flowmore	Ghaziabad
		Sulzer pumps india ltd.	Navi mumbai
		Worthington	Ghaziabad
		Bharat pumps & compressors ltd	Allahabad
		Flowserve India Controls Pvt. Ltd.	Coimbatore
		Jyoti ltd.	Vadodara
2.0	Vertical Centrifugal Pump	Kishore Pump	Pune
		Sam Turbo	Coimbatore
		KSB	Pune
		Best and Crompton	Chennai
		Voltas	Mumbai
		V-Flo Pumps & Systems Co. Ltd.,	Beijing, China
		Kishore Pump	Pune
3.0	Strainers (Y-Type & Basket Type)	Multitetex Filtration Engg Ltd.	Noida
		Sarojini Enterprises	Kolkata
		Otoklin Filters	Mumbai
		BHATIA ENGINEERING CO.	Delhi
		JAYPEE INDUSTRIES PVT. LTD.	Delhi
		FILTERATION ENGINEERS (I) PVT. LTD.	MUMBAI
		OTOKLIN GLOBAL BUSINESS LIMITED	Mumbai
		SUNGOV Engg. PVT. LTD.	Delhi
		Grand Prix	Faridabad
4.0	Fittings (metallic)	M.S. Fittings	Kolkata
		Metal lloyds	Mumbai
		True Forge	Faridabad
		Tube Products	Baroda
		NL Hazra	Kolkata
		Gujrat Infra Pipes	Baroda
		Edwards	USA
		Pipefit Engineers	Baroda
		Siddarth & Gautam	Faridabad
		EBY	Mumbai
		Reliance Forge	Mumbai
5.0	MS/GI ERW Pipes	SAIL	Rourkela
		Jindal	Ghazibad/ Hissar
		Surya Roshni	Bahadur Garh
		TATA Tube	Jamshedpur
		PSL	Chennai/Vizag/Kutch/Daman
		Lalit Profile	Thane
		Samshi Pipes Industries	Vadodara
		Mukut Pipes	Rajpura
		Indus Tubes	G B Nagar
		Mann Ind	Indore
		Surendra Engg	Rajpura
		Pratibha Pipes & Structure Pvt Ltd	Thane
		JCO Gas Pipe	Chindwara
		Nukat Tanks and Vessels	Tarapur
		DADU Pipes	Sikrandrabad
		Good Luck Tubes	Sikandrabad
		Advance Steel Tubes	Sahibabad
		Bihar Tubes	Sikandrabad
		Hi Tech Pipes	Sikandrabad
		Ratnamani	Kutch/Ahmedabad/Chhatral
		Maharashtra Seamless	Raigad
		Welspun	Anjar/Bharuch
6.0	Seamless Pipes	ISMT	Ahmednagar/Baramati
		Maharashtra Seamless	Raigad
7.0	S.S. Pipes	REMI	Mumbai

	(For small Quantity 500 m)		
		Ratmani	Ahmedabad
		Apex Tubes	Behror
		Choksi	Ahmedabad
8.0	CI Gate/ Globe/NRV/ SRV (Manual and motorized)	H.Sarkar	Howrah
		A.V. VALVES LTD	Agra
		Leader	Jalandhar
		SURYA VALVES AND INSTRUMENTS MFG CO.	Chennai
		ATAM VALVES PVT. LTD.	JALANDHAR
		FLUIDLINE VALVES COMPANY PVT.LTD.	Mumbai
		G.M. DALUI AND SONS PVT.LTD.	Howrah
		KBL	Kondhapuri
		Bankim	Kolkata
		VENUS PUMPS AND ENGG. WORKS	Kolkata
9.0	GM valve	A.V. VALVES LTD	Agra
		ATAM VALVES PVT. LTD.	Mumbai
		Leader	Jalandhar
		VALTECH INDUSTRIES	
		SANT VALVES PVT. LTD.	Jalandhar
13.0	Motor	Marathon,	kolkata
		Crompton Greaves	Ahmednagar
		NGEF	Bangalore
		ABB	Bangalore/Faridabad
		Siemens	Mumbai
		Jyoti	Baroda
		LHP	Solapur
		BHEL	Bhopal
		Bharat Electric (BHEL)	
		Bharat Bijlee	Mumbai
		KEC	Bangalore/Hubli
15.0	Steel Plate, Structural Steel tank	SAIL	
		Essar Steel	
		TISCO	
		RINL	
		Jindal	
		Lloyd	
		Ispat	
		Indian Iron & Steel Co. Ltd	
16.0	Control / Power Cable	Cords Cable	Bhiwadi
		Radiant Cables	Hyderabad
		PolyCab	Daman
		KEI	Bhiwadi
		Nicco	Kolkata
		Ravin Cables	Pune
		Incab	Pune
		HVPL	Faridabad
		Torrent cable	Nadiad
		Havells	Alwar
		Paramount	Khushkhera
		SRI Ram Cables	Bhiwadi
		Thermocables	Hyderabad
		Torrent cable	Nadiad
		Universal Cables	SATNA
		Gemscab	Bhiwadi
		Delton	Faridabad
17.0	AGITATOR	REMI	MUMBAI
		FIBRE & FIBRE PRODUTS	
		STANDARD ENGINEERS	MUMBAI
		CROMPTON GREAVES	AHAMADNAGAR
18.0	ORIFICE PLATE	MICRO PRECISION	FARIDABAD
		INSTRUMENTAION LTD	PALGHAT
		CARLO DYNAMICS	HYDRABAD
19.0	BUTTERFLY VALVE	ADVANCE VALVES PVT. LTD.	NOIDA
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD
		INSTRUMENTATION LTD.	PALAKKAD-KERALA
		INTERVALVE (INDIA) LTD.	PUNE

		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI
		SURYA VALVES AND INSTRUMENTS MFG CO.	CHENNAI
		PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED	NAVI MUMBAI
		UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED,	KOLKATA
		VENUS PUMPS AND ENGG. WORKS	KOLKATA
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI
20.0	DUAL PLATE CHECK VALVE	ADVANCE VALVES PVT. LTD.	NOIDA
		ASIAN INDUSTRIAL VALVES & INSTRUMENTS.	CHENAI
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD
		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI
		VENUS PUMPS AND ENGG. WORKS	KOLKATA
21.0	ELECTRICAL HOIST	ARMSEL MHE PVT. LTD	BANGALORE
		ALPHA SERVICES	NEW DELHI
		CONSOLIDATED HOISTS PVT LTD	PUNE
		CENTURY CRANE ENGINEERS PVT. LTD.	FARIDABAD
		EDDY CRANES PVT. LTD.	MUMBAI
		GRIP ENGINEERS PVT. LTD.,	FARIDABAD
		GLOBAL TECHNOLOGIES	HYDERABAD
		HERCULES HOISTS LTD.	RAIGAD
		LIFTING EQUIPMENTS AND ACCESSORIES	NEW DELHI
		MANGLA HOISTS PVT LTD	NEW DELHI
		REVA INDUSTRIES LTD.	FARIDABAD
		ROCKWELL HOISTO CRANES PVT. LTD.	JHAJJAR-HARYANA
		SAFEX ENERGY PVT. LTD.	AHMEDABAD
		TUOBRO FURGUSON (INDIA) PVT LTD	KOLKATA-
22.0	**BALL VALVE**	BDK	HUBLI
		LEADER	JALANDHAR
		BANKIM	KOLKATA
		H SARKAR	KOLKATA
		AV VALVES	AGRA
		HAWA VALVES	MUMBAI
		FLOW CHEM	AHMEDABAD
		STEEL STRON VALVES	MUMBAI
		AKAY VALVES LTD.	MUMBAI
		AQUA VALVES PVT.LTD.	KARNATAKA
		CRESCENT VALVES	MUMBAI
		FISHER SANMAR LIMITED	CHENNAI
		HABONIM VAAS AUTOMATION PVT LTD.,CHENNAI	CHENNAI
		KIRLOSKAR BROTHERS LTD.	PUNE
		KSB PUMPS LTD.	MUMBAI
		MICROFINISH VALVES PVT LTD.	HUBLI
		MICON VALVES (INDIA) PVT.LTD	MUMBAI
		PEC VALVES	MUMBAI
23.0	SLUICE GATE	H SARKAR	KOLKATA
		JASH ENGINEERING	INDORE
		YASHWANT	MIRAJ
		GLOBETECH	HOWRAH
24.0	DIAPHRAGM VALVE	PROCON ENGINEERES	MUMBAI
		HAWA VALVES	MUMBAI
		BDK VALVES	HUBLI
		FOURESS	BANALORE
		INERVALVE	GUJRAT
25.0	3 WAY VALVE	HI TECH	AHMEDABAD
		ADVANCE VALVES PVT.LTD	NOIDA
		BDK	HUBLI
		FOURESS ENGG.INDIA LTD.	MUMBAI
		FLUIDLINEVALVES COMPANY PRIVATE LTD.,	MUMBAI
		INSTRUMENTATION LTD.	PALAKAD
		KIRLOSKAR BROTHERS LTD.	PUNE

		VENUS PUMP & ENGG. WORKS	KOLKATA
		SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY	CHENNAI
		STAFFORD CONTROLS LIMITED	PUNE
		MICON VALVES (INDIA) PVT.LTD	MUMBAI
26.0	PLUG VALVE	FISHER SANMAR LIMITED	CHENNAI
		BDK	HUBLI
		LARSEN & TOUBRO LTD.	MUMBAI
		LEADER	JALANDHAR
		MICON VALVES (INDIA) PVT.LTD	MUMBAI
27.0	FLANGES (SS/CS)	BHARAT FORGE	PUNE
		RELIANCE FORGE	MUMBAI
		MS FITTINGS	KOLKATA
28.0	POSITIVE DISPLACEMETN PUMP	MILTON ROY INIDA	CHENNAI
		SWELLORE	AHMEDABAD
		VK PUMP	NASIK
		DENCIL PUMP	MUMBAI
29.0	VALVES (GATE/GLOBE/NRV/ BALL)-CPVC/PVC/PP/ HDPE/PVDF	GEROGE FISHCHER IPING SYSTEMS PVT LTD	DELHI
		ASTROL PLYTECHINC LTD	AHMEDABAD
30.0	PIPE/FITTINGS/ FLANGES CPVC/PVC/ PP/HDPE/PFDF	GEROGE FISHCHER IPING SYSTEMS PVT LTD	DELHI
		ASTROL PLYTECHINC LTD	AHMEDABAD
31.0	RUBBER LINING FOR PIPES/TANK	RISHI INDUTRIES	SONEPET
		INDUSTRIAL LINING LTD	BARODA
		MIL	CHENNAI
32.0	NON METALIC PUMP (CENTRIFUGAL)	Anticorrosive Pumps	Mumbai
		Rajedia Pumps	Gujrat
		Price Pumps	Mumbai
33.0	Blower	Everest	Delhi
		Kay International	Haryana
		Swam Pneumatics	Delhi
		Kulkarni brothers	Mumbai
34.0	HDPE TANK	SINTEX	
35.0	PRP TANK	TIANODE	CHENNAI
		BHAVI PLAST	MUMBAI
36.0	HYDROGEN DETECTOR	Detection Instruments	INDIA
		HACH	USA
		HONEYWELL	UK
		ORBIT	INDIA
37.0	PAINT	BERGER	
		ASIAN PAINTS	
		SHALIMAR	
		J&N	
38.0	TRANSFORMER RECTIFIER	RAYCHEM RPG	PUNE
		Associated Powercon	PUNE
		HIND RECTIFIER	NASIK
39.0	SELF CLEANING STRAINER	OTOKLIN	MUMBAI
		AMIAD FILTRATION SYSTEMS LTD	ISAREL
		GEA BGR ENERGY SYSTEM INDIA LTD	Chennai
		MULTITEX FILTRATION ENGINEERS LIMITED,	Delhi
		FILTERATION ENGINEERS (I) PVT. LTD.	mumbai
40.0	Chain pulley block	INDEF	
		BRADY	
		Lifting Equipment	
		GRIP ENGG	
		Tractel tirfor	
		REVA	
		TECHNO INDUSTRIES	

FOR C&I ITEMS (TNEB AND BHEL APPROVED)			
SR No.	**Items**	**Approved Vendor**	**Place / Location**
1.0	CONTROL VALVE	DEZURIK-COPES VULCAN LTD	UK
		CONTROL COMPONENT INC	USA
		DRESSER VALVE INDIA PVT LTD	
		FISHER SANMAR LIMITED	
		INSTRUMENTATION LTD	
		FORBES MARSHALL ARCA PVT LTE	
2.0	FLOW ELEMENT	BRISTOL BABCOCK LTD	UK
		BALIGA LIGHTING EQUIPMENTS PVT LTD	CHENNAI
		ENGINEERING SPECIALITIES PVT LTD	
		INSTRUMENTATION LTD	
		MICRO PRECISION PRODUCTS	
		STAR MECH CONTROLS PVT LTD	
3.0	ANUBAR (DELTA TUBE)	STAR MECH CONTROLS (I) PVT LTD	
		SWITZER INSTRUMENT LTD	
4.0	CONTROL VALVE	CONTROL COMPONENT INC.	
		INSTRUMENTATION LTD	
		WEIR VALVES AND CONTROLS UK LTD	
		FORBES MARSHAL ARCA PVT LTD	
		RK CONTROLS INSTRUMENTS PVT LTD	
		EMERSON	CHENNAI
		MIL CONTROLS	
		METSO SINGAPORE PTE LTD	
5.0	FLOW ELEMENT NOZZLE	HYDROPNEUMATICS PVT. LTD.	
		INSTRUMENTATION LTD.	
		MICRO PRECISION PRODUCTS PVT. LTD.	
		STAR-MECH CONTROLS (I) PVT.LTD.	
		SEIKO FLOW CONTROL GMBH	
6.0	FLOW ELEMENT ORIFICE	MICRO PRECISION PRODUCTS PVT. LTD.	
		INSTRUMENTATION LTD.	
		HYDROPNEUMATICS PVT. LTD.	
		Flow Star Engineering Pvt. Ltd.,	
		STAR-MECH CONTROLS (I) PVT.LTD.	
		MINCO (INDIA) PRIVATE LIMITED	
		INSTRUMENTATION ENGINEERS PVT LTD	
7.0	PLC	GE Intelligent Platforms Private Limited	
		SIEMENS LIMITED	
		ROCKWELL AUTOMATION INDIA LTD	
		SCHNEIDER ELECTRIC INDIA PVT.LTD.	
		Honeywell Automation India Limited	
8.0	ROTAMETER	FLOWTECH INSTRUMENTS SERVICES	
		Flow Star Engineering Pvt. Ltd.,	
		EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.	
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	
		INSTRUMENTATION ENGINEERS PVT LTD	
9.0	SIGHT FLOW INDICATORS	BLISS ANAND PVT. LTD.	
		B.K.EQUIPMENTS PVT.LTD.	
		SIGMA INSTRUMENTS CO.	
		FLOWTECH INSTRUMENTS SERVICES	
		INSTRUMENTATION ENGINEERS PVT LTD	
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	
		BLISS ANAND PVT. LTD.	
		B.K.EQUIPMENTS PVT.LTD.	
		SIGMA INSTRUMENTS CO.	

FOR C&I ITEMS (BHEL APPROVED)			
SR No.	**Items**	**Approved Vendor**	**Place / Location**
1.0	ANALYTICAL INSTS.SAMPLE COOLER	FORBES MARSHAL PVT. LTD.	PUNE
		EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	MUMBAI
		SIEMENS LIMITED	MUMBAI
2.0	ANUBAR (DELTA TUBE)	MICRO PRECISION PRODUCTS PVT LTD	FARIDABAD
		DYNAFLUID VALVES AND FLOW CONTROLS	BELGAUM
		TM TECNOMATIC SPA	ITALY
3.0	COL JUNCTION COMPENSATION BOX (CJCB)	CREATIVE INSTRUMENTS AND CONTROLS	BANGALORE
4.0	CONTROL VALVE	SPX FLOW TECHNOLOGIY	AHMEDABAD
		DRESSER VALVE INDIA PVT LTD	COIMBATORE
		DAUME REGELARMATUREN GMBH	GERMANY
		HOLTER REFELARMATUREN GMBH & CO.KG	GERMANY
		KOSO INDIA PVT LTED	NASHIK
		PARCOL SPA	ITALY
		SUZHOU DELAN ENERGY SCIENCE & TECH CO LTD	CHINA
		VALVITALIA SPA	ITALY
		WALDEMAR PRUSS ARMATURENFABRIK GMBH	GERMANY
5.0	ELECTRO MAGNETIC FLOW METER	ELECTRONET EQUIPMENT	PUNE
		ADEPT FLUIDYNE PVT LTD	PUNE
6.0	FLOW ELEMENT	STAR-MECH CONTROLS (I) PVT LTED	PUNE
		INSTRUMENTATION LTD	PALAKKAD
		MICRO PRESISION PRODUCTS PVT LTD	FARIDABAD
		TM TECNOMATIC SPA	ITALY
7.0	FLOW ELEMENT NOZZLE	MINCO (INDIA) FLOW ELEMENTS PVT LTD	GOA
		DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD	BELGAUM
8.0	FLOW ELEMENT ORIFICE	HYDROPNEMATICS PVT LTD	GOA
		DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD	BELGAUM
9.0	INSTRUMENT FITTINGS	PRECISION ENGG INDUSTIES	MUMBAI
		PANAM ENGINEERS	MUMBAI
		PERFECT INSTRUMENTATION COTROL (INDIA) PVT LTD	MUMBAI
		COMFIT AND VALVES PVT LTD	AHMEDABAD
		AURA INCORPORATED	NEW DELHI
		ARYA CRAFTS AND ENGG PVT LTD	MUMBAI
		FLUIDFIT ENGINEERS PVT LTD	MUMBAI
		HP VALVES AND FITTINGS INDIA PVT LTD	CHENNAI.
		FLUID CONTROLS PVT LTD	MUMBAI
		VIKAS INDUSTRIAL PRODUCTS	NOIDA
10.0	INSTRUMENT PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	NOIDA
		FLUID CONTROLS PVT LTD	MUMBAI
		AURA INCORPORATED	NEW DELHI
		PRECISION ENGG INDUSTIES	MUMBAI
11.0	INSTRUMENT TUBE FITTINGS	PRECISION ENGG INDUSTIES	MUMBAI
		AURA INCORPORATED	NEW DELHI
		FLUID CONTROLS PVT LTD	MUMBAI
		VIKAS INDUSTRIAL PRODUCTS	NOIDA
12.0	JUNCTION BOX	SHRENIK & COMPANY	AHMEDABAD
		FLEXPRO ELECTRICALS PVT LTD	KABILPORE
		AJMERA INDUSTRIAL & ENGG WORKS	MUMBAI
		KS ISNTRUMENTS PVT LTD	BANGALORE
		SUCHITRA INDUSTRIES	BANGAORE
13.0	LEVEL GAUGE	SIGMA INSTRUMENTS	MUMBAI
		BLISS ANAND PVT LTD	HARYANA
		TOSHNIWAL BROTHERS PVT LTD	AJMER
14.0	LEVEL SWITCH (CAPACITANCE TYPE)	SAPCON INSTRUMENT PVT LTD	Indore
		BAUMER TECH INDIA PVT LTD	MUMBAI
		V AUTAMAT	NEW DELHI
		BLISS ANAND	HARYANA

		FLOW STAR ENGG PVT LTD	FARIDABAD
		SIGMA INSTRUMENT	MUMBAI
		SOR INC	USA
		LEVCON INSTRUEMENTS PVT LTD	KOLKATA
		PUNE TECHTROL	PUNE
		NIVO CONTROLS PVT LTD	INDORE
15.0	LEVEL SWITCH (CONDUCTIVITY TYPE)	LEVCON INSTRUEMENTS PVT LTD	KOLKATA
		SOR INC	USA
		SIGMA INSTRUMENT	MUMBAI
		RAMAN INSTRUEMENTS PVT LTD	MUMBAI
		HI-TECH SYSTM AND SERVICES LTD	KOLKATA
		BLISS ANAND	HARYANA
		V AUTAMAT	NEW DELHI
		SAPCON INSTRUMENT PVT LTD	Indore
16.0	LEVEL SWITCH (FLOAT TYPE)	V AUTAMAT	NEW DELHI
		BAUMER TECH INDIA PVT LTD	MUMBAI
		BLISS ANAND	HARYANA
		DK INSTRUMENTS	KOLKATA
		GENERAL INSTRUMENT	MUMBAI
		SIGMA INSTRUMENT	MUMBAI
		SOR INC	USA
		SBEM PVT LTD	PUNE
		LEVCON INSTRUEMENTS PVT LTD	KOLKATA
		PUNE TECHTROL	PUNE
17.0	PRESSRUE GAUGE AND DIFF PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD	HYDERABAD
		H GURU	BANGALORE
		H GURU	KOLKATA
		GAUGE BOUDRON INDIA PVT LTD	MUMBAI
		BOSE PANDA	KOLKATA
		PRECISION MASS PRODUCTS PVT LTD	GUJRAT
		AN INSTRUMENT	KOLKATA
		BAUMER	MUMBAI
18.0	PRESSRUE SWITCH AND DIFF PRESSURE SWITCH	PRECISION MASS PRODUCTS	GUJARAT
		BARKSDALE GMBH	GERMANY
		DRESSER INDUSTRIES INC	GUJARAT
		INDOFS (INDIA) LTD	CHENNAI
		GENERAL INSTRUMENT CONSORTIUM	MUMBAI
		KAUSTUBH UDYOG	PUNE
		INDFOS INDUSTRIES LIMITED	GHAZIABAD
		SOR INC	USA
		SWITZER PROCESS INSTRUMENTS PVT LTD	CHENNAI
19.0	PLC	MITSUBISHI ELECTRIC INDIA PVT LTD	MUMBAI
20.0	TEMP ELEMENT	GOA INSTRUMENTS	GOA
		GAUGE BOURDON INDIA	MUMBAI
		DETRIVE INSTRUMENTATION AND ELECTRONICS LTD	MUMBAI
		PYRO ELECTRIC INSTRUMENTS	GOA
		TECHNO INSTRUMENTS	GANDHINAGAR
		TEMPSENS INSTRUMENT (I) PVT	UDAIPUR
		TM TECNOMATIC SPA	ITALY
		THERMAL INSTRUMENT INDIA PVT LTD	MUMBAI
		TOSHNIWAL INDUSTRIES	AJMER
		BAUMER	MUMBAI
21.0	TEMPERATUR GAUGE	BAUMER	MUMBAI
		GAUGE BOURDON INDIA PVT. LTD.	MUMBAI
		H.GURU INDUSTRIES	KOLKATA
		H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	BANGALORE
		GOA INSTRUMENTS INDUSTRIES PVT LTD.,	GOA
		GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	GOA
		FORBES MARSHALL (HYD) LTD.	HYDERABAD
		PRECISION MASS PRODUCTS PVT. LTD.	GUJARAT

		BUDENBERG GUAGE CO.LTD.	UK
		A.N. INSTRUMENTS PVT. LTD.	KOLKATA
22.0	TEMPERATURE SWITCH	INDFOS (INDIA) LIMITED	CHENNAI
		DRESSER INDUSTRIES INC.	GUJARAT
		SWITZER PROCESS INSTRUMENTS PVT. LTD.	CHENNI
		SOR INC.	USA
		TOSHNIWAL BROTHERS PVT.LTD.	AJMER
23.0	TRANSMITTER	Honeywell Automation India Limited	NEW DELHI
		YOKOGAWA INDIA LIMITED,	BANGALORE
		TOSHNIWAL INDUSTRIES PVT. LTD.,	AJMER
		V. AUTOMAT & INTRUMENTS (P) LTD.	NEW DELHI
		SMART INSTRUMENTS LTD, BRAZIL	MUMBAI
		SBEM PVT. LTD.	PUNE
		SIEMENS LIMITED	MUMBAI
		EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	MUMBAI
		Pune Techtrol Pvt. Ltd.	PUNE
		PANAM ENGINEERS	MUMBAI
		NIVO CONTROLS PVT. LTD.	INDORE
		Moore Industries International Inc.	CALIFORNIA
		Endress + Hauser (India) Pvt. Ltd.,	NEW DELHI
		ABB LTD	FARIDABAD
24.0	ULTRASONIC FLOW METER	NIVUS GMBH	GERMANY
25.0	VENTURI METER	MICRO PRECISION PRODUCTS PVT LTD	FARIDABAD
		STAR-MECH CONTROLS (I) PVT LTD	PUNE
		TM TECNOMATIC SPA	ITALY
26.0	VIBRATION MONITORING SYSTEM	SKF INDIA LIMITED	PUNE
		ROCKWELL AUTOMATION INDIA PVT LTD	NOIDA.
		MEGGITT INDIA PVT LTD	BANGALORE
		FORBES MARSHALL (HYD) LTD.	PUNE
		GE INDIA INDUSTIRAL PVT LTD	HARYANA

NOTE: - 1: Any other sub-vendor not specified in above sub-vendor list shall be subject to approval of BHEL/TENGEDCO/DESEIN during detailed engineering.
NOTE:- 2: The above list is subject to approval of M/s TENGEDCO/DESEIN during detailed engineering.

PAINTING SCHEME DETAILS

CHAPTER - 6

PAINTING

1.0 SCOPE

This section defines the technical requirements for surface preparation, selection and application of paints on equipment, vessels, machinery, piping, ducts etc. However, manufacturers shall follow their standard procedures for painting their equipment. The bidder shall submit a detailed painting procedure for approval of owner/ owner's representative after the award of contract.

The following surface and material shall require painting:

a. All un-insulated carbon steel and alloy steel equipment like columns, vessels, storage tanks, pumps, heat exchangers etc.
b. All un-insulated carbon steel and low alloy piping, fitting and valves (including painting of identification marks).
c. All pipe structural steel supports, walkways, platforms, handrails, ladders etc.

The following surfaces and materials shall not require painting :

a. Non-ferrous materials
b. Austentic stainless steel
c. Plastic and / or plastic coated materials
d. Insulated surface of equipment and pipes except color coating wherever required.
e. Painted equipment like blowers, pumps, valves etc. with finishing coats in good condition and with matching color code.

2.0 CODES AND STANDARDS

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS specification for the material and workmanship.

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

IS:5	:	Colours for ready mixed paints and enamels
IS:1303	:	Glossary of terms relating to paints
IS:2379	:	Colour code for identification of pipelines
IS:1477	:	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS:2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS:2395	:	Code of practice for painting of concrete, masonry and plaster surfaces (Parts I & II)

IS:2338	:	Code of practice for finishing of wood and wood based materials (Parts I & II)
IS:158	:	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and heat resisting.
IS:2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS:104	:	Ready mixed paint, brushing, Zinc Chrome, priming
IS:2932	:	Enamel Synthetic exterior (a) Undercoating (b) finishing
IS:4682	:	Code of practice for lining of vessels & equipment
SIS 559000	:	Swedish standard for blasting
ISO 8504-2	:	Preparation of steel substrates before application of paints and related products. Surface preparation methods Part 2 Abrasive blast cleaning
ISO 8501-1	:	Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Part 1 : Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.
SIS 05 5800	:	Surface preparation by acid pickling
SSPC SP08	:	Surface preparation by acid pickling
IS 2629	:	Recommended practice for hot dip galvanizing of iron and steel
ASTM A780	:	Standard practice for repair of damaged galvanized coatings
SSPC	:	Steel structures painting council
NACE	:	National association of Corrosion Engineers
DIN	:	Deutsehes Institute for Normung
BS	:	British Standard
ASTM	:	American Society for Testing material
AWWA	:	American Water works association

3.0 SURFACE PREPARATION

The surface shall be prepared in a manner suitable for coatings. Chemical derusters or rust converters shall not be applied. Acid cleaning is subject to approval of Purchaser/ Purchaser's representative.

3.1 BLASTING

The surface of the part/ component shall be blasted before the coating material is applied.
Compressed air supply for blast cleaning shall be free of water and oil. Air compressors shall not be allowed to deliver air above 1100C. Blasting activity shall be performed at temperatures 30C above due point and substrata temperature between 50C & 500C and relative humidity not exceeding 85% shall be maintained during painting. Necessary safety precautions for equipment and operator shall be adhered to and shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work.

Abrasive used for blast cleaning carbon steel and alloy steel shall be as per ISO 8504-2 and SSPC painting manual. Suggested abrasives are chilled iron grit, shot steel, malleable iron grit and shots of non metallic abrasive (aluminum oxide, copper slag, garnet etc.).
The grade of blasting shall be performed in line with the approved painting scheme.
The nature, quality and grain size of abrasives and the parameter of their use are to be chosen to obtain the required surface profile depth and cleanliness.
Surfaces prepared for coating shall be coated the same day and before any visible rusting occurs (the time elapsed between blast cleaning and commencement pf painting shall under no circumstances exceed 4 hours, but in any case must commence before signs of degradation occur).

The grades of surface finish

	ISO 8501-1	SIS 055900	SSPC	NACE
White metal	Sa3	Sa3	SP5	1
Near White metal	Sa 2½	Sa 2½	SP10	2
Commercial Blast	Sa2	Sa2	SP6	3
Brush off blast	Sa1	Sa1	SP7	4

Unless otherwise specified in the documents, the surface shall satisfy the following requirements after blasting
(a) Blasting according to SIS 055900, Grade Sa 2½

Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer coat shall be 15-25 µm.

3.2 Manual Rust Removal

Manual rust removal shall be allowed for welded zones and for touching up installed components.

3.3 Cleaning

Removal of impurity

	Impurity	Removal
a)	Dust, Loose deposits	Vacuum cleaning, brushing
b)	Adhesive deposits	Power brushing
c)	Oils, greasy impurities	Wet Blasting, Use of Detergent Additives by agreement
d)	Salt deposits	Rinsing
e)	Markings (eg felt up pen)	Organic solvents to manufacturer's specifications eg Trichloro trifluoro ethane and solvents containing acetone (renew solvent and rag frequently)

3.4 Acid Pickling

Prior to galvanizing the surface preparation shall be done by acid pickling as per SSPC-SP-08.

4.0 PROCESSING

4.1 General
Application Conditions

The primer shall be applied to properly prepared surfaces only. The specifications of the coating material manufacturers shall be observed. The minimum temperature shall be + 5^0C and the relative humidity shall not exceed 80%. The temperature of the work piece shall be at least 3^0C above dew point.

4.2 Application Procedure

The primer shall be applied by means of brush or by spary. The top coats shall be applied by means of brush, roller or spray.

At points where coating application is interrupted, the individual layers shall be adequately stepped to ensure proper layer sequence when coating operations are resumed.

4.3 Touching Up

Before each layer is applied, previous coating shall be touched up where necessary by way of rust removal and cleaning according coating manufacturers specification. The final top shall be reapplies completely.

4.4 Uncoated Surfaces

Moving parts of machines (e.g stems, shafts, sliding and locating bearings), nameplates, instruments and sealing surface shall not be coated. Welds shall be left free of coating upto a distance of 30 mm on each side of the weld edge until erection and weld examinations, if any, have been completed.

4.5 Bond Strength

The pill off stress determined using the pull off test method for adhesion shall not be less than 1.5 N/mm2, according to ISO 4624.

5.0 SURFACE CONDITIONS OF COATING SURFACES

The coating surface shall have a uniform film thickness, shade and gloss and shall be free from inclusions, sags and wrinkles.

6.0 COATING SYSTEMS

6.1 General Requirements for Coating Systems

Coating materials according to SSPC, BS 5493 or DIN 55 928 shall be used. Intermediate coats are to be pigmented with micaceous iron oxide. The materials shall be matched with each other so that they are compatible. Coatings deviating this

specification shall be subject to approval. Standards of surface preparation and painting shall give a time to first maintenance of 10 years.

The colour and gloss of top coats shall be in accordance with sub clause suggested colour codes for painting (Sub Clause 6.8)

6.2 Standard Coating System (External Coatings)

(a) Steel Surfaces

(i) All steel structures shall receive two primer coats and two sandwich coat of MIO Epoxy paint and one finish coat of painting. First coat of primer shall be given in shop after fabrication before dispatch to erection site after surface preparation as described below. The second coat of primer shall be applied after erection and final alignment of the erected structures. Two intermediate coats and one finished coat shall also be applied after erection.

(ii) Steel surface which is to be painted shall be cleaned of dust and grease and the heavier layers of rust shall be removed by chipping prior to actual surface preparation. The surface shall be abrasive blasted as explained in clause 3.1 to Sa 2½ finish as per SIS05-5900. Primer paint shall be Zinc Silicate of approved brand. Dry film thickness of each primer shall be 60 microns.

(iii) Two intermediate MIO Epoxy paint, and one top polyurethane coating of approved brand shall be applied. Dry film thickness of each intermediate coat shall be 90 microns and top polyurethane coating shall be 30 microns. The under coat and finish coat shall be of different tint to distinguish the same from finish paint. The total dry film thickness shall be 330 microns. All paints shall be of approved brand and shade as per owner's requirement.

(iv) Joints to be site welded shall have weldable primer applied within 100 mm of welding zone. Similarly where friction grip fasteners are to be used removable anti corrosive coating shall be provided. On completion of the joint the surfaces shall receive the paint as specified.

(v) Surfaces inaccessible after assembly shall receive two coats of primer prior to assembly. Surfaces inaccessible after erection including top surfaces of floor beams, supporting gratings or chequered plate shall receive one additional coat of finish paint over the above number of coats specified before erection. Portion of steel member embedded/ to be encased in concrete shall not be painted.

(b) Gratings and Step Threads

(i) Surface Preparation

Gratings and step threads shall be cleared by acid pickling as per SSPC-SP-08

(ii) Hot Dip galvanizing

The hot dip galvanizing shall be done as per IS 2629. The average mass of coating shall be 610 gm/m2.

(iii) Post Treatment

Immediately after galvanizing post treatment such as chromating shall be applied to retard white rust attack.

(iv) Touch up mechanical damages

The repair of damages coatings shall be done as per the recommended practice ASTM A780.

6.3 Painting of Indoor components such as valves, pumps, motors, electrical parts, tanks etc.

At Works

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 25 µm may be used.

Prime Coat

Two (2) layers of Zinc phosphate epoxy, total dry fim thickness 75µm.

At Site

Thorough cleaning to remove oil, grease, dirt and any other contaminants. Derusting of all mechanical damages according to SIS 055900 Grade ST3. Touch up with dry film thickness 50 µm.

Finish Coat

Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 30-40 microns DFT each coat in approved shades.

Remarks

Equipment coated with a standard application system can be accepted if the quality of this application system is corresponding with the quality of the above mentioned system.

6.4 Painting of Outdoor equipment (external surfaces) such as piping, valves, pumps, motors, electrical parts, tanks etc.

Weather exposure, weather resistance, temperature upto 120^0C as per clause 6.1 & 6.3. However

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Two (2) layers of Zinc phosphate epoxy, total dry fim thickness 75µm.

Intermediate Coat

One (1) layer 2 pack high build epoxy polyamide MIO, DFT 100µm.

Finish Coat

Application of two (2) finishing coats of chlorinated rubber paint in approved shades at 50 microns DFT each coat in approved shades.

6.5 Special Coating

(a) Parts exposed to temperatures above 120^0C, upto 200^0C, not insulated

(i) At Works

Surface Preparation

Blasting according to SIS 055900 grade Sa 2½ and ISO 8501-1:1958. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry fim thickness 75µm.

(ii) At Site

Pretreatment

Dersuting of all mechanical damages, according to ISO 8501-1:1989, grade St 3 touch up with 1 pack inorganic ethyl zinc silicate, dry film thickness 50µm.

Intermediate Coat

I pack silicon acrylic dry film thickness 35 µm.

Final Coat

1 pack silicon acrylic, dry film thickness as 35µm.
Total system dry film thickness 145µm.
Final coat according to colour code.

(b) **Parts exposed to temperatures above 200^{0}C, upto 400^{0}C, not insulated**

(i) At Works

Surface Preparation

Blasting according to ISO 8501-1:1958 grade Sa-2½. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm.

(ii) At Site

Pretreatment

Derusting of all mechanical damages, according to standard Sa 2½ to ISO 8501-1:1988. Touch up with coating system according to manufacturer's recommendations.

(c) **Insulated parts continuously exposed to condensing water or parts exposed to temperatures**

For parts that are provided with insulation on site.

(i) **Insulated parts exposed to condensing water**

At Works

Surface Preparation

Blasting according to Sa 2½ to ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm shall be used.

Prime Coat

Inorganic ethyl Zinc silicate, total dry film thickness 75µm

(ii) **Insulated parts exposed to temperatures**

Parts exposed to temperatures upto < 400^{0}C

Surface Preparation

Blasting according to Sa 2½ to ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm shall be used.

Parts exposed to temperature above 400^0C at works (Steam pipes, pressure tubes and parts for the HRSG, such as heating surfaces, heaters and superheaters, reheaters etc)

Temporary Primer

Varnish

(d) **Intermittent exposure due to condensing water/ chemicals (Indoors)**

(i) At Works

Surface Preparation

Blasting according to Sa 2½ and ISO 8501-1:1988. Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 15-25 µm may be used.

Prime Coat

Two layers of Zinc phosphate primer, total dry fim thickness 75µm.

(ii) At Site

Pretreatment

Dersuting of all mechanical damages, according to standard Sa3 to ISO 8501-1:1988, touch up with 2 pack high build epoxy with volume solid content of more than 85%, 75µm.

Intermediate Coat

2 pack high build epoxy, dry film thickness 80 µm.

Finish Coat

2 pack silicon acrylic, dry film thickness of 50µm.

Total system dry film thickness 205µm.

When exposed o weathering, weather resistance finish coat shall be applied.

(e) **Water Exposure**

(i) At Site/ Works

Pretreatment

Removal of all welding pearls.

Blasting according to Sa 3 to ISO 8501-1:1988

Coat
4 coats 2 pack coal tar epoxy, dry film thickness 125 µm each.

Total system dry film thickness 500µm
Touch up after erection as required.

6.6 Painting of Pipes

6.6.1 Buried Piping

Internal surfaces

(i) Surface cleaning by sand blasting.

(ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.

(iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 150 microns.

Note : All steel pipes carrying sea water shall be internally coated with corrocoat/ polyurea coating having thickness 1500 DFT.

Tests to be carried out after application : Bond/ Adhesion test, Holiday test

External surfaces

(i) Surface cleaning by Sand Blasting.

(ii) Coal tar primer compatible with coal tar enamel grade. The number of coats shall be two with a DFT of 35 microns each.

(iii) Coal tar enamel shall be applied. A single spiral inner wrap of glass fibre tissues shall be applied overlapping at least 25 mm ensuring impregnation of glass fibre tissues in the first coat. The second coat of enamel and second outer wrap of glass fibre felt, Type – I to IS: 7193-1974 will be applied in the same way confirming to Table – 10 of IS – 10221 – 1982.

The total thickness of the coating will not be less than 4.0 mm

(iv) Alternatively Wrapping with coal tar based anticorrosion tape conforming to IS 15337: 2003 is also acceptable in lieu of s.no. (iii) above. Wrapping thickness shall be 4.0 mm.

Tests to be carried out after application : Bond/ Adhesion test, Holiday test

6.6.2 Overground Piping

Internal surfaces

(i) Surface cleaning by sand blasting.

(ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.

(iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 150 microns.

Note : All steel pipes carrying sea water shall be internally coated with corrocoat/ polyurea coating having thickness 1500 DFT.

External surfaces

(i) Surface cleaning by Sand Blasting.

(ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.

(iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

6.7 Internal Coatings

6.7.1 Tanks (Internal surfaces) as specified in relevant sections of specification

Industrial deionised, demineralised and potable water upto 60^0C pH range 4.5-9.5

Blasting according to Sa 2½ and ISO 8501-1:1988.

Prime Coat

Two layers of Zinc phosphate epoxy primer, total dry fim thickness >75µm.

Pretreatment

Dersuting of all mechanical damages, according to standard Sa3 to ISO 8501-1:1988, touch up with 2 pack high build epoxy with volume solid content of more than 85%, 75µm.

Intermediate Coat

2 pack high build epoxy, dry film thickness 80 µm.

Finish Coat

2 pack silicon acrylic, dry film thickness of 150µm per coat.

In case of service or potable water tanks, the coating material selected shall not taint the water. The paint system shall confirm to regulations issued by Food & drug administration/ National Public Health service/ AWWA/ OSHA and comply with applicable laws, regulations, ordinances etc. of the local authority, state or the nation pertains to work.

QA/ QC Procedure including pinhole inspection, shall be submitted for approval by Owner/ Owner's representative.

6.6.2 Rubber Lining of Pipes, Valves and Tanks for DM Water

Pretreatment

Blasting according to Sa 2½ and ISO 8501-1:1988

Rubber Lining

Hard rubber 5 mm for DM water applications as IS – 4682

6.7 **Painting for Electrical items**

6.7.1 All the steel work shall be thoroughly cleaned of rust, scale, oil, grease, dirt and swarf by pickling, emulsion cleaning etc. The sheet steel shall be phosphate/ oven dried and then painted with two coats of zinc rich primer paint. After application of the primer, two coats of finishing epoxy paint shall be applied. The colour of the finishing coats inside shall be glossy white and exterior of the treated sheet steel shall be shade 631 of IS-5/ RAL 7032 for all switchboard/ MCC/ Distribution boards, control panels etc.

6.7.2 All electrical equipment shall be given tropical and fungicidal treatment and outdoor equipment shall be provided with rain hood to prevent entry of rain water into the equipment.

6.7.3 Painting of I & C equipment : Epoxy coating required for all I & C equipment.

6.8 SUGGESTED COLOUR CODES FOR PAINTING

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
1.	Structures, platforms, galleries, ladders and handrails	Dark Admirality Grey	632	-	-
2.	Boiler casing, ducting	Nut Brown	413	-	-

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
3.	Crane				
3.1	Crane structure	Golden Yellow	356	Black	-
3.2	Trolley & hook	Crimson	540	-	-
4.	Fans, pumps, motors, compressors	Light Grey	631	-	-
5.	Tanks (without insulation and cladding)				
5.1	Outdoor	Aluminium	-	-	-
5.2	Indoor	Light grey	631	-	-
6.	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631	-	-
7.	Switchgear	Light grey (Powder coated)		-	-
8.	Control & relay panels	Light grey (Powder coated)	631/70 78 of IS 1650	-	-
9.	Turbines	Light Grey	631	-	-
10.	Generators & Exciter	Light Grey	631	-	-
11.	Transformers	Aluminum	-	-	-
12.	Machinery guards	Signal red	537	-	-
13.	Piping (without insulation and cladding)				
13.1	Water System				
a	Boiler feed	Sea Green	217	-	-

SL. NO.	ITEM/SERVICE	COLOUR	IS-5	COLOUR (BAND)	IS-5
b	Condenstae	Sea Green	217	Light Brown	410
c	DM Water	Sea Green	217	Light Orange	557
d	Soft Water	Sea Green	217	French Blue	166
e	Bearing Cooling Water	Sea Green	217	French Blue	166
f	Potable & filtered Water	Sea Green	217	French Blue	166
g	Service and clarified water	Sea Green	217	French Blue	166
h	Cooling water	Sea Green	217	French Blue	166
I	Sea Water	Sea Green	217	White	-
14.	Ash Transmitting Vessels and pipe lines	Aluminium	-	-	
15.	**Air System**				
15.1	Station air	Sky blue	101	-	-
15.2	Control air	Sky blue	101	White	-
16.	**Oil system**				
16.1	Fuel oil	Light brown	410	French	166
16.2	Light oil (HSD)	Light Brown	410	Brilliant green	221
16.3	Lubricating oil	Light brown	410	Light grey	631
16.4	Transformer oil	Light brown	410	Light orange	557
17.	Gas System				
17.1	Carbon dioxide	Canary yellow	309	Light grey	631
17.2	Hydrogen	Canary yellow	309	Signal red	537
18.	Fire services	Fire red	536	-	-
19.	Effluent pipes	Black	-	-	-
20.	Vacuum pipes	Sky blue	101	Black	-

Notes :

1. This colour code basically refers to IS:2379 for piping with necessary modifications

2. Where band colour is specified, same shall be provided at 30 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.

   Bidder shall furnish his painting specification to suit corrosive atmosphere of coastal area along with the bid. The specification shall in general be in line with the above requirements.

DRAWING DOCUMNTS DISTRIBUTION SCHEDULE

No. of copies required from the contractor after award of the contract.

TABLE-E

S.NO.	DESCIPTION	TANGEDCO	DESEIN	BHEL (PEM)	BHEL SITE AND REGION
1	Drawing for approval/ information	5+1S+2CD	5+1S+1CD	2+1S	--
2	Final drawing (APPROVED)	4+1S+3CD	4+1S+3CD	1+1S	10+1S+1CD
4	AS BUILT DRAWINGS	4+1S+3CD	4+1S+3CD	1+1S	10+1S+1CD
5	CD ROM "FINAL DRAWING"	2CD	1-CD	1CD	2CD
6	Type test reports	2+1S	2+1S	---	2+1S
7	O & M Manuals for approval	2+1CD+SS	2+1CD+SS	1+CD+SS	------
8	Final O & M Manuals	4+6CD+SS	4+4CD+SS	1+CD+SS	10+5CD+SS
9	Performance guarantee test reports	2+1S	2+1S	---	2+1S

* Applicable for vendor drawings

CD - Compact Disc (Read Only)
S-SOFT COPY (IN EMAIL/WRENCH).

NOTE: ALL DRGS. SHALL BE PREPARED ON COMPUTER ***AUTOCAD (LATEST VERSION)*** AND OTHER DOCUMENTS (LIKE DATA SHEET ETC.) ON ***MS-OFFICE (LATEST VERSION).*** SOFTWARE. BIDDER NOT COMPLYING WITH THE REQUIREMENT SHALL NOT BE CONSIDERED.

DRAWING DOCUMENTS REQUIREMENT

DRAWING/DOCUMENTS REQUIREMENT

After award of LOI, following minimum drawing/documents shall be submitted by the bidder for BHEL and Customer approval. However, any additional drawing/document if found necessary for completion of the engineering, the same shall be submitted by bidder without any commercial & delivery implication to BHEL.

For the Drawings/Documents Submission Procedure, please refer **TABLE-E**. The submission of soft copy or hard copy of the drawing/document whichever is later will be considered as final date of submission of the drawing/document. The bidder has to submit the revised drawing/document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. Bidder to comply with the observations of the BHEL and CUSTOMER without price & delivery implication.

Bidder to note that the drawings to be submitted by bidder in the event of award of contract shall be as per the below given drawing/document list. Bidder to note that any additional drawings/documents requirement during detailed engineering shall be provided by bidder without any technical, commercial and delivery implications to BHEL. Bidder confirmed drawings submission schedule as follows:

a. Drawing/documents submission schedule: First submission of basic drawings/ documents – (Please refer MDL for list of basic drawing/documents & submission schedule).
b. Every revised submission incorporating comments – within 7 days.

Bidder further confirmed that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

(a) List and schedule of drawings/documents to be submitted after award of contract:-

TABLE-F

SL NO.	BHEL DRG NO	DRG TITLE	No. of weeks for document submission after placing LOI/PO	Document size
1	PE-V11-412-182-A001	Piping & Instrumentation Diagram	4	A2
2	PE-V11-412-182-A002	Process Design Basis and Sizing Calculation	4	A4
3	PE-V11-412-182-A003	Equipment Layout	4	A1
4	PE-V11-412-182-A004	Sub vendor list & inspection criteria	4	A4
5	PE-V11-412-182-A005	Control Philosophy with control system configuration Diagram	6	A4
6	PE-V11-412-182-A006	Civil Assignment DRAWING	8	A1
7	PE-V11-412-182-A007	Electrical Load list	8	A4
8	PE-V11-412-182-A008	Piping Layout with diffuser installation	10	A4
9	PE-V11-412-182-A009	Datasheet for UPS	10	A4
10	PE-V11-412-182-A010	TECHNICAL DATA SHEET OF VERTICAL / HORIZONTAL PUMPS	10	A4
11	PE-V11-412-182-A011	TECHNICAL DATA SHEET OF BLOWERS	10	A4
12	PE-V11-412-182-A012	GA & Data sheet of Motors	10	A4

13	PE-V11-412-182-A013	QAP FOR VERTICAL / HORIZONTAL PUMPS WITH MOTOR	10	A4
14	PE-V11-412-182-A014	QAP FOR BLOWERS WITH MOTOR	10	A4
15	PE-V11-412-182-A015	Data sheet for instruments AND ANALYSER	10	A4
16	PE-V11-412-182-A016	Datasheet & GA of Hypochlorite generator (Electrolyzer)	10	A4
17	PE-V11-412-182-A017	QAP of Hypochlorite generator	10	A4
18	PE-V11-412-182-A018	GA of Atmospheric Tanks	10	A3
19	PE-V11-412-182-A019	Mechanical Datasheet & GA for Strainers & Valves	10	A4
20	PE-V11-412-182-A020	Datasheet for safety items	10	A4
21	PE-V11-412-182-A021	GA & Data sheet of Transfer Rectifier	10	A4
22	PE-V11-412-182-A022	QAP OF TRANSFER RECTIFIER	10	A4
23	PE-V11-412-182-A023	INSTRUMENT SCHEDULE	12	A4
24	PE-V11-412-182-A024	VALVE SCHEDULE	12	A4
25	PE-V11-412-182-A025	PLC DOCUMENTS FOR DM PLANT--GA & WIRING DETAILS OF PLC PANEL, I/O LIST, BOM, MIMIC DIAGRAM	12	A4
26	PE-V11-412-182-A026	QAP/FAT FOR PLC	12	A4
27	PE-V11-412-182-A027	Cable tray layout	12	A1
28	PE-V11-412-182-A028	QAP / ICL of Elecrochlorination System (BALANCE OF ITEMS)	12	A4
29	PE-V11-412-182-A029	ERECTION PROCEDURE	16	A4
30	PE-V11-412-182-A030	Cable schedule, submission of cable interconnection diagram	16	A4
31	PE-V11-412-182-A031	ENGINEERING BOQ	20	A4
32	PE-V11-412-182-A032	PG Test Procedure	20	A4
33	PE-V11-412-182-A033	O&M Manual	24	A4

In addition of above following documents shall also be submitted by bidder during detail engineering:-
a) Storage instructions
b) Bidder to note that drawings/documents submission shall be through web based Document Management System.
Bidder would be provided access to the DMS for drawings/documents approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.
 Internet explorer version – Minimum Internet Explorer 7
 Internet speed – 2 mbps (Minimum preferred)
 Pop ups from our external DMS IP (124.124.36.198) should not be blocked
 Vendor's internal proxy setting should not block DMS application's link (http://124.124.36.198/wrenchwebaccess/login.aspx)
 DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.
 For quick access bidder may refer the link http://bhelpem.com/DMSManuals/DMSManuals.html

SITE STORAGE AND PRESERVATION

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHNANICAL BOPs

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

PROJECT ENGINEERING MANAGEMENT, POWER SECTOR

BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

1. SCOPE OF THE DOCUMENT

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

2. PURPOSE OF STORAGE & PRESERVATION

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

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

a) GENERAL STORAGE REQUIREMENTS

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

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

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

b) GENERAL PRESERVATION REQUIREMENTS

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

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

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

    a. Rust preventive fluid (RPF)

    b. Rust protective paints

    c. Tarpaulin covers, in case of outdoor storage

    d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –

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

2. Any damages to equipment / materials.

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

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

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

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

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

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

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

iii Open storage (O)

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

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

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

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

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

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

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

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H_2SO_4)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

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

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

5. CONCLUSION

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

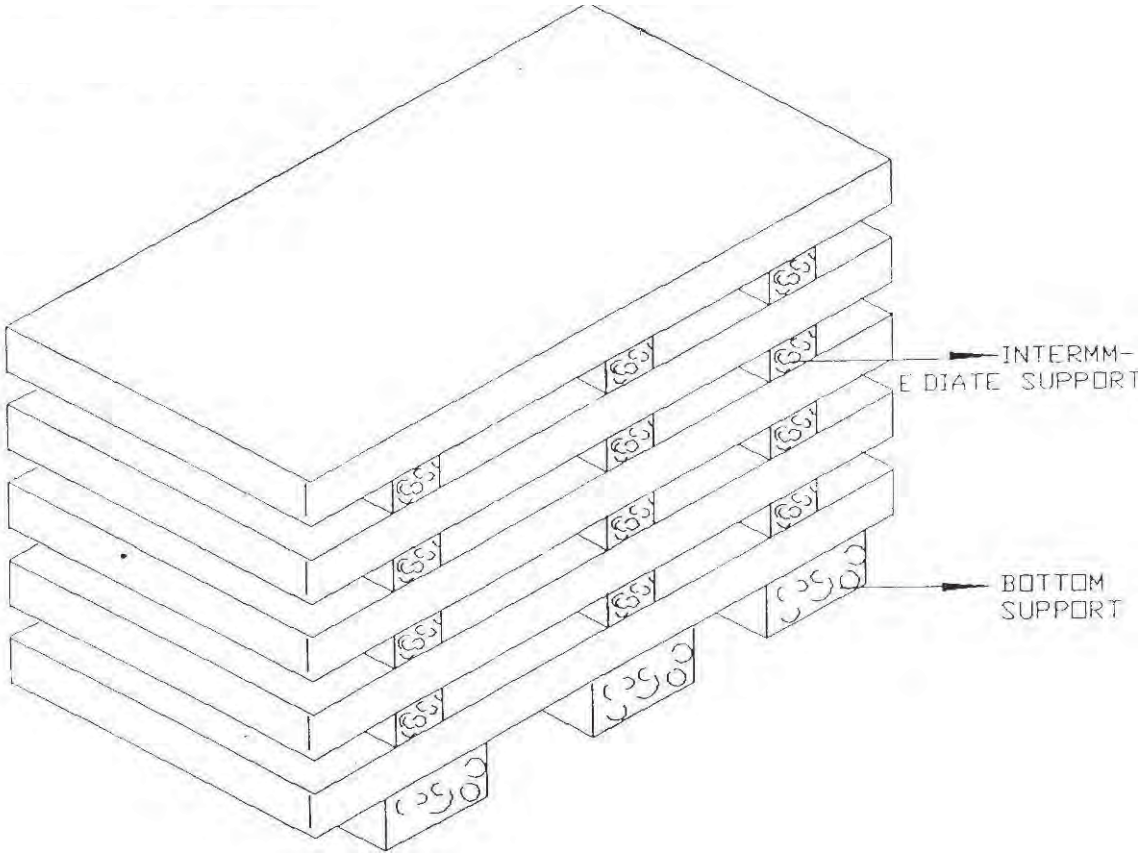


Figure – 1 – PLATE STACKING ARRANGEMENT

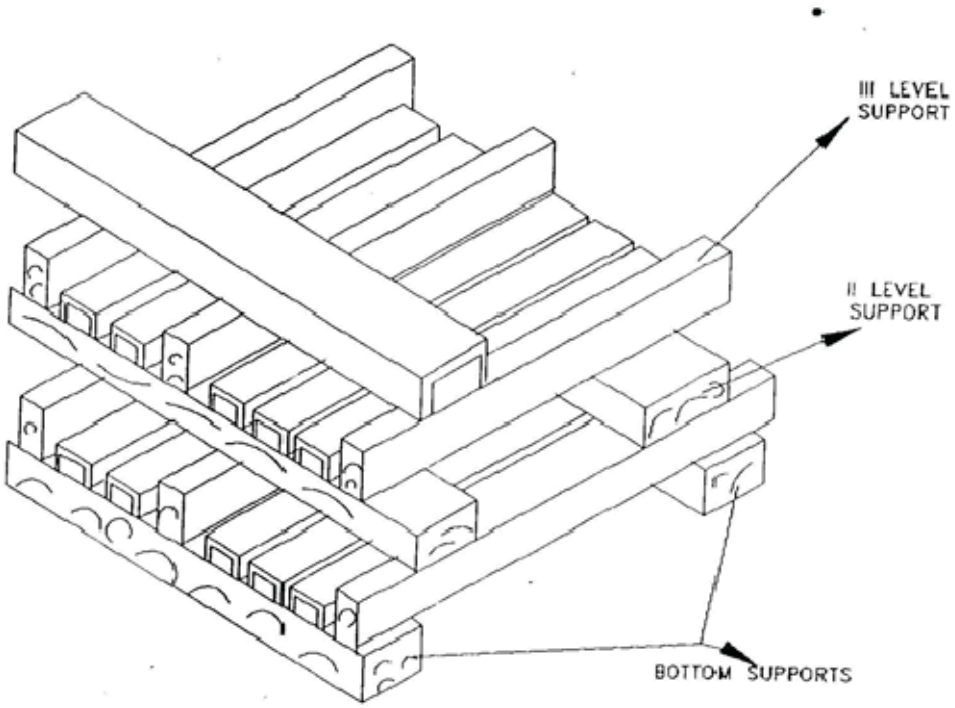
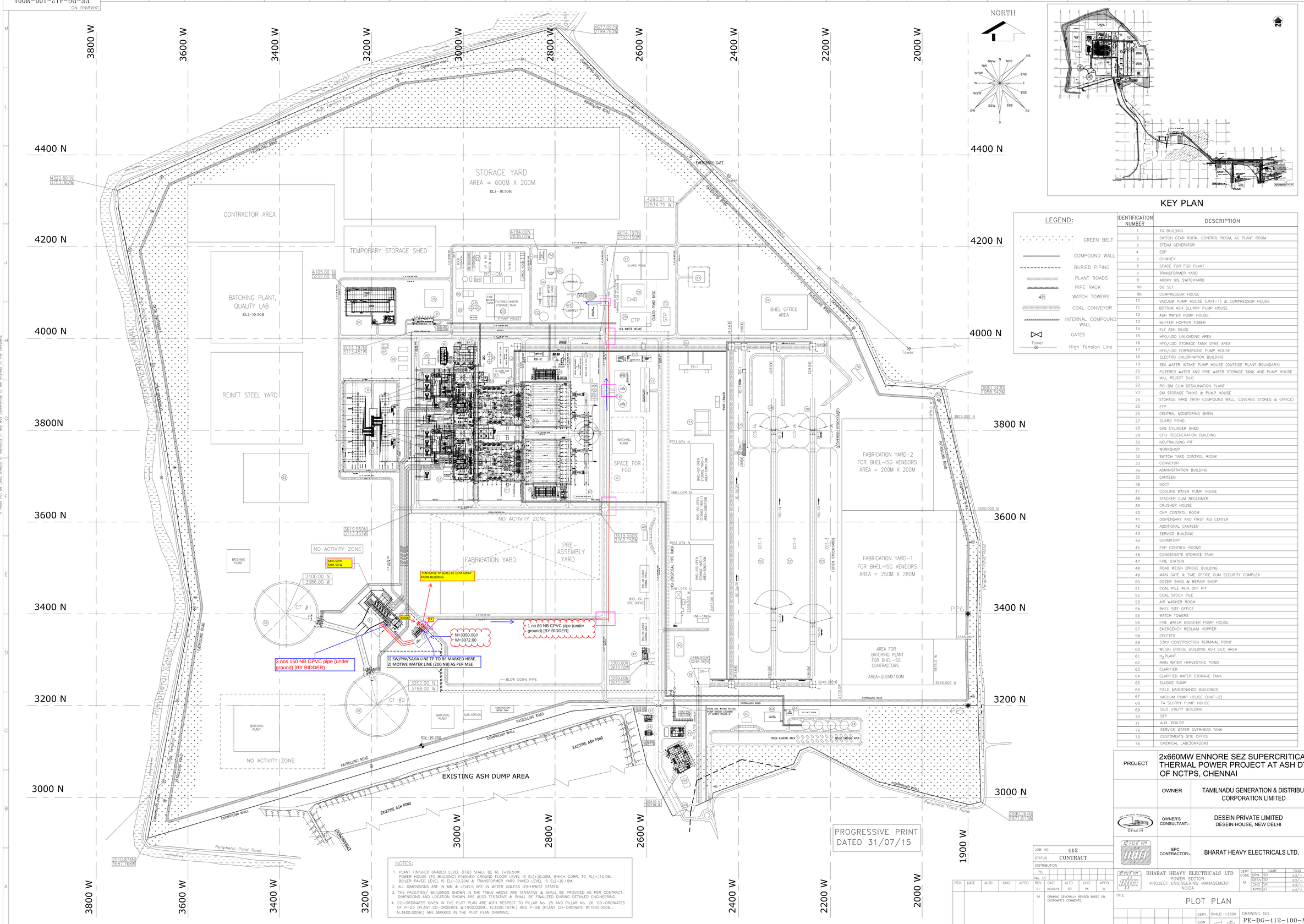


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

PLOT PLAN

DRAWING NO. PE-DG-412-100-M001

FIRST ANGLE PROJECTION — ALL DIMENSIONS ARE IN MM



KEY PLAN

LEGEND:

- GREEN BELT
- COMPOUND WALL
- BURIED PIPING
- PLANT ROADS
- PIPE RACK
- WATCH TOWERS
- COAL CONVEYOR
- INTERNAL COMPOUND WALL
- GATES
- Tower
- High Tension Line

IDENTIFICATION NUMBER	DESCRIPTION
1	TG BUILDING
2	SWITCH GEAR ROOM, CONTROL ROOM, AC PLANT ROOM
3	STEAM GENERATOR
4	ESP
5	CHIMNEY
6	SPACE FOR FGD PLANT
7	TRANSFORMER YARD
8	400KV GIS SWITCHYARD
9a	DG SET
9b	COMPRESSOR HOUSE
10	VACUUM PUMP HOUSE (UNIT-1) & COMPRESSOR HOUSE
11	BOTTOM ASH SLURRY PUMP HOUSE
12	ASH WATER PUMP HOUSE
13	BUFFER HOPPER TOWER
14	FLY ASH SILOS
15	HFO/LDO UNLOADING AREA
16	HFO/LDO STORAGE TANK DYKE AREA
17	HFO/LDO FORWARDING PUMP HOUSE
18	ELECTRO CHLORINATION BUILDING
19	SEA WATER INTAKE PUMP HOUSE (OUTSIDE PLANT BOUNDARY)
20	FILTERED WATER AND FIRE WATER STORAGE TANK AND PUMP HOUSE
21	MILL REJECT SILO
22	RO-DM CUM DESALINATION PLANT
23	DM STORAGE TANKS & PUMP HOUSE
24	STORAGE YARD (WITH COMPOUND WALL, COVERED STORES & OFFICE)
25	ETP
26	CENTRAL MONITORING BASIN
27	GUARD POND
28	GAS CYLINDER SHED
29	CPU REGENERATION BUILDING
30	NEUTRALISING PIT
31	WORKSHOP
32	SWITCH YARD CONTROL ROOM
33	CONVEYOR
34	ADMINISTRATION BUILDING
35	CANTEEN
36	NDCT
37	COOLING WATER PUMP HOUSE
38	STACKER CUM RECLAIMER
39	CRUSHER HOUSE
40	CHP CONTROL ROOM
41	DISPENSARY AND FIRST AID CENTER
42	ADDITIONAL CANTEEN
43	SERVICE BUILDING
44	DORMITORY
45	ESP CONTROL ROOMS
46	CONDENSATE STORAGE TANK
47	FIRE STATION
48	ROAD WEIGH BRIDGE BUILDING
49	MAIN GATE & TIME OFFICE CUM SECURITY COMPLEX
50	DOZER SHED & REPAIR SHOP
51	COAL PILE RUN OFF PIT
52	COAL STOCK PILE
53	AIR WASHER ROOM
54	BHEL SITE OFFICE
55	WATCH TOWERS
56	FIRE WATER BOOSTER PUMP HOUSE
57	EMERGENCY RECLAIM HOPPER
58	DELETED
59	33KV CONSTRUCTION TERMINAL POINT
60	WEIGH BRIDGE BUILDING ASH SILO AREA
61	H_2 PLANT
62	RAIN WATER HARVESTING POND
63	CLARIFIER
64	CLARIFIED WATER STORAGE TANK
65	SLUDGE SUMP
66	FIELD MAINTENANCE BUILDINGS
67	VACUUM PUMP HOUSE (UNIT-2)
68	FA SLURRY PUMP HOUSE
69	SILO UTILITY BUILDING
70	STP
71	AUX. BOILER
72	SERVICE WATER OVERHEAD TANK
73	CUSTOMER'S SITE OFFICE
74	CHEMICAL LAB(30MX20M)

NOTES:

1. PLANT FINISHED GRADED LEVEL (FGL) SHALL BE RL (+)9.50M.
   POWER HOUSE (TG BUILDING) FINISHED GROUND FLOOR LEVEL IS EL(+)0.00M, WHICH CORR. TO RL(+)10.0M.
   BOILER PAVED LEVEL IS EL(-)0.20M & TRANSFORMER YARD PAVED LEVEL IS EL(-)0.10M.
2. ALL DIMENSIONS ARE IN MM & LEVELS ARE IN METER UNLESS OTHERWISE STATED.
3. THE FACILITIES/ BUILDINGS SHOWN IN THE TABLE ABOVE ARE TENTATIVE & SHALL BE PROVIDED AS PER CONTRACT. DIMENSIONS AND LOCATION SHOWN ARE ALSO TENTATIVE & SHALL BE FINALIZED DURING DETAILED ENGINEERING.
4. CO-ORDINATES GIVEN IN THE PLOT PLAN ARE WITH RESPECT TO PILLAR No. 25 AND PILLAR No. 26. CO-ORDINATES OF P-25 (PLANT CO-ORDINATE W:1900.000M., N:3200.107M.) AND P-26 (PLANT CO-ORDINATE W:1900.000M., N:3400.000M.) ARE MARKED IN THE PLOT PLAN DRAWING.

REV.	DATE	ALTD	CHD	APPD
01	20.02.15	SD	SK	JJ

01 — DRAWING GENERALLY REVISED BASED ON CUSTOMER'S COMMENTS.

JOB NO. 412
STATUS CONTRACT
DISTRIBUTION
TO
No. OF

PROJECT	2x660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI
OWNER	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED
OWNER'S CONSULTANT:-	DESEIN PRIVATE LIMITED DESEIN HOUSE, NEW DELHI
EPC CONTRACTOR:-	BHARAT HEAVY ELECTRICALS LTD.

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
M	DRN	SD	sd/-	29.10.2014
	DESN	SD	sd/-	29.10.2014
	CHD	SK	sd/-	29.10.2014
	APPD	JJ	sd/-	29.10.2014

TITLE: PLOT PLAN

DEPT. | SCALE: 1:2500 | DRAWING NO. PE-DG-412-100-M001
SIGN
DATE
SHEET 1 OF 1 | REV. 1A

FORMAT SIZE A0

ELECTRONIC FILE NAME: 412_100_M001_R1.DWG

LIST OF SCHEDULES

SCHEDULE OF PRE-BID CLARIFICATION

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

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

DEVIATION SHEET (COST OF WITHDRAWL)

PROJECT:-2X660 MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NCTPS, CHENNAI

PACKAGE:-ELECTRO CHLORINATION PLANT

TENDER ENQUIRY REFERENCE:-

NAME OF BIDDER:-

SL NO (1)	VOULME/ SECTION (2)	PAGE NO. (3)	CLAUSE NO. (4)	TECHNICAL SPECIFICATION/ TENDER DOCUMENT (5)	COMPLETE DESCRIPTION OF DEVIATION (6)	COST OF WITHDRAWL OF DEVIATION (7)	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWL OF DEVIATION IS APPLICABLE (8)	NATURE OF COST OF WITHDRAWL OF DEVIATION (POSITIVE/ NEGATIVE) (9)	REASON FOR QUOTING DEVIATION (10)
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

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

NOTES:

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

COMPLIANCE CUM CONFIRMATION SCHEDULE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnishing same with the offer:

a.) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions/ deviations with regard to same.

b.) QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein.
QP will be subject to BHEL/Customer approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc.
The charges for 3rd party inspection (Lloyds, TUV or equivalent) for imported components shall be included in the base price of the equipment by the bidder

c.) All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval. GA drawings, as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.

d.) There are no other deviations with respect to specification other than those furnished in the 'Schedule of Deviations'

e.) The offered materials shall be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty, materials shall be subject to approval in the event of order.

f.) The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL).

g.) All sub vendors shall be subject to BHEL/CUSTOMER approval

h.) Any special tools & tackles, if required, shall be in bidder's scope.

i.) Demonstration parameters shall stand valid till the satisfactory completion of demonstration test and its acceptance by BHEL/Customer.

SUGGESTIVE PRICE FORMAT FOR ELECTRO CHLORINATION PLANT	**REV-0**	**DATE-24/10/2016**
NAME OF PROJECT:	**2X660 MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NCTPS, CHENNAI.**	
NAME OF PCKAGE:	**ELECTRO CHLORINATION PLANT**	
TECHNICAL SPECIFICATION:	**PE-TS-412-174-A101**	

Sl. No.	**DESCRIPTION OF EQUIPMENT / ITEM**	**UNIT**	**QTY**
1.0	Total lump-sum firm price for design, engineering, manufacture, supply, fabrication, assembly, inspection/testing at vendor's & sub-vendor's works, painting, maintenance/special tools & tackles, mandatory spares along with spares for erection as required, startup and commissioning spares as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in site transportation, assembly, erection & commissioning, trial run at site, preparation and submission of drawing/documents including "As built" drawings and carrying out performance guarantee test (PG Test) at site & equipment/system guarantee, etc. inclusive of all prevailing taxes, duties and other levies and handover in flawless condition of the package specified above for above mentioned project to the end customer complete with all accessories for the total scope defined as per BHEL NIT and tender technical specification number as specified above, amendment & agreement till placement of order.	SET	

	TITLE *** SCHEDULE OF DECLARATIONS**	**BHEL DOCUMENTS NO.: PE-TS-412-174-A101** VOL III SHEET…….. OF……

*** Bidder shall include this schedule both in technical and Price offers**

DECLARATION

I ……..……certify that all the technical data and information pertaining to this specification are correct and are true representation of the equipment/system covered by our format proposal number Dated …….. and there is no deviation to the specification (except indicated in the deviation sheet (cost of withdrawal).

I hereby certify that I am duly authorized representative of the Bidder's company whose name appears above my signature.

Biders Company Name …….

Authorised representative's
Signature ……..

Name …….

Bider's Name

The bidder hereby agrees to fully comply with the requirements and intent of this specification for the price indicated

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