	Enclosure for Electrical panels/cabinet enclosure	AC rooms- IP 42 class Outdoor-IP 55 class plus canopy
9.0	Sheet steel thickness	Cold rolled sheet steel not less than 2.5mm for front & rear & 2mm for side, top & bottom portion with gland plate of 3mm thick.
10.0	Name plate	Black letter engraved on stainless steel plate. Should indicate the tag number and description of the service.
11.0	Door/Cover	Shall be pad lockable.
12.0	Safety	All live parts shall be shrouded. No live parts shall be accessible after opening the door/cover. Danger warning plates to be provided. Doors shall be pad lockable and interlocked with Power switch.
13.0	Earthing	2 earthing terminals to be provided for connection to the grid.
14.0	Wiring	Refer specification , Section on panel wiring

2.0 Following miscellaneous equipment shall be included in BIDDER's scope.

2.1. Starter Panel for DC Motors

2.2. Local push button stations.

2.3. Junction boxes (JBs)

2.4. Danger boards

2.5. Rubber mats

3.0 STARTER PANEL FOR DC MOTORS

3.1. Starter panel when included in motor Bidder's scope shall meet the following requirements.

3.2. The constructional features of these panels shall be as per cl.no.1.8 above. Please also refer to Section D.10.

4.0 LOCAL PUSH BUTTON STATIONS (LPB)

4.1. Local push button station shall be provided for all the drive motors of the plant (415V motors & 6.6kV/11kV motors) (start / stop push buttons for unidirectional motors, start/stop/reverse push buttons for bi-directional motors & only start push button for emergency motors) as per scheme requirement.

4.2. Start/ Forward/ Open PBs shall have green coloured actuator and Stop/Reverse/Close PBs shall have Red coloured actuator.

4.3. The degree of protection of LPBs shall be IP65 with both canopy and lid for outdoor and IP54 with lid and hinged door for indoor applications.

4.4. All PBs shall be push to actuate type.

4.5. Emergency local stop push button should be lockable in the STOP position, Emergency push buttons shall be stay put type

4.6. All push buttons shall be provided with 2 nos. NO and 2 nos. NC contacts for various interlocking purposes. One contact of stop PB shall be directly wired to the switchgear module for direct tripping and another contact to control system.

4.7. Terminal block of stud type are to be provided in the LPB station. Terminals to be suitable for 2 cores of 2.5 sq mm conductors with 20% spare terminals.

4.8. All LPBs shall be of Poly Carbonate/ FRP/Di-cast aluminium.

4.9. Name plate with Tag number and description of the service controlled by the LPB shall be provided on the front.

4.10. LPBs shall be suitable for wall/column mounting. Covers shall be provided with captive screws.

4.11. The Cable size to be used for LPB connection shall take in to account the voltage drop in the cable between the LPB and the Switchgear/MCC/DCS.

5.0 JUNCTION BOXES (JBs)

5.1. Junction boxes as required for the power plant shall be supplied :

5.2. The JBs used in outdoor areas shall be weatherproof type and coated with epoxy paint. enable running a large core cables from (JB/MB) to control panels, terminal cabinets, etc.

5.3. All JBs, shall be of polycarbonate /FRP/ Di-cast aluminium.

5.4. Danger boards shall be provided in line with the statutory requirements.

5.5. Rubber mats shall be provided to meet the safety and other statutory requirements.

5.6. Spacing of 250 MM between two rows of Terminal blocks and between the gland plate and the bottom most terminal block to be provided.

5.7. Gland plate to be of removable type and made out of 3 mm thick sheet steel.

6.0 TESTING

The following testing shall be conducted on all equipments at works and necessary test certificates shall be furnished.

(a) IR (Insulation resistance) test before and after HV test.

(b) HV test at 2.5kV for 1 Minute.

(c) Electrical Functional test.

(d) Mechanical operation of the components.

(e) Visual check for compliance as per approved drawings.

Note: The international standards such as IEC, which are equivalent to IS, may also be applicable for the above mentioned testing.

7.0 DATA TO BE FURNISHED BY THE BIDDER

7.1 Experience list for the Control panels, JBs offered.

7.2 Descriptive literature/pamphlets on the equipment offered.

8.0 For technical particulars refer datasheet-A.

SPEC.NO. TCE.5750A-H-500-001	**TATA CONSULTING ENGINEERS LIMITED**	VOLUME IV SECTION:D15
PART B	**RRVUNL, 2 x 660 MW, Super-Critical TPS, Stage- V, Units 7 & 8, at Suratgarh, Rajasthan** DATA SHEET B CONTROL PANELS	SHEET 1 OF 2

ENQUIRY/SPECIFICATION NO.:	BIDDER:

1.0	Manufacturer's name	
2.0	Make and type of panel	
2.0	Indoor/Outdoor application	
3.0	Thickness of sheet steel (CRCA)	mm
	(a) Frame	
	(b) Door	
	(c) Cover (side, top and bottom)	
4.0	Degree of protection provided (as per IS:2147 or equivalent)	
5.0	Bill of Material for the various equipment giving make, type, ratings etc. enclosed	Yes/No
6.0	Colour of finish paint	
	(a) Outside	
	(b) Inside	
7.0	Bus bars for power devices (when applicable)	
	(a) Material	(PVC Insulated/ Bare)
	(b) Continuous current rating	A
8.0	Control Wiring/Power Wiring	

NOTES TO BIDDER	SIGNATURE OF BIDDER & DATE
1. ITEMS WHICH DEVIATE FROM THE SPECIFICATION SHOULD BE MARKED WITHIN ASTERISK (*) AND DETAILS TO BE GIVEN IN SCHEDULE OF DEVIATIONS. 2. THIS DATA SHEET SHALL BE FILLED UP COMPLETELY AND A COPY SHALL BE ENCLOSED WITH EACH COPY OF THE BID.	ISSUE R1

ENQUIRY/SPECIFICATION NO.:	BIDDER:

	(a) Material of conductor and size	Cu/Al mm^2
	(b) Conductor –	solid/Stranded
9.0	Panel details	
	(a) Mounting	Wall/floor
	(b) Weight	Kg
	(c) Dimension (approx.) L X B X M	Mm
	(d) Cable entry	Top/ bottom

NOTES TO BIDDER

1. ITEMS WHICH DEVIATE FROM THE SPECIFICATION SHOULD BE MARKED WITHIN ASTERISK (*) AND DETAILS TO BE GIVEN IN SCHEDULE OF DEVIATIONS.
2. THIS DATA SHEET SHALL BE FILLED UP COMPLETELY AND A COPY SHALL BE ENCLOSED WITH EACH COPY OF THE BID.

SIGNATURE OF BIDDER & DATE

ISSUE R1

DATA TO BE FURNISHED BY THE VENDOR AFTER AWARD OF CONTRACT

1.0 Following data shall be submitted within 3 months after placing the order.

1.1 Schematic diagram indicating terminal numbers for external connections and with a Bill of Material for all the equipment.

1.2 Control cabinet drawing showing outline dimensions, cable entry openings, floor / wall / pedestal fixing arrangements, padlocking arrangement, weights.

1.3 MANUFACTURER'S technical literature on various equipments mounted on control cabinet.

1.4 Cabinet internal wiring diagram (This drawing shall be submitted only for information and records and shall be based on a approved schematic drawing. The correctness of this drawing shall be the responsibility of the VENDOR).

1.5 Test certificates for the control cabinet and the various equipments.

1.6 General Arrangement and Mounting arrangement drawing clearly indicating openings for cable entry, details of terminations etc.

1.7 Calculations for the resistor in the starter panel (for DC motor) shall be submitted

SECTION D9

415V SWITCHGEAR/POWER DISTRIBUTION BOARD/MCC

1.0 415 V Switchgear, PMCCs and MCCs required for feeding the all the entire Plant Loads (except River water System) shall be supplied. These shall include as a minimum the following boards for 2 Units:-

a) Turbine PCC
b) Turbine MCC
c) Boiler PCC
d) Boiler MCC
e) Soot blower MCC
f) ESP MCC
g) Mill MCCs
h) TVDB
i) BVDB
j) Hydrogen Plant MCC
k) AC & DC distribution boards
l) AC & ventilation MCC
m) Normal emergency switchgear
n) DC Switchgears
o) Emergency Switchboards (D.G)
p) Cooling Tower MCCs.
q) Intake Water MCCs.
r) Ash handling Plant PMCC
s) Ash water/Silo/Slurry MCC- As required.
t) Fly Ash MCC- 3 Nos.
u) Ash dyke MCC
v) Coal Handling Plant MCCs- As required
w) Wagon tippler MCCs- One MCC per Wagon tippler.
x) Bunker Floor PMCCs- As required
y) Water system switchgear.
z) DM Plant MCC
aa) Chemical House MCC
bb) River water MCC
cc) Electro Chlorination Plant MCC.

dd) Clarified water MCC

ee) Effluent treatment plant MCC

ff) Guard Pond MCC

gg) LDO MCC

hh) HFO MCC

ii) Fuel oil unloading PH MCC A, B

jj) Switchyard PMCC A, B.

kk) Station switchyard auxiliary swbd PMCC 1 , 2

ll) Fire water PH switchgear 1A,1B.

mm) Site office switchgear.

nn) Compressor MCC 1A,1B

oo) Air washer MCC 1A, 1B.

pp) C.W Pump House MCC

qq) Station ACDB 1A,1B.

rr) Work Shop MCC

ss) Admin building PCC

tt) Service building AC and Ventilation MCC

uu) ESP Control Room AC and Ventilation MCC

vv) Receptacle Welding DBs.

ww) Space Heater DB – As required.

1.1 415 V systems shall be 3 phase, 3-wire, solidly grounded system except for those listed in cl.no.1.2 which shall be with 4-wire system. All MCC shall derive power from power source as per Key One line diagram 5750A-738-AU-3001 attached.

1.2 Following PCC/MCC/Distribuiton Boards shall be of 4-wire type. Incomer and bus coupler SFU/MCCB/ACB of all 4 wire PCC/MCC/DB shall be of 4 pole type:

a) Welding receptacle DBs

b) Space Heater DBs

c) Workshop MCC

d) Admin building MCC

e) Site Office switchgear

f) Service building and Ventilation MCCs

g) Station building DBs

h) Switchyard DBs

i) All PCCs

1.3 For codes & standards refer section D28 of this volume.

2.0 FEEDER DETAILS

2.1 Each of the switchgear shall be provided with two bus sections, two incomers and a bus coupler each rated for 100% of the loads connected to the switchgear.

2.2 The switchgears shall be provided with suitable number and type of outgoing feeders for the respective auxiliary loads of the system/area. Additionally following shall be provided in all Switch boards.

(a) Spare feeders:

- 4 Nos. of 400A outgoing feeders shall be provided in station auxiliary service switchgear for Owner's use by the EPC Contractor scope.
- In addition, 20% spares of each rating and type of module shall be considered with a minimum of one number. Any additional quantity required for any increase/ changes during detailed engineering stage shall also be duly considered.

(b) Bus VT module – 1 per bus section.

(c) Control transformer module – 1 per bus section. Where there is no bus section (only one bus) and for the N/E Swicthgear bus section, 2 nos. Control Transformers are to be provided. Control transformers shall be located in Physically separate modules. Each Control transformer shall be sized for complete load of the Switchgear/MCC. i.e., Control Transformers shall be of 2 X100 % capacity with manual and auto changeover facility in case of any one Transformer supply failure.

(d) 240V, 1 phase space heating. 1 per bus section.

(e) Control supply (AC and DC) changeover scheme module.

(f) Each bus section shall have the following feeders for Purchaser's use:

32A – 3 Nos.

63A – 2 Nos.

100A – 2 Nos.

160A – 2 Nos.

(g) Essential / critical loads to receive supply from the Normal-Emergency Switchgear and 220V DCDB.

3.0 SHORT CIRCUIT CURRENTS

3.1 The fault level on the 415V buses shall be calculated based on transformer contribution and motor contribution and shall be limited to 50kA inclusive of 10 % margin. The minimum short time current rating shall be 50 kA for 1 second.

3.2 It is the responsibility of the Vendor to co-ordinate operation of all the ACBs and MCCBs for short circuit condition so that discrimination in operation is provided. Co-ordination and relay setting is in Vendor's scope.

4.0 CONTINUOUS CURRENTS

The continuous current rating of the bus bars, the incomers, bus couplers of the switchgear, which are fed by the transformers shall be rated at the LV side full load current of the corresponding transformers with 20% margin rounded off to the next higher standard rating.

5.0 SPECIFIC REQUIREMENTS

5.1 All the 415V equipments/devices like bus support insulators, CBs, CTs, PTs etc mounted inside the switchgear shall be suitable for continuous operation and satisfactory performance under the following supply conditions.

(a) Variation in supply voltage ±10%

(b) Variation in supply frequency ±5%

(c) Combined voltage and frequency variations: 10% absolute.

5.2 All bus bar, bus-taps shall be insulated with close fitting sleeve of PVC insulation with high dielectric strength.

5.3 The switchgears shall be totally enclosed, metal clad, sheet steel fabricated, indoor, floor mounted fully draw-out modular type construction, dust and vermin proof of uniform height of not more than 2450mm, easily extendable on one side having switchgear designation indicating label's on front and rear, in single/ double front execution in totally draw out. Proper gasketting shall be provided all around the perimeter of the adjacent panels, panel and base frame, removable cover and doors. The switchboard shall be fully compartmentalized. Incomers to the switchgear shall be of cable/ Non-segregated phase busduct. The switchgear shall be capable for the suitable termination.

5.4 Operating devices shall be incorporated only in front of the switchgear.

5.5 Switchgear shall be divided in to distinct vertical section consisting of :-

(a) Completely Enclosed busbar compartment running horizontally.

(b) Individual feeder modules in multi tier arrangements.

(c) Enclosed vertical bus bars serving all modules in vertical section.

(d) Vertical cable alley covering entire height and minimum 300 mm wide and shall have hinged doors.

(e) A horizontal separate enclosure for all-auxiliary power and control bus as required.

5.6 All modules of identical size & type shall be fully interchangeable without any modifications.

5.7 The sheet steel to be used for the metal enclosed switchgear shall be minimum 2.5 mm thick hot rolled or 2 mm cold rolled.

5.8 The cable entry shall be bottom/top with separate gland plate for power and control cable. In case of single core cables, gland plate shall be of non magnetic material. The exact cable entry shall be finalised during detailed engineering.

5.9 All Air circuit breakers (ACBs) and Moulded case circuit breakers shall be of short circuit performance category P2 as per IS:2516 Parts I & II.

5.10 The MCCBs shall be of current limiting type. When MCCB's are used as short circuit protection devices for motor modules they shall provide type C co-ordination with associated contactor and thermal overload relay as per IS: 8544 under all operating conditions for the all currents up to the design fault current. The MCCBs on upstream and downstream shall be co-ordinated.

5.11 Test reports to prove the requirements of Type-C Co-ordination shall be furnished.

5.12 There shall be two number 220V DC control supply for each switchgear. Auto and manual changeover scheme for changeover of supply- 1 to 2 and vice versa shall be provided. Necessary voltage monitoring contactors (for remote alarm) and indication lamps shall be provided.

5.13 Minimum of one NO and one NC spare contacts of all contactors, relay devices shall be wired to terminal block. All spare contacts of all contactors relay terminals shall be wired up to the terminal block.

5.14 For CT & VT circuits disconnecting type of terminals shall be provided.

5.15 Power cable terminal arrangement and size shall be suitable to accommodate two or more number of cables based on requirements and shall facilitate easy maintenance.

5.16 Terminal arrangements shall be such that all terminals at switchgear ends, which are to be connected to remote alarms and indication at DCS, shall be separated out and shall be kept isolated from other Terminals. 240V AC, 110V AC, 24V DC, 220V DC & other voltages shall be segregated to avoid mix up of voltages. This is specifically required to avoid mixing of switchgear high voltage to C &I low voltage system.

5.17 Meters shall be Digital type. For MCC verticals, CT pertaining to a particular module should be mounted in the respective with drawable module it self. CT should not be mounted in cable alley.

5.18 Switchgear shall be suitable for easy extension on one side. It shall be possible at a later stage to add cubicles to the switchgear by extending the bus bars.

5.19 Secondary of CTs & VTs shall be made through disconnecting type terminals with necessary shorting and earthing facilities. All the control wiring shall be through stud type terminal.

5.20 The breaker ratings indicated in the data sheets referred to the nominal rating of the breaker. However, Breakers shall be capable of carrying continuously at least 120% of circuit breaker current at an ambient temperature of 44 deg. and with breaker mounted inside the panel. If a higher rated breaker is necessary to meet this, the same shall be used.

5.21 Dummy cubicles with horizontal bus bars, power control and annunciation cable running through the panel, if necessary, to avoid beam interfering with cable openings and to felicitate easy maintenance shall be provided.

5.22 All the bolted joints in body of the switchgear shall be earthed through flexible jumpers.

5.23 All indicating and integrating instruments, protection and alarm relays , operating and indicating devices shall be visible/ accessible without opening the instrument compartment door. All the hand reset relays shall be mounted on the panel at a conventional height for operation.

5.24 All the internal wiring shall be carried out using 1100V grade, stranded copper conductor with PVC insulation and shall be flame, vermin and rodent proof. The minimum size of the copper conductor used for panel wiring shall be as follows:

- All circuit except CT &PTs: 1.5 sq mm per lead.
- CTs/PTs : 2.5 sq mm/per lead.

5.25 The minimum number of strands per conductor shall be 07. Double flexible wire shall be used for internal wiring of devices mounted on moving parts of Cu conductor of size as mentioned at a) & b) above.

5.26 Following colour coding shall be used for internal wiring:-

- Red, Yellow & Blue: For respective phase /PT wires.
- Black : for neutral wires.
- Green : For Earth wires
- Red ferruled wires for trip circuit.
- All other with grey coloured wires.

5.27 The inter panel wiring shall be brought out to a separate set of terminal blocks located near the slots meant for inter panel connecting wires.

5.28 At least 20% spare spare terminations of CT, PT & others shall be provided on each panel'. and these spare terminals shall be uniformly distributed on all rows of terminal blocks. A clearance of 250 mm shall be maintained between terminal blocks and gland plate and 150 mm between two rows of terminal blocks. at least 20%

5.29 All the electrical equipment shall be fed from main MCC only and if any specific arrangement is needed, separate panel for that shall be provided in switchgear room.

5.30 All LT panels shall be mounted at least on ISMC (Indian Standard Medium Channel) or other applicable 100 channels to prevent ingress of water.

5.31 All hardware required for meeting the functional requirements stated above, whether specifically listed out in the specification or not, shall be included in the scope of supply.

5.32 Current transducers, power transducers and Voltage transducers shall be provided.

5.33 The cable terminations inside the cable alley shall be completely shrouded so that it shall be possible to work on any one of the terminations by switching OFF the corresponding feeder switch only.

5.34 All bezels, handles, screws, bolts, washers, hinges, etc. shall be of the best quality electro galvanized or passivated to withstand attach from corrosive atmosphere.

5.35 Horizontal busbar chambers shall be at the top of the board for bottom cable entry. Busbars shall be completely shrouded to prevent metal pieces falling on the busbar during maintenance.

5.36 In case of copper to aluminium connections, proper treatment shall be given to minimise the bimetallic effect. That is, all joint surfaces at aluminium to copper joints shall be silver / tin plates, alternatively Cu-Al washers (bimetallic washers) can be used..

5.37 On- line energy monitoring system shall be provided on all drives above 80kW rating which will help in preventive maintenance.

5.38 All MCC feeders of 80kW and above rating shall have Ampere,kVA, kW transducers for communicating the data to PLC system for auxiliary consumption analysis.

5.39 Outgoing feeders of rating 200A and above upto 630A (other than motor feeders) shall have MCCBs only with Short-circuit and Earth fault protection. Feeders of rating less than 200A shall be SFU. This is not applicable for feeders feeding other MCCs and switchboards.

5.40 Welding Distribution Boards shall be provided with the following:

a) It shall be with isolating transformer on the incomer with ACB with Over current and Earth fault protections.

b) It shall be provided with maximum 12 nos. Of outgoing feeders.

c) Quantity of Welding receptacles:

(i) One (1) no. in each ESP and Boiler Platform.

(ii) One (1) no. every 50m in each floor of TG building.

(iii) Two (2) nos. each in every building in the power plant other than Admin Building.

(iv) One (1) no. for every 60M in Switchyard and Main Transformer yard.

(v) Looping of welding receptacles not allowed.

6.0 **INCOMERS & BUS COUPLERS.**

6.1 Incoming/ Bus coupler/ Outgoing feeders of rating 200A and above up to 630A (other than motor feeders) shall have MCCBs only with Short-circuit and Earth fault protection. Feeders of rating less than 200A shall be SFU. Feeders rated above 630A shall have ACBs.

6.2 The following minimum protections shall be provided for incomers and bus coupler for switchgears.

- phase inverse time over current relays
- Earth fault relay (for incomer only)
- Numerical relays shall be provided for all protection.

6.3 The incomer modules & bus coupler modules of PMCC as well as important MCC's as mentioned in clause 6.5 irrespective of loads shall be equipped with fully draw out air circuit breaker protected with relays.

6.4 All incomers and outgoing feeders of various loads shall have digital energy meter for energy accounting. The energy Meters of Incomers shall be of the Tri Vector Meter type (TVM) with recording and download facility.

6.5 Important MCCs shall be controlled from remote DCS & ECP. They shall be with ACBs, closing coil, shunt trip coil and relays irrespective of the current ratings.

6.6 The incomer modules shall be interlocked with their upstream breaker such that they can be closed only when upstream breaker is closed and trip automatically when upstream breaker is tripped.

6.7 Each circuit breaker cubicle shall be complete with following minimum accessories:-

a) One spring return Trip normal close (TNC) switch.

b) Large size cluster LEDs for following condition of breaker/contactor:-

(i) "ON"(Red)

(ii) "OFF" (Green)

(iii) Trip relay supervision (White).

(iv) Spring charged (Blue)

(v) DC supply supervision (Violet)

(vi) Trip on fault (Amber)

c) Limit switches for test and service position interlocking.

d) Double pole switch for DC control supply and spring charging motor with HRC fuses or MCB will be provided (Fuse or MCB shall be provided for DC control supply which shall be decided during detailed engineering).

e) Anti pumping relay.

f) Sufficient terminal blocks.

g) Auxiliary relays as required for contact multiplication.

h) Breaker operation counter.

i) Numerical Protective relays along with trip circuit supervision relay and master trip relay.

j) Meters as indicated elsewhere.

k) Required CTs/PTs.

l) Space heaters.

m) One Local/Remote Switch.

n) Required number of 24 V DC DC Interposing Relays.

o) 4-20 mA output Transducers for current, power and voltage.

p) Other associated equipment.

6.8 All the circuit breakers shall be of fully draw out execution with "Test", "Service " &" Fully withdrawn " positions.

6.9 Double tier arrangement shall not be provided for incomers and bus coupler. In case of motor feeders, double tier arrangement may be provided but two breakers of same application motor shall not be provided in one vertical.

6.10 Breakers shall be with motor wound spring operating mechanism, 220 V DC operated Closing and tripping coils.

6.11 Closing action of the CB shall compress the opening spring ready for tripping.

6.12 Proper mechanical indication shall be provided to locate these three positions without opening of the compartment door.

6.13 It shall be possible to bring the circuit breaker to isolated position with the help of external lever without opening the compartment door.

6.14 A stop block shall be provided on the slide rails to prevent the movement of the circuit breaker out of the compartment when it reaches the isolated position so that any accidental fall can be avoided.

6.15 No control & metering equipments should be mounted on breaker compartment door (i.e access to control & metering equipments should be available at all time without opening Breaker Compartment door).

6.16 It shall not be possible to close the Breaker if stored energy mechanism is not charged.

6.17 In case of MCCBs, it shall not be possible to close the Breaker if under-voltage relays release is not energised (if present).

6.18 Movement of the circuit breaker truck from service to test or test to isolated position OR in reverse order shall be possible only when circuit breaker is off.

6.19 It shall not be possible to withdraw the breaker when it is in closed position.

6.20 Opening of compartment door with breaker / isolating switch in Service & Intermediate and ON position and vice versa shall not be possible.

6.21 It shall not be possible to close the Breaker if closing coil is energized.

6.22 It shall not be possible to close the Breaker if OFF – Push Button is locked in off position.

6.23 It shall not be possible to close the Breaker if crank hole is open.

6.24 The Circuit Breaker shall be provided with mechanical ON/OFF, TRIP and SPRING CHARGED, DISCHARGED READY TO CLOSE AND BREAKER POSITION indication, mechanical trip push button.

6.25 The circuit breaker shall be provided with automatic safety shutters, so that before the breaker reaches 'isolated' position the main isolating contacts are completely shrouded. In the draw-out condition, it shall be possible to inspect the Breaker fixed contacts condition by lifting the shutters.

6.26 The protective relays and instruments shall be mounted in separate compartment. This compartment shall be along side and immediately next to the controlled breaker

6.27 Contact erosion indicator shall be provided on Moving contacts of Breaker for visual indication of contact life.

6.28 All the non conducting metal parts of the circuit breaker trolley shall be bonded together and shall make perfect electrical connection to earth through substantial sliding contacts, at service and test positions. Such sliding

contacts shall be arranged to make before power plug in and interrupt after power draw out.

7.0 BUS AND LINE PTs

Bus PT over voltage factor shall be 1.9 for 08 hours. 3 Nos. single phase PTs shall be connected up to form a 3 phase unit.

Each PT cubicle shall be complete with following minimum accessories

(a) PTs shall be fully draw out type with required no of cores and ratios as specified elsewhere.

(b) Voltmeter with selector switch.

(c) Separate Under voltage (2 nos.) and No voltage relays (2 nos.) with timers and fuse fail relays.

(d) Required auxiliary relays.

(e) LEDs for voltage indication.

(f) Auxiliary PTs, as required.

(g) DC and AC control supply and changeover switches with Short Circuit protection.

8.0 MOTOR MODULES

8.1 All LT motors shall be controlled as follows:

a) Up to 50kW: - MPCB + Contactor (MPCB shall be with adjustable S/C and O/L protection).

b) 50kW to 90kW shall have MCCB+ contactor+ bimetallic relay.

c) 90Kw to 160kW shall have ACB +motor protection relay (MPR).

8.2 All motor feeder shall be complete with following minimum accessories.

(a) Interlocking schemes for Space heating arrangements (space heating for motors above 30KW).

(b) 3 position selector switch-Local (switchgear)/Field/Remote (DCS/PLC)

(c) Test services position switches and associated contactors for interlocking.

(d) Power contactors and MPCB or breaker.

(e) Bi-metal relay or Motor Protection relay.

(f) CTs as specified elsewhere.

(g) Local indication lamp for ON, OFF & TRIP/Fault indication.

(h) Relays as required.

(i) ON & OFF PBs, for testing in Test Position.

(j) 24 V DC Interposing relays to accept remote start and stop signals .

8.3 All the motors rated 30 kW and above shall be provided with a CT, ammeter and a current transducer with remote metering in DCS. Further important motor like ID/FD/PA fan, LOP motors, HP/LP bypass motor, mill feeders motor, APH motor, air conditioning motor etc shall also be provided with CT, ammeter and a current transducer with remote metering in DCS irrespective of kW.

8.4 The incomer/bus coupler, module, MPCB/MCCB feeder etc shall confirm to the attached M2 series of schematic drawings.

9.0 ACTUATORS.

All actuators to be supplied with non integral starters.

10.0 METERING.

10.1 Each incomer feeder to all PMCC/PCC/MCCs shall have Voltage, Ampere, kVA, kW, transducers for communicating the data to DCS/PLC system for auxiliary consumption analysis and these parameters voltage, current, kW and kVA of each incomer also shall be available on respective ECP.

10.2 Meters shall be Digital type. All CT s/ PT s, transducers and meters (Energy accounting and audit meters) on 415 V system shall be class 1.0. Metres for motor feeders shall be with suppressed scale.

10.3 All MCC feeders (except motor feeders) of 80kW and above rating shall have Ampere, kVA, kW transducers for communicating the data to DCS/PLC system for auxiliary consumption analysis.

10.4 All the motors rated 30 kW and above shall be provided with a CT, ammeter and a current transducer with remote metering in DCS. Further important motor like ID/FD/PA fan, LOP motors, HP/LP bypass motor, mill feeders motor, APH motor, air conditioning motor etc shall also be provided with CT, ammeter and a current transducer with remote metering in DCS irrespective of kW.

10.5 The Energy accounting and audit meters as required by CEA shall be on a separate core and shall be installed at following locations to facilitate the accounting of the energy generated, transmitted, distributed and consumed in various segments of the power system and the energy loss, namely

- Low voltage side of each incoming transformer feeder of low voltage (415V) buses, and

This CT core and the meters shall have an accuracy of 0.2S for this purpose and PT cores shall have an accuracy class of 0.2 for this purpose.

11.0 ALARMS/INDICATION/SER POINTS

11.1 INCOMERS AND BUSCOUPLER CONTROL.

11.1.1 Incomers/Bus couplers/Ties from/to the various Switchboards (with ACB and MCCB as incomers) listed in Clause 1.0 shall be controlled from DCS/PLC (as applicable) and ECP as explained in clause no. 2.1.1 of section D2.

11.1.2 Interconnecting cables to DCS and required interposing relays (24 V DC) are in Vendor's scope. Interposing relays are to be located in the Switchgear.

11.1.3 Each ECP shall have all the instruments as explained in clause no. 2.1.2 of section D2.

11.1.4 It shall be possible to control every breaker in the test position both from Switchgear as well as remote (DCS) for testing purpose.

11.1.5 **ALL OTHER SERVICES.**

All the motors / Valves and other equipment shall be controlled from respective process control panels/DCS to be supplied by Vendor.

Emergency stop pushbutton shall be provided near all drives except emergency drives and shall be wired directly to MCC. In case of emergency drives, emergency start PB only shall be provided.

11.1.6 The control room shall provide indication & alarms for the 415V auxiliary supply as given below. Any additional indications/alarms considered necessary during detailed engineering also shall be provided. Some of these shall be selected for sequential event recording. For each breaker and bus, grouped alarm for any abnormal conditions shall be provided in the control desk. For all breaker (ACB/MCCB) fed switchgear, status indications shall be available on CRT in form of SLD.

		MCC	DCS / PLC	ECP
STATUS INDICATION				
(a)	Incomer & Bus coupler breaker (ACB/MCCB) feeders			
	➢ Breaker ON	✓	✓	✓
	➢ Breaker OFF	✓	✓	✓
	➢ Breaker in local	✓	✓	✓
	➢ Breaker in remote	✓	✓	✓
	➢ Breaker in service	✓	✓	✓
	➢ Breaker in test	✓	✓	✓
	➢ DC supply healthy	✓	✓	✓

		MCC	DCS / PLC	ECP
	➢ Breaker spring charged	✓	✓	✓
	➢ Trip Relay supervision	✓	✓	✓
(b)	Incomer & Bus coupler breaker (SFU) feeders			
	➢ Incomer /Bus coupler ON	✓	✓	✓
(c)	Motor Feeders			
	➢ Motor ON	✓	✓	×
	➢ Motor OFF	✓	✓	×
	➢ Motor Auto trip.	✓	✓	×
	➢ Motor Local Emergency PB pressed	×	✓	×
	➢ Feeder Fault	×	✓	×
	➢ Breaker in Remote	×	✓	×
	➢ Breaker in Field	×	✓	×
	➢ Breaker in Local	✓	✓	×
	➢ Breaker in service	✓	✓	×
	➢ Breaker in test	✓	✓	×
	➢ Breaker spring charged	✓	✓	×
	➢ Trip Relay supervision	✓	✓	×
ALARM SIGNALS				
(d)	Incomer & Bus coupler breaker (ACB/MCCB) feeders			
	➢ Breaker auto tripped/L/O Relay operated	×	✓	✓
	➢ Sources paralled beyond pre-set time	×	✓	✓
	➢ Common outgoing feeder fault	×	✓	✓
	➢ Incoming 220 V DC control supply failed	×	✓	✓
(e)	Incomer & Bus coupler breaker (SFU)			

		MCC	DCS / PLC	ECP
	feeders			
	➢ Incomer/Bus coupler Fuse blown	✓	✓	✓
(f)	BUS/Line PT			
	➢ Bus under voltage	✓	✓	✓
	➢ Bus PT fuse failed	✓	✓	✓
	➢ BUS PT not in service	✓	✓	✓
(g)	Motor Feeders			
	➢ Overload alarm	×	✓	×
	➢ Feeder fault / closing permissive not available	×	✓	×
	➢ Breaker trip circuit trouble	×	✓	×
	➢ Trip through process interlock.	×	✓	×
	➢ Local push button pressed	×	✓	×
	➢ Breaker spring not charged alarm	×	✓	×

11.1.7 The current, voltage, Power measurements for each bus shall be available both on control room as indicated in this section and elsewhere in the specification. Also for specific motors where the current transducers are indicated, the measurement shall be available at the DCS.

11.1.8 Each remote controlled feeder including spare feeders shall be provided with 2nos interposing relays for start & stop.

11.1.9 The operation, indications and fault alarms for the motors of the auxiliaries shall be displayed as covered in the specification as part of C&I requirements.

12.0 TESTS

12.1 Switchgear shall be subjected to all routine tests as per relevant standards along with following tests:

(a) Mechanical operation test

(b) Insulation resistance and 500V DC Megger before/ after 1 minute HV test

(c) Electrical control, interlock and sequential operation tests

(d) Verification of wiring as per approved schematic.

12.2 Temperature rise test on each type and rating of Breaker and associated panels shall be carried out by the Vendor on breaker/Panel to be supplied for this project.

12.3 For all other type tests BIDDER shall submit valid type test reports for similar switchgear and ratings of breakers included in the offer. If these tests are not done or test results are not found satisfactory by the PURCHASER then such tests shall be carried out by Vendor without any cost implication.

12.4 Routine tests shall be carried out on all associated equipment supplied with switchgear as per relevant standards. Type test certificates of all associated equipment shall be furnished.

12.5 Valid type and routine test certificates shall be submitted by the VENDOR before despatch of the switchgear.

13.0 For technical particulars refer datasheet-A.

Sr. No.	Description		unit	Client specification
1.0	Manufacturer's name			*
2.0	Make of major components (ACB, Contactor, MCCB , CTs, PTs)			*
3.0	Type & model number of panel			*
4.0	Applicable standard.			*
5.0	Nominal system voltage, phase & frequency		V	415 V, 3 phase, 50 Hz, 3-wire/ 4- wire
6.0	System neutral earthing considered			Effectively earthed
7.0	Maximum system voltage		V	456.5
8.0	One minute power frequency withstand voltage	Power circuits	KV rms	2.5
		Control circuits		1.5
		Aux. circuits connected to secondary of CTs		2.0
9.0	Short circuit withstand capability a) Short time for 1 sec b) Dynamic rating		KA rms KA peak	Min. 50 KA Min. 127.5KA
10.0	Reference ambient temperature		Deg. C	50
11.0	Continuous current rating under site reference ambient condition		A	*
12.0	Maximum temperature of Bus Bars, dropper, connectors & contacts at continuous current rating under site reference ambient temperature		Deg C	90 deg. C for non silver plated joints 105 deg. C for silver plated

			joints
13.0	Material of bus bars considered		Copper / Aluminum Alloy
14.0	Cable entry		Bottom only
15.0	Degree of protection		IP- 52 upto 1600A and IP-42 above 1600A.
16.0	Thickness of sheet steel enclosures / doors.		
	Cold Rolled		2mm
	Hot rolled		2.5mm
17.0	Shade of paints		Powder coated paint of shade RAL 7032 (Siemens Grey)
18.0	Earthing bus bar size & material considered		75 x12 mm (min) , GS
19.0	Clearance in air of live parts		
	a) phase to phase		25 mm
	b) phase to earth		19 mm
20.0	Circuit breaker		
	a) Type		*
	b) Rated operating duty		O-3min-CO-3min- CO
	c) Rated current at site reference ambient temp.	A	
	d) Rated breaking current	KA rms	
	e) Rated making current	KA peak	*
			*
	f) Short time current withstand capacity for 1	KA	

	sec duration	rms	
	g) Asymmetrical breaking current		*
	(1) AC component		*
	(2) DC component	KA rms	as per IEC – 62271
	h) operating time		*
	(1) opening time		*
	(2) closing time		
	i) Closing and opening coil particulars.	Cycles	220V DC
	j) Switching over voltage factor	Cycles	2.2
21.0	Trip free operating mechanism type		Motor charged spring (manual trip & close facility to be provided)
22.0	Auxiliary control voltage for trip, close, annunciation and spring charging.		220 V DC (+/- 15 %)
23.0	Auxiliary control voltage for space heater, DC failure annunciation, motor winding / space heaters, lighting etc		240V AC, 1-Ph, 2 wire, 50 Hz
24.0	Breakers application		
	a) Incomer s		Yes
25.0	Details of contactors/ Switches/Fuses.		*
	• Type		
	• Rated operating duty		

	• Rated current at site reference ambient temp. • Rated breaking current • Rated making current • Short time current withstand capacity for 1 sec duration • Asymmetrical breaking current o AC component o DC component • Operating time o opening time o closing time		
26.0	Details of CTs • Type • Ratio • Burden • Accuracy class • Knee point voltage • Magnetizing current at Vk/2 • Secondary resistance • Class of insulation • Short time & dynamic current rating • Applicable standard		(Cast resin, Class E or Better) **

	• No. of cores		
27.0	Details of VTs • Type • Ratio • Burden • Accuracy class • Magnetizing characteristic • Method of connection • Class of insulation • Rated voltage factor (continuous & 8 hours) • Applicable standard • No. of cores		(Cast resin Class E or Better , Overvoitage factor 1.5 continious,1.9 for 08 hours) **
28.0	Particular of meters		*
29.0	Particular of relays		*
30.0	Panels construction details		*
31.0	**STARTERS**		
31.1.	Type		DOL/Soft Starters
31.2.	Contactor rated duty as per IS:13947		Uninterrupted
31.3.	Utilisation category as per IS:13947		AC 3 for non reversible AC 4 for reversible

31.4.	Control scheme & bill of material enclosed	YES/ NO	Yes
	CONTROL TRANSFORMER : A) Separate for each module B) Common for each switchgear section with 100% standby	 YES/ NO YES/ NO	 NO YES
31.5.	Single phasing preventer required	YES/ NO	Yes

NOTE :

1.0 '*' Information shall be filled furnished by BIDDER in contract document.

2.0 '**' BIDDER shall furnish these details after award of contract.

SPEC.NO. TCE.5750A-H-500-001	**TATA CONSULTING ENGINEERS LIMITED**	VOLUME IV SECTION: D9
PART B	**RRVUNL, 2 x 660 MW, Super-Critical TPS Stage- V, Unit # 7 & 8 at Suratgarh, Rajasthan** DATA SHEET B 415V MCC	SHEET 1 OF 10
ENQUIRY/SPECIFICATION NO.:	BIDDER:	

1.0	SPECIFIC PARTICULARS		
1.1	Switchgear designations		
1.2	Single front or double front	SF/DF	
1.3	Applicable Standard		
1.4	Fully drawout/semi drawout/Fixed	FD/SD/F	
1.5	Total dimensions of each complete switchgear L x W x D	mm L W D	
1.6.1	Width of each vertical section with cable alley	mm	
1.6.2	Width of cable alley only	mm	
1.7	Minimum clear space required a) In front b) Back	 mm mm	
1.8	Max. cubicle weight with components	kg	
1.9	Have all the feeders and components specified in enclosed Drawings and Data Sheets A - 3 been provided ?		YES/NO
2.0	GENERAL PARTICULARS		
2.1	Sheet steel		

NOTES TO BIDDER

1. ITEMS WHICH DEVIATE FROM THE SPECIFICATION SHOULD BE MARKED WITHIN ASTERISK (*) AND DETAILS TO BE GIVEN IN SCHEDULE OF DEVIATIONS.
2. THIS DATA SHEET SHALL BE FILLED UP COMPLETELY AND A COPY SHALL BE ENCLOSED WITH EACH COPY OF THE BID.

SIGNATURE OF BIDDER & DATE

ISSUE R1

	a) Cold rolled/Hot rolled b) Thickness : i) Frames ii) Door iii) Rear cover iv) Side and top covers v) Panel partitions	 mm mm mm mm mm	
2.2	Degree of protections provided by the enclosure (As per IS : 13947)		
2.3	Earth busbar size	Sq.mm	GI/AL/CU
2.4	BUSBAR a) Material of busbars b) Section c) Continuous current rating under site conditions d) Whether busbars have been insulated e) Type of insulation f) Temperature rise over the reference ambient	 Sq.mm A °C	 AL/CU PH : N: YES/NO

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ISSUE R1

	when carrying rated current		
	g) Material of busbar supports		
	h) Clearance in air :		
	i) Between phases	mm	
	ii) Between phases earth	mm	
	i) Short time rating (One Sec.)	kA	
	j) Momentary rating (peak)	kA	
3.0	CIRCUIT BREAKERS		
3.1	Maker's name		
3.2	Maker's type designation		
3.3	Applicable standards		
3.4	Circuit breakers type (air break and or MCCB)		
3.5	Rated voltage	V	
3.6	Rated operating duty		
3.7	Rated current	A	
3.8	Derating factor for operation under site conditions		
3.9	Rated symmetrical breaking current at rated voltage. (Indicate power factor)	kA P.F.	
3.10	Rated peak making current	kA	

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ISSUE R1

3.11	Rated short time withstand rating (for 1 sec.) (For MCCB, BIDDER to indicate the time)		
3.12	Operating mechanism type		
3.13	Limits of voltage for satisfactory operation of the following devices as a % of normal voltage i) Operating mechanism ii) Closing at normal voltage iv) Trip coil	 % % %	
3.14	Power required for closing at normal voltage	W	
3.15	Power required for tripping at normal voltage	W	
3.16	Spring charging motor details : i) Rating ii) Rated voltage iii) Spring charging	 kW V, AC/DC Sec.	
3.17	Overload release provided	YES/NO	
3.18	Short circuit release settings and time delay features		
3.19	Undervoltage release setting		
3.20	Have electrical and mechanical anti-pumping features been provided	YES/NO	
3.21	Have type test certificates been enclosed ?	YES/NO	
4.0	AIR BREAK SWITCHES		
4.1	Make		
4.2	Type		

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ISSUE R1

4.3	Rated Voltage		
4.4	Applicable standards		
4.5	Maximum prospective fault current withstand of composite unit of switch and fuse	kA (peak)	
5.0	FUSES		
5.1	Make		
5.2	Type		
5.3	Applicable standards		
5.4	Rated voltage	V	
5.5	Rated current for individual circuits to be provided as per requirements of protection coordination	YES/NO	
6.0	CONTACTORS		
6.1	Make		
6.2	Rated duty		
6.3	Rated Utilisation Category		
6.4	Applicable standards		
6.5	Rated (thermal) current provided as per specification	YES/NO	
6.6	Rated voltage of auxiliary contacts	V	
6.7	Rated voltage of coil	V	
6.8	Rated breaking capacity	Factor of rated current	
6.9	Rated making capacity	Factor of rated current	
6.10	Limits of operation i) Supply voltage variation ii) Supply frequency variation for closing	 + % + %	

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	iii) Drop out voltage	%	
6.11	No of auxiliary contacts : I) Normally open ii) Normally closed		
7.0	SINGLE PHASING PREVENTERS		
7.1	Is it in built-in bimetal thermal overload relay	YES/NO	
8.0	CURRENT TRANSFORMERS.		
8.1	Make		
8.2	Applicable standards		
8.3	All other parameters of CT as per enclosed SLD/list and Section-D	YES/NO	
9.0	VOLTAGE TRANSFORMERS		
9.1	Make		
9.2	Applicable standards		
9.3	Ratio	V/V	
9.4	Output per phase	VA	
9.5	Accuracy class		
9.6	Over voltage factor		
9.7	Class of insulation		
10.0	CONTROL TRANSFORMERS		
10.1	Make		
10.2	Type		
10.3	Applicable standards		
10.4	Ratio		
10.5	Class of insulation		
10.6	Rated output	VA	
11.0	INSTANTANEOUS OVERCURRENT RELAY		
11.1	Application (phase fault or earth fault)		
11.2	Make		

NOTES TO BIDDER

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ISSUE R1

11.3	Type designation		
11.4	Setting range		
12.0	INVERSE TIME AND THERMAL OVERCURRENT RELAY		
12.1	Application		
12.2	Make		
12.3	Type		
12.4	Current setting range		
12.5	Time setting range at 10 times the current setting	Sec.	
13.0	UNDERVOLTAGE RELAY		
13.1	Make		
13.2	Type		
13.3	Voltage rating	V	
13.4	Setting range	V	
14.0	AUXILIARY RELAYS AND TIMERS		
14.1	Make		
14.2	Type		
14.3	Coil voltage	V	
15.0	CONTROL/SELECTOR SWITCH		
15.1	Make		
15.2	Type designation		
16.0	VOLTMETER		
16.1	Make		
16.2	Type		
16.3	Applicable standards		
16.4	Accuracy class		
17.0	AMMETER		
17.1	Make		
17.2	Type		
17.3	Applicable standards		
17.4	Accuracy class		
18.0	WATTMETER		
18.1	Make		

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18.2	Type		
18.3	Applicable standard		
18.4	Accuracy class		
19.0	INDICATING LAMPS		
19.1	Make		
19.2	Type		
19.3	Voltage	V	
19.4	Series resistor	Ohms	
19.5	Wattage of lamp	W	
20.0	PUSH BUTTONS		
20.1	Make		
20.2	Type designation		
20.3	No of contacts: i) Normally open ii) Normally closed		
20.4	Contact rating	A	
21.0	SPACE HEATER		
21.1	Make		
21.2	Type		
21.3	Rated voltage	V	
21.4	Heater output for each vertical panel	W	
21.5	Thermostat at setting °C		
22.0	WIRING AND TERMINAL BLOCKS		
22.1	Voltage grade		
22.2	Insulation		
22.3	Minimum size of conductor for : i) Power wiring ii) Control wiring	 Sq.mm Sq.mm	
22.4	Type of terminal blocks :		

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	i) For withdrawable Type ii) For Fixed type		
22.5	Minimum current rating of terminal blocks	A	
22.6	Whether terminals for CT's have been provided with short circuiting facilities	YES/NO	
23.0	PUSH BUTTON STATION		
23.1	Metal Enclosure : i) Die-cast aluminium/sheet metal of		
	2mm thickness ii) Degree of protection iii) Painting, inscription earthing terminals as specified	 YES/NO	
23.2	Gland plate and cable glands provided	YES/NO	
22.3	Facility for fixing on wall/structure provided	YES/NO	
23.4	No. of Contacts : i) Normally open ii) Normally closed		
23.5	Contact rating : I) At 415 V AC ii) At 110 V AC iii) At 220 V DC	 A A A	
23.6	Terminal blocks with identification nos.	YES/NO	

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ISSUE R1

	provided for external connections.		

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DATA TO BE FURNISHED BY THE CONTRACTOR AFTER AWARD OF CONTRACT

1.0 **OVERLOAD RELEASE**

(a) Characteristics
(b) Settings

2.0 **SINGLE PHASING PREVENTERS**

2.1 Make

2.2 Type designation

2.3 Rated voltage

3.0 **AUXILIARY RELAYS AND TIMERS**

3.1 Time delay range (for timers) Sec.

3.2 Resetting features

3.3 No. of contacts

3.3.1 Normally open/Normally closed

3.3.2 Contact rating A

4.0 **LIST OF DRAWINGS**

The VENDOR shall furnish the following drawings for each panel and switchgear.

4.1 Overall outline dimensions and general arrangement including plan, front elevation, rear & side elevations, clearances required in front and back, details of busduct connections, if any.

4.2 Switchgear layout plan including floor openings, fixing arrangements and loading details.

4.3 Schematic control diagrams to cover controls, protection, interlocks, instruments, space heaters, etc. for each type of module

4.4 (a) Detailed internal wiring diagram of each type of module, including terminal block numbers, ferrule numbers and the PURCHASER's external cable connection designations

(b) Itemised bill of material for each module, listing all devices mounted and also otherwise furnished like cable glands, indicating the MANUFACTURER's type, rating, quantity & special notes, if any.

4.5 Interpanel interconnection wiring diagram including terminal numbers and ferrule numbers

4.6 Switch development diagrams

4.7 Block Interlock Diagrams for I/C,B/C & Motor Modules of various types.

5.7	Each type of protection relay and circuit breaker release characteristics	6 months
5.8	Fuse characteristic curves for each type and rating of fuse	6 months
5.9	Space heater ratings and numbers provided per cubicle and the internal distribution scheme for the same, for each switchgear	6 months

NOTES:

(a) The VENDOR shall be entirely responsible for the correctness of the internal wiring diagrams mentioned against Item 5.4.

(b) The VENDOR shall ensure that the characteristics of the CTs, fuses, protection relays, VTs and all other devices offered by him are such as to be suitable for the purpose for which they are intended.

(c) The VENDOR shall plan his manufacturing schedule so as to allow atleast 4 weeks time for approval of the drawings after their receipt by the PURCHASER.

6.0 **TEST CERTIFICATES**

6.1 Type test certificates of all standard component parts, e.g. contactors, breakers, switches, fuses, relays, CTs, VTs, and for the standard factory built assembly shall be submitted by the VENDOR within 3 months from receipt of order.

7.0 **INSTRUCTION MANUALS**

The VENDOR shall furnish specified number of copies of the instruction manual which would contain detailed instructions for all operational & maintenance requirement. The manual shall be furnished at the time of despatch of the equipment and shall include the following aspects :

a) Outline dimension drawings showing relevant cross-sectional views, earthing details and constructional features.

b) Rated voltages, current, duty-cycle and all other technical information which may be necessary for correct operation of the switchgear.

c) Catalogue numbers of all components liable to be replaced during the life of the switchgear.

d) Storage for prolonged duration.

e) Unpacking.

f) Handling at site.

g) Erection.

h) Precommissioning tests.

i) Operating procedures.

j) Maintenance procedures.

k) Precautions to be taken during operation and maintenance work.

SECTION D16

CABLES AND CABLE CARRIER SYSTEM

1.0 CABLES

1.1 H T POWER CABLES

System cables shall be 11kV (UE) and 6.6 kV (UE) grade suitable for use in medium resistance earthed system, stranded & compacted aluminium conductor, extruded semi conducting screen over conductor, XLPE insulated, semi-conducting followed by copper tape screened, extruded PVC Type ST – 2 inner sheathed, aluminium/GS wire armoured, overall FRLS PVC outer sheathed, conforming to IS 7098 (Part II), IEC-502 for constructional details and tests.

1.2 L T POWER CABLES

LV Power Cables shall be 1100 V grade, single / multi core, stranded aluminium conductor, XLPE insulated, with PVC inner sheath, armoured and outer sheath made of FRLS PVC compound, generally conforming to IS 7098 (for XLPE). The cables used for DC system shall be of single core type. Minimum conductor cross section of power cables shall be 6-sq. mm for aluminium cables.

1.3 CONTROL CABLES

Control cables shall be 1100 V grade, multi core, minimum 1.5 sq. mm cross section, stranded copper conductor having minimum 7 strands, PVC insulated, PVC inner sheathed / galvanised steel wire armoured, overall FRLS PVC outer sheathed generally conforming to IS 1554 Part-I. In situations where accuracy of measurement or voltage drop in control circuit warrants, higher cross sections as required shall be used.

1.4 INSTRUMENTATION CABLES

The instrumentation cables shall be Annealed, tinned stranded copper conductor, 0.5 sq mm , twisted into pairs, overall screened (I1 type) for digital signals, individual and overall screened (for I2 type) for low level analog signals, individual triplet and overall screened (type I3), PVC insulated , inner PVC sheathed, GS wire armoured and overall sheathed with FRLS PVC. The insulation shall be strippable manually as well as by mechanical stripping devices without damage to the conductor.

1.5 TRAILING POWER AND CONTROL CABLES FOR MOBILE EQUIPMENT.

11 kV(UE) and 6.6 kV (UE) and 1100V-(E) grade power & control flexible trailing, annealed tinned copper conductor, EPR insulated, EPR inner sheathed, CSP outer sheathed and shall have conductor screen of rubber. Cables shall conform to IS requirements and any other applicable standards.

1.6 FIRE SURVIVAL CABLES

1.6.1 Power and control, single/multi, stranded copper conductor fire survival cables complying with IEC-60331 shall be provided for following systems as per CEA guidelines.

(a) DC emergency lube oil pumps

(b) DC seal oil pumps

(c) DC emergency lighting cables for main building

(d) Batteries to chargers and DC distribution boards

(e) Turbine lube oil pumps

(f) Jacking oil pumps

(g) Emergency turbine trip by pushbutton in control room

(h) Boiler Turbine: Generator inter trip which includes the interconnecting cables between:

- Boiler master fuel trip and turbine trip relays
- Generator trip relays and turbine trip relays
- Generator trip relays and 400kV breakers
- Generator trip relays and generator field breakers
- Generator trip relays and ST and UT breakers

1.6.2 FS cables shall have following properties:

(a) Excellent fire resistance characteristics

(b) Cables shall have features of nontoxic and low smoke generation

(c) Flame non-propogation property

(d) Ability to withstand burning & continue to function during and after fire

(e) Low smoke emission & low halogen property to maintain circuit integrity to essential services under severe fire condition.

1.6.3 Construction of FS cables

(a) Conductor- Copper stranded

(b) Fire proof layer- heat barrier based

(c) Insulation- elastomer rubber

(d) Fire proof layer- same as 2 above but optional – natural or synthetic, fibre or elastomer

(e) Filler- suitable filler optional

(f) Binder tape – two layers of glass fibre tape

(g) Inner sheath- HOFR FRLS elastomer (heat & oil flame retardant)

(h) Armouring/screening – suitable wire

(i) Over all sheath – HOFR FRLS

1.7 Cables for the fire detection and alarm system and communication system shall be as described else where.

2.0 CABLE PROPERTIES

2.1 All single core power cables shall have wire / strip armouring of aluminium, whereas multi core power cable shall have galvanised steel wire / strip armouring.

2.2 The sheath shall be resistant to water, UV radiation, fungus, termite and rodent attack.

2.3 The outer sheath of FRLS PVC compound shall meet the following performance requirements:

(a) The critical oxygen index value shall be minimum 29 when tested at 27± 2^{0}C as per ASTM-D-2863-77 and the temperature index shall be minimum 250^{0}C at oxygen index value of 21 when tested as per ASTM-D-2863.

(b) The maximum acid gas generation as determined by titration method shall be less than 20% by weight when tested as per IEC-60754-1 (1994). Halogen acid content in outer sheath in FS cables shall not be more than 2%.

(c) Flammability

(i) Cables shall pass tests under fire condition as per IS-10810-Part-53.

(ii) Cables shall also pass tests as per IS-10810 Part-61 & Part-62. Category group shall be considered as Category 'A'.

(iii) Fire survival cables in addition to tests (i) and (ii) above shall pass tests as per IEC-331.

(d) The smoke generation under fire shall have maximum smoke density rating of 60% when tested as per ASTM-D-2843-77 (1977). Smoke density in FS cables shall not exceed 20%.

(e) The cables shall pass the ultraviolet tests as per DIN 53387.

(f) The cables shall pass the tests for Water absorption tests as per IS 10810.

2.4 The finished cable shall pass the flammability test as per IEC-322-1 (1993) and IEEE-383. In addition, it shall also pass flammability test as per Class F3 of Swedish Standard SS-424-1475 (1977).

2.5 In addition, cables for devices mounted on or near hot surfaces of Steam Generators, Turbine Generators, Main steam etc shall have heat resistance type outer sheath.

2.6 All LT cable shall have embossing at interval of 1 meter for owner name, size/ core type and length.

2.7 All cables shall be embossed with the name of RVUNL in addition to what is specified in the standards.

3.0 DESIGN CRITERIA FOR CABLE SIZING

3.1 POWER CABLES

Power cable sizes shall be selected on the following basis:

3.1.1 Power cables shall carry the full load current of the circuit continuously under site conditions considering the condition listed below:-

(a) Ambient design temperature 50 deg. C.

(b) Maximum allowable temperature under normal full load condition and under short circuit condition based on material selected (XLPE).

(c) Maximum short circuit fault current.

(d) Ambient temperature for underground cables, 50 deg. C.

(e) De-rating factors as per IS/IEC and manufacturer's standard catalogues.

3.1.2 Power cables shall withstand the fault current of the circuit for the duration not less than the maximum time taken by the primary protective system to isolate the fault. Fault clearing times for ties between two 6.6 kV switchgears shall be considered as 1 sec. Fault clearing times for ties between two 415V switchgears shall be considered as 0.5 sec.

3.1.3 For the cables to 415 V motors and feeders protected by fuses, the cross section shall be chosen according to the cut-off current of the fuse and its fusing time.

3.1.4 Voltage drop from transformer secondary to motor terminals during starting of motors will be limited to the following values:

(a) For HV motors (except MDBFP motor) – 15% of the rated voltage

(b) For MDBFP motors – 20% of the rated voltage

(c) For LV motors – 15% of the rated voltage.

3.1.5 Voltage drop in feeder cables shall be limited to 3% during full load running condition. Voltage drop from transformer secondary to motor terminals during full load running of motors shall be limited to 5 % of rated voltage.

3.1.6 For power supply to valve actuator motors, actuators of various isolating and regulating dampers and exhaust fans, 3 core 2.5 sq. mm stranded copper conductor cable may be used in view of ease of termination. These cables shall be in other respects similar to cables described in Clause 1.2 above.

3.1.7 Design Calculation for arriving at cable size shall be submitted for purchaser's approval.

3.1.8 DC System Cables:-

3.1.8.1 1100 V grade, single core cables as specified in LT power cables shall be used from batteries/ battery chargers to main DCDB, between main Distribution Board, from main Distribution Board to sub distribution board, main DC supply to various system cabinets/panels, Switchgears etc and for critical auxiliaries. Flexible cables with PVC insulation shall be used where termination of XLPE/PVC insulated cables is difficult.

3.1.8.2 Voltage drop in cables between battery to DCDB and battery charger to DCDB shall be limited to 2%. Voltage drop in cables between DCDB and loads shall be limited to 3%.

3.1.8.3 Design Calculation for arriving at cable size shall be submitted for purchaser's approval.

3.2 CONTROL CABLES

3.2.1 Current transformer leads shall be checked for the lead burden vis-a-vis the current transformer VA capacity. In case 2.5 sq. mm conductor impose unacceptably high burden on CTs, 4.0-sq. mm conductor shall be used. The conductor material shall be copper.

3.2.2 Voltage transformer leads shall be checked for voltage drop which shall be limited to within 1% for all cases other than tariff metering. For tariff metering the voltage drop shall be limited to 0.2%. In case the voltage drop with 2.5 sq. mm conductors exceed this value, higher conductor sizes shall be used.

3.3 INSTRUMENTATION CABLE

3.3.1	Element identification	:	As per IEC-60189-2
3.3.2	Core wrapping	:	By non-hygroscopic material by taping or by extrusion
3.3.3	Element screening	:	By copper tape of minimum 0.04mm thickness or by copper laminated plastic tape
3.3.4	Rip cord	:	Non-metallic rip cord under the core wrapping
3.3.5	Drain wire	:	A tinned copper drain wire of minimum 0.05 mm^2 cross section in contact with each screen of cabling element.

Cabling elements shall be any one of the following:

A 'Pair' of two insulated conductors twisted together designated by alphabet 'p' printed on a binding tape at 200 mm intervals.

A 'Triple' of three insulated conductors twisted together designated by alphabet 't', printed on a binding tape at 200 mm intervals.

Maximum length of lay in the finished cable shall be 120 mm.

3.3.6 Units

Cables shall be bunched together in units of twenty cabling elements or sub units of five or ten elements, stranded in concentric layers. The units or sub

units shall be designated by p1, p2, p3,. t1, t2, t3..,q1, q2, q3, .., or Q1, Q2, Q3 ..., etc. depending on the combination.

3.3.7 Overall screening and armouring

Cables shall have an overall screen made up of copper/aluminium tape of 0.04 mm thickness or copper/aluminium of 0.008 mm thickness laminated with plastic tape with a minimum overlap of 15%.A drain wire of tinned copper with minimum 0.5 mm^2 cross section shall be provided in continuous contact with the screen.

3.3.8 Inner and Outer Sheath

The inner and outer sheaths shall consist of black PVC compound.

3.3.9 Insulation Resistance

Minimum insulation resistance per km shall be 500 mega Ohm.

3.3.10 Mutual Capacitance

Mutual capacitance of any pair of conductors shall not exceed 120 nF/km.

3.3.11 Capacitance Unbalance

The capacitance unbalance between any two pairs shall not exceed 400 pF for 500 metre length of cable.The construction, performance and testing of cables except as mentioned above shall generally comply with the following standards :

IEC-60189 - Part-1 : Low frequency cables and wires with PVC insulation and sheath. General test and measuring methods

IEC-60189 - Part-2: (-do- Cables in pairs and triples).

4.0 CABLE TERMINATIONS

4.1 Cables shall be laid in trays /trenches/ conduits by the Bidder. Also joint markers shall be provided at each joint.

4.2 All 1100V termination for XLPE/PVC power cables and control cables shall be by Double compression weather proof type cable glands. Heavy duty, tinned, long barrel copper lugs shall be used for termination.

5.0 CABLE JOINTS

Cable joints shall be avoided to the extent possible. If joints are unavoidable due to circuit length, in excess of permissible maximum drum length, they shall be heat shrinkable types having a short circuit with stand capacity value as specified in clause 3.1.2 above. Lugs shall be heavy duty, tinned copper, long barrel type. All cable glands shall be double compression, weather proof.

6.0 POWER RECEPTACLES

3 phase, 5 pin, 63A power receptacles with switch shall be provided . The receptacle shall be industrial heavy duty type and shall have suitable interlock facility for safety. The receptacle shall conform to IS 1293 and the switch to IS 4064.

7.0 CABLE CARRIER SYSTEM

7.1 The cable carrier system shall be designed considering the following :

(a) Facility for easy laying of cables.

(b) Access to maintenance.

(c) Neat and aesthetic appearance.

(d) Safety of equipment & personnel.

(e) Ground water seepage.

(f) Drainage system for oil and water.

7.2 Cables shall be laid in prefabricated ladder (for power and control) / perforated (instrumentation) type trays and in conduits. Also joint markers shall be provided at each joint. The cable trays shall be laid vertical in boiler and ESP area, coal handling and ash handling area.

7.3 Cable trays and supporting structures in chemically corrosive area like battery room and water treatment plant shall be mild steel painted trays finished with chlorinated rubber based paint/epoxy paint.

7.4 Cable trenches will be avoided to the extent possible inside Fuel oil pump house, water treatment plan where possibility of oil and water collection exists and Boiler & ESP areas.

7.5 No direct underground burial cables shall be laid except lighting tower, street lighting. For some exceptional case like isolated individual equipments it shall be allowed after approval by the owner /consultant.

8.0 CABLE INSTALLATION AND ACCESSORIES

8.1 All material and accessories required for cable installation like cable trays, tray covers, support steel, etc., shall be hot dip galvanized. Conduits/pipes shall also be hot dip galvanized steel. The racks/trays, conduits/pipes, trenches required to route the cables to individual equipment shall be supplied and installed by the BIDDER.

8.2 Separate trays shall be provided for LV Power (AC&DC)/Control & Instrumentation cables.

8.3 After laying all the cables, BIDDER shall dress all cables by clamping at every metre, so that the cables are securely held and aesthetically good.

8.4 Cable trays shall be avoided very close to the pipes carrying high temperature steam. When they are inevitable, it shall be laid after OWNER approval and

suitable insulation material shall be provided between the cable trays and pipes.

8.5 1100 V cables up to 120-sq. mm. can be laid in two layers. Control and Instrumentation cables can be laid in three layers.

8.6 One spare conduit shall be provided for cable of center / outer drive in clarifier.

8.7 Power and control cables for critical / emergency drives / equipment like DC EOP / JOP shall be kept away and routed in separate cable trays

8.8 All cable entries to the buildings to be sealed by fire proof & water proof cement after cable installation.

8.9 One drum (500m) spare LT power/control of each size of cable shall be included.

9.0 CABLE TRAYS AND COVERS

9.1 All outdoor cable trays are to be provided with covers. All vertical cable tray race ways are to be provided with covers all round. Cable trays shall be of ladder / perforated type complete with all necessary coupler plates, elbows, tees, bends, reducers, stiffeners and other accessories. Cable trays of ladder and perforated types and the associated accessories such as coupler plates, tees, elbows, etc., shall be fabricated from 12 gauge (2.5 mm thick) mild steel sheets. Cable tray covers shall be provided for all cable trays and raceways. The cable tray accessories like trays, elbows, bends, etc., shall be fabricated and galvanized before bringing to site. Cable tray covers shall be fabricated from 16 gauge (1.7 mm thick) MS sheets. All the sheet steel shall be hot dip galvanized.

9.2 1100 V rated cables of sizes 120-sq. mm and above shall be laid in single layer. Single core cables used for 3-phase AC power circuits shall be laid in Trefoil form with suitable PVC aluminum clamps to hold the cables.

9.3 The sizing of cable trays from TG building to other areas shall consider para 9.2 above an additionally to avoid crowding and criss crossing of cables, especially in boiler area where vertical risers are to be provided for various power, control and instrumentation cables to higher elevations of boiler.

9.4 Slotted angles shall not be used for cabling. In all locations smaller size cable trays of 50 mm / 100 mm wide shall be used for one or two cables.

10.0 FIRE-PROOF SEALING OF CABLE PENETRATION

Cables / cable tray openings in walls and floors or through pipe sleeves from one area to another or one elevation to another, between the units and within the same unit, shall be sealed by a fire-proof sealing system. The fireproof sealing system (FPSS) shall effectively prevent the spread of fire from the flaming to the non-flaming side, in the event of a fire. The FPSS shall conform to the following requirements:

(a) FPSS shall have a fire rating of two hours.

(b) The FPSS shall be subjected to fire endurance test, hose stream test, temperature measurement of non-flaming side as per ASTM-E119. 'Standard method of fire tests of building construction and materials'.

(c) The FPSS will also conform to the in-combustibility test carried out in accordance with IS: 3144-1992.

(d) Under fire condition, the FPSS material shall not emit excessive smoke or any corrosive or toxic fumes.

(e) FPSS shall have minimum life of 25 years.

11.0 FIRE BREAK

11.1 Fire break shall be provided by applying a suitable fire-resistant coating on cables for the required length to meet the fire rating of 30 minutes.

11.2 Fire break shall be provided at an interval of 15 metres in the straight portion of each of the cable tray above ground, at intervals of 30 metres in cable trenches and at 5M for all vertical trays. All cable inter section and tee offs shall be provided with firebreaks.

11.3 When pipe sleeves are provided for cables from outdoor areas to indoor areas, the pipe opening at the outdoor side shall be sealed by fire proof sealing material, which is also continuously waterproof. The indoor side of the pipe opening shall also be sealed by continuous fire proof sealing materials. The duct banks in outdoor areas also need to be sealed by water poof seals. It is necessary to explore possibility of applying waterproof coating on fireproof sealing.

12.0 TESTS

All routine tests and FRLS tests as per relevant standard shall be performed on each size of cable. If same size is supplied in different lots, inspection shall be done for each lot. If same cable is supplied by different agencies, test shall be carried out on cables supplied by each agency. These tests shall be carried out as per relevant standards as applicable.

Routine and acceptance test shall be carried out on FPSS.

Type test certificates for type tests conducted on identical design and size of the Cables shall be submitted for review. If type tests have not been done or the certificates are found to be not in order by purchaser then these type tests shall be conducted on Cables to be supplied for this project at no extra cost to Purchaser.

13.0 For technical particulars refer datasheet-A.

Sr. No.	Description	unit	Client specification
1.0	Name of manufacturer		*
2.0	Make of cable		
3.0	Conductor No. core x Size Form- circular/segmented Effective cross sectional area sq. mm		*
4.0	Whether cores identification numbers for cables with 5 cores and above to be provided		Yes
5.0	Whether incremental running lengths are marked on cable		Yes
6.0	Finished cable a) Diameter under armour in mm b) Diameter over armour in mm c) Overall diameter in mm		*
7.0	Cable drums a) Whether cable drums confirm to IS : 10417 b) Length of cables in drum & tolerance c) Weight of cable drum without cables d) Weight of cable drum with cables e) Type of end sealing		*
8.0	FRLS cables a) Critical oxygen index value at 250 deg C when tested for temperature index test as per ASTM-		Ref. Clause 2.3

Sr. No.	Description	unit	Client specification
	D-2863 b) Total acid gas generation by weight when tested as per IEC – 754-1 in % c) Percentage of light transmission under fire for assessment of smoke generation when tested as per ASTM – D – 2843-77 d) Will the cables offered against this specification pass the flammability tests as per 1) Class – F3 – Swedish standard S5-424- 1475 2) IEC 60332 – 1C 3) IEC 60331 – 1		
9.0	Maximum dielectric loss of cable per KM at normal voltage and frequency	Watt/ km	*
10.0	Short circuit capability for 1 Sec (HT & LT Power Cable)	kA rms	Minimum 40kA and 50 kA for HT and LT respectively and shall be in line with requirements of the switchgear and protection.
11.0	Maximum dielectric stress at core screen	KV/c m	*
12.0	Max. overall diameter of cables	mm	*

'*' indicated above shall be filled by BIDDER.

ENQUIRY/SPECIFICATION NO.:	BIDDER:

Sl. No.	Description	Unit	Bidder's Offer
1.0	**Cables**		
1.1	Name of manufacturer		
1.2	Conductor a) No. core x Size b) Form- circular/segmented c) Effective cross sectional area sq. mm		
1.3	Whether cores identification numbers for cables with 5 cores and above to be provided		
1.4	Whether incremental running lengths are marked on cable		
1.5	Finished cable a) Diameter under armour in mm b) Diameter over armour in mm c) Overall diameter in mm		
1.6	Cable drums a) Whether cable drums confirm to		

NOTES TO BIDDER

1. ITEMS WHICH DEVIATE FROM THE SPECIFICATION SHOULD BE MARKED WITHIN ASTERISK (*) AND DETAILS TO BE GIVEN IN SCHEDULE OF DEVIATIONS.
2. THIS DATA SHEET SHALL BE FILLED UP COMPLETELY AND A COPY SHALL BE ENCLOSED WITH EACH COPY OF THE BID.

SIGNATURE OF BIDDER & DATE

ISSUE R1

ENQUIRY/SPECIFICATION NO.:	BIDDER:

	IS : 10417 b) Length of cables in drum & tolerance c) Weight of cable drum without cables d) Weight of cable drum with cables e) Type of end sealing		
1.7	FRLS cables		
	a) Critical oxygen index value at 250 deg C when tested for temperature index test		
	b) Total acid gas generation by weight		
	c) Percentage of light transmission under fire for assessment of smoke generation		
	d) Will the cables offered against this specification pass the flammability tests		
1.8	maximum dielectric loss of cable per KM at normal voltage and frequency	Watt/km	

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ISSUE R1

ENQUIRY/SPECIFICATION NO.:	BIDDER:

1.9	Short circuit capability for 1 Sec (HT & LT Power Cable)	kA rms	
1.10	Maximum dielectric stress at core screen	KV/cm	
1.11	Max. overall diameter of cables	mm	
2.0	**Cable Terminations & Joints**		
2.1	Name of manufacture		
2.2	Applicable standards		
2.3	Nominal (Ph -Ph) system voltages	kV	
2.4	AC Withstand voltage (Ph-ground)	kV	
	• Time duration	Min.	
2.5	Partial discharge at 2 Uo	pC	
2.6	Impulse withstand, 1.2 / 50 μs	kV	
2.7	Load cycle test		
a)	Each cycle – heating duration	Hrs	
b)	Temperature	deg. C	
c)	Cooling duration	Hrs	
d)	No. of cycles		

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ENQUIRY/SPECIFICATION NO.:	BIDDER:

e)	Continuous phase to ground voltage withstand	kV	
2.8	Thermal withstand short circuit current 1 sec	kA	
2.9	Dynamic short circuit withstand	kAp	
2.10	Type test report for all the tests enclosed as specified	Yes / No	
2.11	Kit Particulars		
a)	Material of the tubing / moulded party		
b)	Method of stress control		
c)	Method of environmental seal		
d)	List of items included in the kit		
	• For terminations		
	• For joints		
e)	Whether heating device included	Yes/No	
	• How many such device included	Qty	
f)	Allowable kit storage temperature	deg. C	
g)	Kit shelf life	Years	

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ISSUE R1

2.12	Cable terminations/joints instruction manual enclosed	Yes/No	
3.0	**Fire Proof Sealing System/Fire stops**		
3.1	Manufacturers name		
	Type of FPSS provided		
3.2	Duration for which the FPSS will retain its guaranteed properties (Life expectancy)	Yrs.	
3.3	Minimum shelf life of the materials used in the fire stops	Months	
3.4	Applicable standard		
3.5	Performance tests		
3.5.1	Whether type test certificates for the following tests enclosed		
	• Fire rating test	Yes/No	
	• Hose stream test	Yes/No	
4.0	**Fire Breaks**		
4.1	Manufacturers name		

NOTES TO BIDDER

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SIGNATURE OF BIDDER & DATE

ENQUIRY/SPECIFICATION NO.:	BIDDER:

4.2	Applicable standard		
4.3	Duration for which the FPSS will retain its guaranteed properties (Life expectancy)	Yrs.	
4.4	Minimum shelf life of the materials used in the fire stops	Months	
4.5	Type test certificates of the following tests enclosed		
	• Ampacity test	Yes/No	
	• Flame test	Yes/No	
	• Water proof test	Yes/No	

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

1.0 Construction details including type of material used and thickness of each material for each type of cable in a tabular form.
2.0 Instruction Manuals
2.1 Two (2) number of copies of instruction manuals, descriptive bulletins etc. shall be furnished prior to despatch of cables. The manual shall include amongst others, the following particulars.
2.2 General information.
2.3 Principal technical data.
2.4 Description of insulation, sheathing and screening. This should include data on resistance to attack by chemicals, fungus, termites, rodents, water and ultra-violent radiation.
2.5 Installation and termination instructions.
3.0 Test Certificates
2.6 Type test certificates for all types of cables included in the order and special tests on FRLS/FS cables.
4.0 Any other information specifically called for by PURCHASER or ENGINEER subsequent to order.

5.0 **DATA FOR APPROVAL**
5.1 Technical particulars of all cables, Termination kits/joints, FPSS & Fire breaks.
5.2 Cable Sizing Calculations for both HT & LT cables.
5.3 QAP for all cables.

	TITLE	SPECIFICATION NO. PE-TS-392-165-0001
BHEL	**COLTCS/SCS** **2X660 MW SURATGARH STPP** **LV MOTORS** **DATA SHEET-A**	VOLUME II B SECTION D REV NO. 00 DATE 24.05.2013 SHEET 1 OF 1

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	160 KW
3.0	Type of motor	:	3-Phase squirrel cage class-I energy efficient induction motors as per IS-12615
4.0	Installation (Indoors/ Outdoors)	:	As required
5.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz ± 5%
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal boxes		
	o 90 kW and upto 160kW (Breaker controlled)	:	50 KA for 1 sec.
	o 50 kW and upto 90kW (MCCB controlled)	:	50 KA for 0.25 sec.
	o Below 50kW (MPCB controlled)	:	50 KA for 0.25 sec.
	f) LV System grounding	:	Effectively grounded
6.0	Class of insulation	:	Class 'F', with temp rise limited to class B.
7.0	Minimum voltage for starting (As percentage of rated voltage)	:	85% of rated voltage
8.0	Power cables data	:	Shall be given during Detailed engg
9.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg
10.0	Space heater supply	:	240 V, 1¢ , 50 Hz
11.0	Rating up to which Single phase motor	:	Shall be given during Detailed engg.
12.0	Locked rotor current		
	a) Limit as percentage of FLC	:	600% (including 20% tolerance)
13.0	Additional tests	:	As per QP
14.0	Flame-proof motor		
	a) Enclosure suitable (As per IS:2148)	:	As per requirement
	b) Classification of Hazardous area (As per IS: 5572 part-I)	:	As per requirement
15.0	Makes	:	ABB / CGL/ KEC/ Siemens/ ALSTOM

	TITLE	SPECIFICATION NO. PE-TS-392-165-0001
BHEL	**COLTCS/SCS** **2X660 MW SURATGARH STPP** **LV MOTORS** **DATA SHEET-A**	VOLUME II B SECTION D REV NO. 00 DATE 24.05.2013 SHEET 1 OF 1

16.0 Paint shade : Shade 631 of IS 5

17.0 Degree of Protection of enclosure(motors): IP 55 (for outdoor motors)
IP 54 (for indoor motors)

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION NUMBER
	SHEET 1 OF 9	BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
		SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION / VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVENT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVENT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION TITLE
	SHEET 2 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION NUMBER
	SHEET 3 OF 9	BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
		SYSTEM :	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2	
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG.	MANUFR'S DRG.	-DO-	3	-	2	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2	

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION TITLE			
	SHEET 4 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION NUMBER .
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
	SHEET 5 OF 9	SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVENT SPEC./ ASTM-E165	MANUFR'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION NUMBER :
	SHEET 6 OF 9	BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION TITLE
		SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	FOR MV MOTOR
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	THREE DIPS TO BE GIVEN

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
	SHEET 7 OF 9	BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
		SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (L V & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10	10	10	11
		4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	VERIFICATION FOR MV MOTOR ONLY
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1	

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION NUMBER :
	SHEET 8 OF 9	BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
		SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1$	1	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1$	1	$ NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1$	1	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1$	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION NUMBER		
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION TITLE		
	SHEET 9 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.

4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

	QUALITY PLAN	CUSTOMER :	PROJECT	SPECIFICATION :
			TITLE	NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01	SPECIFICATION TITLE
	SHEET 1 OF 2	SYSTEM	ITEM AC ELECT. MOTORS BELOW 55KW (LV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10	10	10	11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3

BHEL	PARTICULARS	BIDDER/VENDOR
	NAME	
	SIGNATURE	

	QUALITY PLAN	CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01	SPECIFICATION : TITLE :
	SHEET 2 OF 2	SYSTEM	ITEM AC ELECT. MOTORS BELOW 55KW (LV)	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	

NOTES:

1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON

2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.

Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

BHEL	PARTICULARS	BIDDER/VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

ANNEXURE-II

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)

2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V

: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

	LOAD DATA (ELECTRICAL)	JOB NO.	382	ORIGINATING AGENCY		PEM (ELECTRICAL)
		PROJECT TITLE	2x6600 MW SURATGARH STPS	NAME		DATA FILLED UP ON
		SYSTEM	COLTCS & SCS	SIGN.		DATA ENTERED ON
		DEPTT. / SECTION	ELECTRICAL	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE

SECTION D3

STANDARD TECHNICAL SPECIFICATION FOR C&I SYSTEMS

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE**	SPECIFICATION NO.: VOLUME SECTION REV. NO. / DATE: SHEET 1 OF 2

Data Sheet No.: **PE-DC-999-145-I026-A**

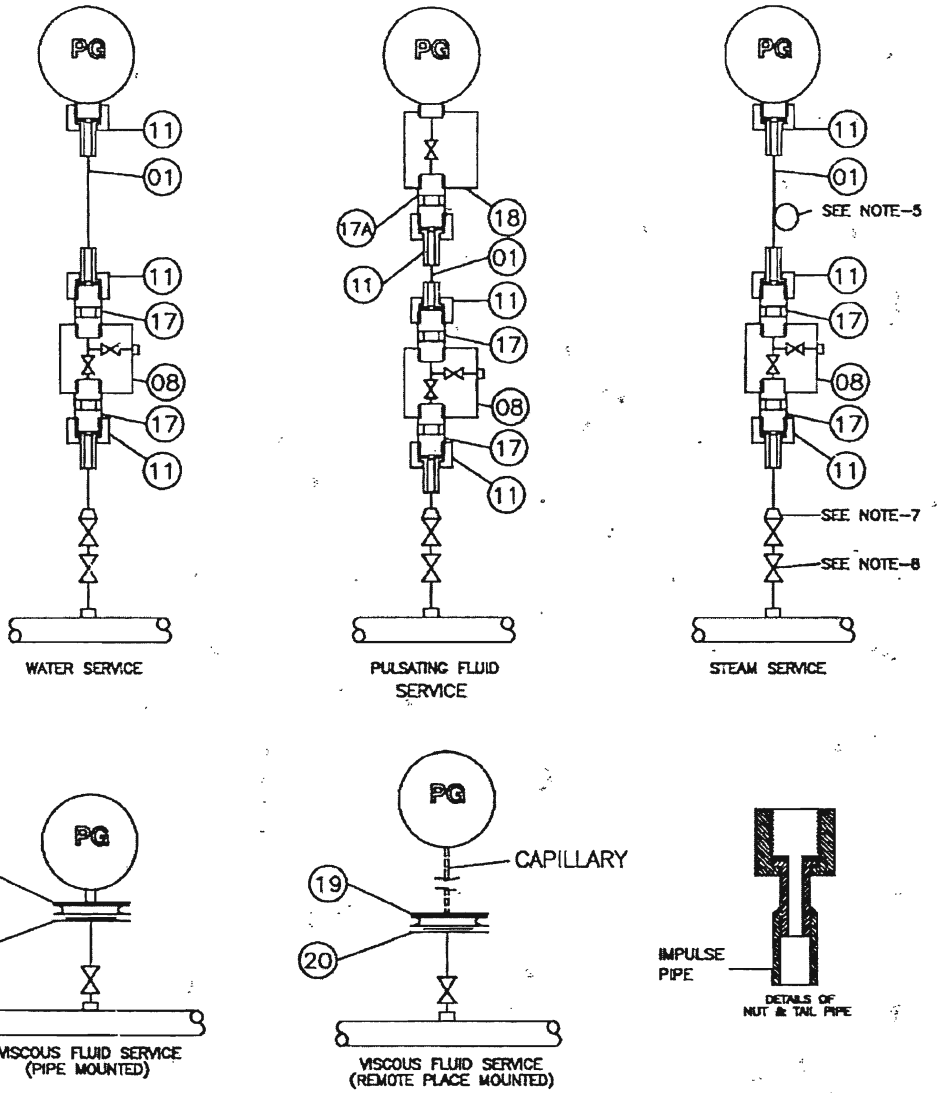
TECHNICAL REQUIREMENTS FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE (TO BE FILLED BY PURCHASER)			TO BE FILLED-UP /CONFIRMED BY BIDDER
=GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	SENSING ELEMENT	☐ BOURDON ☐ DIAPHRAGM (BOURDON FOR HIGH PRESS AND DIAPHRAGM FOR LOW PRESS APPLICATION)	
	MATERIAL	SENSING ELEMENT – AISI 316 SS MOVEMENT – AISI 304 SS CASING – ☐ DIE CAST AL ■ SS	
	ENCLOSURE	CLASS: ☐ IP-55 ■ IP-65 ☐ EXPL PROOF PAINT: ☐ ENAMEL ☐ EPOXY	
	DIAL	SIZE: 150 MM COLOR: WHITE NUMERALS: BLACK SCALE: LINEAR, 270° ARC GRADUATED IN METRIC UNITS	
	CASE	COLOUR : BLACK	
	SPAN/ ZERO ADJUSTMENT	INT. MICRO SCREW	
	RANGE SELECTION	SHOULD COVER 125% OF OPRATING PARAMETER	
	OVER RANGE PROTECTION	1.5 TIMES OF FSD	
	BLOW OUT DISC	REQUIRED	
	SWITCHING FACILITY (IF APPLICABLE)	NOT REQUIRED	
	TYPE	☐ MICRO SWITCH ☐ OTHER	
	NO. / TYPE OF CONTACTS	2 NOS. SPDT	
	CONTACT RATING	5A 230V AC, 0.25A 220V DC	
	SETTING RANGE	FIELD ADJUSTABLE OVER FULL RANGE	
	REPEATABILITY	± 1% OF FSR	
	POWER SUPPLY	☐ 230V AC ☐ 110V AC	
PERFORMANCE	ACCURACY	± 1% OR BETTER OF FULL SCALE DEFLECTION	
CONNECTION	PROCESS	☐ M20 x 1.5 (M) ☐ ½" NPT (M) ■ ½" NPT (F) ☐ OTHER	
	LOCATION	BOTTOM	
ACCESSORIES	NAME PLATE / METAL TAG	SS	
	OTHER	SIPHON FOR STEAM, SNUBBER FOR PUMP DISCHARGE, CHEMICAL SEAL DIAPHRAGM FOR CORROSSIVE, OIL SERVICES and SLURRY APPLICATION TO BE PROVIDED	
OTHER REQUIREMENT	INSTRUMENT LIST	INSTRUMENT LIST COMPRISING OF TAG NO., SERVICE, DESIGN/OPERATING PRESSURE & TEMPERATURE TO BE ATTACHED	
QUALITY REQUIREMENT	CHECK LIST FOR PG/DPG	REFER CHECK LIST NO PE-CL-999-145-I 026-0	

FORM NO. PEM - 6668-0

TITLE

TYPICAL INSTALLATION DIAGRAM FOR PRESSURE GAUGE

SPECIFICATION NO. PES-145-26A			
VOLUME IIB			
SECTION D			
REV. NO. 02	DATE	20.08.97	
SHEET 3	OF	4	



ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY			
				WATER	PULSATING	STEAM	VISCOUS
01	SEAMLESS STEEL IMPULSE PIPE	ASTM A106/A335	1/2"/15NB	1.5M	1.5M	1.5M	
08	TWO VALVE 3-WAY MANIFOLD	STAINLESS STEEL SS316	1/2"NPT(F) ENDS	01	01	01	
17	MALE CONNECTOR	STAINLESS STEEL SS316	1/2"NPT(M)x M20x1.5(M)	02	02	02	
17A	MALE CONNECTOR	STAINLESS STEEL SS316	M20x1.5(M) ENDS		01		
18	SNUBBER	STAINLESS STEEL SS316	M20x1.5(F) ENDS		01		
19	CHEMICAL SEAL	STAINLESS STEEL SS316	2" ANSI 300				01
20	MATING FLANGE	ASTM A105	2" ANSI 300				02
11	M20x1.5 SS NUT WITH ANNEALED COPPER WASHER & 100mm LONG TAIL PIPE TO SUIT 1/2"NB PIPE	STAINLESS STEEL SS316	M20x1.5x 1/2"NB	03	03	03	

FORM NO. PEM – 6656–0

	TITLE	SPECIFICATION NO. PES–145–26A	
	TYPICAL INSTALLATION DIAGRAM FOR PRESSURE GAUGE	VOLUME IIB	
		SECTION D	
		REV. NO. 02	DATE 20.08.97
		SHEET 4	OF 4

NOTES :–

1. IMPULSE PIPES SHALL BE OF SEAMLESS AND ANNEALED CARBON STEEL OR ALLOY STEEL (CONFORMING TO ANSI B36.10) IN LINE WITH THE MAIN PIPE MATERIAL. STAINLESS STEEL TUBES SHALL BE USED FOR ANALYTICAL MEASUREMENTS.

2. ALL IMPULSE PIPES AND FITTINGS SHALL BE OF RATING TO SUIT THE ASSOCIATED PROCESS PARAMETERS IN THIS REGARD THE GENERAL GUIDELINES ARE GIVEN BELOW

	SERVICE	IMPULSE PIPE		PIPE FITTINGS	
		MATERIAL	SCHEDULE	MATERIAL	CLASS
i)	MAINSTM/HP BYPASS UPSTREAM/ UPSTREAM OF AUX PRDS FROM MS	SA335 Gr P22	SCH.160	ASTM A182 Gr F22	6000
ii)	FEED & SPRAY WATER	SA106 Gr C	SCH.160	ASTM A105	6000
iii)	HRH/ LP BYPASS STEAM	SA335 Gr P22	SCH.80	ASTM A182 Gr F22	6000
iv)	CRH TILL HPBP/HPBP DOWN STREAM/ EXTRN TO HPH5	SA106 Gr B	SCH.40	ASTM A105	3000
v)	CRH LINE AFTER HPBP/EXTRN/ HEATER DRAINS/CONDENSATE AND OTHER LOW PRESS LINES	SA106 Gr B	SCH.40	ASTM A105	3000

3. PIPE FITTINGS SHALL BE OF FORGED MATERIAL CONFORMING TO ANSI B16.11–1991.

4. SNUBBER SHALL BE PROVIDED FOR PUMP DISCHARGE PRESS MEASUREMENTS AND CHEMICAL SEAL DIAPHRAGM FOR HEAVY FUEL OIL SERVICES.

5. IN CASE OF STEAM SERVICE SYPHON SHALL BE MADE BY BENDING THE TUBE OR PIPE.

6. VALVE MANIFOLDS & SNUBBER SHALL BE OF FORGED SS–316.

7. 25NB x 15NB WELDED REDUCER SHALL BE USED FOR ROOT VALVE OF 25NB SIZE.

8. ROOT VALVES AND REDUCERS (IF APPLICABLE) SHALL BE IN THE SCOPE OF AGENCY SUPPLYING THE MAIN PIPE/EQUIPMENT. THE SELECTION CRITERIA FOR ROOT VALVES SHALL BE AS FOLLOWS :–

OPERATING PRESS Kg/Cm2	OPERATING TEMP DEG. C	SIZE NB	BODY MATERIAL	QUANTITY NOs.
< 40	< 425	15	FCS	01
40–60	< 425	15	FCS	02
> 60	< 425	25	FCS	02
––	> 425	25	FAS	02

9. INSTALLATION FOR DIFF. PRESS GAUGE SHALL BE SIMILAR TO PRESS GAUGE EXCEPT THE FOLLOWING

   i) IT SHALL HAVE TWO LIMBS FOR PROCESS CONNECTIONS AND EACH CONNECTION SHALL BE SIMILAR TO THAT SHOWN FOR PRESS GAUGE

   ii) IT SHALL HAVE FIVE VALVE MANIFOLD IN PLACE OF THREE WAY MANIFOLD

FORM NO: PEM-6666-0

	CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE GAUGE (Mechanical Auxiliary Packages)	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 2 OF 2
		Data Sheet No.: PE-CL-999-145-I026-0

SL NO	TESTS/CHECKS	QUANTM OF CHECK	REFERENCE DOC: ACCEPTANCE NORMS	AGENCY P	AGENCY W	AGENCY V	REMARKS
1.0	CHECK FOR		APPROVED TECHINCAL REQUIREMENT/ DATA SHEET				MFR TO CARRY OUT ROUTINE TEST ON 100%. WHEN MATL CORELATION ARE NOT AVAILABLE MFR'S COMPLIANCE TO BE PROVIDED
	1.1 DIAL SIZE	100%		M	C	C	
	1.2 MODEL NO/TAG NO	100%		M	C	C	
	1.3 RANGE/SCALE	100%		M	C	C	
	1.4 END CONNECTION	100%		M	C	C	
	1.5 SWITCH CONTACT RATING & NOS	100%		M	C	C	
2.0	CALIBRATION						
	2.1 ACCURACY	100%		M	C	B	
	2.2 REPEATABILITY (FOR SWITCH)	100%		M	C	B	
	2.3 SET POINT ADJUSTMENT FOR SWITCH	100%		M	C	C	
3.0	OVER PRESSURE & LEAK TEST	100%		M	C	C	
4.0	OPERATION OF PR. RELEIF DEVICE	ONE PER TYPE		M	C	C	
5.0	REVIEW OF T.C. FOR MATERIAL OF–						
	5.1 SENSOR	FOR LOT		-	-	B	
	5.2 MOVEMENT			-	-	B	
	5.3 PROCESS CONNECTION			-	-	B	
	5.4 HOUSING			-	-	B	
6.0	REVIEW OF T.C. FOR DEGREE OF PROTECTION	TYPE TEST		-	-	B	
7.0	REVIEW OF T.C. FOR CONTACT RATING OF SWITCH	ONE PER TYPE		-	-	B	
8.0	ACCESSORIES AS APPLICABLE	100%		M	C	C	

LEGEND:
M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.

NOTE:
CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.

FORM NO. PEM-6666-0

BHEL	**TECHNICAL REQUIREMENTS FOR PRESSURE /DIFFERENTIAL PRESSURE SWITCH (Mechanical Auxiliary Packages)**	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 2

Data Sheet No.: **PE-DC-999-145-I031-0A**

TECHNICAL REQUIREMENT FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH (TO BE FILLED BY PURCHASER)			TO BE FILLED BY THE BIDDER
GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	PRESSURE ELEMENT	☐ DIAPHRAGM ☐ BELLOW (for low range) ☐ PISTON ☐ BOURDON (for high range)	
	MATERIAL	ELEMENT: ■ AISI 316 SS ☐ Ph. Br. CASING : DIE CAST AL WITH EPOXY COATING	
	ENCLOSURE	☐ IP-55 ■ IP-65 ☐ EXPL. PROOF	
	SWITCH TYPE	☐ MICRO ☐ ENCLOSURE HERMETICALLY SEALED	
	SWITCH CONTACT	TWO NOS. SPDT	
	SWITCH RATING	5A 230V AC, 0.25A 220V DC	
	SET POINT	ADJUSTABLE THROUGHOUT THE RANGE	
	DIFFERENTIAL	☐ FIXED ■ ADJUSTABLE OVER WIDE RANGE	
	MOUNTING	☐ DIRECT ☐ PANEL OR RACK	
	OVER RANGE PROTECTION	150% OF FSD	
PERFORMANCE	REPEATABILITY	± 0.5 %	
	DIAPHRAGM SEAL	DIAPHRAGM WITH CHEMICAL SEAL FOR CORROSSIVE & OIL SERVICES TO BE PROVIDED	
	NAME PLATE/METAL TAG	SS	
CONNECTION	PROCESS	½" NPT (F) AT BOTTOM	
	ELECTRICAL	WITH CABLE GLAND TO SUIT CABLE OF MAXIMUM o.d. 17.5 MM.	
OTHER REQUIREMENT	INSTRUMENT SCHEDULE	INSTRUMENT LIST COMPRISING OF TAG NO., SERVICE, RANGE, MEDIUM, STATIC PRESSURE, DESIGN/OPERATING PRESSURE & TEMPERATURE TO BE ATTACHED	
QUALITY REQUIREMENT	CHECKLIST FOR PS/DPS	REFER CHECK LIST NO. PE-CL-999-145-I031-0	

FORM NO. PEM - 6666-0

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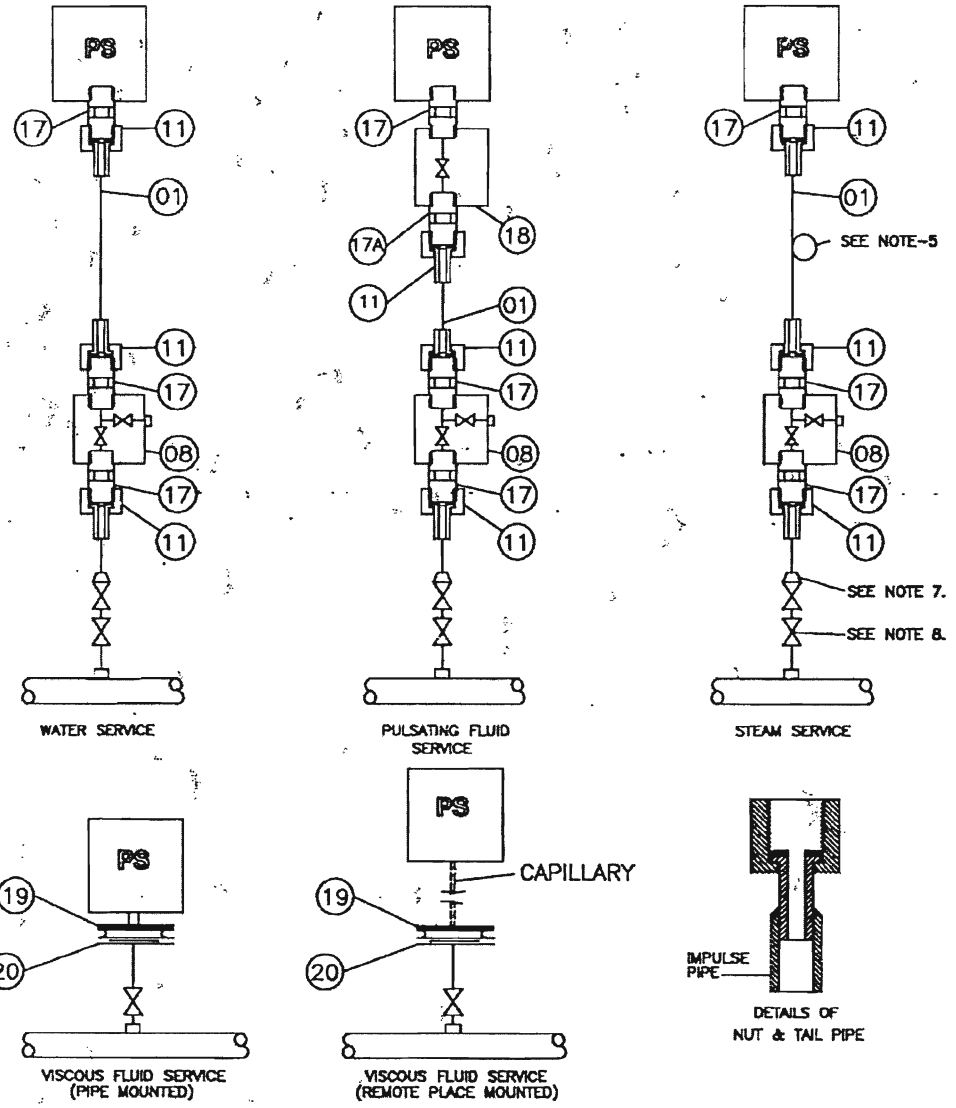
– TITLE

TYPICAL INSTALLATION DIAGRAM FOR PRESSURE SWITCH

SPECIFICATION NO. PES–145–31A			
VOLUME IIB			
SECTION D			
REV. NO. 02	DATE	20.08.97	
SHEET 3	OF	4	



ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY			
				WATER	PULSATING	STEAM	VISCOUS
01	SEAMLESS STEEL IMPULSE PIPE	ASTM A106/A335	1/2"/15NB	1.5M	1.5M	1.5M	
08	TWO VALVE 3-WAY MANIFOLD	STAINLESS STEEL SS316	1/2" NPT(F) ENDS	01	01	01	
17	MALE CONNECTOR	STAINLESS STEEL SS316	1/2" NPT(M)x M20x1.5(M)	03	03	03	
17A	MALE CONNECTOR	STAINLESS STEEL SS316	M20x1.5(M) ENDS		01		
18	SNUBBER	STAINLESS STEEL SS316	M20x1.5(F) ENDS		01		
19	CHEMICAL SEAL	STAINLESS STEEL SS316	2" ANSI 300				01
20	MATING FLANGE	ASTM A105	2" ANSI 300				02
11	M20x1.5 SS NUT WITH ANNEALED COPPER WASHER & 100mm LONG TAIL PIPE TO SUIT 1/2"NB PIPE	STAINLESS STEEL SS316	M20x1.5x 1/2"NB	03	03	03	

	TITLE	SPECIFICATION NO. PES-145-31A
BHEL	TYPICAL INSTALLATION DIAGRAM FOR PRESSURE SWITCH	VOLUME IIB
		SECTION D
		REV. NO. 02 DATE 20.08.97
		SHEET 4 OF 4

NOTES :-

1. IMPULSE PIPES SHALL BE OF SEAMLESS AND ANNEALED CARBON STEEL OR ALLOY STEEL (CONFORMING TO ANSI B36.10) IN LINE WITH THE MAIN PIPE MATERIAL. STAINLESS STEEL TUBES SHALL BE USED FOR ANALYTICAL MEASUREMENTS.

2. ALL IMPULSE PIPES AND FITTINGS SHALL BE OF RATING TO SUIT THE ASSOCIATED PROCESS PARAMETERS IN THIS REGARD THE GENERAL GUIDELINES ARE GIVEN BELOW

	SERVICE	IMPULSE PIPE		PIPE FITTINGS	
		MATERIAL	SCHEDULE	MATERIAL	CLASS
i)	MAIN STM/HP BYPASS UPSTREAM/ UPSTREAM OF AUX PRDS FROM MS	SA335 Gr P22	SCH.160	ASTM A182 Gr F22	6000
ii)	FEED & SPRAY WATER	SA106 Gr C	SCH.160	ASTM A105	6000
iii)	HRH/LP BYPASS STEAM	SA335 Gr P22	SCH.80	ASTM A182 Gr F22	6000
iv)	CRH TILL HPBP/HPBP DOWNSTREAM/ EXTRN TO HPH5	SA106 Gr B	SCH.40	ASTM A105	3000
v)	CRH LINE AFTER HPBP/EXTRN/ HEATER DRAINS/CONDENSATE AND OTHER LOW PRESS LINES.	SA106 Gr B	SCH.40	ASTM A105	3000

3. PIPE FITTINGS SHALL BE OF FORGED MATERIAL CONFORMING TO ANSI B16.11-1991.

4. SNUBBER SHALL BE PROVIDED FOR PUMP DISCHARGE PRESS MEASUREMENTS AND CHEMICAL SEAL DIAPHRAGM FOR HEAVY FUEL OIL SERVICES.

5. IN CASE OF STEAM SERVICE SYPHON SHALL BE MADE BY BENDING THE TUBE OR PIPE.

6. VALVE MANIFOLDS & SNUBBER SHALL BE OF FORGED SS-316.

7. 25NB x 15NB WELDED REDUCER SHALL BE USED FOR ROOT VALVE OF 25NB SIZE.

8. ROOT VALVES AND REDUCERS (IF APPLICABLE) SHALL BE IN THE SCOPE OF AGENCY SUPPLYING THE MAIN PIPE/EQUIPMENT. THE SELECTION CRITERIA FOR ROOT VALVES SHALL BE AS FOLLOWS :-

OPERATING PRESS Kg/Cm2	OPERATING TEMP DEG. C	SIZE NB	BODY MATERIAL	QUANTITY NOs.
< 40	< 425	15	FCS	01
40-60	< 425	15	FCS	02
> 60	< 425	25	FCS	02
--	> 425	25	FAS	02

9. INSTALLATION FOR DIFF. PRESS SWITCH SHALL BE SIMILAR TO PRESS SWITCH EXCEPT THE FOLLOWING

   i) IT SHALL HAVE TWO LIMBS FOR PROCESS CONNECTIONS AND EACH CONNECTION SHALL BE SIMILAR TO THAT SHOWN FOR PRESS SWITCH

   ii) IT SHALL HAVE FIVE VALVE MANIFOLD IN PLACE OF THREE WAY MANIFOLD

FORM NO. PEM-6666-0

	CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE SWITCH (Mechanical Auxiliary Packages)	SPECIFICATION NO.:	
		VOLUME	
		SECTION	
		REV. NO.	DATE:
		SHEET 2 OF 2	
		Data Sheet No.: **PE-CL-999-145-I031-0**	

SL NO	TESTS/CHECKS	QUANTUM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGENCY P	W	V	REMARKS
1.0	CHECK FOR		APPROVED TECHINCAL REQUIREMENT/ DATA SHEET/ RELEVANT STANDARD / MANUFACTURER CATALOGUE				MFR TO CARRY OUT ROUTINE TEST ON 100%.
	1.1 MODEL NO/TAG NO	100%		M	C	C	
	1.2 RANGE/SCALE	100%		M	C	C	
	1.3 END CONNECTION	100%		M	C	C	
	1.4 SWITCH CONTACT RATING & NOS	100%		M	C	C	
2.0	CALIBRATION						
	2.1 REPEATABILITY	100%		M	C	B	
	2.2 DIFFERENTIAL	100%		M	C	B	
	2.3 SET POINT ADJUSTMENT	100%		M	C	B	
3.0	OVER PRESSURE & LEAK TEST	100%		M	C	C	
4.0	REVIEW OF T.C. FOR MATERIAL OF–						WHEN TC FOR MATERIAL FOR THE PROJECT NOT AVAILABLE , COMPLIANCE CERTIFICATE TO BE PROVIDED BY THE MANUFACTUR ER.
	5.1 SENSOR	FOR LOT		-	-	B	
	5.2 MOVEMENT			-	-	B	
	5.3 HOUSING			-	-	B	
5.0	REVIEW OF T.C. FOR DEGREE OF PROTECTION	TYPE TEST		-	-	B	
6.0	REVIEW OF T.C. FOR MICRO SWITCH	FOR LOT		-	-	B	
7.0	ACCESSORIES AS APPLICABLE	100%		M	C	C	

LEGEND:
M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.

NOTE:
CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER**	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 1 OF 2

TAG No. ..... Qty..... Data Sheet No.: **PES-145-01-DS1-0**

Data Sheet A & B

		DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL	MANUFACTURER		
	MODEL NUMBER		
TECHNICAL	TYPE (SMART TRANSMITTER)	☐ INDUCTANCE ☐ CAPACITANCE ☐ STRAIN GAUGE	
	POWER SUPPLY	24V DC	
	TRANSMITTER MEASUREMENT	☐ PRESSURE ■ DIFF. PRESSURE	
	OUTPUT SIGNAL	4-20 mA	
	NO. OF WIRE	TWO	
	ACCURACY	± 0.075% OF SPAN	
	LINEARITY, HYSTERISIS AND DEAD BAND	± 0.1% OF SPAN	
	REPEATABILITY	± 0.05% OF SPAN	
	STABILITY	± 0.25 % OF SPAN OR BETTER FOR 6 MONTHS	
	SENSITIVITY	± 0.05% CF SPAN	
	MATERIAL		
	A) BODY	ALUMINIUM HOUSING (Epoxy Coated)	
	B) ELEMENT	316 SS	
	C) SEAL	TEFLON	
	CONTINUOUSLY ADJUSTABLE SPAN AND ZERO ADJUSTMENT PROVIDED	■ YES ☐ NO	
	MOUNTING	☐ WALL/PIPE STAND ■ TRANSMITTER RACK	
	ENCLOSURE	IP-65	
	TURN DOWN RATIO	30:1	
	INSULATION RESISTANCE	TO BE SPECIFIED BY BIDDER	
	ZERO SUPPRESSION RANGE	TO BE SPECIFIED BY BIDDER	
	ZERO ELEVATION RANGE	TO BE SPECIFIED BY BIDDER	

FORM NO. PEM-6666-0

BHEL	**DATA SHEET FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER**	SPECIFICATION NO.:
		VOLUME
		SECTION
		REV. NO. / DATE:
		SHEET 2 OF 2

TAG No. ..... Qty..... Data Sheet No.: **PES-145-01-DS1-0**

Data Sheet A & B

DATA SHEET-A FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	INTEGRAL INDICATOR(LCD TYPE)	■ YES ☐ NO	
	TRANSMITTER SHALL BE ABLE TO DRIVE OUTPUT IMPEDANCE OF 700 OHMS.	YES	
	ZERO DRIFT	< 0.1%	
	SPAN DRIFT	< 0.1%	
	MANIFOLD		
	DIFFERENTIAL PRESSURE MEASUREMENT	5 WAY	
	CABLE ENTRY DETAIL	SUITABLE FOR DIA OF 17.5 mm	

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

FORM NO. PEM-6666-0

	CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (Mechanical Auxiliary Packages)	SPECIFICATION NO.:	
BHEL		VOLUME	
		SECTION	
		REV. NO.	DATE:
		SHEET 1 OF 1	
		Data Sheet No.: PE-CL-999-145-I026-0	

SL NO	TESTS/CHECKS	QUANTM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGENCY			REMARKS
				M	C	B	
1.0	CHECKS FOR VISULA, MODEL TAG NO.	SEE NOTE-1 BELOW	APPROVED TECHINCAL REQUIREMENT/ DATA SHEET	P	W	V	MFR TO CARRY OUT ROUTINE TEST ON 100%. WHEN MATERIAL CORELATION ARE NOT AVAILABLE MFR'S COMPLIANCE TO BE PROVIDED
2.0	PROCESS CONNECTION	-do-		P	W	V	
3.0	ACCURACY	-do-		P	W	V	
4.0	REPEATEABILITY	-do-		P	W	V	
5.0	HYSTERISIS	-do-		P	W	V	
6.0	EFFECT OF TEMP VARIATION ON ACCURACY	-do-		P	W	V	
7.0	SPAN /ZERO ADJUSTMENT	ONE/TYPE		P	W	V	
8.0	EFFECT OF SUPPLY VOLTAGE VARIATION	ONE/TYPE		P	W	V	
9.0	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
10.0	BURN IN TEST	ONE/TYPE		P	W	V	
11.0	DEGREE OF PROTECTION	ONE/TYPE		P	W	V	

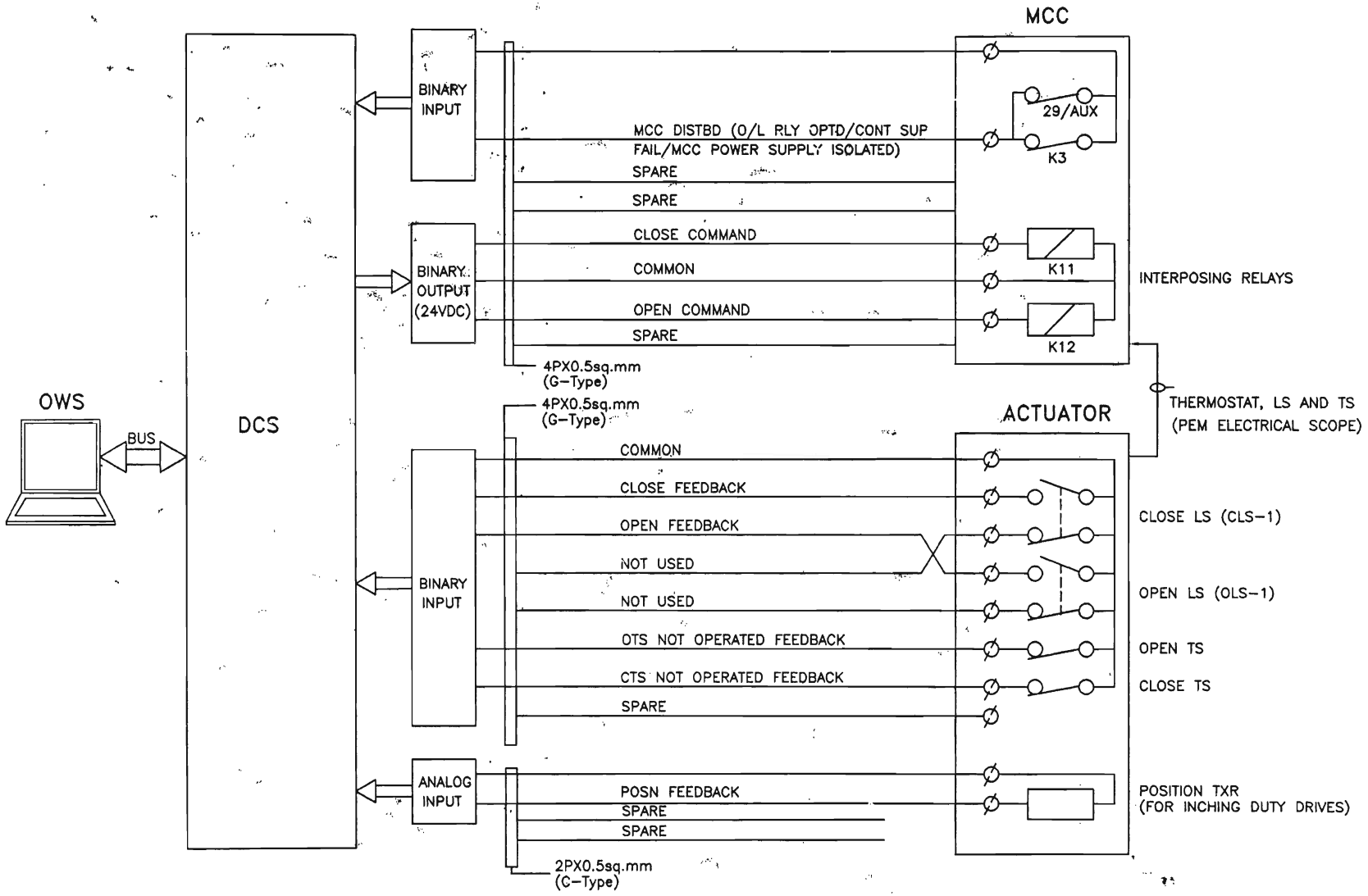
LEGEND:
M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.

NOTE:

1. QUANTUM OF CHECK SHALL BE AS BELOW
   100 % - BY MANUFACTURER
   RANDOM FOR EACH TYPE – BY BHEL & CUSTOMER
2. MANUFACTURER TO MAINTAIN CALIBRATED INSTRUMENT HAVING BETTER ACCURACY THAN THE ITEM UNDER TEST. INSPECTING ENGINEER SHALL CHECK THE SAME.
3. IN CASE OF IMPORTED ITEMS CONTRACTORS SHALL REVIEW TC's AND NOT INSPECT.

CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.

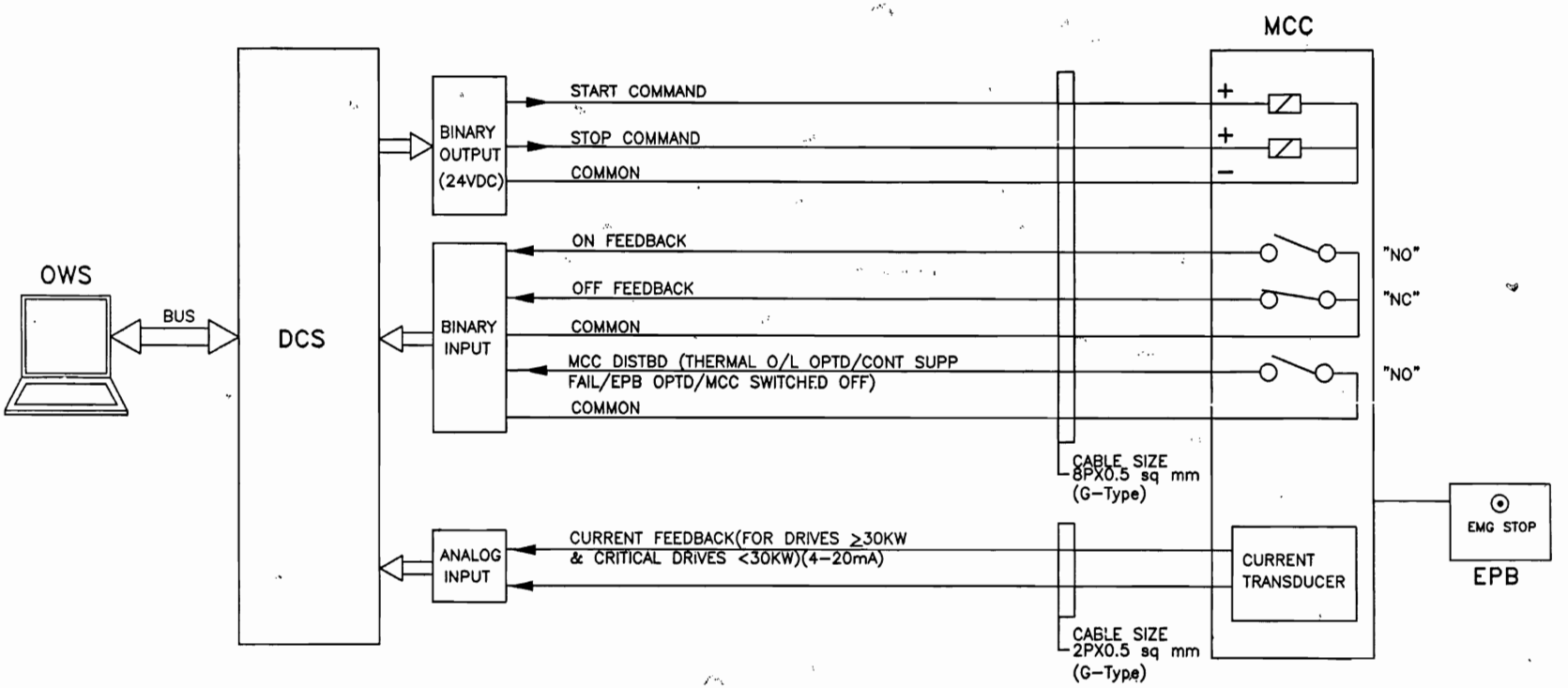
DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH MCC)



BHEL	PROJECT: 2 X 660 SURATGARH STPS, STAGE-V	DRG.NO.	PE-DM-392-145-1002
		DATE	09.04.2013
	TITLE DDCMIS INTERFACE FOR BIDIRECTIONAL DRIVE	REV.NO.	00
		SHT	7 OF 12

L16

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE



BHEL	PROJECT: 2X660 MW SURATGARH STPS, STAGE-V	DRG.NO.	PE-DM-392-145-1002
		DATE	09.04.2013
	TITLE: DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE	REV.NO.	00
		SHT	8 OF 12

LIST OF SUB-VENDORS (AS ON DATE)

SPEC.NO. TCE.5750A-H-500-001	**TATA CONSULTING ENGINEERS LIMITED**	VOLUME V SECTION:TABLE17
Package: EPC	**RRVUNL, 2 x 660 MW,Super-Critical TPS,Stage-V, Unit # 7 & 8 at Suratgarh, Rajasthan** **INSTRUMENTATION AND CONTROL EQUIPMENT** LIST OF SUB VENDORS	SHEET 1 OF 16

The list of acceptable makes for I&C equipment / system are as listed below: -

AIR FILTER REGULATORS

PLACKA
Shavo – Norgan (India) Pvt Ltd.
ABB Ltd.
BELLS CONTROLS LTD.
Schrader – Schorill Duncan Ltd., Mumbai.
Vel jan Hydrair Pvt Ltd., Hyderabad.

GAS ANALYSERS

Emerson Process Management
ABB Ltd.
Teledyne
Novatel
Codel
Land Combustion
Fuji.
Yokogawa Bluestar Ltd.
Chemtrols.
Siemens.

NITRIC OXIDE (NOX) ANALYSER

Land Combustion Ltd.
Emerson Process Management
Horiba
Chemtrols
Siemens
ABB Ltd.

OXYGEN MEASUREMENT (ZIRCONIUM PROBE)

ABB Ltd.
H & B (HARTMANN & BRAUN)
Emerson Process Management
Seco Controls
Land Combustion.

ISSUE
R1

PARTICULATE EMISSION

Land Combustion Ltd.
Emerson Process Management
Siemens
Durag.
Fireye.
Sintrol – oy – Finland.
Erwin – Sick (Germany)
Oldham (France)

SMOKE DENSITY

Skil
Teledyne / Honeywell
Codel
Land Combustion
EMERSON PROCESS MANAGEMENT
Durag

SULPHUR-DI-OXIDE (SO2)

ABB
Land Combustion ltd.
Emerson Process Management
Horiba,
Fuji.

COMPENSATING CABLE

Industrial Instrumentation Consortium
General Instruments
Toshiniwal Industries Pvt. ltd.
Polycab.
Udey Pyro Cables.
REL

INSTRUMENT CABLES

Incab
Delton
Fort Globster Industries

Universal Cables Ltd
Reliance Cables

Gems Cab

CONTROL CABLES
Delton
Incab
Universal Cables ltd
Reliance Cables
Gems Cab.

CONDUCTIVITY MEASUREMENT

Emerson Process Management
Honeywell
ABB Ltd.
Polymetron.
Yokogawa Bluestar Ltd

DISSOLVED OXYGEN MEASUREMENT

Honeywell
Polymetron
Emerson Process Management
ABB
Yogokawa Bluestar Ltd.

HYDRAZINE ANALYSER

Hach
ABB
Polymetron
Emerson Process Management

PH

Hach
Polymetron
Forbes Marshall
Honeywell
Emerson Process Management
ABB Ltd

SILICA

Hach
Polymetron
Braun & Leube
ABB
Emerson Process Management

CONTROL VALVES

Dresser Masoneilan - France,
Fisher
Yamatake
CCI
ABB
Welland & Tuxhorn
Gulde Regal Armtturen.
Pneucon

ELECTRICAL ACTUATORS

Vaas Bernard
Auma India Ltd.
Limitorque
Rotork Controls Ltd.
Antrieb

DIFFERENTIAL PRESSURE INDICATORS

Indfoss
AN Instruments
Switzer Instruments Ltd.
Waaree Instruments Ltd.
General Instruments (GIC)
H.Guru
A N Instruments

DIFFERENTIAL PRESSURE SWITCHES

Indfoss
Switzer Instruments Ltd.
Varma Trafag
Waaree Instruments Ltd

General Instruments (GIC)

PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER

Honeywell
Emerson Process Management
ABB
Yokogawa
Fuji
Yamatake
Endress & Hauser
SIEMENS

DIGITAL DISPLAY UNIT

Laxsons
Yogokawa Bluestar Ltd.
Tata Honeywell Ltd.
Gossien Metrawatt

DISPLACEMENT TYPE LEVEL TRANSMITTERS

Dresser Masoneilan
Emerson Process Management
Magnetrol
Yamatake
Endress & Hauser

ELECTRIC METERS

AE
MECO
Gossien
ABB

E/P CONVERTERS

Bells Controls Ltd.
ABB
Emerson Process Management
Sical Yamatake

FLOW ELEMENT

Starmech
Micro precision products
Engineering Specialities Pvt Ltd.
Mech Engg
General Instruments (GIC)
Teleflow
Emerson
Dag Process Instruments
Hydropnematic

FLOW GLASSES

Eureka
General Instruments
Levcon
V.Automat & Instrument (p) Ltd.
Bliss Anand

FLOW INTEGRATORS

Lectrotek
Nishko
ABB Ltd.
Rockwin

ILLUMINATED PUSH BUTTONS

EAO
H & B
L & T
Ronan
Honeywell
Siemens

STANDALONE SER

Hathaway (Imported)
Ronan (Imported)

MICROPROCESSOR BASED ANNUNCIATION SYSTEM

Hathaway (Imported)
Ronan (Imported)

LEVEL GAUGES

Chemtrols Engg.
Levcon
Sigma Instruments co.
Technomatic (India) pvt. ltd.
Teleflo Instruments co. ltd.
Pune Techtrol
B K Equipment
V Automat
SBEM
Bliss Anand

LEVEL SWITCHES

Bells Control Ltd.
Levcon
Magnetrol
Placka
Pune Techtrol
B K Equipment
V Automat
SBEM
Bliss Anand

POSITION TRANSMITTER

Endress & Hauser
Yamatake
Siemens
Gulde

PRESSURE INDICATORS

H.Guru
Bells Controls ltd.
General Instruments

A.N. Instruments
Gauges Bourdon
Industrial Eqpt. co.
Waaree Instruments Ltd.
Odion
Druck India
Wika Instruments

PRESSURE SWITCHES

Indfoss (India) Ltd.
Switzer Instruments ltd.
Varma Trafag
A.N. Instruments
Waaree Instruments Ltd
Dag Process Instruments
Chemtrols

PUSH BUTTONS

Honeywell
Larsen & Toubro ltd.
Siemens ltd.
Tele Mechanic

RECEIVER INDICATOR (BAR GRAPH)

Laxons
Masibus
Industrial Instrumentation
Yokogawa
Teletherm Instruments co.

RECEIVER RECORDER / MULTIPOINT RECORDER

Laxons Engg. & Electronic Pvt. ltd.
Yokogawa.
Tata Honeywell
ABB
Digital Electronics.
Penny & Guile

RELAYS

Jyothi
ABB
Paramount
Omron
SIEMENS

SAMPLE COOLER

Polymetron
Emerson Process Management
Sentry
Lowe

SAMPLING RACK

Emerson Process Management
Polymetron

SOLENOID VALVES

Asco
Avcon
Rotex
Schrader
Herion-Norgren
Schovill Duncan Ltd.

TEMPERATURE INDICATORS

G.I.Consortium
Bells Controls
Waaree instruments ltd
Dresser-USA

TEMPERATURE SWITCH

Ashcroft
Switzer Instruments Ltd.
Waaree Instruments Ltd
Dresser-USA

TEMPERATURE TRANSMITTERS

ABB Ltd.
Emerson Process Management
Camille-Baur
P & F.

THERMO COUPLE ASSEMBLY

Industrial Instrumentation
General Instruments
Nagman Sensors (p) Ltd
Pyro Electric instruments
Toshniwal Industries Pvt. Ltd.
Altop
Temsens
Waaree

THERMOWELL

General Instruments
Nagman Sensors (p) Ltd.
Pyro Electric Instruments
Detriev Instrumentation
Toshniwal Industries ltd.
Altop
Temsens
Waaree

RTD

Industrial Instrumentation
Nagman Sensors (p) Ltd.
Toshniwal Industries Pvt. Ltd
Pyro Electric Instruments
Altop
Temsens
Waaree

UNIT CONTROL PANELS

Industrial Controls & Appliances (P) Ltd.
J & H

Chemin
Rittal

LOCAL CONTROL PANELS

Industrial Controls & Appliances (P) Ltd.
J & H
Pyrotech
Rittal
Chemin

VARIABLE AREA FLOWMETERS

Eureka
Krone – Marshall
Scientific Devices
Chemtrols
Trac
Instrument Engineers

CONDITION MONITORING SYSTEM

Bently Nevada
Schenk Avery
SPM Instruments Ltd.
Rockwell Automation.
Shinkawa.

ANNUBAR

Dietrich
Emerson Process Management

ASSIGNABLE TREND RECORDER

Honeywell
Yokogawa
Penny & Guile

DESUPERHEATER

Fisher
Dresser Masoneilan

CCI

FLOAT & CHORD TYPE LEVEL INDICATOR

Jayati
Pune Techtrol
B K Equipment
V Automat
SBEM
Bliss Anand

LEVEL SWITCH (PROBE TYPE)

Level Stat
Solatron
Keystone
Yarway.

LAB INSTRUMENTS

Dead Weight Tester (Pneumatic)

Pressurements
Waaree Instruments Ltd

PRESSURE AND VACCUM GENERATORS WITH FINE REGULATOR

Superb Instruments

HIGH PRECISION REGULATORS FOR PRESSURE & VACUUM

Fairchild

HIGH TEMPERATURE FURNACE

Nagman
Waaree Instruments Ltd

DIGITAL STORAGE OSCILLOSCOPE

Phillips

AC CLAMP ON METER

Extech

DIGITAL STROBOSCOPE

Lutron

SLING SYNCHROMETER

Extech

PORTABLE FLUE GAS ANALYSER

Emerson Process Management

BAROMETER

Standard make subject to purchaser's approval

SMD REWORK STATION

Soldron
Hakko
OKS

LAB & Control room FURNITURE

Godrej

PNEUMATIC POSITIONER / ELECTRO PNEUMATIC POSITIONER

Masoneilan (India) Ltd.
ABB

ULTRASONIC TYPE LEVEL SWITCHES

Nivo Controls Pvt Ltd.
SB Electro Mechanics Ltd.
E & H.
Emerson Process Management

RF Level Switch.

EIP Bulk Controls Pvt Ltd.
EIP Enviro Controls.

TERMINAL BLOCKS

Phoenix
Weidmueller
Wago

MINIATURE CIRCUIT BREAKERS

Siemens
ABB
L & T.

LARGE VIDEO SCREENS / PLASMA VIDEO WALLS

Barco
Synelec
SONY
SAMSUNG
LG

DCS

ABB
BHEL
Tatahoneywell
Emerson Process Management
Invensys
Siemens
Yokogawa Bluestar Ltd

PLC

AllenBradley
ABB
Honeywell

BUNKER LEVEL INDICATORS

Pepper &Flucs
E&H
Emerson Process Management
EIP Enviro Controls

PLASMA MONITORS

Sony
Samsung
LG

WORK STATIONS / MIS STATIONS/SERVERS

IBM
HP
DELL

MASS FLOW METER

Emerson Process Management
E&H

SCREW PUMPS & DEAD WEIGHT TESTER(Hydraulic)
Manometer India
Budenberg
Nagman
Druck

VIBRATION ANALYSIS SYSTEM

Bentley Nevada
Bruelenzar
Rockwell
SKF

FURNACE FLAME ANALYSIS SYSTEM

Durag, Hitech(BFI)
EU tech scientific engg., GMBH

PADO

STEAG encotec (India) Pvt. Ltd. (Evonics)
Honeywell
Invensys
Emerson

CMMS

Honeywell
InvensysABB
TCS

AAQMS & MMS

Chemtrols
Campbell scientific canda corp
Honeywell (Teledyne)
Techmark engineers and cosultants (Horiba)
Nevco engg pvt. Ltd. (LSI lastern)

NOTES

1. The final make selected out of the recommended makes listed above shall be subject to purchaser / consultant's approval during detailed Engineering.

2. Wherever the make is not specified for any item, the Bidder shall indicate 2 or 3 reputed makes, out of which Purchaser / Consultant shall select any one which is acceptable suggest an acceptable make. This shall have no price implication.