

- 3.05.00 Push Button
- 01. Type : Shrouded square format
 - 02. Face Dimension : 32 x 32 mm (maximum)
 - 03. Contact Configuration : 2 NO + 2 NC
 - 04. Contact Addition : Add-on block up to 4 each with 2 pairs of contacts
 - 05. Contact Material : Hard Silver Alloy
 - 06. Contact Rating : 500V / 10 A
 - 07. Utilization Category : AC11 / DC11
 - 08. Insulation Voltage : 2 KV for 1 minute between terminals and earth
 - 09. Mechanical Life : 1 million operation
 - 10. Construction : Aluminum shrouding with plastic lens
 - 11. Colors : Red, Green, Yellow, Black, etc.
 - 12. Connection ; Screw terminals
 - 13. Enclosure Class : IP-52
 - 14. Legend : Engraving
- 3.06.00 Illuminated Push Button
- 01. Type : Square format
 - 02. Face Dimension : 32 x 32 mm (maximum)
 - 03. Contact Configuration : 2 NO + 2 NC (minimum)
 - 04. Contact Addition : Add-on-Block up to 4 each with 2 pairs of contacts
 - 05. Contact Material : Hard Silver Alloy
 - 06. Contact Rating : 500 V/ 10A
 - 07. Utilization Category : A C11 / DC11
 - 08. Insulation Voltage : 2 KV for 1 minute between terminals and earth
 - 09. Mechanical Life : 1 Million Operation
 - 10. Lamp : LED with built-in resistors as required
 - 11. Lamp Rating :-
 - a) Voltage : 240 V AC
 - b) Watt : 2 Watt (approx.)
 - 12. Lamp and Lens Replacement : From front
 - 13. Construction : Transparent Plastic Lens
 - 14. Color : Red, Green, Amber, Yellow etc.
 - 15. Connection : Screw terminals

16. Enclosure Class : IP-52
17. Legend : Engraving
- 3.07.00 Selector Switch
01. Type : 2/3/4 position stay put type with rotary lever actuator.
02. Face Dimension : 32 x 32 mm (maximum)
03. Contact Configuration : 4 pair of contacts
04. Contact Addition : Add-on-Block up to 4 each with 2 pairs of contact
05. Contact Material : Hard silver Alloy
06. Contact Rating : 500 V/10 A
07. Utilization Category : AC11 / DC11
08. Insulation Voltage : 2 KV for 1 minute between terminals and earth
09. Mechanical Life : 1 million operation
10. Construction : Aluminum shrouding
11. Connection : Screw terminals
12. Enclosure Class : IP-52
- 3.08.00 Indicating Lamp
01. Type : LED with built-in resistor
02. Face Dimension : 32 x 32 mm (maximum)
03. Voltage : 240 V AC
04. Watt : 2.5 Watt (approximate)
05. Lamp and Lens Replacement : From front
06. Construction : Transparent Plastic lens
07. Color : Red, Green, Amber, Yellow etc.
08. Connection : Screw terminals
09. Legend : Engraving
- 3.09.00 Indicating Meters (A.C)
01. Type : Rectifier type
02. Face Dimension : 96 x 96 mm
03. Scale : Radial arc of 240 Deg.
04. Accuracy : 1.5% of full scale.
±0.5 Hz for frequency meter
05. Input : 0-1/0-5A for current measurement, 0-240V,
50 ± 2.5 Hz for voltage / frequency measurement
06. Zero Adjustment : Screw on meter face

- 07. Enclosure : Shielded Case
- 08. Mounting : Flush Panel
- 09. End Scale Suppression : 6 times the measuring range only for motor ammeters

3.10.00 Indicating Meters (D.C)

- 01. Type : Taut band moving coil
- 02. Face Dimension : 96 x 96 mm
- 03. Scale : Radial arc of 240 Deg.
- 04. Accuracy : 1.5% of full scale
- 05. Input : 0-75 mA for current measurement. Direct reading for voltage measurement.
- 06. Zero Adjustment : Screw on meter face
- 07. Enclosure : Shielded case
- 08. Mounting : Flush Panel
- 09. End Scale Suppression : 2 times the measuring range only for motor ammeters.

For electrical system's meter and for synchronization, Bidder shall refer to electrical volume of the specification

3.11.00 Auxiliary Relay

- 01. Type : Electromagnetic
- 02. Coil voltage : 240 V A.C / 220V DC. For any other voltage bidder to make his own arrangement.
- 03. Contact Configuration : 2 NO & 2 NC (Minimum), additional contacts as per requirement with provision for additional contact block expansion
- 04. Contact rating : 250V/5A (A.C/D.C.)
- 05. Operating range : 80 to 110% of rated voltage
- 06. Insulation : 2 KV for 1 minute between terminals & earth.
- 07. Mechanical life : 20 million operations
- 08. Coil protection : Diode/surge suppressor
- 09. Connection : Screw terminals.
- 10. Mounting : Projection mounting inside panel

3.12.00 Electrical Transducer

Transducers shall be provided for conversion of AC electrical quantities such as voltage, current and power. Transducer shall be suitable for 220V DC auxiliary supply. Transducers shall be of low burden type having 4 – 20 mA DC linear galvanically isolated output compatible with secondary indicating instrument. Transducer shall be dual channel type. Accuracy class of Transducers shall be as per IS14570:1998 or IEC688:992

3.13.00 Synchroscope

Synchroscope shall be designed to provide an illuminate and indication of phase and frequency difference between bus voltage and Generator voltage. It shall denote the actual frequency difference corresponding to the inverse of time taken for one rotation of the illuminated vector spot. The instrument shall be designed for industrial applications, which require precise, reliable and robust instruments for the display range and indication. Synchroscope shall be designed as per the DIN / IEC / BS standards.

4.00.00

CONTROL VALVES, ACTUATORS & ACCESSORIES

General Technical Guidelines for the Control Valves shall be as follows :

- a) Bidder shall exercise caution in selecting severe service control valves like BFP recirculation valves, HP & LP bypass valves, superheater & reheater attemperator valves, PRDS valves for Boiler & Turbine, Soot blower steam pressure control valve, control valves whose down stream are connected to vacuum such as HP/LP heater emergency level control, condenser make up water control valve, separator level control and CEP minimum flow control valve. For such critical applications, Bidder shall offer valves which are proven for similar application. Above valves shall have leakage class equal or better than class-V with metal-to-metal seating.
- b) Wherever, steam conditioning calls for Pressure reducing & desuperheating, combined PRDS type valves shall be offered.
- c) Bidder shall provide redundant control valves for Main condensate flow control, Superheat attemperation control and Reheat attemperation control as a minimum for high availability. For other application, if the availability criteria for the plant cannot be met even with the best established product, redundant control valves shall be provided.
- d) Control valves shall be located near floor or platform for ease of access and with adequate clearances for maintenance and lay-down and shall be placed as station with upstream motorized isolating valve, down-stream isolating valve, inching duty motorized bypass valve and manual drain valves. Each redundant control valve shall have its upstream motorized and down-stream manual isolating valves. Where quick shut off requirement is foreseen such as in case of SH & RH attemperation valves, upstream isolation valve shall be pneumatic type.

4.01.00

General

4.01.01

Control valves for regulating service shall normally be globe body, preferably cage guided, metal-to-metal seated, pneumatically operated and shall be provided with characterized plugs having ANSI leakage class-IV except for the control valves indicated above.

4.01.02

Where the operating time is critical for the operation of the plant, as in case of HP or LP bypass valves, hydraulic actuators with electro-hydraulic interface shall be offered.

4.01.03

Bonnet joints for all control valves shall be of flanged and bolted type.

4.01.04

Flanged valve shall be rated at no less than class 300 lbs.

4.01.05

Valve Body / End Connections

- 4.09.00 Valve Accessories
Accessories shall include side mounted hand wheels, limit switches, junction boxes, airlock relays etc.. Solenoid valve wherever required shall be furnished.
- 5.00.00 **CONTROL DESK / PANEL / RACK**
- 5.01.00 Convenient and logical approach to operational interfaces and aesthetics in the overall view of the panel /desk shall be considered.
- 5.02.00 For items susceptible to vibration, suitable anti-vibration padding shall be provided to prevent damage or malfunction.
- 5.03.00 All items inside the panels/cabinets shall be neatly arranged with easy access/maintenance approach.
- 5.04.00 Incoming power supply feeders shall be duplicated. Alarm shall be provided for failure of a power supply feed.
- 5.05.00 Desk / panel shall be provided with interior illumination, utility receptacles with plug and cooling fan.
- 5.06.00 Panel / Desk shall have gland plate at cable entry to panel. Thickness of gland plate shall not be less than 3 mm.
- 5.07.00 Wire shall be routed / laid through covered trough.
- 5.08.00 Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.
- 5.09.00 Nameplate
- a) Nameplate shall be provided for instrument or device mounted on the panel.
 - b) Nameplates for panels shall be provided both in front and rear.
- 5.10.00 Control Desks
- 5.10.01 Devices mounted on the desks shall be flush type. Devices shall be so mounted that their removal and replacement can be accomplished without interruption of services to others.
- 5.10.02 Desk shall be ergonomically designed to suit working on a 24 X 7 basis. Aesthetics, ergonomics and illumination shall be considered while positioning of the desk, large video screen and panels in control room.
- 5.10.03 Control desk shall be free standing floor mounting type of table-top design with compartments for locating the hardware. Desk shall be constructed from aluminum extrusion with high pressure laminate MDF board for work surface of approved colour. Aluminium structure shall be anodized or powder coated paint finish.
- 5.10.04 Monitors with retractable keyboard, emergency push buttons shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate..
- 5.10.05 Desks shall be of modular, scalable and industrially ruggedized design and shall have Telephones and Intercom connections.
- 5.10.06 Desks shall have concealed cable trays for wire dressing.

- 5.10.07 Design shall include Earthing bolts.
- 5.10.08 Back installed items shall be suitably concealed from front view.
- 5.11.00 Back Up Panel
- 5.11.01 Construction shall be from sheet steel of thickness not less than 3mm.
- 5.11.02 Electrical upright Panel construction & design shall be similar to back up panel. Control switches, meters, indicators, synchronizer, excitation control switch, annunciation window etc. along with associated mimic diagram, as recommended, shall be provided for manual synchronization of generator.
- 5.12.00 Cabinets / Enclosure / Panels
- 01. Material of construction : Cold rolled steel sheet
 - 02. Thickness of Sheet :
 - a) 3.0 mm for faces supporting instruments / terminals.
 - b) 2 mm for other sides and top.
 - 03. Construction : Welded throughout as per approved National Standards.
 - 04. Panel height : 2300 mm (approx)
 - 05. i) Corners : 7 mm inner radius
 - ii) Dimensional Tolerances :
 - a) In height & length - 3 mm
 - b) In height between adjacent sections - 2 mm.
 - c) Total for a group - 6 mm
 - 06. Doors : Double, recessed, turned back edges
 - i) Thickness of Sheet : 2 mm
 - ii) Hinges : Stainless steel
 - iii) Door latches : Three point type
 - iv) Door gaskets : Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure.
 - v) Opening of the doors : Outward
 - vi) Louvers : With removable wire mesh to ensure dust and vermin proof.
 - 07. Color of interior : Brilliant white
 - 08. Colour external : RAL 7032
 - 09. Painting : Epoxy powder coated or better
 - 10. Gland plates : Removable 4 mm thick (bottom)
 - 11. Cable entry : Bottom
 - 12. Hardware :
 - a) Anti vibration pad- 15 mm
 - b) Predrilled base channel ISMC - 100 or equivalent for all sides.

- c) Stainless steel buff- finished 2 mm thick kick plate for all sides.
- d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws.
- e) Rubber strips to ensure air tightness between kick plate and finished floor.
- f) Lifting hook / Eye bolt
- g) Drawing pocket
- h) Door switch, lamps, thermostat, heaters and fans

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

5.13.00 Local Instrument Racks & Enclosure

5.13.01 General Requirements

- a) Devices located in the field shall be grouped and installed in the enclosure (Open / Closed Rack) in Boiler and TG Building.
- b) Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc.
- c) No more than six instruments shall be grouped in a single rack / enclosure.
- d) Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point.
- e) Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.
- f) Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.
- g) Instrument piping and tubing shall be hydrostatically tested at one and one-half times the maximum system pressure except for low pressure and vacuum measurement for which the test pressure will be as per piping standard.
- h) Service air connection shall be provided for continuous and intermittent purging of impulse pipe in dusty medium. Continuous purging shall be adopted for differential pressure measurement such as flue gas and coal air mixture application. Pressure measurement shall have only intermittent purging whenever required. In case of continuous purging, an air header shall be formed this shall receive service air through isolation valve and air filter regulator. Air shall be fed from the air header to both the impulse pipes near to take off points through isolation valves and flow regulators. Air header shall be constructed from stainless steel. Impulse pipe for such applications shall have a four-way valve. One port of the valve shall have an adaptor to connect flexible stainless steel braided nylon hose to the service air. Rating of the hose shall not be less than 10 Kg/sq.cm.

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

- i) Gate or ball type (full ported) instrument isolation valve and globe type blow down drain valve adequate for duty requirement and for withstanding continuous design pressure and temperature of main process medium shall be provided in the hook up plumbing. For process pressure equal or above 40 kg / sq.cm single instrument isolation valve and double blowdown valves shall be used before connecting to blowdown header. Whereas for line pressure less than 40 kg/ sq.cm, single instrument isolation valve and single blow down valves can be used before connecting to blow down header. Instrument manifolds shall be non integral and shall be installed close to the instrument.
- j) Drawing K9213R-DWG-I-0200 shall be referred for typical arrangement of Local instrument enclosure and rack.

5.13.02 Closed Instrument Rack

- a) Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load-bearing posts shall be suitably supported by gusset plates or moment members.
- b) Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.
- c) 2" NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any member, which would reduce access, shall be avoided.
- d) Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior. Key shall be of identical for all enclosures.
- e) Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box.
- f) Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket. Impulse lines within the enclosures shall be properly clamped.
- g) All internal wirings between the instruments and junction box shall run through flexible conduits.
- h) Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Header shall be of 2" NB ASTM A 106, Sch-80 Gr. C installed at a slope of 1:25 and extended beyond the rack for connection to plant drain header.
- i) Each rack shall be provided with one receptacle, light fixtures each at instrument & Junction box compartments with wire guard.

5.13.03 Open Instrument Rack

- a) Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or falling objects and shall be epoxy painted. Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable protective grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project. Canopy shall be of CRCA steel sheet of at least 3 mm thickness. Center posts or any member, which would reduce access, shall be avoided.
- b) 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments.
- c) All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible.
- d) All racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Header shall be of 2" NB ASTM A 106, Sch-80 Gr. C installed at a slope of 1:25 and extended beyond the rack for connection to plant drain header.

5.13.04 Junction Box

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

- a) Junction box shall be provided at a dry compartment at one side of the enclosure / rack with front opening type door. Earth stud shall be furnished at rack for safety grounding.
- b) Terminals shall be screwless cage clamp type of reputed make and 20% spare terminals shall be furnished in the junction box.

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

~~6.01.00 System Functional Description~~

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

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

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

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

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

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

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

8.18.01 A Portable data collector shall be provided for taking periodic collection of non critical machine data. Machine condition monitoring system shall be capable to analyze the data. Instrument shall be microprocessor based and ready for use in harsh environment. Integral LCD display shall provide the necessary display of readings & spectral data. Minimum 02 channels along with additional input for phase reference measurement shall be available with the instrument.

8.18.02 Instrument shall include necessary accelerometers and other devices with accessories for collection of machine parameters. A long life Ni-Cd battery pack shall be used. Replacement of battery shall not lead to loss of stored data.

8.18.03 Shaker table shall be provided for testing & calibration.

9.00.00 **INSTRUMENTATION & CONTROL CABLE**

9.01.00 Cables shall be flame retardant low smoke (FRLS) type. In hazardous areas cables of suitable R/L ratio shall be provided for intrinsic safety.

9.02.00 Durable marking shall be provided on the surface of the cable at intervals not exceeding 5 mtrs. Marking shall include Manufacturer's name, Year of manufacture, Voltage grade, Type of cables (Conductor size & no. of pairs / triads / type of compensating /extension cable), Insulation material, FRLS etc.

9.03.00 Sequential length marking shall also be provided at every meter interval on outer sheath of cable.

9.04.00 Standard seasoned wooden drum containing minimum 500 /1000 M \pm 5% length. Drum shall be anti rodent, anti termite and smooth finish. Both end of cable shall be capped by means of non hygroscopic sealing material.

9.05.00 Thermocouple Extension & Compensating Cable

- | | | |
|-----------------------------|---|--|
| 01. Conductor | : | Solid conductor |
| 02. Conductor size | : | 0.75 sq.mm |
| 03. Type | : | KX (Extension) (Chromel Alumel)
RX (Compensating) (Copper-Copper alloy)
JX (Extension) (Iron Constantan) |
| 04. Conductor Insulation | : | HR PVC Type-C (IS-5831,1984) 0.6 mm thick |
| 05. Operating Voltage | : | 300V /500V RMS (Core to earth / core to core) |
| 06. Twisting | : | Pair twisted with lay of 60 mm (max) |
| 07. Twisting Direction | : | All pairs in the same direction. Lapped to form bunch with mylar tape. |
| 08. Screen (Pair & Overall) | : | Aluminium mylar tape with a thickness of 28 μ m (min.) for individual pair screen and 60 μ m (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire. |

09. Drain wire : Annealed tinned copper wire, stranded.
Size 0.5 Sq. mm. (No. of strands / size:-
7 / 0.3mm)
10. Inner Sheath : Extruded FRLS PVC (anti rodent, anti
termite & moisture resistant properties)
HR PVC Type ST2 of IS-5831,1984
Thickness as per IS-1554Part-I 1976
11. Rip Cord : Non metallic under sheath
12. Armouring : GI wire / strip as per IS 3975
13. Outer Sheath : Extruded FRLS PVC (anti rodent, anti
termite & moisture resistant properties)
HR PVC Type ST2 of IS-5831,1984
Thickness as per IS-1554Part-I 1976
14. Filler : Non hygroscopic with FRLS property
15. Temperature Range : Up to 85 °C
16. Insulation at 20° C : 100 MOhms/Km [Min]
17. Capacitance at 800 Hz : 120 nf/km
18. Cross talk : 60 dB
19. Attenuation : 1.2 dB/Km
20. Codes & Standards : a) IEC 332-1
b) ANSI MC 96.1
c) IS-8784-1987
21. Tests : a) Oxygen Index: Min.29 at room
temp. (ASTM-D-2863)
b) Acid Gas Gen.: Max.20% by weight
as per IEC 754 Part-I
c) Temp Index : Min 250 DEG C at
21Oxy. Ind. (ASTM-D-2863)
d) Smoke Density Rating : Max.60%
(ASTM-D-2843).
e) Flammability Test : as per IEC 332
Part-I /IEEE-383
Swedish Chimney Test - SS-424-
1475 F3
f) High voltage test
Core to core- 1.5 KV for 1 min.
Core to screen- 1.0 KV for 1 min.
g) Insulation Resistance 100 M Ohm /
Km Min

- h) Rodent & Termite repulsion test
(Presence of lead shall be confirmed)

22. Conductor material & sheath color for thermocouple cable as per ANSI MC 96.1

CABLE TYPE	OVERALL SHEATH COLOR	WIRE	SHEATH COLOR	CONDUCTOR MATERIAL
KX	Yellow	Positive	Yellow	Nickel / Chromium
		Negative	Red	Nickel / Aluminum
JX	Black	Positive	White	Iron
		Negative	Red	Constantan
RX	Green	Positive	Black	Copper
		Negative	Red	Copper Nickel Alloy

23. Durable printed or embossed numbering at regular interval of 50mm shall be provided for identification of pairs.

9.06.00 Instrumentation multi Paired Signal Cable

01. Conductor type : Stranded (7) annealed tinned copper
02. Conductor size : 0.5 / 1.0 / 1.5 Sq.mm (as required)
03. Conductor resistance : 39 Ω/Km/18 Ω/Km/12 Ω/Km
04. Conductor Insulation : HR PVC Type-C (IS-5831,1984) 0.6 mm thick
05. Operating Voltage : 300 / 500V RMS (Core to earth / core to core)
06. Twisting : Twin twisted with lay of 60 mm
07. Twisting Direction : All pairs in the same direction. Lapped to form bunch with mylar tape.
08. Screen (Pair & Overall) : Aluminium mylar tape with a thickness of 28 μm (min.) for individual pair screen and 60 μm (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire.
 - * Analog signals- Individual pair & overall shield to be considered.
 - * Binary signals- overall shield to be considered.

09. Drain wire : Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm)
10. Inner Sheath : Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)
HR PVC Type ST2 of IS-5831,1984
Thickness as per IS-1554, Part-I 1976
11. Rip Cord : Non metallic under sheath
12. Armouring : GI wire / strip as per IS 3975
13. Outer Sheath : Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties)
HR PVC Type ST2 of IS-5831,1984
Thickness as per IS-1554, Part-I 1976
14. Filler : Non hygroscopic with FRLS property.
15. Temperature Range : 85 °C
16. Insulation at 20 Deg.C : 100 MOhms/Km [Min]
17. Capacitance at 800 Hz : 120 nf/km
18. Cross talk : 60 dB
19. Attenuation : 1.2 dB/Km
20. Codes & Standards : a) IPCEA-S-61-402
b) BS 5308
c) IEC 332-1
d) ASTM-B-33
e) IS-8130-1984
f) IS 1554 Part-1
g) IS 10810
21. Sheath colour : Inner- Black and Outer- Gray
22. Tests : a) Oxygen Index: Min.29 at room temp. (ASTM-D-2863)
b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I
c) Temp Index : Min 250 ° C at 21Oxy. Ind. (ASTM-D-2863)
d) Smoke Density Rating : Max.60% (ASTM-D-2843).
e) Flammability Test : as per IEC 332 Part-I
f) Swedish Chimney Test-SS-424-1475 F3
g) Insulation Resistance 100 M Ohm / Km Min

- h) High voltage test
 - Core to core- 1.5 KV for 1 min.
 - Core to screen- 1.0 KV for 1 min.
- i) Rodent & Termite repulsion test
(Presence of lead shall be confirmed)

23. Colour of core for Instrumentation Cable (As per IS-9938)

PAIR	CORE	COLOR
1st	1st	Blue
1st	2nd	Red
2nd	1st	Gray
2nd	2nd	Yellow
3rd	1st	Green
3rd	2nd	Brown
4th	1st	White
4th	2nd	Black

Above 4 Pairs, 4 Pairs making a unit shall have indelible printed colour coded bands like Pink for 1st unit, Orange for 2nd unit and Violet for 3rd unit and so on. In addition band marking, for example single band for 1st. unit, double band for 2nd. unit and so on, shall be provided on each conductor for identification of unit. Band marking on individual core shall be provided at regular intervals not exceeding 50 mm.

9.07.00 Cables near high temperature zone shall be capable of withstanding high temperature and terminated in junction box / panel in normal temperature zone. Teflon insulated and sheathed thermocouple extension cables and copper conductor cables shall be used in high temperature zone. Conductor and sheath shall be extruded FEP (Teflon) as per VDE 0207 Part 6 and ASTM D 2116. These cables shall be pair, multipair, triad, multitriad and twisted & shielded.

9.08.00 Control & power Cable

Bidder shall refer to Volume IIF of the electrical specification for detail.

10.00.00 **ERECTION HARDWARE**

This section provides the general technical guidelines for the erection materials for instruments. All erection materials shall be of good quality and conform to the operating environment of the corresponding instrument.

10.01.00 Electrical Accessories

Electrical conduit and associated materials shall conform to the requirements of the articles which follow :

- a) Rigid Steel Conduit
 - i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm.

- ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.
- iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with ANSI C 80.1 and UL6. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.
- iv) All conduit fittings shall conform to the requirements of ANSI C 80.4 and UL-514 where these standards apply.
- b) Flexible Conduit
 - i) Flexible conduit shall be of three layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material.
 - ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/Sq. cm and temperature up to 200 °C.
- c) Special Fittings
 - i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed.
 - ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.

10.02.00

Electrical Junction Box

1.	Type of Enclosure	: Dust tight & weatherproof conforming to IP 65
2.	Material	: 3 mm sheet steel
3.	Type of Cover	: Solid unhinged with retention chain
4.	Paint	: RAL 7032
5.	Mounting	: Surface
6.	Cable Entry	: 3 mm (min) Gland plate
7.	Gasket	: Neoprene
8.	Grounding	: Brass earth lug with green screw head External-2 nos , Internal-1no.M6
9.	Number of Drain Holes	: Two at bottom capped
10.	Identification	: Label for JB and Tags for cable

11.	Accessories	: Rail mounted cage clamp type screwless terminals with markers, Cable gland, Ferrules, Canopy at top
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10.03.00 Cable Gland

1.	Type	: Double compression
2.	Entry Thread	: NPT
3.	Material	: Brass
4.	Finish	: Cadmium Plated.
5.	Protection	: IP 54 or better
6.	Accessories	: Neoprene gasket, locknuts, reducers etc

10.04.00 Cable Tray

1. Material : Mild steel, slotted
2. Thickness : not less than 2.0 mm
3. Finish : Hot dip galvanized
4. Perforation : As per MFR standard
5. Cover : Suitable for tray

10.05.00 Process Hook Up Accessories & specification

Material and rating of the hook up items shall suit the piping and fluid condition. Hook up materials shall be IBR certified for applicable cases. Bidder shall furnish hook up drawings and the drawings for open racks & closed racks for owner's approval.

10.05.01 Seamless Stainless Steel Pipe

1. Reference : ASTM A-312 TP 316
2. Material Grade : TP 316
3. Type : Seamless /Plain end
4. Size : ½" NB
5. Schedule : 40
6. Standard Length : 5 meter

10.05.02 Stainless Steel Pipe Fittings

1. Reference : ASTM A-182 F 316 / ANSI B16.11

2. Type : Forged
3. Rating : 3000 lbs / 6000 lbs / 9000 lbs
4. Size : ½" NB
5. End connection : Generally socket weld
6. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

10.05.03 Seamless Stainless Steel Tube

1. Reference : ASTM A-213 TP 316
2. Material Grade : TP 316
3. Size : ½" OD X 2.1 MM Thick
4. Type : Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
5. Properties : The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
6. Test Pressure : 400 Kg/Sq. cm (minimum)
7. Tolerance : ± 0.13 mm for outside diameter
: ± 15 % for wall thickness
8. Standard Length : 5 meter
9. Test : Flare, Hardness, Ball and Bubble Test

10.05.04 Stainless Steel Tube Fittings

1. Reference : ASTM-A-182
2. Type : Double ferrule double compression
3. Material : 316 Stainless steel forged
4. Ferrule : 316 Stainless Steel
5. Type of Fittings : Male / female connector, elbow, cross /equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation.
6. Size : To suit SS tubing and NPT end connection

- 10.05.05 C.S. Pipe
1. Reference : ASTM-A 106 Gr. C
 2. Material : Cold drawn seamless black C.S.
 3. Type : Seamless / Plain ends
 4. Size : ½" NB
 5. Schedule : 80, 160, XXS as required
 6. Standard Length : 5 meter
- 10.05.06 C.S. Pipe Fittings
1. Reference : ASTM-A 105 / ANSI B16.11
 2. Type : Forged
 3. Rating : 3000 lbs / 6000 lbs / 9000 lbs
 4. Size : ½" NB
 5. End connection : Generally socket weld
 6. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.
- 10.05.07 A.S. Pipe
1. Reference : ASTM-A 335 P22 AS PER ANSI B 36.10
 2. Material : Cold drawn seamless A.S.
 3. Type : Seamless / Plain ends
 4. Size : ½" NB
 5. Schedule : XXS
 6. Standard Length : 5 meter
- 10.05.08 A.S. Pipe Fittings
1. Reference : ASTM-A 182 F22 AS PER ANSI B 16.11
 2. Type : Forged
 3. Rating : 9000 lbs
 4. Size : ½" NB
 5. End connection : Generally socket weld

6. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

10.05.09 Carbon Steel Globe Valve

1. Reference : ASTM A-105
2. Type : Globe
3. Construction : Forged Body Cadmium Plated
4. End Connection : ½" Socket Weld
5. Rating : Cl. 800 / CL. 2500
6. Material : Body - Carbon steel
: Stem - Hardened Steel
: Plug - AISI 316 SS
: Seat- Stainless steel stellited
7. Packing : Teflon / Grafoil as required
8. Yoke : ASTM A105
9. Hand wheel : Carbon steel
10. Design standard : As per ANSI B 16.34

10.05.10 Stainless Steel Globe Valve

1. Reference : ASTM A-182 F316
2. Type : Globe
3. Construction : Forged Body
4. End Connection : Socket Weld
5. Proof Pressure : 400 Kg/Cm2
6. Material : Body - Stainless steel
: Stem - Hardened Steel
: Plug - AISI 316 SS
: Seat- Stainless steel stellited
7. Packing : Teflon as required
8. Yoke : ASTM A182 F316

9. Handwheel : Carbon steel
10. Design standard : As per ANSI B 16.34
- 10.05.11 Alloy Steel Globe Valve
1. Reference : ASTM A-182 F22
2. Type : Globe
3. Construction : Forged Body
4. End Connection : ½" Socket Weld
5. Rating : CL. 2500
6. Material : Body - Alloy steel
: Stem - Hardened Steel
: Plug - AISI 316 SS
: Seat- Stainless steel stellited
7. Packing : Grafoil as required
8. Yoke : ASTM A182 F22
9. Handwheel : Carbon steel
10. Design standard : As per ANSI B 16.34
- 10.05.12 Condensate Pot
1. Reference : ASTM A182 F22 /ASTM A105
2. Material : Alloy steel / carbon steel as per application
3. Construction : Drilled from barstock
4. End connection : 3 nos. ½" socket weld end
5. Accessories : Vent valves
- 10.05.13 Instrument Valve Manifold
1. Type : Two valve manifold
: Five valve manifold
2. Mounting : Remote 2" Pipe Mounting
3. Construction : Single block (bar stock)
4. Material : Forged body and bonnet AISI 316 stainless

- steel
5. Ports : 1/2 " NPT (F)
 6. Rating : 420 Kg/Sq. cm at ambient
 7. Operating Temperature : (-)30 to (+)170 Deg C
 8. Packing : PTFE Wafer
 9. Seat & Stem : AISI 316 SS
 10. Plug : AISI 316 SS free to turn on stem / 17-4 PH
 11. Handle Bar : AISI 316 SS
 12. Connection : Straight
 13. Accessories : Plugs for all ports, Mounting Bracket , bolts , nuts

10.06.00 Pneumatic Hook Up Accessories

10.06.01 Air Header

Technical Particulars	For Panel	For Field
Material of Construction	: Stainless steel	: Stainless steel
Inlet Connection	: 2" NPT (M)	: 1" NPT (M)
Header Take-off Material	: Stainless steel	: Stainless steel
Take off connection	: 1 / 2" NPT (M)	: 1/ 2" NPT (M)
Take-off Valves Material	: stainless steel	: stainless steel
Tube Take-off	: Tube adapter on valve	: Tube adapter on valve
Drain	: SS drain valve at lowest point	: SS drain valves at lowest point

10.06.02 Seamless Stainless Steel Tube

1. Reference : ASTM A-269 TP 316
2. Material Grade : TP 316
3. Size : ¼" OD X 0.049" wall thickness

4. Type : Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
5. Properties : The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
6. Test Pressure : 400 Kg/Sq. cm
7. Tolerance : ± 0.13 mm for outside diameter
: ± 15 % for wall thickness
8. Standard Length : 5 meter
9. Test : Flare, Hardness, Ball and Bubble Test

11.00.00 **SPECIAL TOOLS & TACKLE AND TEST EQUIPMENT FOR AND OTHER SYSTEMS**

- 11.01.00 Bidder shall supply a complete set of new, unused and reliable type of special tools and tackle and test equipment which are necessary or convenient for erection, commissioning, maintenance and overhaul of the plant and equipment provided under this specification.
- 11.02.00 The tools & tackle and Test Equipment shall be shipped in separate container, clearly marked with names of the equipment for which they are intended.
- 11.03.00 Bidder shall furnish list of tools & tackle and test equipment proposed to be supplied along with the bid.

material with suitably colored lettering engraved on the back.

- c) The nameplates shall be held by self-tapping screws. The size of nameplate shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for the panels.
- d) Items of plant such as valves, which are subject to handling, are to be provided with an engraved chromium plated nameplate or label with engraving filled with enamel, suitably mounted or affixed with strong rustproof chain.
- e) All such nameplates, instruction plates, lubrication charts etc. shall be with English inscriptions.

8.00.00 **METERING BASES AND CHART UNITS**

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

- i) Pressure : Kg/cm²
Differential Pressure : mm of H₂O column / Kg/cm²
- ii) Draught : mm of H₂O column
- iii) Vacuum : Kg/cm² (abs)/mm of Hg column
- iv) Temperature : Degree Celsius (°C)
- v) Flow (Steam, Water) : Tonnes / hr, M³/Hr
- vi) Flow (Oil) : M³ / Hr, Litter/Hr
- vii) Flow Air : Tonnes / hr / M³ / Hr.
- viii) Density : gms / c.c.
- ix) Level : mm /%
- x) Conductivity : μS / cm or mS/cm
- xi) Gas Analyzer : Percentage by weight or as specified in respective case.
- xii) Dissolved Oxygen / Silica / Sodium : ppm /ppb

9.00.00 **PROCESS CONNECTION & INSTRUMENT HOOK UP**

9.01.00 Instrument connection to the process system (piping, vessel etc.) shall be according to the process & piping specification upto and including the root valves. Root valves shall be installed as close as possible to the piping or vessel.

- 9.02.00 Each instrument shall have its own independent connection to the process except for instruments located on standpipe. Each instrument shall be connected independently to the standpipe through isolation valve.
- 9.03.00 Isolation and blowdown drain valves adequate for duty and capable of withstanding continuous design condition of main process shall be provided. Instrument blow down valve near to the instrument shall be of gradual opening type. For process pressure equal or above 40 kg/ sq.cm double blowdown valves shall be used connecting to blowdown header. Instrument manifold / gauge valve shall be installed close to the instrument.
- 9.04.00 The nominal size of the takeoff connections on line shall not be less than NPS ½" for source conditions not in excess of either 900 psi or 425OC and NPS ¾" (for adequate physical strength) for design conditions exceed either of these limits. Where the size of the main is smaller than the limits given above, the takeoff connections shall not be less than the size of the main line.
- 9.05.00 Process connection for instruments lines and vessels shall be in accordance to standards such as ASME or other recognized international standards. Table below indicates the type of connection generally to be used.

INSTRUMENTS	EQUIPMENT / PIPE SIDE	INSTRUMENT SIDE
Level Instruments		
Internal Displacer	4" - Flanged	4" - Flanged
External Displacer	2" - Flanged	2" - Flanged
Level gauge	¾" -Flanged	¾" - Flanged
DP Type	½" (min.)-welded	½"- NPT
	1" – welded for vessel like HP heaters, LP heaters, De-aerator etc. application	
External cage Level switch	1"- welded	1"- welded
Flow Instruments		
DP Type	½" - welded in general	½" - NPT
	1" – welded for high pressure / temperature main steam, feed water, PRDS etc. application	
Pressure Instruments		
Conventional	½" (min.)-welded	½" - NPT
	1"- welded for high pressure/	

INSTRUMENTS	EQUIPMENT / PIPE SIDE	INSTRUMENT SIDE
	temperature main steam, feed water, PRDS etc. application	
Diaphragm type-HFO application	3"- Flanged	3"- Flanged
Temperature Instruments		
Thermowell	Generally - M 33 X2 (M); 1½" Flanged- For air/FG path application	½" NPT
Analyzer		
Liquid analyzer	½"- 1" - welded	½"

- 9.06.00 Size of impulse pipe for pressure measurement in air and flue gas duct path of boiler shall not be less than ¾" NB.
- 9.07.00 Separate stubs and take-off points with thermo well / root vlves shall be provided for performance guarantee test.
- 9.08.00 Impulse pipes shall be clamped at suitable interval not exceeding 1.5 meter. Process pipe shall not be used for supporting the impulse pipe.
- 9.09.00 Fittings shall conform to ANSI B 16.11. Threads of piping component shall be of tapered construction.
- 9.10.00 Instrument blowdown header shall in no case be lower than the material grade ASTM A 106 Gr. C.
- 9.11.00 Impulse pipe shall be laid at least with slope of gradient 1:10 to avoid any air pocket or water accumulation.
- 9.12.00 Expansion loop shall be provided at least at every 2.5 meter interval without affecting the gradient of slope in long run impulse pipe to avoid stress on the piping.
- 9.13.00 Siphon shall be provided in the impulse pipe or tube to protect the instruments where fluid temperature is 100 OC or more.
- 9.14.00 Orientation of tapplings shall be as follows :
- For liquid service within 45 ° at lower half of the pipe horizontal plane.
 - For gas service within 90 ° at upper half of the pipe horizontal plane.
 - For steam service within 45 ° at upper half of the pipe horizontal plane.

As a rule tap orientation of high and low pressure side should be parallel and symmetrical.

9.15.00 Pressure & Differential pressure instruments in steam and liquid services shall be located below the taps and the piping shall be sloped to avoid formation of air pocket.

9.16.00 Pressure & Differential pressure instruments in air and flue gas service shall be located above the taps and the piping shall be sloped back to process to avoid formation of any liquid.

9.17.00 Impulse pipe including taps for furnace, flue gas and coal mill application shall be provided with air purge connection. Differential instruments for such application shall have continuous and as well as intermittent purging. Whereas, pressure measurement shall have only intermittent purging.

9.18.00 Material of impulse pipe for the instruments mounted on rack and enclosure shall be same as that of main process pipe except stainless steel tube of Gr. 316 or better shall be provided for connection in between impulse pipe (from tee connection on impulse pipe) and instrument manifold valve & instruments. Impulse pipe, tubes, fittings and accessories shall have the same design pressure and temperature applicable for the related main pipe.

~~10.00.00 **POWER SUPPLY SYSTEMS**~~

~~10.01.00 Instrumentation power supply system shall include all conditioning equipment required to accommodate normal variations in the electrical supply. All panels and cabinets shall accept redundant power feeds from two different sources.~~

~~10.02.00 Type of power supply systems envisaged for the various I & C system including DCS are as follows:~~

~~a) 240V AC Redundant UPS system HMIs, Main Plant Field devices / equipment, CCTV, EWLI, CEMS, SWAS etc. and PLC of package System~~

~~b) 24V / 48 VDC Supply for DCS~~

~~11.00.00 **ENVIRONMENTAL CONSIDERATIONS**~~

~~I & C components should operate properly with no degradation in expected lifetime or in operation parameter in the normal power plant environment. I & C system shall be designed considering all the operating conditions which may be encountered during installation and operation.~~

~~11.01.00 Temperature~~

~~11.01.01 Where the environmental extreme exceeds the capabilities of the selected system, Bidder should take appropriate steps to control the environment.~~

~~11.02.00 Humidity~~

~~11.02.01 I & C system shall be designed to withstand the humidity limits specified for the project. Condensation shall not be allowed to form in the cabinets nor~~

SPECIFIC TECHNICAL REQUIREMENTS (C&I)

CONTROL PANELS SPECIFICATION

7.12.00 Panels, Cubicles and Enclosures

7.12.01 General

- a) All panels, cubicles and enclosures shall be furnished complete with integral piping, internal wiring, convenience outlets, internal lighting, grounding, ventilation, space heating, vibration isolating pads and other accessories.
- b) Unless otherwise specified cable entry for panels / desks / cabinets shall be through bottom via glanding plate. Fireproof seal shall be used to seal the bottom to prevent entry of dust.
- c) Panels and cabinets shall be constructed from steel sheet reinforced as required to provide true surface and adequate support for devices mounted thereon. Thickness of the steel plate shall conform to the requirements of UL 50 or equivalent standard. Panels and cabinets shall be of adequate strength to support mounted components during shipment and to support a concentrated load of 100 Kilograms on their top after erection.
- d) Panel /cabinet shall have eyebolt on top for lifting.

7.12.02 Surface Preparation and Painting

Sheet metal exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below:

- a) Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale. Oil, grease and salts etc. shall be removed from by one or more solvent cleaning methods prior to blasting.
- b) Two spray coats of epoxy primer surfacer shall be applied to all exterior and interior surfaces, each coat of primer surfacer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades:
 - i) Exterior – RAL 7032.
 - ii) Interior - Brilliant White.
- c) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections shall not be acceptable.

7.12.03 Wiring

Wiring within the panels shall conform to NEC standards and shall be factory installed and tested at the works. All interior wiring shall be installed neatly. Features shall not be limited to the following :

- a) All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks.
- b) Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized print shall be used with cross- identification.
- c) Wire termination shall be made with insulated sleeve and crimping type lugs. All external connections shall be made with one wire per terminal. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs shall not be used.
- d) Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables.
- e) Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring.
- f) All low-level signal cables shall be separately bundled from control cable.
- g) Wires shall be dressed and run in troughs with clamp-on type covers. Wirings shall be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.
- h) Shield wires shall be terminated on separately.
- i) Common connections shall be limited to two wires per terminal.
- j) Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue to the conductor.
- k) Wiring shall be arranged to enable instruments or devices to be removed and/or serviced without disturbing the wiring. No wire shall be routed across the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices.
- l) Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.
- m) Panels /cabinets /desks shall be provided with removable gasketed cable gland plates and cable glands. Split type grommets shall be used for prefab cables.
- n) Wire shall be multistranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-1981.

- o) Wire sizes used for internal wiring shall not be lower than the followings :
- Control wiring (switches, pushbuttons etc.) : 1.5 Sq.mm
 - Power supply/receptacle /illumination wiring : 2.5 sq. mm or higher as per load
 - 4-20mA DC current and low voltage signal upto 48V DC : 1.0 Sq. mm
- p) Identification of conductors shall be done by insulation color-coding identified on drawings or by printed wiring lists.

7.12.04 Grounding

- a) System cabinet AC and DC ground shall be electrically isolated from each other and also electrically isolated from the Instrumentation signal ground. All the above ground shall be individually connected to the single point on the ground pit. Dedicated redundant earth pit shall be provided which shall be away from the HV equipment. This earth pit shall not be shared with other electrical equipment ground and shall also be insulated from other electrical system ground to ensure single point grounding of the system. Grounding resistance shall be better than 1.0 ohm. IEEE guideline shall be followed while designing the grounding system.
- b) Panels and cabinets shall be provided with a continuous tinned copper ground bus bar of minimum 25 mm x 3 mm cross section, extending along the entire length of the panel / desk / cabinet assembly. The ground bus shall be bolted to the panel structure and effectively ground the entire structure.
- c) The panel /desk /enclosure /JB ground shall have two (2) bolt drilling with GI bolts and nuts at each end to connect to GI/ copper flat ground riser by means of insulated copper ground cable of required cross section with lug.
- d) Circuits requiring grounding shall be individually and directly connected to the panel ground bus.
- e) For electronic system cabinets, the electronic system ground bus shall be similar but insulated from the cabinet and shall be separately connected to the system ground. Signal cable shields shall be grounded at the panel end only and shall not be left open. The ground in between panels of a shipping section shall be firmly looped.
- f) Electrical meters, relays, transmitters and switching devices, operating at a voltage less than 50V may be grounded through the steel structure.

7.12.05 Panel / Cabinet/ Desk/Enclosures Environmental Protections

- a) Panels, cabinets, desks, distribution boxes, junction boxes, terminal boxes and all other field mounted equipment / enclosures shall suit the environmental condition of the area and shall not be inferior than the requirement indicated in the following table.

SL. NO.	LOCATION	ENCLOSURE TYPE
1.	Indoor type non- ventilated enclosure in non-hazardous area	IP-54
2.	Indoor type ventilated enclosure in non-hazardous area	IP -42
3.	Enclosure in Air conditioned area	IP-22 with suitable canopy at top to prevent ingress of dripping water.
4.	Outdoor type in non-hazardous areas	IP-55
5.	Outdoor in hazardous areas	As per requirements of the NEC Code for the location

- b) The construction of electrical enclosures located in areas subject to conditions classified in the National Electrical Code (NEC) as hazardous shall be of a type designated suitable for the environment in which they are located.

7.12.06 Terminal Blocks

- a) Terminals shall be chromated galvanized DIN rail mounted screwless cage clamp type. Terminals shall have screwed connection for conductor cross-section above 2.5 mm². Terminal blocks shall conform to IEC 947-7-1.
- b) The characteristics of the terminal blocks shall be as follows.
- i) High contact force, independent of conductor cross-section and large contact surface area.
 - ii) Self-loosening protection.
 - iii) Resistant to thermal aging and vibration.
 - iv) Low and constant voltage drop
- c) Tension spring shall be made of high quality, non-rusting, acid-resistant steel. The current bar shall be of tin-lead plated copper or brass.

- d) Terminals shall be of non flammable suitable thermoplastic material such as polyamide.
- e) Terminal blocks shall be mounted vertically in panels and cubicles with clearance for at least 100 mm between two sets and between wall and terminal block.
- f) Terminal blocks shall be provided with white marking strips / self-adhesive marker cards. Power terminals shall have protection covers.
- g) At least 10%percent spare unwired terminals shall be provided for all panels /cabinets /desks /junction box etc.. This shall be in addition to 10%spare wired terminals of spare IO channels and 10% wired spare modules.
- h) Bottom of the terminal block shall be at least 200 mm above the cable gland plate for bottom entry type panels.
- i) For extending 24 V / 48 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.
- j) Other requirements of the terminal blocks are as follows:
 - i) The last block in a rail-mounted assembly shall be closed with an end plate and end bracket.
 - ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.
 - iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.
 - iv) It shall be possible to use jumper plugs through the test plug socket to connect adjacent terminals.
 - v) Where more than one connection to a terminal block is required, two tier terminals shall be used.
 - vi) Terminal blocks shall be of different colors depending on voltage levels.

7.12.07 Nameplates and Labels

- a) Each item shall have permanently attached to it, in a prominent position, a rating plate of non-corrosive material upon which is to be engraved the manufacturer's name, equipment, type / model number, range, serial number, together with details of the loading conditions under which the item of plant in question has been designed to operate.
- b) Such nameplates or labels are to be of white non-hygroscopic material with engraved black lettering, or alternatively of transparent plastic

material with suitably colored lettering engraved on the back.

- c) The nameplates shall be held by self-tapping screws. The size of nameplate shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for the panels.
- d) Items of plant such as valves, which are subject to handling, are to be provided with an engraved chromium plated nameplate or label with engraving filled with enamel, suitably mounted or affixed with strong rustproof chain.
- e) All such nameplates, instruction plates, lubrication charts etc. shall be with English inscriptions.

8.00.00 **METERING BASES AND CHART UNITS**

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

- i) Pressure : Kg/cm²
Differential Pressure : mm of H₂O column / Kg/cm²
- ii) Draught : mm of H₂O column
- iii) Vacuum : Kg/cm² (abs)/mm of Hg column
- iv) Temperature : Degree Celsius (° C)
- v) Flow (Steam, Water) : Tonnes / hr, M³/Hr
- vi) Flow (Oil) : M³ / Hr, Litter/Hr
- vii) Flow Air : Tonnes / hr / M³ / Hr.
- viii) Density : gms / c.c.
- ix) Level : mm /%
- x) Conductivity : μS / cm or mS/cm
- xi) Gas Analyzer : Percentage by weight or as specified in respective case.
- xii) Dissolved Oxygen / Silica / Sodium : ppm /ppb

~~9.00.00 **PROCESS CONNECTION & INSTRUMENT HOOK UP**~~

~~9.01.00 Instrument connection to the process system (piping, vessel etc.) shall be according to the process & piping specification upto and including the root valves. Root valves shall be installed as close as possible to the piping or vessel.~~

As a rule tap orientation of high and low pressure side should be parallel and symmetrical.

9.15.00 Pressure & Differential pressure instruments in steam and liquid services shall be located below the taps and the piping shall be sloped to avoid formation of air pocket.

9.16.00 Pressure & Differential pressure instruments in air and flue gas service shall be located above the taps and the piping shall be sloped back to process to avoid formation of any liquid.

9.17.00 Impulse pipe including taps for furnace, flue gas and coal mill application shall be provided with air purge connection. Differential instruments for such application shall have continuous and as well as intermittent purging. Whereas, pressure measurement shall have only intermittent purging.

9.18.00 Material of impulse pipe for the instruments mounted on rack and enclosure shall be same as that of main process pipe except stainless steel tube of Gr. 316 or better shall be provided for connection in between impulse pipe (from tee connection on impulse pipe) and instrument manifold valve & instruments. Impulse pipe, tubes, fittings and accessories shall have the same design pressure and temperature applicable for the related main pipe.

10.00.00 **POWER SUPPLY SYSTEMS**

10.01.00 Instrumentation power supply system shall include all conditioning equipment required to accommodate normal variations in the electrical supply. All panels and cabinets shall accept redundant power feeds from two different sources.

10.02.00 Type of power supply systems envisaged for the various I & C system including DCS are as follows:

- a) 240V AC Redundant UPS system HMIs, Main Plant Field devices / equipment, CCTV, EWLI, CEMS, SWAS etc. and PLC of package System
- b) 24V / 48 VDC Supply for DCS

11.00.00 **ENVIRONMENTAL CONSIDERATIONS**

I & C components should operate properly with no degradation in expected lifetime or in operation parameter in the normal power plant environment. I & C system shall be designed considering all the operating conditions which may be encountered during installation and operation.

11.01.00 Temperature

11.01.01 Where the environmental extreme exceeds the capabilities of the selected system, Bidder should take appropriate steps to control the environment.

11.02.00 Humidity

11.02.01 I & C system shall be designed to withstand the humidity limits specified for the project. Condensation shall not be allowed to form in the cabinets nor

should water be allowed to be admitted through conduit entering the cabinets from top or sides.

11.03.00 Atmospheric Contamination

11.03.01 Particulate contamination from fly ash and coal dust and gaseous contaminants such as SO₂ and other flue gas constituents in the coal fired plant are foreseen. This hazard shall be taken into design considerations.

11.04.00 Vibration

11.04.01 Design of the systems shall include features such as locking devices, anti vibration pads etc, to withstand vibration. In general, I&C equipment shall be installed away from the vibration zone.

11.05.00 Lightning

11.05.01 Protection against lightning shall be considered by providing proper grounding, metal oxide varistors, spark gap lightning arrester, optical isolator and isolation transformer.

12.00.00 **SECURITY**

12.01.00 Door lock shall be provided in all Panels, Cabinets and Enclosures.

12.02.00 System mode key switch or password to prevent tampering of system program.

12.03.00 Redundant elements of the system shall not be exposed to the common hazards. For example routing of the redundant network cable through separate cable raceway, using separate cabinet / separate rack for redundant controller and redundant IO modules.

13.00.00 **ACCEPTANCE TESTS**

The Bidder shall be required, as part of his Tender, to fully integrate and test all the equipment, included in his Tender, at site and respective Control packages at the manufacturer's works. Owner / Consultants shall witness these tests.

However, for DCS the Bidder shall consider in his Tender the following tests:

(a) Factory Acceptance Test (FAT)

After completion of manufacture of DCS and prior to delivery to Site, the manufacturer shall functionally test the assembled system. The test shall be carried out with all input / output cubicles, control processors, data highway, operator's consoles, Engineer's console and peripheral devices connected in the specified configuration. The fully configured software shall also be loaded and tested at the same time.

The FAT shall include the following activities:

- Complete hardware inspection;



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1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for transportation and delivery to site, supervision, erection, and commissioning at site of Local Panels required for control and monitoring of the Auxiliary Plant & Equipment.

2.0 CODES AND STANDARDS

- 2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.
- 2.2 As a minimum requirement, the following standards shall be complied with:
- a) IS-6005 : 1998 : Code of practice for phosphating of iron and steel.
 - b) IS-5 : 2007 : Colors for ready mixed paints and enamels.
 - c) IS-1248:2003 : Direct Acting Indicating Analog Elec Measuring Instruments.
 - d) IS/IEC 60947:Part 1:2004 : Low Voltage switchgear & control gear: Part-I (General Rules)
 - e) IS-8828:1996 : Circuit breaker for household and similar installations.
 - f) IS-13947 (Part-I):1993 : Low Voltage switchgear & control gear : Part-I (General Rules)
 - g) ISA-18.1:1979 : Annunciator Sequences and Specification
 - h) NFPA-496:2003 : Purged & Pressurised Enclosure for Electrical Equipment in Hazardous Locations.

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

- 3.1.1 The local panels shall house the secondary instruments, annunciation system, Single loop controller, Control switches / push buttons, indicating lamps/LED cluster, relays, timers and other devices required for operation and monitoring of the equipment locally.
- 3.1.2 The panels shall be of free standing type either welded construction on angle iron (minimum section of 50 x 50 x 4 mm) structure or folded construction by sheet metal formation depending upon the equipments to be mounted on it. The panels shall be robustly built and stiffeners as necessary shall be provided.
- 3.1.3 The panel shall be suitably reinforced to ensure adequate support for all instruments mounted thereon. All welds on exposed panel surfaces shall be ground smooth.
- 3.1.4 The salient features of construction shall be:
- Sheet material: Cold rolled sheet steel
 - Frame thickness: Not less than 3.0mm
 - Enclosure thickness: Not less than 3.0 mm for load bearing sections (Mounted with instruments)
2.0 mm for doors and Not less than 2.0 mm for others
 - Gland plate thickness: 3.0mm
 - Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.
- 3.1.5 The panel shall be provided with rear doors with integral lockable handle. The door when locked shall be held at minimum three places. The door width shall not be more than 550mm. The doors shall be provided with suitable stiffeners to prevent buckling. The handle shall be on the right side of the door. The door shall be removable type with concealed hinges to facilitate maintenance work. Suitable pocket inside the door shall be provided for keeping the drawings / documents. Double door shall be provided with suitable glass windows, as per the requirement.
- 3.1.6 Suitable neoprene gasket shall be provided on all doors and removable covers. Suitable ventilation system along with louvers shall be provided at bottom and top of the doors covered with removable wire mesh.



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- 3.1.7 The class of protection shall be in accordance with IP-55 unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).
- 3.1.8 All steel surfaces shall be cleaned by sand / pellet blasting, treated for pickling, degreasing and phosphating etc. by seven tank method. The panel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / synthetic enamel based final paint of color shade and finish as given in data sheet-A (No. PES-145A-DS1-0). Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.
- 3.1.9 The cable glands of the required size and type as given in data sheet-A (No. PES-145A-DS1-0) shall be supplied alongwith the Panel.
- 3.1.10 All operable and indicating devices shall be mounted on the front of the panel while aux. Relays / timers MCBs etc. required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function.
No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.
- 3.1.11 Single / dual control power supply feeders of voltage class as specified in data sheet-A (No. PES-145A-DS1-0) shall be provided by the purchaser. In case redundant power supply feeders are provided then auto changeover unit shall be mounted on the panel are in the panel supplier's scope. Where DC control power supply is specified an additional 240V, 50 Hz AC supply feeder for powering of space heater and lighting shall be provided by the purchaser. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any other power supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.
- 3.1.12 The internal wiring shall be carried out with 1100 volt grade PVC insulated copper multi strand wire / flexible of 1.5mm² size. AC & DC wires shall be kept separate from each other. Separate coloured wires to be used for AC and DC circuits. All wires shall be properly numbered and identified with ferrules as per the Control scheme / wiring diagram. Wires shall be routed and run through PVC troughs.
- 3.1.13 Terminal blocks shall be clip on type, 1100 volts grade. Separate terminal blocks shall be used for AC & DC circuits. The terminals shall be suitable for terminating 0.5 mm² to 2.5mm² external cables. The TB points in terminal block shall be cage clamp type / screw type. The terminal for ammeters shall be provided with removable links for shorting CTs. Each terminal strip shall be provided with identification strip. The terminal shall not be mounted below 250 mm height from finished floor. The panel shall have ten (20) percent spare terminal.
- 3.1.14 The interior of each panel shall be suitably illuminated through fluorescent lamps / tube lights with shrouded cover of minimum 15W operable on 240V 50 Hz AC power supply through panel door switch. A 15 Amp. 3-pin Power receptacle shall be provided.
- 3.1.15 Suitable space heaters operable on 240 Volts 50 Hz AC power system shall be provided at the panel bottom. These shall be designed to maintain the panel temperature five (5) deg. C above the ambient temperature during maintenance shutdown. Suitable isolating and control devices comprising of MCB, thermostat etc. shall be provided for the space heater.
- 3.1.16 The panel shall be provided with a copper earth bus of 25 x 6 mm size running throughout the width of the panel. It shall be terminated internally with 10 mm bolts at extreme ends for connection to; main station earth. The panel mounted equipments / devices shall be connected to earth bus through green coloured PVC insulated stranded copper conductor of 2.5 mm² size.
- 3.1.17 Local Panel shall be provided with main name plate of 150 mm x 40 mm size having inscription of 20 mm height. The individual devices on the panels shall be as provided with separate name plate with inscription of 3 mm height. The instrument / devices shall be provided with stick on label plates inside the panel. The material of the main and individual labels shall be three (3) ply 3 mm thick Traffolyte



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Sheet / 2 mm Anodised Aluminium Plate. The inscription shall be with white letters on black background on traffolyte sheet. The labels shall be fixed by self tapping non-rusting screws.

- 3.1.18 Vendor shall furnish electric load and heat load list (in case panel is to be placed in ac environment) of each panel.
- 3.2 Hazardous Area Panel Requirement
- 3.2.1 The Local Panel located in hazardous area shall be pressurized as per NFPA-496 requirements to render it non-hazardous. Alarms shall be provided for local and remote annunciation when pressurisation falls below 2.5 mm of water column. Protection shall be of type Z of NFPA-496. It shall not be possible to switch ON the power of purged section unless it is purged as per the recommendation of NFPA-496. Vendor must provide a protective device on the panel to protect the panel from over pressurisation.
- 3.2.2 Vendor shall supply pressurisation kit consisting of valves, restriction orifices, dual filter regulation, pressure gauges, pressure switches, rotameter etc. Pressurisation kit shall be surface mounting on a metal board and located outside the local panel. Pressurisation kit shall further consist of solenoid valve flow switch, timer blow off safety device etc., so as to make purging fully automatic. However final start shall be manual. Panel protection against over pressure to be provided as per NFPA-496.
- 3.2.3 Pressurised local control panel pressurization kit assembly design shall provide minimum leakage flow through the Local Control Panel. Panel venting shall be as per NFPA-496.
- 3.2.4 All components in the local panel like indicating instruments, push buttons switches, lamps etc., which are required to be energized without panel pressurization or before completion of purge cycle shall be explosion proof as per NEMA-7 & suitable for area classification.
- 3.2.5 All push buttons etc. requiring frequent operation during machine running shall have good positive sealing. Weatherproof housing or cover to be provided wherever necessary. Vendor shall provide pressurisation bypass switch outside explosion proof enclosure of pressurized panel with lamp indication. This shall be used only during maintenance. All hinges, screws, other non-painted metallic parts shall be of stainless steel material.
- 3.2.6 Provision to switch off manually all types of power shall be provided in the panel. In addition, it shall also be possible to switch off power circuits / components which are powered from motor control centre or control room manually in case of pressurization failure. All such cables from MCC and main control room shall be terminated in explosion proof boxes (NEMA-7).
- 3.3 Control & Monitoring devices
- 3.3.1 Instruments like Indicators, recorders, single loop controllers etc. as applicable and specified elsewhere for the plant / equipment shall be supplied and mounted on the panel.
- 3.3.2 Alarm Annunciator System
It shall be solid state discrete facia type having a sequence of ISA-S18.1A or as specified, opaque facia windows of 70 mm x 50 mm size, having two (2) lamps per window, and hooter of 10W, and provision for repeat group alarm at remote. The annunciator shall be provided with ten (10) percent spare windows or minimum two (2) windows along with electronics.
- 3.3.3 Relays
The relays shall be electromagnetic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable. There shall be ten (10) percent spare contacts.
- 3.3.4 Timers
The timers shall be electronic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However, minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable.



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3.3.5 Control / Selector Switches

Switches shall be Rotary Cam type with minimum of 5 Amps AC & 2 Amp DC continuous current rating. Selector switches shall be stay put type while control switches shall be spring-return-to-neutral type. Contact configuration and rating shall be as per the control function requirement. The switches shall be lockable type wherever specified. Each switch shall be provided with engraved plates indicating the switch position / functions.

3.3.6 Push Buttons / Indicating Lights

The push buttons shall be momentary action self-resetting type, however stop P.B. for unidirectional drives shall be provided with manual reset facility. Its contact configuration & rating shall be as required for the control function but minimum 2 NO + 2 NC of 5 Amp. AC rating. It shall have round coloured projecting tab and engraved escutcheon plate / inscription plate. Colour coding of push buttons shall be as under:

RED	Motor OFF / Valve CLOSE	YELLOW	Alarm acknowledge	Left Hand Side
GREEN	Motor ON / Valve OPEN	BLACK	Lamp test	Right Hand Side

Indicating lights shall be suitable for direct connections across specified power supplies. It shall be fitted with built in resistance to prevent circuit tripping on shorting of lamp filament. It shall be fitted with LED cluster type lamp replaceable from front.

GREEN	Motor OFF / Valve CLOSED condition	AMBER	Motor tripped	Left Hand Side
RED	Motor ON / Valve OPEN condition	WHITE	Normal / healthy	Right Hand Side

3.3.7 Ammeters

Ammeter shall be 96 x 96 mm size, 90 deg. deflection, 1.5% accuracy, 1 Amp. CT operated or with 4-20mA input and Flush mounting type as called for in the data sheet-A (No. PES-145-54A-DS1-0). Ammeters for motors shall have six (6) times folded scale at upper end to enable motor starting current indication

3.3.8 Miniature Circuit Breaker (MCB)

These shall be instantaneous magnetic trip type for short circuit in addition to current time inverse delayed thermal trip feature for over current protection. The housing of MCB shall be made of non-ignitable, high impact material. It shall have minimum short circuit rating of 9 KA for AC Voltages and 4 KA for DC Voltages.

3.3.9 Makes of various instruments / devices shall be as given below

1.	Alarm Annunciators	:	Procon / IIC
2.	Ammeters	:	AEP / IMP
3.	Control / Selector Switches	:	Alsthom / Kaycee / Siemens / L&T
4.	Push Buttons / Indicating Lamps	:	Siemens / L&T / Teknic / Alsthom
5.	Auxiliary Relays	:	Jyoti / Siemens / L&T / OEN
6.	Timers	:	L&T / Alsthom / Bhartiya Cutler Hammer
7.	MCBs	:	S&S Power Engg. / Indo Asian / MDS
8.	Terminal Blocks	:	Jyoti / Elmex

4.0 TESTING AND INSPECTION

4.1 The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.

4.2 BHEL's standard Quality Plan for LCP is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.



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4.3 The vendor shall conduct the following tests as a minimum requirement:

4.3.1 Routine Tests

1. High Voltage (H.V.)
2. Insulation Resistance (I.R.)
3. Functional

4.3.2 Type Tests

1. Enclosure Class Test

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

The bidder shall supply all commissioning spares and consumables 'as required' during Start-up, as part of the main equipment supply.

5.2. Mandatory Spares

The bidder shall offer alongwith main offer, the Mandatory Spares as specified elsewhere in the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.

5.3. Recommended Spares

The bidder shall furnish a list of Recommended Spares indicating the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation alongwith unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

6.0 DRAWINGS AND DOCUMENTS

6.1 The bidder shall furnish the following documents in required number of copies along with the bid :

1. Data Sheet no. PES-145A-DS1-0
2. General Arrangement Drawing.
3. Catalogue and technical information for instruments and devices.
4. Quality Plan.

6.2 The vendor shall furnish the following documents in required number as agreed after the award of contract:

1. Data Shee No. PES-145A-DS2-0
2. GA Drawing indicating layout of instruments, construction details, foundation details, cable gland plate alongwith cable glands and all details mentioned in this specification.
3. Control Schematic Diagram along with grouping of different terminals for various functions.
4. Catalogue and technical information for instruments and devices with selected options clearly marked.
5. O&M Manuals.
6. "As Built" Drawing.
7. CDs.

7.0 MARKING AND PACKING

7.1 Panel with all instruments / devices mounted on it shall be suitably packed & protected for the entire period of despatch, storage and erection against impact, abrasion, corrosion, incidental damage due



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to vermin, sunlight, high temperature, rain moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in Transit and storage in open.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Local Panels : Data sheet no. PES-145A-DS1-0
- Data sheet C for Local Panels : Data sheet no. PES-145A-DS2-0



DATA SHEET FOR LOCAL PANELS

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TAG No. Qty.....

Data Sheet No.: PES-145A-DS1-0

Data Sheet A & B

DATA SHEET-A FOR LOCAL PANEL
(TO BE FILLED BY PURCHASER)

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

GENERAL	MANUFACTURER		
	CONSTRUCTION	<input type="checkbox"/> FOLDED <input type="checkbox"/> WELDED (As per requirement EDN)	
	ENCLOSURE SHEET THICKNESS	FRONT	<input checked="" type="checkbox"/> 3.0 mm (FOR FACES SUPPORTING INSTRUMENTS/TERMINALS)
		OTHER	<input checked="" type="checkbox"/> 2.0 mm (FOR OTHER SIDES AND TOP)
		DOOR	<input checked="" type="checkbox"/> 2.0 mm
		HEIGHT	<input type="checkbox"/> 2365 mm for stand alone panels. (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)
	OTHER	<input type="checkbox"/>	
TECHNICAL	INPUT POWER SUPPLY *	<input type="checkbox"/> 240V 50 Hz AC <input type="checkbox"/> 220V DC <input type="checkbox"/> 415V 3 PHASE 3W <input type="checkbox"/> 415V 3 PHASE 4W	
	NO. OF FEEDERS	<input type="checkbox"/> ONE <input checked="" type="checkbox"/> TWO	
	CONTROL SUPPLY	<input type="checkbox"/> 110V AC <input type="checkbox"/> 220V AC <input type="checkbox"/> 220V DC <input type="checkbox"/> Other. (As per requirement)	
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)	_____ NOS. (AS REQUIRED)	
	PAINT TYPE	<input type="checkbox"/> EPOXY ENAMEL <input checked="" type="checkbox"/> EPOXY POWDER COATED OR BETTER (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)	
	PANEL COLOUR (EXTERNAL)	<input type="checkbox"/> LIGHT GREY (Shade 631 IS-5) <input type="checkbox"/> OPALINE GREEN (Shade 275) . <input checked="" type="checkbox"/> RAL 7032 (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)	
	FINISH (EXTERNAL)	<input type="checkbox"/> MATT <input type="checkbox"/> GLOSSY <input type="checkbox"/> SEMI GLOSSY	
	PANEL COLOUR (INTERNAL)	<input type="checkbox"/> WHITE <input type="checkbox"/> CREAM <input type="checkbox"/> OFF WHITE <input checked="" type="checkbox"/> BRILLIANT WHITE	
	FINISH (INTERNAL)	<input type="checkbox"/> MATT <input type="checkbox"/> GLOSSY <input type="checkbox"/> SEMI GLOSSY	
	CLASS OF PROTECTION	<input type="checkbox"/> IP-42 (FOR INDOOR SERVICE) <input checked="" type="checkbox"/> IP-55 (FOR OUTDOOR SERVICE) <input type="checkbox"/> ANY OTHER	
	CONTROL HARDWARE	<input checked="" type="checkbox"/> RELAY BASED	
	FOUNDATION ARRANGEMENT	<input type="checkbox"/> FOUNDATION BOLTS <input type="checkbox"/> ANCHOR FASTENERS	
	WEIGHT OF PANEL (Kg.)		
	PANEL TYPE	<input type="checkbox"/> PRESSURISED <input type="checkbox"/> UNPRESSURISED As per Requirement	
	CABLE GLAND	<input checked="" type="checkbox"/> DOUBLE COMPRESSION	
	AMMETER (TYPE OF INPUT) *	<input type="checkbox"/> 1 Amp CT <input type="checkbox"/> 4-20 mA	



DATA SHEET FOR LOCAL PANELS

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

Data Sheet A & B

DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
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* TO BE CO-ORDINATED WITH PEM ELECTRICAL

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



DATA SHEET FOR LOCAL PANELS

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TAG No. Qty.....

Data Sheet No.: PES-145A-DS1-0

Data Sheet C

DATA SHEET-C FOR LOCAL PANEL
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

GENERAL	MANUFACTURER		
	CONSTRUCTION	<input type="checkbox"/> FOLDED <input type="checkbox"/> WELDED (As per requirement EDN)	
	ENCLOSURE SHEET THICKNESS	FRONT	
		OTHER	
		DOOR	
		HEIGHT	
		OTHER	
TECHNICAL	INPUT POWER SUPPLY		
	NO. OF FEEDERS		
	CONTROL SUPPLY		
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		
	PAINT TYPE		
	PANEL COLOUR (EXTERNAL)		
	FINISH (EXTERNAL)		
	PANEL COLOUR (INTERNAL)		
	FINISH (INTERNAL)		
	CLASS OF PROTECTION		
	CONTROL HARDWARE		
	FOUNDATION ARRANGEMENT		
	WEIGHT OF PANEL (Kg.)		
	PANEL TYPE		
	CABLE GLAND		
	AMMETER (TYPE OF INPUT)		
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY
	Shiv Kumar	Anisha B Singhal	Anisha B Singhal
	COMPANY SEAL		
	NAME:		
	SIGNATURE:		
	DATE:		

SPECIFIC TECHNICAL REQUIREMENTS (C&I)

APPLICABLE CODES AND STANDARDS

box or enclosure shall leave from terminal blocks and not from other devices in the enclosure.

The required quantities of cable accessories shall be similarly estimated on the basis of number of terminations and proposed routing of the cables. Any shortfall in the quantity of accessories observed during actual laying shall be compensated at no extra cost.

5.00.00 **PROVEN PRODUCT**

If Bidder is offering their own system or through their collaborator, then same is acceptable subject to satisfactory performance in last 3 years for at least one unit of not less than 600 MW capacity.

If DCS is bought out for bidder then same shall be from following vendors meeting specification and satisfactory performance in last 3 years for at least one unit of not less than 600 MW capacity.

Latest system from following vendors

M/s Siemens

M/s Yokagawa

M/s Honeywell

M/s ABB

Ovation.

5.01.00 Similarly, all other I & C equipment / systems / sub-systems / instruments and accessories in the power cycle shall also be of make and model whose guaranteed and trouble-free performance has been proven at least for two (2) years in not less than two (2) different reheat type pulverized coal fired units of unit size not less than 600 MW.

5.02.00 Bidder shall furnish required information to fully satisfy Owner regarding successful operation and high reliability of products / systems furnished.

6.00.00 **CODES AND STANDARDS**

6.01.00 Items such as thermowells, control valves, flow elements and other in line devices in high and medium pressure steam, feed water and similar services, which fall under the purview of Indian Boiler Regulation Act shall be either certified by IBR or shall be certified by authorities acceptable to IBR. It shall be responsibility of Bidder to obtain the necessary approval of the concerned Authority / Chief Inspector of Boilers for the design and design calculations, manufacturing and erection procedure as called for under the IBR Act for all items requiring such certification.

6.02.00 Generally, the following latest edition of codes and standards prevailing at the time of award of contract shall be applicable.

- 1) Temperature Measurement

- a) Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).
 - b) Temperature Measurement - Thermocouples - ANSI - MC 96.1 - 1982.
 - c) Temperature Measurement by electrical resistance thermometers - IS: 2806
 - d) Thermometer-element-Platinum resistance - IS: 2848 / DIN 43760.
- 2) Pressure Measurement
- a) Instrument and apparatus for pressure measurement - ASME PTC 19.2 (1964).
 - b) Bourdon tube pressure and vacuum gauges - IS: 3624/1996.
- 3) Flow Measurement
- a) Instruments and apparatus for flow measurement - ASME PTC 19.5 (1972) Interim supplement, Part-II
 - b) Measurements of fluid flow in closed conduit - BS 1042.
- 4) Electronic Measuring Instruments and Control Hardware
- a) Automatic null balancing electrical measuring instruments -ANSI C 39.4 (Rev. 1973), IS 9319
 - b) Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 / 1974.
 - c) Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1: ANSI MC 12.1 / 1975.
 - d) Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975) - ISA -S26 (1968).
 - e) Surge withstand capability (SWC) tests - ANSI C 37.90A (1989), IEC-255.4.
 - f) Printed circuit boards - IPC TM-650, IEC 326C.
 - g) General requirements and tests for printed wiring boards - IS-7405 (Part-I)/1973.
 - h) Edge socket connectors - IEC 130-11.
 - i) Requirements and methods of testing of wire wrap terminations--DIN 41611 Part-2.
 - j) Dimensions of attachment plugs and receptacles- ANSI C73-1973.(Supplement ANSI C73a – 1980)
- 5) Instrument Switches and Contacts

- a) Contact Rating - AC services NEMA ICS Part-2 125, A-600
- b) Contact Rating - DC services NEMA ICS Part-2 125, N-600
- 6) Enclosures
 - a) Enclosures for Industrial Controls and Systems--NEMA ICS-6-110.15 through 110.22
 - b) Racks, panels and associated equipment -EIA: RS-310-B-1983 (ANSI C83.9 - 1972).
- 7) Apparatus, Enclosures and Installation Practices in Hazardous Area
 - a) Classification of hazardous area - NEMA Article 500, Volume-6, 1978.
 - b) Electrical Instruments in hazardous dust locations - ISA-RP 12.11.
 - c) Intrinsically safe apparatus - NFPA Article 493 Volume-4 1978.
 - d) Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Article 496 Volume-4, 1978.
- 8) Sampling System
 - a) Stainless Steel material of tubing and valves, for sampling system - ASTM A 269-79 GRTO-316.
 - b) Submerged helical coil heat exchangers for sample coolers -- ASTM D11-98.
- 9) Annunciators
 - a) Specifications and guides for the use of general-purpose annunciators - ISA RP 18.1.
 - b) Surge withstand capability tests -ANSI C37.90 a -1971 and IEEE Standard 472-1974.
- 10) Interlocks, Protections
 - a) Relays and relay system associated with electric power apparatus - IEEE Standards 3.13.
 - b) Surge withstand capability tests - ANSI C37.90 a - 1971 and IEEE Standard 472-1974.
 - c) General requirements and tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I)/1973.
 - d) Turbine water damage prevention - ASME-TDP-1-1980.
 - e) Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.
- 11) UPS System

- a) Practice and requirements for semi-conductor power rectifiers - ANSI C34.2.
- b) Relays and relay systems associated with electrical power apparatus IEEE Standard - 3.13.
- c) Surge withstand capability tests - ANSI C 70.90 A/1971, IEC-255.4.
- d) Recommended practice for sizing large lead storage batteries for generating stations and sub-stations - -IEEE-485.

12) Control Valves

- a) Control valve sizing (Incompressible fluids) - ISA-S39.2 / 1972.
- b) Control valve sizing (Compressible fluids) - ISA-S39.4 / 1972.
- c) Control Valve seat leakage – ANSI / FCI 70.2
- d) Face to face dimensions of Control Valves - ANSI B16.10
- e) Control Valve Capacity Test Procedure – ISA – S75.02

13) Instrument Tubing

- a) Seamless Carbon Steel Pipe - ASTM-A-106.
- b) Forged carbon steel fittings - ASTM-A-105.
- c) Dimensions of fittings - ANSI-B16.11.
- d) Code for pressure piping, welding, hydrostatic testing - ANSI-B 31.1.
- e) Nomenclature for instrument tube fittings - ISA-RP 42.1 / 1982.
- f) Seamless Stainless Steel Tube ASTM A-213 TP 316 / ASTM A-269 TP 316
- g) Seamless Alloy Steel Pipe ASTM A 335 P22
- h) Seamless Stainless Steel Pipe ASTM A-312 TP 316

14) Cables

- a) Thermocouple extension wires / cables - ANSI MC96.1.
- b) Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy-IPCEA S-61-402
- c) Guide for design and installation of cable system in power generating station (insulation, jacket materials) -IEEE Standard 422.
- d) Requirements of vertical tray flame test - IEEE 383
- e) Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B33.

15) Electronic Cards, Subassemblies and Components

a) Unpackaged

- i) Vibration : IEC-68.2.6
- ii) Shock : IEC-68.2.27
- iii) Drop & Topple : IEC-68.2.31

b) Packaged

Vibration, Drop & Static Compression - NSTA.

c) Electromagnetic Compatibility

- i) Electrical Fast Transient : IEC-801.4
- ii) Surge Withstand : IEC-255.4
- iii) Radiated Electromagnetic Field : IEC-801.3
- iv) Electrostatic Discharge : IEC-801.2
- v) Electromagnetic Emissions : VDE 0871, Class-B

16) Cable Trays, Conduits

- a) Guide for the design and installation of cable system in power generating station (cable trays, support systems, conduits)- IEEE Standard 422, NEMA VE-1, NEC-1981. Test Standards NEMA VE-1-1979.
- b) Galvanizing of carbon steel cable trays - ASTM A-386.

~~7.00.00 **DESIGN CRITERIA**~~

~~This section lays down the general design criteria to be adapted in designing the instrumentation and control system of the plant.~~

~~7.01.00 General Requirements~~

~~7.01.01 Instrumentation, control and automation devices and accessories shall be designed with the following considerations:~~

- ~~a) Stable in spite of temperature fluctuations.~~
- ~~b) Able to withstand high humidity.~~
- ~~c) Weather proof.~~
- ~~d) Dust proof.~~
- ~~e) Corrosion resistant.~~
- ~~f) Erosion resistant.~~

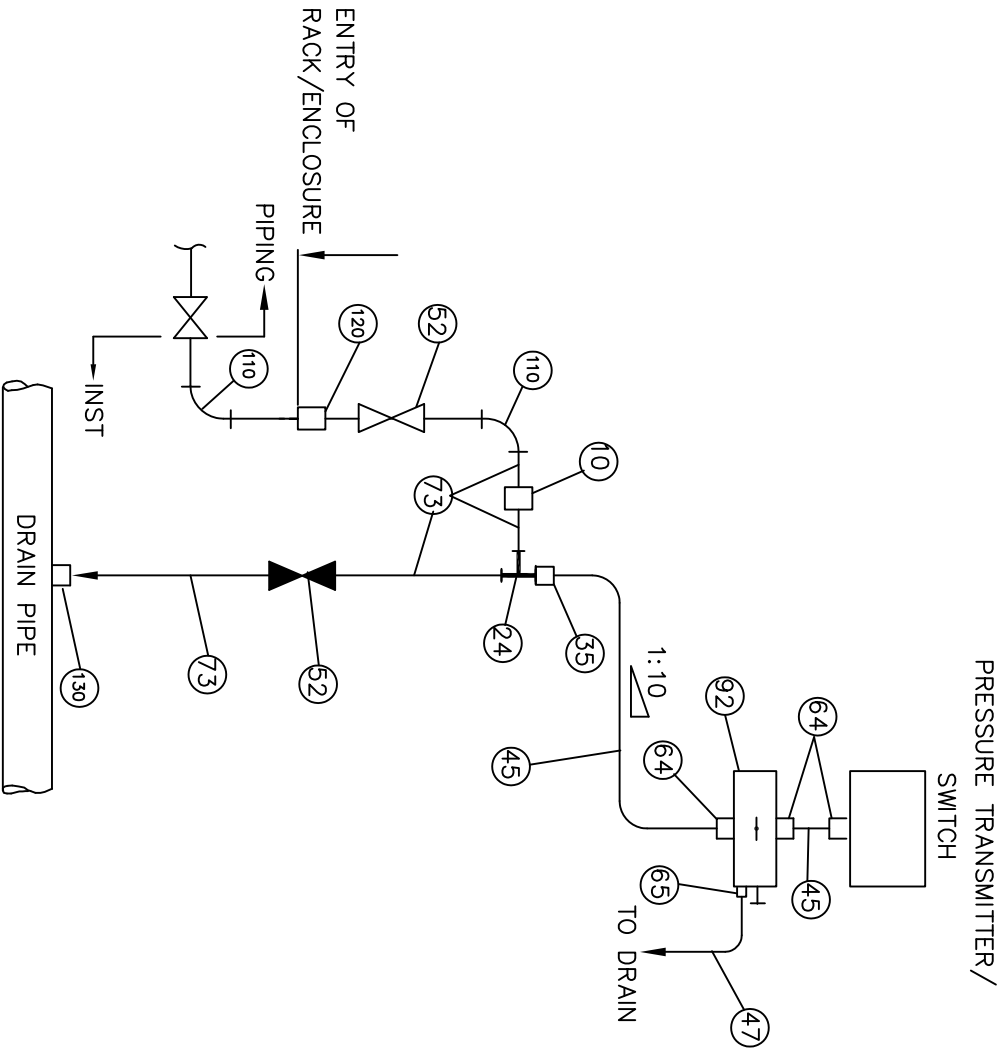
1X800 MW Wanakbori STPP

SECTION: C
SUB SECTION :
C&I
SHEET 18 of 18

SPECIFIC TECHNICAL REQUIREMENTS (C&I)

DRAWINGS

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



BILL OF MATERIAL

ITEM NO.	QTY./INST	DESCRIPTION
24	1	EQUAL TEE (FEMALE) 1/2" SW 3000lbs
35	1	MALE CONNECTOR 1/2" PE X 1/2" OD 3000 lbs
52	2	GLOBE VALVE 1/2" SW 600lbs
45	3Mtrs.	TUBE 1/2" OD 2.1 MM THICK
64	3	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 3000 lbs
73	2Mtrs	IMPULSE PIPE 15 NB SCH 80
92	1	2 VALVES MANIFOLD 1/2" NPT(F)
10	1	FULL COUPLING 1/2" SW 3000lbs
47	0.15Mtrs.	TUBE 8 MM OD 1.0 MM THICK
65	1	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 3000 lbs
110	2	90° ELBOW 1/2" SW 3000lbs
120	1	BULK HEAD UNION/COUPLING. CL: 3000 LBS/ 1/2" NB-SW/AS PER ANSI B16.11
130	1	HALE COUPLING. CL: 3000 LBS/ 1/2" NB-SW/ AS PER ANSI B16.11

SERVICE : CONDENSER PRESSURE, INSTRUMENT AIR ETC.

PRELIMINARY
TENDER PURPOSE ONLY

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

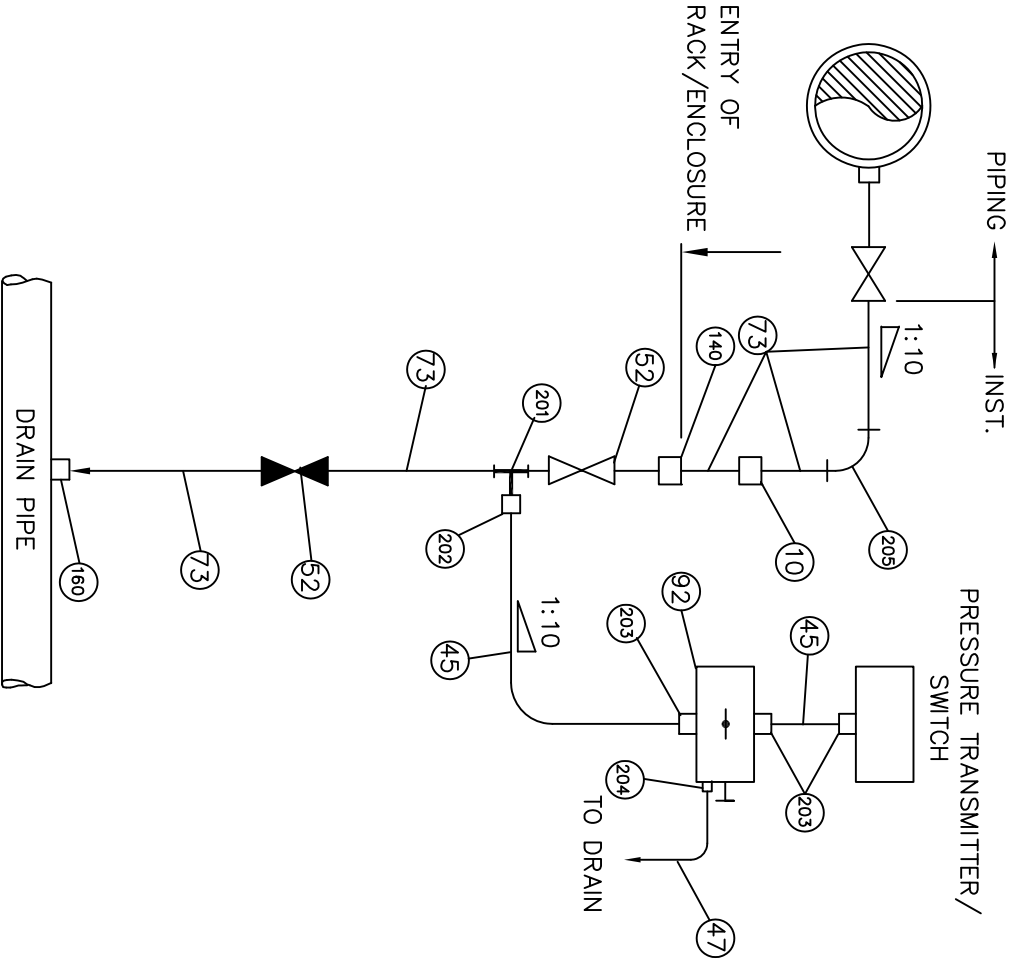
TYPICAL INSTRUMENT INSTALLATION DIAGRAM
1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)
GUJARATI STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT



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

JOB NO. DCP- K9213R SCALE NIL SH. 3 OF 20
DWG. NO. K9213R-DWG-1-0060 REV. 0

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



BILL OF MATERIAL

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

SERVICE : CONDENSATE, FEED WATER ETC.

PRELIMINARY
TENDER PURPOSE ONLY

APPROVED	CHECKED	DRAWN	REV.	DATE
GP	AT	SD	0	21.04.10

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

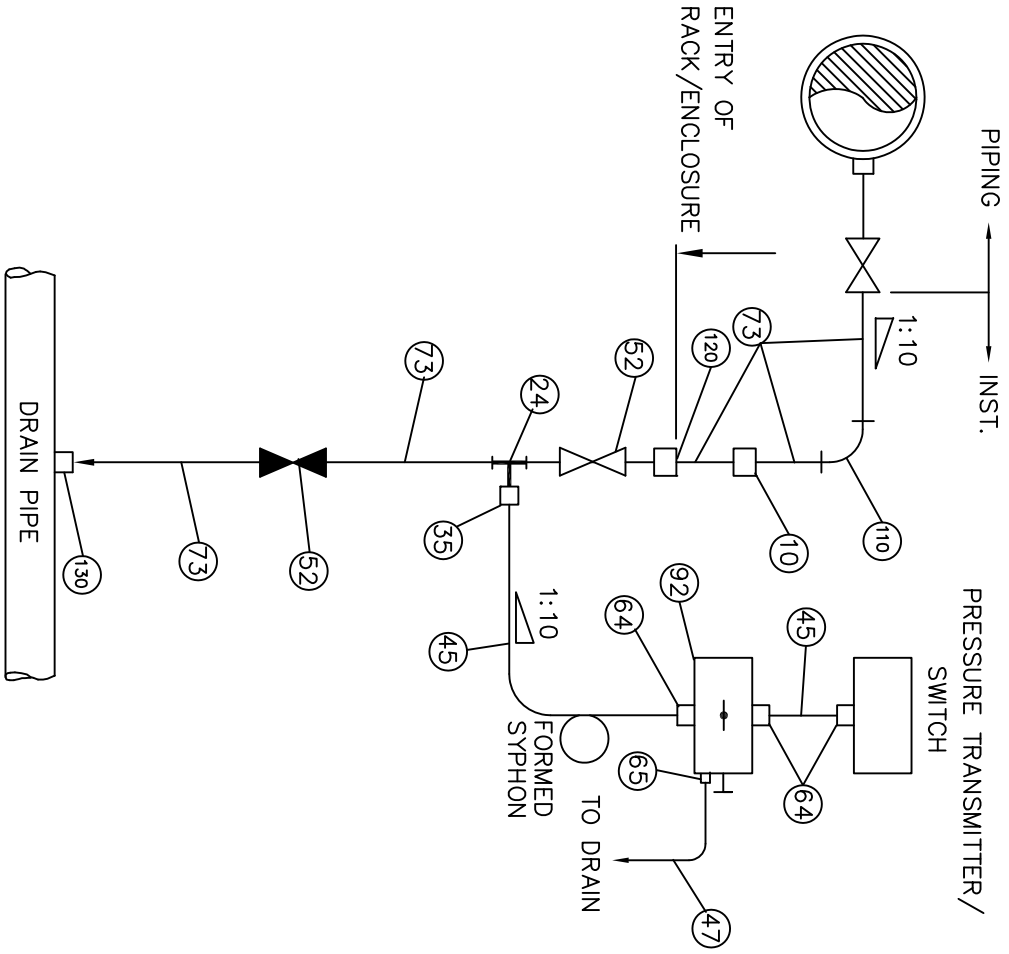
1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANKBORI THERMAL POWER STATION, GUJARAT)

GUJARATI STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCPL-K9213R SCALE NIL SH. 4 OF 20
DWG. NO. K9213R-DWG-I-0060 REV. 0

**PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED BELOW SOURCE POINT(WITH SYPHON)**



BILL OF MATERIAL

ITEM NO.	QTY./INST	DESCRIPTION
24	1	EQUAL TEE (FEMALE) 1/2" SW 3000lbs
35	1	MALE CONNECTOR 1/2" PE 1/2" OD 3000 lbs
52	2	GLOBE VALVES 1/2" SW 600lbs
45	3 Mtrs	TUBE 1/2" OD 2.1 MM THICK
64	3	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD 3000 lbs
73	15Mtrs.	IMPULSE PIPE 15 NB SCH 80
92	1	2 VALVES MANIFOLD 1/2" NPT(F)
10	1	FULL COUPLING 1/2" SW 3000lbs
47	0.15Mtrs.	TUBE 8 MM OD 1.0 MM THICK
65	1	MALE CONNECTOR 1/4" NPT(M) X 8 MM OD 3000 lbs
110	1	90° ELBOW 1/2" SW 3000lbs
120	1	BULK HEAD UNION/COUPLING CL: 3000 LBS/ 1/2" NB-SW AS PER ANSI B16.11
130	1	HALF COUPLING CL: 3000 LBS/ 1/2" NB-SW AS PER ANSI B16.11

SERVICE : LOW PRESSURE STEAM

PRELIMINARY
TENDER PURPOSE ONLY

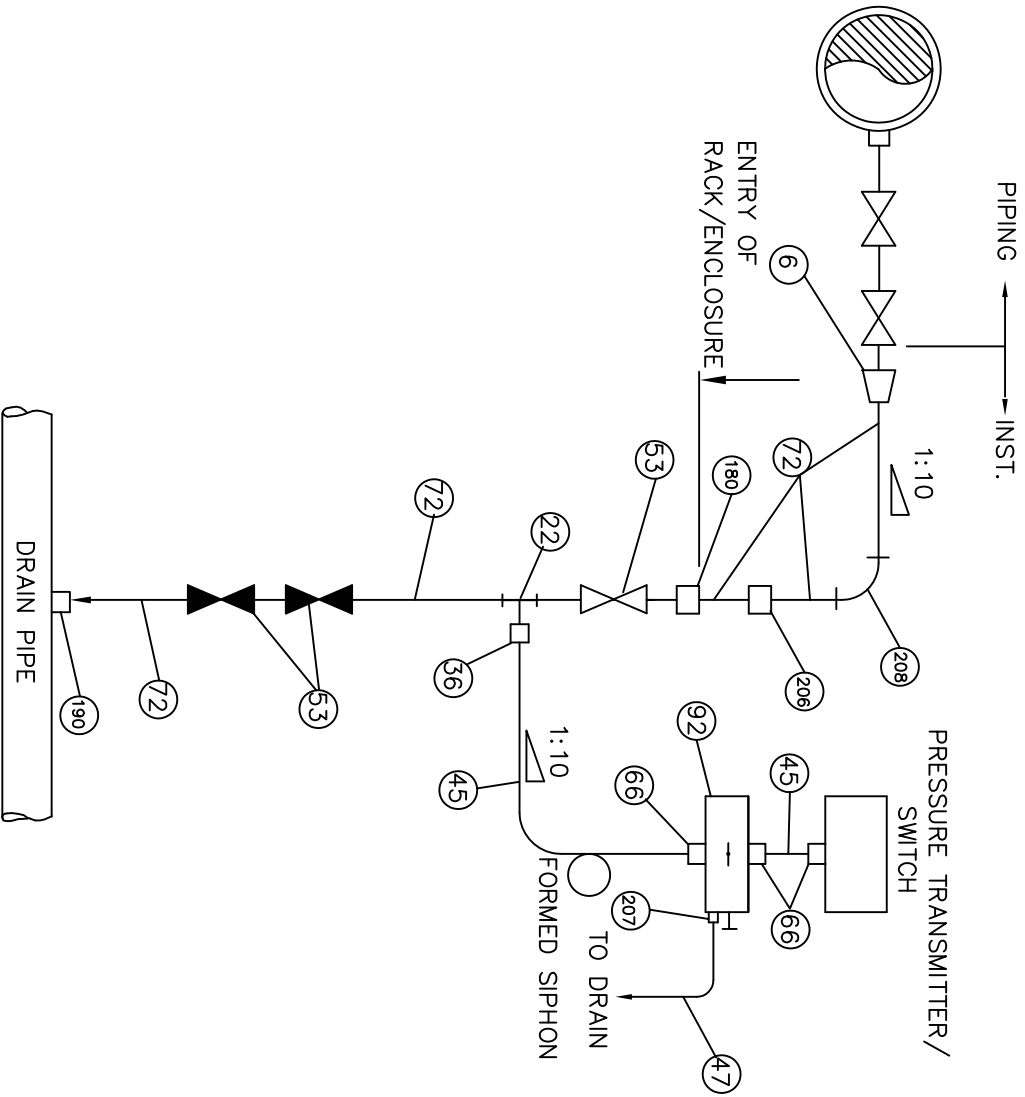
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE
gp	AT	SD		0	21.04.10

TYPICAL INSTRUMENT INSTALLATION DIAGRAM
1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)
GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

JOB NO. DCP-1-K9213R SCALE NIL SHT. 5 OF 20
DWG. NO. K9213R-DWG-1-0060 REV. 0

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



BILL OF MATERIAL

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

SERVICE : MEDIUM & HIGH PRESSURE STEAM

PRELIMINARY
TENDER PURPOSE ONLY

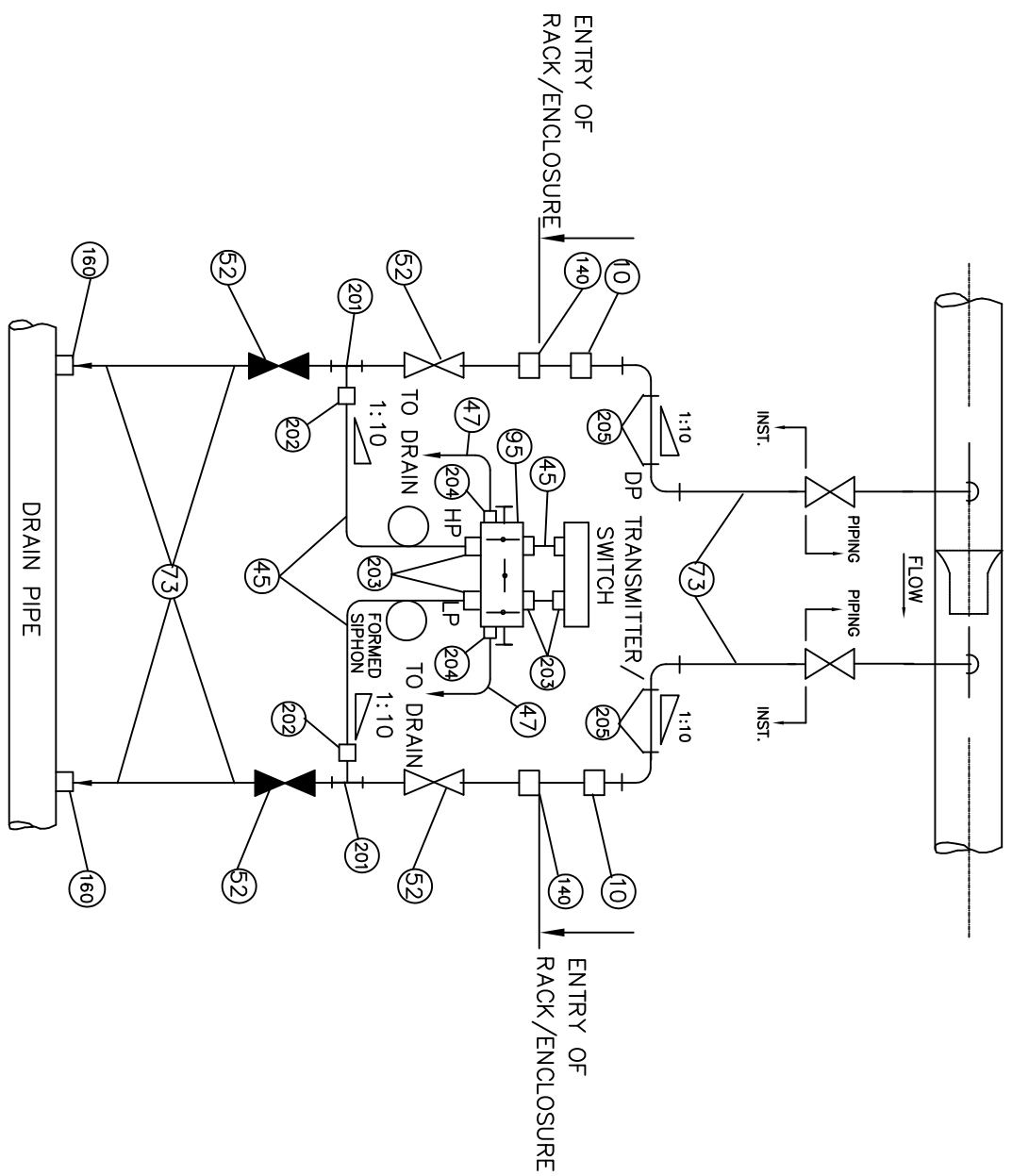
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GP	AT	SD		0	21.04.10

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

1x800kW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WAMBARON THERMAL POWER STATION, GUJARAT)
GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

	DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI	
	JOB NO. DCP L-K9213R SCALE NIL DWG. NO. K9213R-DWG-I-0060	SHT. 6 OF 20 REV. 0

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



BILL OF MATERIAL

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

SERVICE : CONDENSATE, FEED WATER ETC.

PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE

PRELIMINARY
TENDER PURPOSE ONLY

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

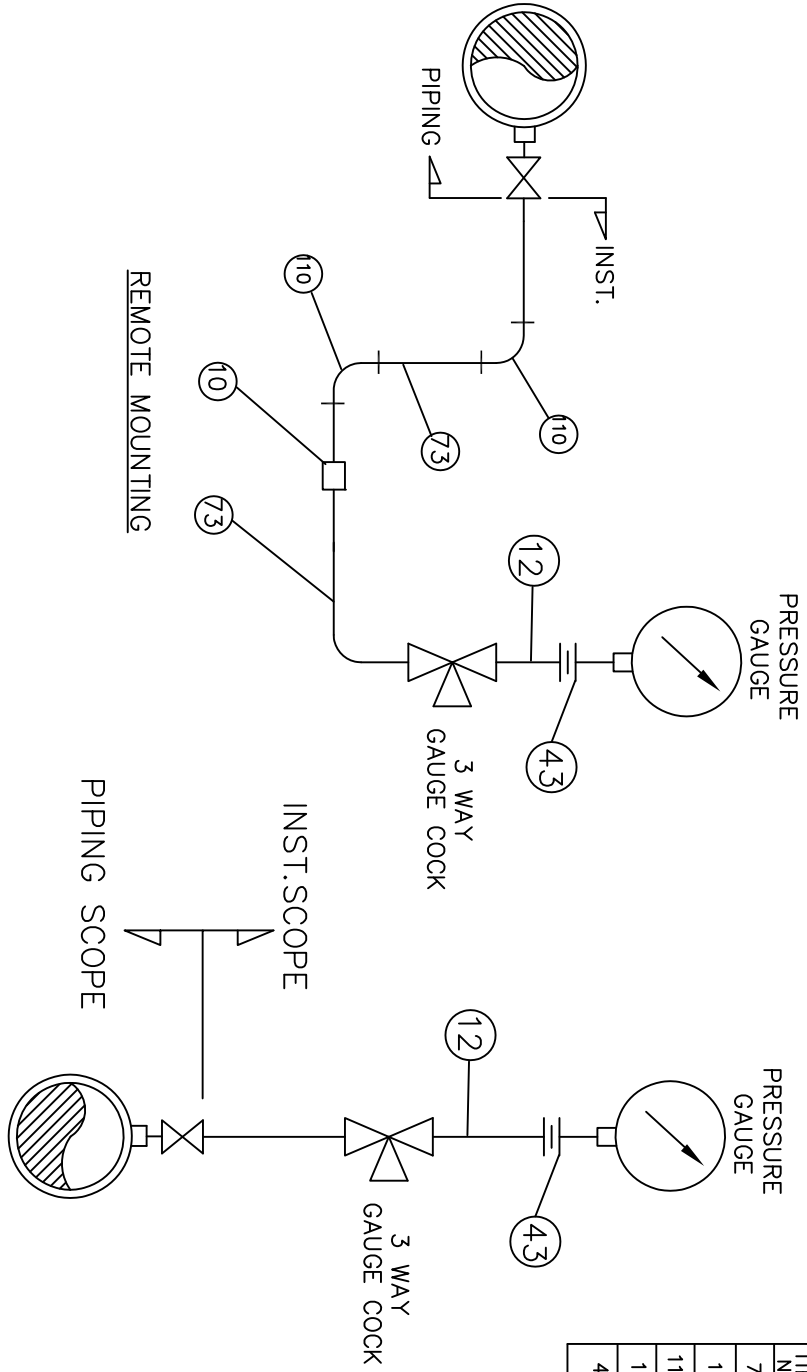
TYPICAL INSTRUMENT INSTALLATION DIAGRAM

1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANABORI THERMAL POWER STATION, GUJARAT)
GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT



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

JOB NO.	DCPL-K9213R	SCALE	NIL	SHT.	7 OF 20
DWG. NO.	K9213R-DWG-I-0060			REV.	0



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

SERVICE : WATER, CONDENSATE ETC.

ON TAP MOUNTING

PIPING SCOPE

INST. SCOPE

REMOTE MOUNTING

PRESSURE GAUGE

PRESSURE GAUGE

3 WAY GAUGE COCK

3 WAY GAUGE COCK

INST.

PRELIMINARY
TENDER PURPOSE ONLY

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADDODARA, GUJARAT



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

JOB NO. DCPL-K9213R SCALE NIL SHT. 11 OF 20
DWG. NO. K9213R-DWG-I-0060 REV. 0

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



**TITLE : TECHNICAL SPECIFICATION
FOR
CONDENSER ON LOAD TUBE CLEANING
SYSTEMS (COLTCS)**

SPEC. NO. PE-TS- 408 -165-N002

VOLUME : IIB

SECTION : D

REV. NO. 0

DATE : 27.05.2015

SHEET 1 of 1

SECTION – D

STANDARD TECHNICAL SPECIFICATION

**SECTION D1 : CONDENSER ONLOAD TUBE CLEANING
SYSTEM**

SECTION D2 : ELECTRICAL SYSTEMS

SECTION D3 : C&I SYSTEM



**TITLE : TECHNICAL SPECIFICATION
FOR
CONDENSER ON LOAD TUBE CLEANING
SYSTEMS (COLTCS)**

SPEC. NO. PE-TS- 408 .165-N002

VOLUME : IIB

SECTION : D


REV. NO. 0


DATE : 27.05.2015


SHEET 1 of 1


SECTION D1


**STANDARD TECHNICAL SPECIFICATION
FOR
CONDENSER ONLOAD TUBE CLEANING SYSTEMS**


	TITLE : STANDARD TECHNICAL SPECIFICATION CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO. PE-TS-999-165-N001	
		VOLUME : II B	
		SECTION : D	
		REV. NO. 00	DATE :27.09.07
		SHEET 1	OF 14
1.00.00	<u>GENERAL</u>		
	<p>This specification covers the design, performance and operational requirements, configuration and constructional features, manufacture, assembly, inspection and testing at the manufacturer's and/or his sub-contractor's works and painting for delivery of condenser on-load tube cleaning system (sponge rubber balls type) complete with all accessories as specified hereinafter. Each half of the condenser shall be provided with an independent tube cleaning system.</p>		
2.00.00	<u>CODES AND STANDARDS</u>		
2.01.00	<p>The design, materials, manufacture, inspection and testing of the condenser on-load tube cleaning system complete with all accessories, shall comply with the requirements of the latest versions of the following appropriate codes and standards.</p>		
2.01.01	<p>IS/BS/DIN/US Standards regarding pressure vessels, pumps, piping, flanges and others as necessary.</p>		
2.01.02	<p>IS/BS/DIN/ASTM Standards for materials specification and testing procedures.</p>		
2.01.03	<p>IS/BS/DIN/AWWA Standards for valves and the testing.</p>		
2.02.00	<p>In case of any conflict between the above codes/standards and this specification, the later shall prevail and in case of any further conflict in the matter, the interpretation of the specification by the Engineer shall be final and binding.</p>		
3.00.00	<u>DESIGN AND CONSTRUCTION</u>		
3.01.00	<p>General Requirements</p>		
3.01.01	<p>Unless otherwise necessary, manufacturer's standard and proven models of the tube cleaning system shall be supplied.</p>		
3.01.02	<p>The tube cleaning system shall be capable of safe, continuous and trouble-free operation for removal of fouling and scaling materials from condenser tubes. Vibration, noise, mechanical stresses shall be kept within allowable limits specified by relevant codes/standards. In design, due attention shall be given to ease of maintenance, repair and cleaning.</p>		
3.01.03	<p>Suitable Corrosion allowance shall be provided whenever necessary. Adequate provision for future installation of cathodic protection shall be provided.</p>		
3.01.04	<p>The tube cleaning system shall consist of ball separator at condenser outlet, recirculating pump, ball collector, differential pressure measuring system for ball separator, ball monitoring system, cleaning balls, piping valves, distributors, injection nozzles, instrumentations, control panel, interconnecting cables and others as necessary. The configuration of the tube cleaning system shall be as described in section C and / or as per the scheme enclosed.</p>		


	TITLE : STANDARD TECHNICAL SPECIFICATION CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO. PE-TS-999-165-N001	
		VOLUME : II B	
		SECTION : D	
		REV. NO. 00	DATE :27.09.07
		SHEET 2	OF 14
3.02.00	<u>Performance Requirements.</u>		
3.02.01	The tube cleaning system with all accessories shall be designed and guaranteed to meet the following requirements :		
	The tube cleaning system shall perform satisfactorily under the flow and pressure drop conditions (in the condenser) specified in Data Sheet - A and shall be capable of removing the various forms of fouling and scaling from condenser tubes.		
3.02.02	The ball separator at the condenser outlet, shall be designed such that the pressure drop across the ball separator under clean conditions shall not be more than that specified in Data Sheet - A. The performance of the ball separator shall be continuous with minimum number of backwashing operations.		
3.02.03	The power consumption by ball recirculation pump during various operations shall be minimum possible-		
	The quantity of cleaning balls worn out and / or lost, shall be minimum possible.		
3.03.00	<u>Operational Requirements.</u>		
	The tube cleaning system and other accessories shall be designed for the following operation modes :		
3.03.01	Complete automatic start-up of tube cleaning system initiated by pressing the push button (manual command).		
3.03.02	Complete automatic shut-down of tube cleaning system with ball collection, effected by the following :		
	<ul style="list-style-type: none"> ◆ Push button (manual command). ◆ Adjustable timer (after a defined cleaning period). ◆ Ball monitoring system (when the number of oversized balls falls below a set value). 		
3.03.02	Complete automatic backwashing of ball separator with ball collection, effected by the following :		
	<ul style="list-style-type: none"> ◆ Differential pressure measuring system at a pre-determined differential across the ball separating strainer/ screen. ◆ Adjustable timer ◆ Push button 		
3.03.04	Complete automatic emergency backwashing of ball separator with alarm indication, effected by differential pressure measuring system.		
3.03.05	Manual operation for start-up, shut-down with ball collection backwashing of ball separator, flushing of differential pressure measuring system etc., in case of failure of control system.		


	TITLE : STANDARD TECHNICAL SPECIFICATION CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO. PE-TS-999-165-N001	
		VOLUME : II B	
		SECTION : D	
		REV. NO. 00	DATE :27.09.07
		SHEET 3	OF 14
3..04.00	<u>Ball Separator</u>		
3.04.01	Ball separator body shall be of rigid construction and shall be designed and manufactured as per the applicable codes for pressure vessels. It shall house the ball separating screen / strainer and shall have flanged inlet, outlet, ball extraction opening and pressure measuring tapings etc. Body shall be designed and manufactured as per the applicable codes for pressure vessels and to take care of forces and moments as enclosed in the specification. However in no case thickness of housing/body shall be less than the connecting pipe thickness as specified in data sheet A		
3.04.02	The ball separator shall be provided with manhole with bolted cover and sight glass to observe its internals.		
3.04.03	If specified in Data Sheet -A, ball separator body shall be Epoxy lined.		
3.04.04	The ball separating screen / strainer shall be designed for the maximum differential pressure across the separator and shall be securely mounted in the body. Screen / strainer shaft shall be sized adequately considering the overloading of screens / strainer due to debris accumulation.		
3.04.05	The ball separating strainers / screens shall have electric actuators for swivelling to allow for their backwashing. Also suitable handwheels shall be provided to enable manual swivelling of strainers / screens.		
3.05.00	<u>Ball Recirculating Pump</u>		
3.05.01	The ball recirculating pump shall be horizontal centrifugal type. The casing shall be designed to withstand 1.5 times the shut-off pressure or twice the operating pressure, whichever is higher.		
3.05.02	The impeller shall be non-clog type and shall be contoured suitably to avoid damage to the cleaning balls. The impeller shall be secured suitably to the shaft and shall be retained against circumferential movement by keys, pins or lock rings. Loctite compound shall be applied after tightening of locknuts to prevent dislocation of impeller.		
3.05.03	Replaceable type wearing ring shall be provided to prevent damage to the casing and impeller.		
3.05.04	Pumps shall be provided with mechanical seals to the extent feasible. If Gland packing is provided it should be of good quality to be provided to prevent leakage of water from pump glands.		
3.05.05	Shaft size selected shall take into Consideration the critical speed which shall be away from the operating speed as recommended in applicable codes / standards. Renewable type fine finished shaft sleeves shall be integral with water thrower plates at the end and the length must extend beyond the outer faces of gland packing so as to distinguish between the leakage between shaft and the shaft sleeve and that past the seals / glands.		


	TITLE : STANDARD TECHNICAL SPECIFICATION CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO. PE-TS-999-165-N001	
		VOLUME : II B	
		SECTION : D	
		REV. NO. 00	DATE :27.09.07
		SHEET 4	OF 14
3.05.06	Bearings of adequate design shall be provided for taking the entire pump load arising from all probable conditions of continuous operation through its range of operation. The bearings shall be designed on the basis of 20,000 working hours minimum for the load corresponding to the duty point. Proper lubricating element does not contaminate the liquid being pumped. Bearings shall be easily accessible without disturbing the pump assembly		
3.05.07	Stuffing box of suitable design to permit replacement of packing without removing any part other than the gland shall be provided. The stuffing boxes shall be sealed / cooled by the fluid being pumped.		
3.05.08	Pumps shall be of self-lubricated, self - sealed and self-cooled type. All pipework, fitters etc., for sealing, cooling and lubricating purpose shall be supplied and no external cooling/lubricating/sealing water will be supplied. Pump capacity shall take into account the cooling/lubricating/sealing water requirement.		
3.05.09	All rotating components shall be statically and dynamically balanced.		
3.05.10	The pump shall be designed such that pump impellers and other accessories of the pump, are not damaged due to flow reversal.		
3.05.11	The pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the head Vs. flow characteristic curve over a range or 40% of rated flow to 120 -130 % of rated flow.		
3.05.12	The pump shall preferably be non-overloading type. The total head Vs. capacity curve shall be continuously rising from the maximum flow point towards shut-off without any zone of instability.		
3.05.13	The pump shall run smoothly without undue noise and vibration. Peak to peak vibration limits and noise level shall be within the acceptable values of applicable codes/standards.		
3.05.14	The pump and motor shafts shall be connected through a pin and rubber bush flexible type of couplings. Suitable coupling guards shall be provided for the couplings.		
3.05.15	The pump shall be capable of being started with discharge valve fully opened. Motor rating shall be adequate for this condition. The output KW rating of the pump drive motor shall not be less than the larger of the following :		
	a)	Maximum power input to the pump over the entire range for maximum flow to shut-off condition.	
	b)	125% of power input to the pump at duty point corresponding to 103% of the rated speed.	
3.06.00	<u>Ball Collector</u>		
3.06.01	The body of the ball collector shall be designed to withstand 2.0 times the operating pressure or 1.5 times the recirculating pump shut-off pressure, whichever is higher.		


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	<p>The ball collector shall be designed and manufactured as per the applicable codes for pressure vessels.</p>		
3.06.02	<p>Ball collector shall be provided with an inspection window/sight glass for visual inspection of the cleaning balls.</p>		
3.06.03	<p>Ball collector shall be provided with suitable ports with covers for ball feeding and removal.</p>		
3.06.04	<p>The ball collector shall be provided with vent and drain connections with isolating valves.</p>		
3.06.05	<p>Provision shall be made in the ball collector for separating the undersized balls and ball collector shall have a separate chamber for collecting the undersized balls.</p>		
3.06.06	<p>If specified in Data Sheet -A, ball collector body shall be lined with suitable resilient material.</p>		
3.06.07	<p>The differential pressure measuring system shall be provided with D.P. transmitter ,DPS & DPGof remote seal arrangement.</p>		
3.07.00	<p><u>Differential Pressure Measuring System.</u></p>		
3.07.01	<p>The ball separator shall be provided with a measuring system for differential pressure across the ball separating strainer/screen, to check debris accumulation and to initiate ball catching and backwashing operations. This shall consist of a differential pressure switch/transmitter for automatic backwashing operation, a differential pressure guage for manual observation with adequate number of tappings with isolating valves.</p>		
3.07.02	<p>The contacts for differential pressure switch/transmitter and for differential pressure guage shall be independent so that in the event of failure of one, the other is available.</p>		
3.07.03	<p>The differential pressure measuring system shall be with remote seal arrangement .</p>		
3.08.00	<p><u>Ball Monitoring System</u></p>		
3.08.01	<p>Ball monitoring system shall be provided for continuously monitoring the quantity and size of the cleaning balls in circulation. The monitoring system shall perform the following functions :</p>		
	<p>a) Continuously counting the oversize balls in circulation and giving an alarm calling for investigation of ball losses, when the number of oversize circulating balls falls below a set valve.</p>		
	<p>b) Continuously measuring the size of the balls in circulation and initiating the shut-down of the tube cleaning system with alarm calling-for replacement of balls when the number of oversized balls falls below a set valve.</p>		
	<p>c) Bidder's if not manufacturing ball oversized monitor,can supply automatic ball sorter in lieu of same for automatic sorting of the undersized balls.</p>		


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3.08.02	The monitoring system shall be of proven and reliable design and shall be complete with necessary transducers, amplifiers, transmission lines, power cables and electronic processor etc.		
3.08.03	The electronic processor of the ball monitoring system shall be housed in the control panel and shall consist the following : -		
	a)	Indicators for	
		<ul style="list-style-type: none"> ◆ required basic ball charge. ◆ recirculating ball quantity. ◆ oversized ball quantity. 	
	b)	Time counters for	
		<ul style="list-style-type: none"> ◆ total cleaning system operating hours. ◆ cleaning system operating hours with sufficient number of oversized balls. 	
	c)	Recorder for ball consumption.	
3.08.04	The ball monitoring system shall have provisions for self-testing and self-calibration.		
3.09.00	<u>Cleaning Balls</u>		
3.09.01	The sponge rubber cleaning balls shall be slightly oversized to the internal diameter of condenser tubes and should be able to remove all fouling and scaling deposits in the condenser tubes.		
3.09.02	The specific gravity of the cleaning balls shall be such that good distribution of balls across the tube sheet and cleaning of all tubes are ensured.		
3.09.03	The composition of the cleaning balls shall be based on natural rubber and shall be suitable for temperature upto 100°C. Hardness of the cleaning balls shall be compatible to tube material and corrosion/fouling behaviour. If cleaning balls consist of abrasive coated balls, the abrasive material shall also be compatible for use with the tube material.		
3.09.04	Calculations and basis for selection of cleaning balls circulation quantity, type, size, hardness, cleaning frequency etc., shall be furnished during contract stage.		
3.10.00	<u>Piping, Valves, Distributors and Injection Nozzles.</u>		
3.10.01	Interconnecting piping, valves, injection nozzles and other fittings shall be designed to withstand 2.0 times the operating pressure or 1.5 times the pump shut-off pressure whichever is higher.		
3.10.02	Interconnecting piping shall be sized and routed optimally. Velocity in the pipe work shall be less than 1.5 m/s for pump suction and less than 2.2 m/s in other pipe work.		
3.10.03	Necessary isolation valves, vent and drain valves for various equipments shall be provided. Valves shall conform to appropriate standards. Valves provided in ball transport piping shall be ball type. Gland packing of all valve shall be of superior quality to avoid leakage. All valves upto 150 Nb shall be ball valves. For higher sizes ,		


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	gate / globe /B.F. valves shall be provided. All instrument valves shall be needle valves.		
3.10.04	Adequate number of ball injection nozzles shall be provided for proper distribution of cleaning balls in condenser inlet. Ball injection nozzles shall be flanged type and shall have two sets of flanges, one for connecting to ball transport pipe and other for connecting to the stub on condenser inlet pipe for ease of removal during repairs or checking.		
3.10.05	Distributors (if applicable) with sight glass shall be provided wherever ball transport piping branching out or joining together for proper guidance of cleaning balls.		
3.10.6	Type of valves shall be ball valves, no diaphragm type valve shall be used.		
3.11.00	<u>Actuators</u>		
3.11.00	Tube cleaning system shall be provided with actuators wherever necessary for various automatic operations. The actuators shall be electric motor operated and shall meet the requirements of the enclosed specification. The actuator shall be provided with auxiliary handwheel for manual operation in the event of control system failure.		
3.12.00	<u>Electric Motors</u>		
	The drive motors for recirculating pump and differential pressure measuring system flushing pump shall conform to the requirements of the enclosed specification.		
3.13.00	<u>Instrumentation and Control System.</u>		
3.13.01	Complete instrumentation and control system for automatic operation of tube cleaning system, protection, interlocking, indication / annunciation of differential pressure and other malfunctions etc., shall be provided. This shall consist of adequate operational hardware, local control panel (As applicable) and interconnecting control and power cabling between the control panel and various equipments in the tube cleaning system.		
3.13.02	The control panel shall house all necessary instruments, indicating / annunciation lamps, alarms, differential pressure indicator, timer, function selection switches, ball monitoring system processor, relays, protection and interlocking systems, start / stop push button etc., and shall be complete with internal wiring. The control panel shall meet the requirements of the enclosed specification.		
3.13.03	Pressure gauges shall be provided at recirculating pump suction and discharge. All instrumentation shall be of reputed make and shall meet the requirements of the enclosed specifications.		
3.14.00	<u>Other Accessories.</u>		
3.14.01	Counter flanges, complete with gaskets, bolts and nuts etc., shall be supplied for ball separator inlet, outlet connections and all other terminal points Fabrication, dimensions and drilling of the flanges shall conform to the codes/standards specified in		


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	Data Sheet-A / Section -C.		
3.14.02	Ball recirculating pump, ball collector with interconnecting piping and valves, shall be mounted on a frame. For fixing the frame, necessary foundation plates, bolts, nuts etc. shall be provided.		
3.14.03	Suitable lifting arrangement shall be provided for various equipments of the tube cleaning system, for handling during erection and maintenance.		
3.15.00	<u>Materials of Construction</u>		
	Materials of various equipments in the tube cleaning system shall be corrosion resistant and consistent with the fluid handled. However, material specification for various components shall be equal to or superior to those specified in Data Sheet-A.		
4.00.00	<u>PAINTING</u>		
4.01.00	The surface preparation of the various equipments / components of the tube cleaning system shall be done as per the standard mentioned in Data Sheet - A and shall include the following :		
	a) Removal of oil, grease, dirt and swarf etc.		
	b) Removal of rust and scale etc.		
	c) Sand blasting / shot blasting.		
4.02.00	All internal surfaces of the various equipments / components of the tube cleaning system, which are subjected to immersion or water spray and which are not made of stainless steel or other corrosion resistant materials after surface preparation, shall be coated with epoxy paint of approved make and quality over a coat of zinc chromite primer, unless otherwise specified in Data Sheet - A.		
4.03.00	The external surfaces of the various equipments / components of the tube cleaning system after surface preparation, shall be coated with synthetic enamel paint of approved make and quality over two coats of red oxide primer, unless otherwise specified in Data Sheet -A.		
5.00.00	<u>SHOP INSPECTION AND TESTS</u>		
5.01.01	<u>General</u>		
5.01.01	Manufacturer shall conduct all tests and stage inspections as per the approved		


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	<p>quality plan to ensure that the various equipments and other accessories of the tube cleaning system shall conform to the requirements of this specification and of the applicable codes / standards.</p>		
5.01.02	<p>All materials used for manufacture /fabrication of the various equipments of the tube cleaning system shall be of tested quality. Relevant test certificates for chemical analysis, mechanical tests and heat treatment shall be made available before the final shop inspection. In case the relevant test certificates are not available, the manufacturer shall arrange to carry out the necessary tests as per the approved quality plan and applicable codes at his cost for which samples shall be identified by BHEL's representative.</p>		
5.01.03	<p>All shop tests shall be conducted as per approved quality plan and test certificates / reports for the same shall be furnished to BHEL for approval.</p>		
5.01.04	<p>Qualification of welding procedures and welders shall be as per ASME B&PV code, Section - IX / applicable codes.</p>		
5.2.00	<p><u>Ball Separator</u></p>		
5.02.01	<p>Chemical analysis, mechanical tests shall be carried out on materials used for body, strainer / screen, strainer / screen shaft and other appurtenances as per the applicable material specification standards.</p>		
5.02.02	<p>All butt welded joints shall be subjected to radiographic/ ultrasonic testing as per applicable codes. However, all welded joints shall be subjected to 100% magnetic particle / penetrant testing to ensure freedom from defects.</p>		
5.02.03	<p>Strainer / screen shaft shall be subjected to ultrasonic test as per ASTM-A388 for subsurface defects with acceptance norms as per ASME B&PV code, Section VIII, Division 1.</p>		
5.03.00	<p><u>Ball Recirculating Pump</u></p>		
5.03.01	<p>Chemical analysis, mechanical tests shall be carried out on materials used for casing, impeller, shaft, sleeves, wear rings etc., as per the applicable material specification standards.</p>		
5.03.02	<p>The casting used for pump casing and impeller shall be sound, clean and free from porosity, blow holes, hard spots, cold shuts, distortion and other harmful defects. All accessible surfaces of the impeller shall be subjected to penetrant test as per ASTM-E165 for surface defects with acceptance norms as per ASME B&PV code, Section VIII, Division 1. No welding or repairs shall be carried out without prior permission of BHEL.</p>		
5.03.03	<p>Pump shaft and sleeves shall be subjected to ultrasonic test as per ASTM - A388 for sub-surface defects and penetrant test after finish machining as per ASTM-E165 for surface defects.</p>		
5.03.04	<p>Wear rings shall be subjected to penetrant test as per ASTM-E165.</p>		
5.03.05	<p>Pump impellers and rotor assembly shall be statically and dynamically balanced as</p>		

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	per ISO-1940		
5.04.00	<u>Ball Collector</u>		
5.04.01	Chemical analysis, mechanical tests shall be carried out on materials used for body and other appurtenances / accessories as per the applicable material specification standards.		
5.04.02	All but welded joints shall be subjected to radiographic / ultrasonic testing as per applicable codes. However, all welded joints shall be subjected to 100% magnetic particle / penetrant testing to ensure freedom from defects.		
5.05.00	<u>Piping, Valves, Distributors, and Injection Nozzles.</u>		
5.05.01	Chemical analysis, mechanical tests shall be carried out for materials used for piping, fittings, valves, distributors and injection nozzles.		
5.05.02	All welded joints of distributors & injection nozzles shall be subjected to penetrant test as per ASTM-E165 for surface defects with acceptance norms as per ASME B&PV code, Section VIII, Division 1.		
5.05.03	Inspection and testing of valves including leakage test shall be carried out as per the requirements of the applicable standards. Valve stem and ball shall be subjected to penetrant test as per ASTM-E165.		
5.05.04	All materials for various nozzles, stubs, gaskets, nuts, bolts etc. shall be of tested quality and correlating test certificates for chemical and mechanical properties shall be furnished.		
5.06.00	<u>Rubber Lining (as applicable)</u>		
	Rubber lining shall be subjected to surface crack test, 100% spark and hardness tests and shall be checked for layer thickness, defects etc.		
5.07.00	<u>Flanges</u>		
5.07.01	Chemical and mechanical test certificates shall be furnished for flange materials.		
5.07.02	In case of fabricated flanges, all the welds shall be subjected to 100% radiography as per ASME B&PV code, Section VIII, Division 1.		
5.07.03	In case of forged flanges, ultrasonic testing shall be carried out as per ASTM-A 388.		
5.07.04	If the thickness of the plate used for flanges is 40mm or more, the same shall be checked ultrasonically as per ASTM-A435 to demonstrate the absence of lamination and lack of fusion etc.		
5.07.05	Flanges shall be checked for edge preparation, fit up and satisfactory working with matching parts.		

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5.08.00	<u>Dimensional Checks.</u>	<p>Dimensional checks for various equipments/components of the tube cleaning system shall be carried out as per assembly drawing approved by BHEL. Alignment and fit up of movable parts shall be checked.</p>	
5.09.00	<u>Hydrostatic Test</u>	<p>Hydrostatic test shall be conducted on various assemblies / equipments / components of the tube cleaning system at a pressure of 1.5 times and design pressure. The duration of the test shall be minimum 30 minutes.</p>	
5.10.00	<u>Leakage Test</u>	<p>Leakage test shall be conducted at the design pressure on all assemblies of the tube cleaning system to demonstrate that the assemblies are leak tight and no water seepage shall take place at various nozzles and valve connections.</p>	
5.11.00	<u>Performance Test on Recirculating Pump</u>	<p>Performance test on recirculating pump with drive motor shall be conducted as per BS-599 / ASME PTC 8.0. Performance curves i.e., discharge flow Vs head, discharge flow Vs power consumption and discharge flow Vs efficiency shall be plotted and acceptance norms shall be as per BS-599 / ASME PTC 8.0. Vibration and noise shall be measure and acceptance norms shall be as per Hydraulic Institute (USA) standard.</p>	
5.12.00	<u>Functional Tests</u>	<p>Various assemblies / equipments / components of the tube cleaning system shall be subjected to functional tests and the following shall be checked.</p>	
5.12.01		Smooth and free operation of all movable parts.	
5.12.02		Interlock and sequential operation.	
5.12.03		Satisfactory operations of ball monitoring system.	
5.12.04		Satisfactory operations of actuators torque switches, limit switches etc.	
6.00.00	<u>TESTING AT SITE</u>	<p>After completion of installation at site, the tube cleaning system will be tested to check that the tube cleaning system performance meets the requirements of this specification. Rectification of all defects shall have to be done by the supplier at no extra cost to the owner / purchaser. However, the owner / purchaser reserves the right to reject the equipments / parts not meeting the requirement if the deficiency still persists.</p>	

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7.0.0	Performance Guarantee and Bid Evaluation criteria for Condenser on Load Tube Cleaning System. <p>The Tube Cleaning Systems shall be guaranteed to meet the performance requirements specified in Section-D , Data Sheet A and Guarantee schedule and also for trouble free operation after commissioning. Schedule of performance guarantees (enclosed in Volume III) duly filled and signed shall be furnished with the bid.</p> <p>The Performance guarantees of equipments shall stand valid till the satisfactory completion of performance testing & its acceptance by BHEL/ Customer. If the guarantee period specified in the Commercial Specification is higher, same shall prevail.</p>		
7.01.00	Performance Parameters to be guaranteed by bidders shall be as under : <ol style="list-style-type: none"> i) Pressure drop in ball separator in clean condition viz. after back washing. ii) Percentage recovery of balls (min. 95% recovery) iii) Life of Sponge Rubber Ball (Min. 4 weeks) 		
7.02.00	Bidder to note that bids shall be evaluated on account of pressure drop across ball collecting strainer (in clean condition) and liquidated damages on account of not meeting the same during PG test shall be in accordance with following : <p>A) Bid Evaluation Criteria & Liquidated Damages:</p> <p>The bids received shall be evaluated for Pressure drop across balls collecting strainers :</p> <ul style="list-style-type: none"> • The permissible limit of pressure drop across balls collecting strainers in clean condition shall be 0.15 MWC. • If the pressure drops quoted are higher than above limit, the bids shall be technically loaded @ indicated in Data Sheet A . • However no advantage shall be given for pressure drops quoted less than above permissible limit. • The maximum acceptable limit for pressure drop across balls collecting strainer shall be (with technical loadings) 0.2 MWC. <p>The bids will be technically rejected for pressure drops quoted higher than above maximum limit.</p> <ul style="list-style-type: none"> • The guaranteed pressure drops shall be demonstrated at site by bidder and if found higher shall be subject to LD @ twice the bid evaluation factor as above. 		
7.03.00	Other Guaranteed Parameters to be demonstrated at site <ol style="list-style-type: none"> i) Life of sponge rubber balls shall be minimum 4 weeks. ii) Percentage recovery of balls shall be minimum 95%. 		


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<p>Any deviation to above balls life and percentage recovery will not be accepted.</p> <p>Bidder to indicate the life of sponge rubber ball and nos. of balls lost during 1000 hours of plant operation in the Guarantee schedule and shall demonstrate same at site.</p> <p>In case the successful bidder fails to demonstrate any of these parameters he shall carry out modifications at his own cost, to purchasers approval.</p> <p>In case bidder fails to demonstrate above parameters to purchaser's satisfaction even after modification carried by him at site, the purchaser has the right to reject the equipment out rightly.</p>			
8.00.00	<u>QUALITY ASSURANCE & QUALITY PLAN</u>		
8.01.00	The tube cleaning system and other accessories to be supplied, shall have assured quality and workmanship.		
8.02.00	Typical quality plans are enclosed herewith this specification for bidder's guidance. The bidder shall furnish his own quality plan based on materials, equipments and components of the tube cleaning system being offered.		
9.00.00	<u>NAME PLATE AND TAG NUMBERS</u>		
9.01.00	Ball separator, recirculating pump, ball collector shall be provided with a permanently attached brass or stainless steel plate indicating the following details :-		
	<ul style="list-style-type: none"> a) Design and maximum flow rates. b) Design and test pressures. c) Design temperature. d) Empty and operating weights. 		
9.02.00	Each valve in the tube cleaning system shall be provided with a name plate indicating the following :-		
	<ul style="list-style-type: none"> a) Service. b) Design and test pressures. c) Maximum flow and flow direction. d) Size. e) Tag Number. 		
	Tag Numbers will be indicated on the drawings submitted for approval during contractstage.		
9.03.00	Each motor shall be provided with a name plate indicating the following details :		
	<ul style="list-style-type: none"> a) Supply conditions. b) KW Rating. c) Make. 		


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10.00.00 **DRAWING, DATA & INFORMATION TO BE SUBMITTED AFTER THE AWARD OF CONTRACT.**

The drawings, data and other documents as required in Data Sheet-C shall be furnished after the award of contract.

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	TITLE : DATA SHEET - C CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO. PE-TS-999-165-N001	
		VOLUME : II B	
		SECTION : D	
		REV. NO. 05	DATE :29.07.2007
		SHEET 1 OF 2	
1.00.00	<u>DRAWING, DATA & INFORMATION TO BE SUBMITTED AFTER THE AWARD OF CONTRACT.</u>		
	After the award of contract, the following drawings, data and information is to be submitted for review / approval of BHEL as per the distribution schedule given in Section - C.		
1.01.00	Within 2 (two) weeks of the date of LOI, the following shall be submitted,		
1.01.01	Data sheet (s) - B.		
1.01.02	Final versions of the following drawings to enable BHEL to finalise the layout and to design foundations and structures :-		
	a) General arrangement / installation drawings of ball separator, ball recirculating unit, control panel each complete with all accessories, incorporating the principal dimensions and weights of equipment offered, size and location of various nozzle connection, supporting arrangement (wherever applicable) and scope of supply etc.		
	b) Foundation arrangement drawings (wherever applicable) showing load data on supports, size and location of anchor bolts etc.		
	c) General arrangement drawing indicating the layout of the equipments and interconnecting piping with pipe supports.		
1.01.03	Bar chart and inspection schedule.		
1.02.00	Within the stipulated time period as per Vendor's drawing /document list, the following shall be submitted.		
1.02.01	Cross Sectional/ detailed drawing of ball separator, recirculating pump, ball collector, differential pressure measuring system, ball monitoring system distributors, injection nozzles actuators, motors, control panel etc, indicating bill of quantities and materials of construction.		
1.02.02	Final versions of calculations and basis for selection of cleaning balls circulation quantity, type, size, hardness, cleaning frequency etc.		
1.2.03	Flow and control logic diagrams for various operations of the tube cleaning system.		
1.02.04	Detailed schedule of valves indicating Tag numbers, type, make size, pressure and temperature ratings, materials etc.		
1.02.05	Detailed schedule of instruments indicating tag numbers, type, make, materials , of construction, range and accuracy etc.		
1.2.6	Detailed schedule of piping and fittings indicating sizes, materials, maximum working pressure and temperatures etc.		
1.02.07	Control panel layout and list of instruments provided on control panel.		

	TITLE : DATA SHEET - C CONDENSER ON - LOAD TUBE CLEANING SYSTEM (Sponge Rubber Ball Type)	SPECIFICATION NO. PE-TS-999-165-N001	
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1.02.08	List of annunciations, protections and interlocks provided.		
1.02.09	Detailed drawings of flanges.		
1.02.10	Ball recirculating pump performance characteristic curves.		
1.02.11	Write-up and instruction manuals for erection, operation and maintenance.		
1.02.12	Storage instructions.		
1.02.13	Vendor to send 3 sets of final documents (O&M manual, GA drg, P&ID) direct to site under intimation to PEM.		
<p>G:\MSEWASH\STCOTCS.RTF</p> <p style="text-align: center; opacity: 0.5;">DMS (BHEL-PEM) 6043712 - 27/11/2015</p>			



TITLE : STANDARD TECHNICAL SPECIFICATION

DATA SHEET-A

CONDENSER ON - LOAD TUBE CLEANING
SYSTEM (Sponge Rubber Ball Type)

SPEC. NO. PE-TS- 408-165-N002

VOLUME : II B

SECTION-D

REV. NO. 0

DATE: 27.11.2015

SL.NO PROJECT :

1X800 MW WANAKBORI TPS UNIT-8

1	GENERAL		
1.1	Nos. of tube cleaning systems sets required for station	NOS.	Two (02) Nos. for One Unit. viz. One independent set common for each half of two condensers placed in series There are 2 nos. condenser per Unit in Series,i.e. Balls from one Separator/ Collector has to pass through two nos. Condensers placed in Series.
1.2	Liquid handled		<i>Clarified Water as per Analysis</i> Attached along with project information in section B.
1.3	Size of COLTCS	Nb	2700 NB
2.0	DESIGN		
2.1	Operating pressure at Condenser inlet flange	kg/cm ² (g)	Approx 1.5 to 2.5
2.2	Design Pressure for ball separator	kg/cm ² (g)	5.5 kg/cm ² (g) & vacuum 0.1 kg/cm ² (abs)
2.3	Design Mechanical Temperature	Deg. C	60
2.4	Condenser Details		
	a) Type of condenser		<i>Single pass</i>
	b) No. of Condenser sections	Nos.	2 (Two)
	c) No. of passes per condenser section (viz. condenser half)	Nos.	1 (One)
	d) No. of tubes per condenser	Nos.	2X29755
	• Condensing zone		2X27673
	• Air Cooling zone		2X2082
	e) Tube Dia. OD x Thickness		



TITLE : STANDARD TECHNICAL SPECIFICATION

DATA SHEET-A

CONDENSER ON - LOAD TUBE CLEANING
SYSTEM (Sponge Rubber Ball Type)

SPEC. NO. PE-TS- 408-165-N002

VOLUME : II B

SECTION-D

REV. NO. 0

DATE: 27.11.2015

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	• Top two rows	mm x mm	25.4 x 0.889
	• Remaining	mm x mm	25.4 x 0.7112
	f) Length of tubes between ends.	mm	14730
	g) Tube material		Welded SS: ASTM A 249 TP 304
	h) Pressure drop across condenser - At Normal flow (between Inlet and Outlet flanges of condenser)	MWC	2X2.86 MWC (excl. interconnection pipes) (However the actual value can vary +/-10% of the design value)
2.5	CW flow rate through each ball separator		
	- Normal	cu.m/hr	42105
	- Maximum	cu.m/hr	50526
2.6	Design differential pressure for ball separator strainer/screen	Kg/cm ² (g)	0.2
2.7	Pressure drop across ball separator i.e. between inlet & outlet flanges in clean condition at normal flow.	MWC	0.15
2.8	Pressure drop across ball separator in choked condition when strainer backwashing starts	MWC	Not to exceed 0.30
2.9	No. of balls required for COLTCS per condenser section	Nos.	Minimum 10% of number of condenser tubes per condenser section
3	<u>CONNECTING PIPE DETAILS</u>		
3.1	Condenser inlet pipe		
	a) Material		Carbon Steel to IS – 2062 Gr. B rolled & welded conforming to IS:3589



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DATA SHEET-A

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SYSTEM (Sponge Rubber Ball Type)

SPEC. NO. PE-TS- 408-165-N002

VOLUME : II B

SECTION-D

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1X800 MW WANAKBORI TPS UNIT-8

	b) O.D. X Thickness	mm x mm	2740 X 20
3.2	Condenser outlet pipe		
	a) Material	CS	Carbon Steel to IS – 2062 Gr. B rolled & welded conforming to IS:3589
	b) O.D. X Thickness	mm x mm	2740 X 20
3.3	Manhole		Yes, 600 NB size
4.0	<u>MATERIALS OF CONSTRUCTION</u>		
4.1	BALL SEPARATOR		
	a) Body / housing		Carbon Steel to IS -2062 Gr.B. with epoxy painted inside (with minimum housing thickness same as connecting pipe thickness)
	b) Screen / Strainer		SS-316
	c) Strainer shaft		SS-316
	e) Internal Hardware in contact with circulating water including nuts, bolts , etc.		SS-316
	f) Site Glass provision		Yes
4.2	BALL RECIRCULATING PUMP		Non Clog type
	a) Casing		SA 351 Gr. CF8M
	b) Impeller		SA 351 Gr. CF8M
	c) Shaft		SS-316
4.3	BALL COLLECTOR		



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	a) Body / housing		Stainless steel, SS 304
	b) Screen / Strainer		SS-316
	c) Site Glass Provision		Yes
4.4	Differential pressure measuring system		SS-316
4.5	Injection nozzle		SS-316
4.6	Valves		
4.6.1	Check Valves (65 NB & Above)		For sizes 65 NB and above-Swing check type or dual plate type.
	a) Body & Bonnet		SS316, Flanged Ends
	b) Disc for Check Valve		SS316
	c) Stem		ASTM A182 Gr F6a
4.6.2	Check Valves (50 NB & Below)		For size 50 NB and below-Piston type
	a) Body & Bonnet		SS-316, Socket welded Ends
	b) Disc for Check Valve		SS316
	c) Stem		ASTM A182 Gr F6a
4.6.3	Gate/ Globe Valves 50 Nb & Below		
	Body & Bonnet		SS-316, Socket welded Ends
4.6.4	➤ BF/Gate/Globe Valves (65 NB & above)		Butterfly valves are applicable only for sizes 400Nb and above.



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	➤ Body & Disc		SA 351 CF8M
	➤ Shaft		ASTM A 182 F316
	➤ Stem		ASTM A182 Gr F6a
	➤ Sealing, Retaining segment & internals		18 – 8 SS
	➤ Bearings		Self lubricating
	➤ Companion Flange		SS316
	C) Ball valves		
	i) Body		SA 351 CF8M
	ii) Ball		SA 351 CF8M
	iii) Stem		SS 316
4.7	Interconnecting Piping		By Bidder
	Material		SS-316
5	COUNTER FLANGES for Ball Separator		
	a) Flanges		Carbon Steel to IS 2062 Gr. B or eq for thickness, drilling etc refer Annexure II in section C1
	b) Fasteners		A 193 & A 194 (In Bidder's scope).
Note : To suit the counter flange supplied by purchaser.			



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	c) Gaskets		Min 4 mm thick rubber (In Bidder's scope).
6	<u>OTHER FLANGES/ COUNTER FLANGES</u> (for interconnecting piping, valves, bends, fittings, distributors, nozzles & support installation materials)		In Bidder's scope
6.1	MATERIALS		
	a) Flanges/ counter flanges		SS-316
	b) Fasteners		A 193 & A 194
	c) Gaskets		Min 4 mm thick rubber
7.0	Material of Other components not specified above		Suitable for intended duty and shall be subject to Purchasers approval during detailed engg. In the event of order.
8.0	<u>PAINING</u>		
8.1	<u>INTERNAL SURFACE</u>		
	a) Surface preparation		SA - 2.5 of Swedish Specn. SIS-05-59-00-1967
	b) Primer		Two coat of Epoxy Resin based Red oxide primer
	c) Final paint		Adequate no. of coats of coal tar epoxy paint to achieve total dry film thickness of 200 to 250 microns
8.2	<u>EXTERNAL SURFACE</u>		
	a) Surface preparation		SA-2.5 of Swedish Specn. SIS-05-5900-1967



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	b) Primer		Two coat of Red Lead primer
	a) Intermediate		--
	d) Final paint		Adequate no. of coats (min. Two) of Synthetic Enamel paint to achieve total DFT of min. 200 microns. Colour- code shall be as per IS 9404 (Appendix-A)
9.0	Adequate provision for future installation of cathodic protection (Sacrificial type anodic protection by Purchaser)		YES
10.0	Flow straightener for streamlining the CW flow in ball collecting strainer		If required as per bidder's design – the same to be incorporated by bidder in its constructional feature.
11.0	Performance Guarantee & Bid Evaluation		
11.1	Performance Parameters to be Guaranteed		
	❖ Pressure drop in ball separator in clean condition		As per Guarantee schedule of bidder
	❖ Percentage recovery of balls		As maximum as possible and Min. 90 % recovery.
	❖ Life of sponge Rubber Balls		Min. 3 weeks
11.2	Bid evaluation Criteria & Liquidated damages		As per clause no 8.00.00 of Section C1
11.3	Bid evaluation rate		@ Rs. 14.0 Lacs per 0.05 MWC pr. drop across each balls collecting strainer
11.4	Liquidated damages		Twice the bid evaluation rate
12.0	The tube cleaning system shall be designed for following operation modes		
	a) Automatic start up initiated by push button		YES



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	b) Automatic shut down with ball collection effected by : i. Push button ii. Adjustable timer iii. Ball monitoring system		YES
	c) Automatic backwashing of ball separator with ball collection effected by : a. Push button b. Adjustable timer c. Diff. Pressure measuring system		YES
	d) Automatic emergency backwashing of ball separator effected by diff. Pressure measuring system		YES
	e) Automatic ball sorting initiated by push button		YES
	f) Provision for manual operation of complete tube cleaning system in case of control system failure		YES
	g) Whether the contacts for DPG, DPS and DPT are independent		YES
	h) Timer for Backwashing		YES



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	<p>i) Whether the ball monitoring system is designed to perform the following functions :</p> <ul style="list-style-type: none"> i. Continuously counting the balls in circulation and giving an alarm calling for investigation of ball losses when the number of balls falls below a set value ii. Continuously measuring the size of the balls in circulation and initiating the shutdown of the tube cleaning system with alarm calling for replacement of balls when the no. of oversized balls falls below a set value 		YES
	<p>j) Whether the electronic processor of the ball monitoring system is provided with the following :</p> <ul style="list-style-type: none"> i. Indicators for required basic ball charge ii. Indicators for recirculating ball quantity iii. Indicators for oversized ball quantity iv. Time counters for total cleaning system operating hours v. Time counters for cleaning system operating hours with sufficient no. of oversized balls vi. Recorders for ball consumption 		YES
	<p>k) Whether provision for self-testing and self-calibration are made</p>		YES
13.0	Mandatory Spares to be supplied under this specification.		Quantity for one unit



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1	Complete Set of Pump without Motor	Set	One (1)
2	Valve Complete Assembly		10% of each type and size of total population or minimum 1(one) No. whichever is higher
3	Normal Sponge Rubber Balls & Abrasive Balls		for one year Operation
4	C&I Spares		As per attached Annexure-V
5	<u>Electrical Spares</u>		
5.1	415 Volt Motor (above 30KW Rating upto 200KW)		
5.1.1	End Shield Cover Driving & Non-Driving End		1 Set for each type and rating of Motor
5.1.2	Driving End & Non-Driving End Bearing		1 Set for each type and rating of Motor
5.1.3	Cooling Fan		1 No. for each type and rating of Motor
5.1.4	Motor Space Heater		1 No. for each type and rating of Motor
5.1.5	Motor Terminal Block		1 No. for each type and rating of Motor
5.1.6	Complete Set of Coupling		1 Set for each Application
5.2	415 Volt Motor (Upto 30KW Rating)		



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5.2.1	Driving End & Non-Driving End Bearing		3 Set for each type and rating of Motor
5.2.2	Cooling Fan		2 No. for each type and rating of Motor
5.2.3	Motor Terminal Block		5 No. for each type and rating of Motor
5.2.4	Complete Set of Coupling		1 Set for each Application
	Notes for Mandatory Spares: 1. In case if such items of spares indicated as “not applicable” by bidder in its offer, are found applicable at a later date during execution of the project, such items of spares are to be supplied within the ordered cost of the mandatory spares. 2. Wherever % is indicated for the mandatory spares, the quantity shall be calculated for % of supply for total quantity for 1 unit of 1 x 800 MW, unless otherwise specified. The quantity to be reckoned for % indicated shall be rounded off to the next higher whole number. For example if the % arrived is 0.2 the quantity to be supplied shall be 1 and if the % arrived is 5.1 the quantity to be supplied shall be 6. 3. In respect of quantity mentioned as 'Set' means the total quantity of all the components/items used in particular equipment unless otherwise specified.		
14.0	Documents enclosed for bidder's reference		
	❖ Water Analysis		Indicated in project information in Section B.
	❖ GA of CW piping in TG hall		Attached as per Annexure-III


ANNEXURE-V
C&I Mandatory spares


10.2.1.1	Feeder/Transformer Protection	4 Nos.each type and rating	4No's of Numerical relays. Incomer protection of breakers is applicable. Transformer protection is not applicable.		BAP
10.2.1.2	Motor Protection	5 Nos.each type and rating	Not Applicable		BAP
10.2.2	Conventional (Electromagnetic/Static type) Relay	10% for each type and rating or minimum one (1) no. whichever is more	Not Applicable		BAP
10.3	Generator Protection System				
10.3.1	Numerical microprocessor based Relay	10% for each type and rating or minimum one (1) no. whichever is more	Lot Price for applicable items under Sno 10.3 and Sno 10.4		BPL SCS
10.4	Generator Transformer Protection System				
10.4.1	Numerical microprocessor based Relay	10% for each type and rating or minimum one (1) no. whichever is more	Price for applicable items included at Sno 10.3 above		BPL SCS
11.0	UPS (Main UPS for DCS System)				
11.1	Fuse	3 (Three) times of total quantity of each type of fuses used in the system			EDN
11.2	SCR	10% of total quantity of each type used in the system or minimum 2(two) nos. whichever is more.			
11.3	Diode	10% of total quantity of each type used in the system or minimum 2(two) nos. whichever is more.			EDN
11.4	IGBT	2 (two) nos.			EDN
11.5	Electronic Module/ PCB				
11.5.1	Static Switch	1 (one) no. each type of Electronic Card/PCB/modules used in the system			EDN
11.5.2	Inverter	1 (one) no. each type of Electronic Card/PCB/modules used in the system			EDN
11.5.3	Static voltage Regulator	1 (one) no. each type of Electronic Card/PCB/modules used in the system			EDN
11.5.4	Charger	1 (one) no. each type of Electronic Card/PCB/modules used in the system			EDN
11.6	UPS Battery				
11.6.1	Battery Cell (Uncharged, Dry)	8 nos.			EDN
11.6.2	Inter connecting cell strips	10 nos.			EDN
11.6.3	Vent cap	10 nos.			EDN
11.6.4	Hydrometer	1 no.			EDN
11.6.5	Rubber gloves	1 pair			EDN
11.6.6	Voltmeter for measuring cell voltage (Center zero type)	1 no.			EDN
11.6.7	Funnel	1 no.			EDN
11.6.8	Jug	1 no.			EDN
11.6.9	Apron & Goggles	1 set			EDN
11.6.10	Cell lifting puller	1 no.			EDN
11.6.11	Insulated socket spanner with handle	1 no.			EDN
11.6.12	Terminal screw with bellaville washer	5% of total quantity used			EDN
11.6.13	Plastic filling bottle	1 no.			EDN
11.6.14	Thermometer	1 no.			EDN
11.7	For other applicable items SI No.12 & 8 of this document shall be followed.		Not quoted as the spec. is not clear		EDN
12.0	Control Panel/Desk Mounted Items				EDN
12.1	Push Button				
12.1.1	Complete assembly	5Nos for each colour			EDN
12.1.2	Contact Element (1NO + 1NC) Block	20Nos.			EDN
12.2	Selector Switch	10Nos. for each type and rating			EDN
12.3	Meter (Analog or Digital)				
12.3.1	Ammeter	10% for each type and range or minimum one (1) no. whichever is more			EDN


12.3.2	Voltmeter	10% for each type and range or minimum one (1) no. whichever is more			EDN
12.3.3	Frequency	10% for each type and range or minimum one (1) no. whichever is more			EDN
12.3.4	MW	10% for each type and range or minimum one (1) no. whichever is more			EDN
12.3.5	MVAR	10% for each type and range or minimum one (1) no. whichever is more			EDN
12.3.6	Power Factor	10% for each type and range or minimum one (1) no. whichever is more			EDN
12.3.7	Synchroscope	10% for each type and range or minimum one (1) no. whichever is more			EDN
12.4	Indicating Lamps complete assembly	10Nos. for each Colour and type			EDN
12.5	Mimic Lamps	10Nos. for each Colour and type			EDN
12.6	MCB	2Nos. for each type and rating			EDN
12.7	Door Limit Switch	2Nos.			EDN
12.8	Annunciation system				EDN
12.8.1	Lamp Box with Facia & Lamps (LED type)	25Nos.			EDN
12.8.2	Hooter	1No.			EDN
12.8.3	Each type of PCB (for non-PLC driven system)	1(one) no.	Part of DCS		EDN
13.0	Actuator		(LOT PRICE FOR APPLICABLE ITEMS IN THE LIST OF ITEMS INDICATED BELOW IN SL NO 13.1 TO 13.4, 13.6 & 13.7)		Trichy/ Trichy Valves
13.1	Complete set of Actuator	1No. for each type and rating			Trichy/ Trichy Valves/ BAP
13.2	Limit Switch	2 Nos each type and rating			Trichy/ Trichy Valves
13.3	Torque Switch	2 Nos each type and rating			Trichy/ Trichy Valves
13.4	Auxiliary Contact	1 no each type and rating			Trichy/ Trichy Valves
13.5	Motor	1 no each type and rating	Not envisaged. Hence not offered	Refer Sno 15 of BH-29 attached herewith.	Trichy/ Trichy Valves
13.6	Complete Seal kit	1Set for each type and rating			Trichy/ Trichy Valves
13.7	Complete O-Ring Set	1Set			Trichy/ Trichy Valves
14.0	Illumination		LOT PRICE for applicable items under Sno 14.0 Illumination		TBG/PEM
14.1	Comptalux Lamp 100 W	40 nos.			TBG/PEM
14.2	High Pressure Mercury Vapour Lamp 125W	20 nos.			TBG/PEM
14.3	High Pressure Sodium Vapour Lamp 70W	150 nos.			TBG/PEM
14.4	High Pressure Sodium Vapour Lamp 150W	40 nos.			TBG/PEM
14.5	High Pressure Sodium Vapour Lamp 250W	40 nos.			TBG/PEM
14.6	High Pressure Sodium Vapour Lamp 400W	40 nos.			TBG/PEM
14.7	Ignitors (Separate type) for High Pressure Sodium Vapour Lamp	200nos.			TBG/PEM
14.8	Ballast for 1 x 125 W High Pressure Mercury Vapour Lamp	30 nos.			TBG/PEM
14.9	Ballast for 1 x 70 W High Pressure Sodium Vapour Lamp	150 nos.			TBG/PEM
14.10	Ballast for 1 x 150 W High Pressure Sodium Vapour Lamp	100 nos.			TBG/PEM
14.11	Ballast for 1 x 250 W High Pressure Sodium Vapour Lamp	50 nos.			TBG/PEM
14.12	Capacitor for 1 x 125 W High Pressure Mercury Vapour Lamp	50 Nos.			TBG/PEM


GSECL	BHEL		
Equipment/Package Name	Remarks	Remarks as per post-bid resolution dt 9.01.2013 (BH-29)	Name of Unit
General			
The Bidder shall offer mandatory spares of the same make, model and type for items which are offered in the main offer. Further, offered spare parts shall be of the same grade and shall have same performance as the instruments which they are to replace.			
Field Instruments (Transmitters/temperature elements (TC / RTD) / Gauges / Switches etc. along with relevant accessories)			
			Trichy/ HWR/ HYD/ BAP/ PC Chennai/ EDN
10 (ten) percent of total of each type or at least one (whichever is higher) of each type along with accessories.	Lot Price for applicable items		
Steam & Water Analysis System (SWAS)			
2 (two) numbers conductivity / pH transmitter along with probes.			EDN
Electronic modules of each type for conductivity, pH, silica, dissolved oxygen, Hydrazine etc.			EDN
Other items as recommended by Supplier.	No other items offered.	Refer Sno 15 of BH-29 attached herewith.	EDN
Continuous Emissions Monitoring System (CEMS)			EDN
Analyzer spares like transmitter lens & receiver lens, protection windows for transmitter & receiver, integral pressure & temperature sensors, Signal processing unit - one set of each type.	Lot Price for applicable items		EDN
Cooling and purging air blower unit and set of filters -1 (one) number for each type.			
Light source and detector unit for opacity - 1 (one) number.			
Other items as recommended by Supplier.	No other items offered.	Refer Sno 15 of BH-29 attached herewith.	
Vibration Monitoring System (TG, TDBFP & HT drives covered in supplied package)	Lot price for applicable items in the list of items indicated below		Trichy/ HYD/ EDN
10 (ten) percent of total of each of velocity coil type, accelerometer type and proximity type vibration transducer (as applicable) or at least one (whichever is higher).			Trichy/ HYD/ EDN
2 (two) numbers of power supply modules.			Trichy/ HYD/ EDN
10 (ten) percent of each type of vibration monitor cards and other electronic cards or 2 (two) nos. of each type, whichever is higher.			Trichy/ HYD/ EDN
Control System (DCS, PLC etc.)	Lot price for applicable items		HWR/ EDN
2 (two) numbers each of keyboard and cursor control devices.			
2 (two) numbers of LCD TFT (24") Monitors.			
10 (ten) sets of spare interface cables with connecting plugs for each type of peripherals & I / O hardware.			
10 (ten) percent of power supply modules of the total qty. offered for each type or 4 (four) numbers, whichever is higher.			
10 (ten) percent of the total qty. offered for each type of electronic modules (I / O) or 5 (five) numbers of each electronic type of module, whichever is higher.			
10 (ten) percent of total bus couplers and communication interface cards of each type or 2 (two) numbers of bus couplers and communication interface cards whichever is higher.	Price Included in electronic modules above		
Controllers for DCS,Control panel ST,Boiler control system,Balance of plant system,PLC system/Sub-systems	For applicable		EDN
10%of each type(at least 1 no. of each type) whichever is higher.	Lot price for applicable items in the list of items indicated below		Trichy/ EDN
CCTV			Trichy/ EDN
2 (two) numbers of cameras and fixing accessories.			Trichy/ EDN


	Manufacturer's Name & Address		STANDARD QUALITY PLAN			BHEL Doc No.:	PE-QP-999-165-N008 REV-01
			INDEX			Vendor Q.P. NO.	PROJECT:
						PACKAGE : COLTCS	CUSTOMER:
					Date :	PURCHASER:	
					Page 01 of 15	CONSULTANT:	
						P.O. No.	
		SL. NO.	DESCRIPTION				PAGE NO.
		1	BALL SEPARATOR				2 TO 5
			WORM GEAR				6
			ACTUATORS				6
		2	BALL RECIRCULATION SKID				7
			BALL VESSEL				7,8
			BALL INJECTION NOZZLE				8
			BALL RECIRCULATING PUMP				9
			BALL VALVE				10
			RECIRCULATING PUMP MOTOR				11
		3	V - PIECE				11
		4	BALL OVERSIZE MONITOR				12
		5	PRESSURE GAUGE, DP GAUGE, DP SWITCH & DP TRANSMITTER				13
		6	CLEANING BALLS				13
		7	ALL COMPONENT & EQUIPMENT				13
		8	STARTER PANEL				14
		9	FASTENERS				15
		Note :Items not included in quality plan to be inspected as per approved data sheet/drawings					
		ANNEXURES					
		DRY RUN TEST PROCEDURE FOR BALL SEPERATOR					
		HYDRO STATIC TEST PROCEDURE					
		LEAK TIGHTNESS TEST PROCEDURE					
		PACKING PROCEDURE					
		LEGEND					
		* Records identified with "STAR" shall be essentially included by contractor in QA Documentation.					
		** M :Manufacturer / Manufacturer's Sub-contractor					
		C : Contractor					
		O : Owner					
Manufacturer / Sub-Contractor Signature		Contractor	Indicate : "P" - Perform, "W" - Witness and "V" - Verification				Reviewed By
						Name & Sign. Of approving authority & Seal	


		Manufacturer's Name & Address		STANDARD QUALITY PLAN					BHEL Doc No.:		PE-QP-999-165-N008		
				Item : Ball Separator		Vendor Q.P. NO:		PROJECT:					
		P.O. No.				PACKAGE : COLTCS		CUSTOMER:					
						Date :		PURCHASER:					
						Page 02 of 15		CONSULTANT:					
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency			Remarks	
1	2	3	4	5	6	7	8	9	D*	M	C	O	11
1.0.0	Ball Separator												
1.1.0	Raw Material												
[a]	Housing Shell, Nozzle flanges	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/cast / heat / batch	Approved sheet drg/Data	Approved sheet drg/Data	Mill Test Certificate / Lab test report/Raw material flow sheet	*	P	V	V	
		Surface defects	Minor	Visual	100%	Approved sheet drg/Data	Approved sheet drg/Data	Inspection report/ Raw material Flow sheet	-	P	V	V	
		Sub Surface Defects	Major	Ultrasonic test	100%	ASME SA 435	ASME SA 435	Inspection report	*	P	V	V	Plates > 20mm Thk only (UT - Full Volume)
[b]	Nozzle Pipes	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/heat	Approved sheet drg/Data	Approved sheet drg/Data	Mill Test Certificate / Lab test report/Raw material flow sheet	*	P	V	V	
		Surface defects	Minor	Visual	100%	Approved sheet drg/Data	Approved sheet drg/Data	Inspection report/ Raw material Flow sheet	-	P	V	V	
		Leak Tightness	Major	Hydrostatic test	100%	Approved sheet drg/Data	Approved sheet drg/Data	Mill Test Certificate	*	P	V	V	
[c]	Main Flange	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/cast / heat / batch	Approved sheet drg/Data	Approved sheet drg/Data	Manufacturer's Test Certificate	*	P	V	V	
		Heat treatment (Normalising)	Major	Verification	HT Chart	Approved sheet drg/Data	Approved sheet drg/Data	Manufacturer's Test Certificate	*	P	V	V	if casting
		Surface defects	Critical	Magnetic particle test	100%	Approved sheet drg/Data	Approved sheet drg/Data	Inspection report	*	P	V	V	if casting
		Sub-surface defects	Critical	Ultrasonic test	100%	ASME SA609 / SA 435	ASME SA609 Level II / SA 435 / SA 388	Inspection report	*	P	V	V	
[d]	Screen Shaft	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/heat	Approved sheet drg/Data	Approved sheet drg/Data	Mill Test Certificate / Lab test report/Raw material flow sheet	*	P	V	V	
LEGEND													
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C : Contractor O : Owner													
Manufacturer / Sub-Contractor Signature Contractor Indicate : "P" - Perform, "W" - Witness and "V" - Verification													
									Reviewed By		Name & Sign. Of approving authority & Seal		


		Manufacturer's Name & Address				STANDARD QUALITY PLAN				BHEL Doc No.: PE-QP-999-165-N008				
		P.O. No.				Item : Ball Separator		Vendor Q.P. NO:		PROJECT:				
						PACKAGE : COLTCS		CUSTOMER:						
						Date :		PURCHASER:						
						Page 03 of 15		CONSULTANT:						
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency			Remarks		
1	2	3	4	5	6	7	8	9	D*	**	10	11		
		Surface defects on machined area	Critical	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V		
		Sub-surface defects	Critical	Ultrasonic test	100%	ASME SA745	ASME SA745	Inspection report	*	P	V	V		
[e]	Screen ribs	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample / heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / Lab test report/Raw material flow sheet	*	P	V	V		
		Corrosion Resistance	Major	IGC	One/Heat	ASTM A 923	ASTM A 923	Test Report/Lab test report	*	P	V	V		
		Surface Defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report/ Raw material Flow sheet	-	P	V	V		
[f]	Ball Extraction Nozzle Pipe [Duplex Stainless Steel]	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample / cast/heat/ batch	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / Lab test report/Raw material flow sheet	*	P	V	V		
		Surface Defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report/ Raw material Flow sheet	-	P	V	V		
		Leak Tightness	Major	Hydrostatic Test	100%	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's Test Certificate	*	P	V	V		
1.2.0	Inprocess Quality Control													
1.2.1	Welding procedure specification	Correctness	Critical	Scrutiny	100%	ASME Sec.IX	ASME Sec.IX	QW 482 of ASME Sec.IX	*	P	V	V		
1.2.2	Welding procedure qualification	Weld soundness	Critical	Physical test	100%	ASME Sec.IX	ASME Sec.IX	QW 483 of ASME Sec.IX	*	P	V	V		
1.2.3	Welder performance qualification	Weld soundness	Critical	Radiography	100%	ASME Sec.IX	ASME Sec.IX	QW 484 of ASME Sec.IX	*	P	V	V		
1.2.4	Fit-up of butt weld	Alignment and dimensions	Major	Template, visual	100%	Manufacturing Drawing	ASME Sec VIII Div.1	Log book		P	W/V	--		
1.2.5	Fit-up of shell flange and nozzle assembly to shell	Orientation, alignment and dimensions	Major	Template, visual	100%	Manufacturing Drawing	ASME Sec VIII Div.1	Log book		P	--	--		
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Manufacturer / Sub-Contractor			Contractor			Indicate : "P" - Perform, "W" - Witness and "V" - Verification								
Signature									Reviewed By			Name & Sign. Of approving authority & Seal		


		Manufacturer's Name & Address					STANDARD QUALITY PLAN			BHEL Doc No.:		PE-QP-999-165-N008		
		P.O. No.					Vendor Q.P. NO:		PROJECT:					
		Item : Ball Separator					PACKAGE : COLTCS		CUSTOMER:					
		Date :					Page 04 of 15		PURCHASER:					
									CONSULTANT:					
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency				Remarks	
1	2	3	4	5	6	7	8	9	D*	M	C	O	10	11
1.2.6	Weld quality for Pressure Parts													
	[a] Root run	Surface defects	Major	Penetrant test / Visual	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Operation Process Sheet	-	P	V	V		
1.2.7	[a] Completed butt welds	1.Surface defects	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V		
		2.Sub-surface defects	Critical	Radiography test	10% of total weld length & 100% T Joints	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 4 / UW 52	Radiographs & inspection report	*	P	V	V		RT films will be reviewed by BHEL
	[b] Completed fillet welds	Surface defects	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V		
1.2.8	Fabricated Shell (Prior to sand blasting)	1.Dimensions, Orientation	Major	Measurement by visual	100%	Manufacturing Drawing	Manufacturing Drawing	Inspection report	*	P	V	V		
		2. Hydro test	Critical	Hydrostatic Pr. @ 1.5 times design pr. (positive) Duration 30 minutes	100%	ASME Sec.VIII Div.1	No Leakage	Inspection report	*	P	W	V		
1.2.9	Pickling and Passivation	Protection Layer	Major	Visual	100%	IS : 10117	IS : 10117	Log Book	-	P	--	--		
1.2.10	Final tests (completed equipments)- After assembly	1.Dimensions, orientation, workmanship & finish	Major	Measurement by visual	100%	G.A.drawing	G.A.drawing	Inspection report	*	P	W	W		
		2.Leak tightness for assembly	Critical	Leak Tightness @ design pr. (positive) Duration 30 minutes	100%	ASME Sec.VIII Div.1	No Leakage	Inspection report	*	P	W	W		
		3.Dry function test for Ball Separator	Critical	Operational test	100%	Approved procedure	Approved procedure	Inspection report	*	P	W	W		
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Manufacturer / Sub-Contractor								Reviewed By		Name & Sign. Of approving authority & Seal				
Signature														


		Manufacturer's Name & Address				STANDARD QUALITY PLAN				BHEL Doc No.: PE-QP-999-165-N008			
		P.O. No.				Item : Ball Separator		Vendor Q.P. NO:		PROJECT:			
						PACKAGE : COLTCS		Date :		CUSTOMER:			
						Page 05 of 15				PURCHASER:			
										CONSULTANT:			
Sl. No.	Component / Operation	Characteristics	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency			Remarks	
1	2	3	4	5	6	7	8	9	D*	M	C	O	11
1.3.0	Rubber Lining for ball Separator Shell, V-Piece & skid IC Pipe.												
1.3.1	Rubber formulation	Tensile elongation and hardness	Major	Physical test	One per lot	Manufacturer's procedure	BS 6374/Equivalent	Manufacturer's test certificate		P	V	V	
		Polymer Identification	Major	Flame test	One per lot	For Semi Ebonite	For Semi Ebonite	Inspection report	*	P	V	V	
						Ebonite Polymer catches fire; catches fire and On removal from fire it continues to burn	Ebonite Polymer catches fire; catches fire and On removal from fire it continues to burn						
		% Change in weight after 24 hrs immersion in sea water at 70 degrees	Major	Immersion test (bleeding test)	One per lot	ASTM D 471	+/- 1 %	Inspection report	*	P	V	V	
1.3.2	Surface preparation of items to be lined	Free from rust, scale, dust and grease	Major	Visual	100%	SA 2.5	SA 2.5	Manufacturer's Internal inspection		P	-		
1.3.3	Vulcanising	Temperature, Pressure and time	Major	Process monitoring	100%	Manufacturer's procedure	Manufacturer's procedure	Process Procedure		P	-	-	
1.3.4	Vulcanised rubber lined items	a) Chip test	Major	Chip test	One per lot	Approved drawing and BS 6374/Equivalent	BS 6374/Equivalent	Inspection report	*	P	V	V	
		b) Adhesion, Visual defects, thickness and hardness	Major	Measurement, visual inspection	100% visual, Thickness hardness at random	Approved drawing and BS 6374/Equivalent	BS 6374/Equivalent	Inspection report	*	P	V	V	
		c) Spark test for Pin holes at 5 kv/mm	Major	Spark test for Pin holes	100%	Approved drawing and BS 6374/Equivalent	BS 6374/Equivalent	Inspection report	*	P	V	V	
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		Manufacturer's Name & Address				STANDARD QUALITY PLAN				BHEL Doc No.: PE-QP-999-165-N008				
P.O. No.		Item : WORM GEAR & ACTUATORS				Vendor Q.P. NO:		PROJECT:		CUSTOMER:				
						PACKAGE : COLTCS		Date :		PURCHASER:				
						Page 06 of 15		CONSULTANT:						
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency				Remarks	
1	2	3	4	5	6	7	8	9	D*	M**	C	O	10	11
1.4.0	Complete Unit of Worm gear	Reduction Ratio	Critical	Functional Test	100%	Approved Sheet Data	Approved Data Sheet							
		Angle of Rotation						Manufacturer test certificate	*	P	V	V		
		Input Torque												
		Output Torque												
		Degree of protection	Critical	Water & Dust ingress tests	Type test	Approved Data Sheet	Approved Data Sheet	Type test certificate	*	V	V	V		
1.5.0	Actuators	Routine Test	Major	Electrical test	100%	Supplier catalogue	Supplier catalogue ADS	Manufacturer TC	*	V	V	V		Review of TCs
		Make, Range, Model	Major	Visual	100%									
		Assembly check alongwith ball valves	Major	Visual	100%	Supplier catalogue	Supplier catalogue / ADS	Inspection Report	-	P	--	--		
		Functional check alongwith settings/auxiliary contacts	Major	Visual	100%									
Note: ADS - APPROVED DATA SHEET														
LEGEND														
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		Manufacturer's Name & Address					STANDARD QUALITY PLAN			BHEL Doc No.:		PE-QP-999-165-N008			
		P.O. No.		Item : Ball Recirculation Skid & Ball Vessel		Vendor Q.P. NO:		PACKAGE : COLTCS		PROJECT:					
						Date :		Date : Page 07 of 15		CUSTOMER:					
								PURCHASER:		CONSULTANT:					
Sl. No.	Component / Operation	Characteristics	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency			Remarks			
1	2	3	4	5	6	7	8	9	D*	**	C	O	10	11	
2.0.0	Complete Skid														
	Recirculating Skid with ball vessel and ball oversize monitor	Completeness, Correctness, Orientation, Dimensions	Major	Visual & Measurement	100%	Approved Drawing	Approved Drawing	Inspection report	*	P	V	V			
	Ball Vessel														
2.1.0	Raw Material														
[a]	Housing Shell, Nozzle flanges and dished end	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / Lab test report / raw material flow sheet	*	P	V	V			
		Surface defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Mill TC/Inspection report	*	P	V	V			
		Sub-surface defects	Major	Ultrasonic test	100%	ASME SA 435	ASME SA 435	Inspection report	-	P	V	V	Plates > 20mm Thk only (UT - Full Volume)		
2.2.0	Inprocess Quality Control														
2.2.1	Welding procedure specification	Correctness	Critical	Scrutiny	100%	ASME Sec.IX	ASME Sec.IX	QW 482 of ASME Sec.IX	*	P	V	V			
2.2.2	Welding procedure qualification	Weld soundness	Critical	Physical test	100%	ASME Sec.IX	ASME Sec.IX	QW 483 of ASME Sec.IX	*	P	V	V	Welding procedure already approved by BHEL/LRQA/GL/DNV/TUV shall be employed for this job.		
2.2.3	Welder performance qualification	Weld soundness	Critical	Radiography	100%	ASME Sec.IX	ASME Sec.IX	QW 484 of ASME Sec.IX	*	P	V	V	Welders already qualified by BHEL/LRQA/GL/DNV/TUV shall be employed for this job.		
2.2.4	Dished end for ball vessel	Dimensions	Major	Template	100%	Manufacturing Drawing	ASME Sec VIII Div.1	Inspection report	-	P	V	V			
		Surface defects	Critical	Penetrant test	100%	ASME Sec VIII Div.1	ASME Sec VIII Div.1 Appendix 8	Inspection report	-	P	V	V			
LEGEND															
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Manufacturer / Sub-Contractor Signature								Contractor		Reviewed By		Name & Sign. Of approving authority & Seal			


													
Manufacturer's Name & Address				STANDARD QUALITY PLAN				BHEL Doc No.:		PE-QP-999-165-N008			
P.O. No.				Item : Ball Vessel & Ball Injection Pipe				Vendor Q.P. NO:		PROJECT:			
								PACKAGE : COLTCS		CUSTOMER:			
								Date :		PURCHASER:			
								Page 08 of 15		CONSULTANT:			
Sl. No.	Component / Operation	Characteristics	Class	Type of	Quantum of	Reference	Acceptance	Format of	Agency				Remarks
		Checked		Check	Check	Documents	Norms	Record		M	C	O	
1	2	3	4	5	6	7	8	9	D*	**	10		11
2.2.5	Fit-up of butt weld	Alignment and dimensions	Major	Measurement	100%	Manufacturing Drawing	ASME Sec.VIII Div.1	Log book	-	P	W/V	--	BHEL to witness >20mm thick butt joint.
2.2.6	Fit-up of shell flange and nozzle assembly to shell	Orientation, alignment and dimensions	Major	Template, visual	100%	Manufacturing Drawing	ASME Sec.VIII Div.1	Log book	-	P	--	--	
2.2.7	Weld quality for Pressure Parts												
	[a] Root run	Surface defects	Major	Penetrant test / Visual	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Operation Process Sheet	*	P	V	V	
2.2.8	[a] Completed butt welds	1.Surface defects	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V	
		2.Sub-surface defects	Critical	Radiography test	10% of total weld length & 100% T Joints	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 4 / UW 52	Radiographs and inspection report	*	P	V	V	RT films will be reviewed by BHEL
	[b] Completed fillet welds	Surface defects	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V	
2.2.9	Fabricated Shell	1.Dimensions, Orientation	Major	Measurement	100%	Manufacturing Drawing	Manufacturing Drawing	Inspection report	*	P	V	V	
		2. Hydro test for Ball Vessel	Critical	Hydrostatic Pr. @ 1.5 times design pr. (positive) [Duration 30 minutes]	100%	ASME Sec.VIII Div.1	No leakage	Inspection report	*	P	W	V	Hydrostatic test shall be conducted along with Recirculating skid Assly for Ball Vessel.
2.2.10	Pickling and Passivation	Protection Layer	Major	Visual	100%	IS : 10117	IS : 10117	Log Book		P	--	--	
2.2.11	Ball Injection Pipe	Chemical & Physical properties	Major	Chemical & mechanical tests	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / Lab test report / raw material flow sheet	*	P	V	V	
		Surface defects	Minor	Visual	100%	Approved drg/ Data sheet	Approved drg/ Data sheet	MTC / Inspection report	-	P	V	V	
		Leak Tightness	Major	Hydrostatic test	100%	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's Test Certificate	*	P	V	V	
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Manufacturer / Sub-Contractor Signature								Reviewed By		Name & Sign. Of approving authority & Seal			

		Manufacturer's Name & Address					STANDARD QUALITY PLAN			BHEL Doc No.:		PE-QP-999-165-N008	
		P.O. No.					Vendor Q.P. NO:		PROJECT:				
		Item : BALL VALVES					PACKAGE : COLTCS		CUSTOMER:				
		Date :					Page 10 of 15		PURCHASER:				
									CONSULTANT:				
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency				Remarks
1	2	3	4	5	6	7	8	9	D*	**	10	O	11
2.4.0	Ball valves												
2.4.1	Materials												
	Body and Tail end pieces	Chemical,Physical properties	Major	Chemical & Physical analysis	One Sample/Cast / heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's T.C.	*	P	V	V	
2.4.2	Ball	Chemical,Physical properties	Major	Chemical & Physical analysis	One Sample/Cast / heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's T.C.	*	P	V	V	
2.4.3	Stem	Chemical,Physical properties	Major	Chemical & Physical analysis	One Sample/Cast / heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's T.C.	*	P	V	V	
2.4.4	In-process inspection												
2.4.5	Machining of body, end, pieces, ball	Dimension	Major	Measurement	100%	Approved drg/Data sheet	Approved drg/Data sheet	Log book	-	P	V	V	
2.4.6	Ball	a) Surface defects	Critical	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V	
		b) Hardness	Major	Hardness testing	Random	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report	*	P	V	V	
2.4.7	Assembly	a) Dimensions	Major	Measurement	100%	EN ISO 17292	EN ISO 17292	Manufacturer's T.C.	*	P	V	V	
		b) Opening / Closing	Major	Operation	100%	--	As per approved data sheet	-	-	P	V	V	Test at works for opening / closing time of actuator operated valves.
2.4.8	Testing												
	[a] Body	Leakage	Critical	Hydraulic test	100%	EN 12266-1&2/API 598/Appd data sheet	EN 12266-1&2/API 598 & Appd. Data sheet	Manufacturer's T.C.	*	P	V	V	
	[b] Seat test	Leakage	Critical	Hydraulic test	100%	EN 12266-1&2/API 598/Appd data sheet	EN 12266-1&2/API 598 & Appd. Data sheet	Manufacturer's T.C.	*	P	V	V	
	[c] Seat	Leakage	Critical	Air test	100%	EN 12266-1&2/API 598/Appd data sheet	EN 12266-1&2/API 598 & Appd. Data sheet	Manufacturer's T.C.	*	P	V	V	
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Manufacturer / Sub-Contractor		Contractor						Reviewed By		Name & Sign. Of approving authority & Seal			
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Sl. No.		Component / Operation		Characteristics		Class		Type of		Quantum of		Reference		Acceptance		Format of		Agency			Remarks		
1		2		3		4		5		6		7		8		9		10			11		
		Checked		Check		Check		Documents		Norms		Record		M C O									
																							
Manufacturer's Name & Address										STANDARD QUALITY PLAN										BHEL Doc No.:		PE-QP-999-165-N008	
P.O. No.										Item : RECIRCULATING PUMP MOTOR										Vendor Q.P. NO:		PROJECT:	
V PIECE										PACKAGE : COLTCS										CUSTOMER:			
										Date :										PURCHASER:			
										Page 11 of 15										CONSULTANT:			
2.5.0		Motor		Routine test, Load test & IR		Major		Electrical test		100% test		IS:325		IS:325		Manufacturer test certificate		* P V V			Review of supplier TC		
				Make , Rating		Major		Verification		100%		Appd drg/Data sheet		Appd drg/Data sheet		Inspection report		* V V V					
				Degree of Protection		Critical		Verification		Type test		IP 55		IP 55		Manufacturer's test Certificate		* V V V					
3.1.0		V - Piece																					
		Raw material inspection		Chemical & Physical properties		Major		Chemical & mechanical tests		One sample/heat		Approved drg/Data sheet		Approved drg/Data sheet		Mill Test Certificate / lab test report / raw material flow sheet		* P V V					
		In process inspection		b) Surface defects		Major		Visual		100%		Approved drg/ Data sheet		Approved drg/ Data sheet		MTC / Inspection report		* P V V					
				c)Sub-surface defects		Critical		Radiography test		10% of total butt weld length		ASME Sec.VIII Div.1		ASME Sec.VIII Div.1 Appendix 4		Radiographs and inspection report		* P V V					
				d) Hydro Static Test		Critical		Hydrostatic Pr. @ 1.5 times design pr. (positive) [Duration 30 minutes]		100%		ASME Sec.VIII Div.1		No leakage		Inspection report		* P V V					
LEGEND																							
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		Manufacturer's Name & Address					STANDARD QUALITY PLAN				BHEL Doc No.: PE-QP-999-165-N008		
		P.O. No.		Item : Balli Monitoring System (Ball Oversize Monitor)			Vendor Q.P. NO:		PACKAGE : COLTCS		PROJECT:		
							Date : Page 12 of 15		CUSTOMER:		PURCHASER:		
											CONSULTANT:		
Sl. No.	Component / Operation	Characteristics	Class	Type of	Quantum of	Reference	Acceptance		Format of	Agency			Remarks
							Documents	Norms		Record	M	C	
1	2	3	4	5	6	7	8	9	D*	**	10	11	
4.1.0	Raw Material Housing shell, Flanges	Chemical properties	Major	Chemical Analysis	One sample/heat	Approved drg/Data sheet	Approved drg/Data sheet	Mill test Certificate / lab test report/raw material flow sheet	*	P	V	V	if fabricated type
		Physical properties	Major	Physical test	One sample / cast/heat/ batch	Approved drg/Data sheet	Approved drg/Data sheet	Mill test Certificate / lab test report/raw material flow sheet	*	P	V	V	
		Surface defects	Minor	Visual	100%	Approved drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate/Inspection report	*	P	V	V	
		Sub-surface defects	Major	Ultrasonic test	100%	ASME SA 435	ASME SA 435	Mill Test Certificate	*	P	V	V	Plates > 20mm Thk only (UT - Full Volume)
4.2.0	Inprocess Quality Control												
4.2.1	Welding procedure specification	Correctness	Critical	Scrutiny	100%	ASME Sec.IX	ASME Sec.IX	QW 482 of ASME Sec.IX	*	P	V	V	
4.2.2	Welding procedure qualification	Weld soundness	Critical	Physical test	100%	ASME Sec.IX	ASME Sec.IX	QW 483 of ASME Sec.IX	*	P	V	V	Welding procedure already approved by BHEL/LRQA/GL/DNV/TUV shall be employed for this job.
4.2.3	Welder performance qualification	Weld soundness	Critical	Radiography	100%	ASME Sec.IX	ASME Sec.IX	QW 484 of ASME Sec.IX	*	P	V	V	Welders already qualified by BHEL/LRQA/GL/DNV/TUV shall be employed for this job.
4.2.4	Fabricated Shell	1.Surface defects (fillet welds)	Major	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V	
		2.Dimensions, Orientation	Major	Measurement by visual	100%	Approved doc./ Data sheet	Approved documents / Data sheets	Inspection report	*	P	V	V	
		3. Hydro test	Critical	Hydrostatic Pr. @ 1.5 times design pr. (positive) [Duration 30 minutes]	100%	ASME Sec.VIII Div.1	No leakage	Inspection report	*	P	W	V	Hydrostatic test shall be conducted alongwith Recirculating skid assembly
		4. Functional Test	Major	Functional	100%	Approved procedure	Approved procedure	-	-	P	V	V	Functional test to be done at site
LEGEND													
* Records identified with "STAR" shall be essentially included by contractor in QA Documentation.													
** M : Manufacturer / Manufacturer's Sub-contractor C : Contractor O : Owner													
Manufacturer / Sub-Contractor		Contractor		Indicate : "P" - Perform, "W" - Witness and "V" - Verification									
Signature								Reviewed By		Name & Sign. Of approving authority & Seal			

		Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.: PE-QP-999-165-N008			
		Item : Starter Panel			Vendor Q.P. NO:		PROJECT:					
		P.O. No.			PACKAGE : COLTCS		CUSTOMER:					
					Date :		PURCHASER:					
					Page 14 of 15		CONSULTANT:					
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency			Remarks
									M	C	O	
1	2	3	4	5	6	7	8	9	10			11
8.0.0	Starter panel											
08.1.0	Incoming Material											
08.1.1	Fabricated & Painted Panel	Dimension	Major	Measurement	100%	Approved Drgs.	Approved Drgs.	Inspection report	-	P	--	--
		Panel G.A.	Major	Measurement	100%	Approved Drgs.	Approved Drgs.	Inspection report	-	P	--	--
		Paint colour	Major	Visual	100%	Approved Drgs.	Approved Drgs.	Inspection report	-	P	--	--
		Paint thickness	Major	Measurement	100%	Approved Drgs.	Approved Drgs.	Inspection report	-	P	--	--
		Paint Shade, Adhesion	Major	Visual	Sample	Approved Drgs.	Approved Drgs.	Inspection report	-	P	--	--
08.1.2	Wire	Size / Colour / Rating / Surface Defects	Major	Visual / Dimension	Sample	IS 694	Specification drawings	Inspection report	-	P	--	--
08.1.3	Panel Mounting	Make, Functional, Type & Rating	Major	Visual / Electrical	100%	Approved BOM	Approved BOM	---		P	V	V
08.2.0	In Process Inspection											
10.2.1	Name Plate, Component Mounting, Etc.	Workmanship, Finish, Correctness	Major	Visual	100%	Approved Drgs.	Approved drawings	Inspection report	-	P	--	--
08.2.2	Electrical Wiring of Panels	Continuity, Colour of wires, Bunching and Grouping	Major	Visual	100%	Mounting Drawing	Approved drawings	Inspection report	-	P	--	--
08.2.3	Ferruling of Cables	Start & End	Major	Visual	100%	Manufacturer's drawing	Manufacturer's drawing	Inspection report	-	P	--	--
08.3.0	Final Inspection											
08.3.1	Workmanship, Finish & Paint shade / Thickness	Visual	Major	Visual	100%	G.A Drawing	Approved drgs.	Inspection report	*	P	W	V
08.3.2	Overall Dimension, G.A of starter panel	Measurement	Major	Visual	100%	G.A Drawing	Approved drgs.	Test Certificate	-	P	W	V
08.3.3	Component Identification	Visual	Major	Visual	100%	G.A Drawing	Approved drgs.	Inspection report	-	P	W	V
08.3.4	Degree of Protection	Ingress Protection IP55	Critical	Environmental	Verification	Approved drgs.	IS 2147	Inspection Report		P	V	V
08.3.5	IR - HV - IR	Electrical	Critical	Electrical	100%	Approved Procedure	Approved Pcedure	Inspection report	-	P	V	V
08.3.6	Functional & Continuity	Functional	Major	Functional	100%	Appd Drawing	Appd Drawing	Inspection report	*	P	W	W
			LEGEND									
			* Records identified with "STAR" shall be essentially included by contractor in QA Documentation.									
			** M : Manufacturer/ Sub-contractor									
Manufacturer / Sub-Contractor			Contractor		C : BHEL		O : Owner					
Signature			Indicate : "P" - Perform, "W" - Witness and "V" - Verification									
										Name & Sign. Of approving authority & Seal		

		Manufacturer's Name & Address					STANDARD QUALITY PLAN				BHEL Doc No.:		PE-QP-999-165-N008		
		P.O. No.					Item : FASTENERS		Vendor Q.P. NO:		PROJECT:				
									PACKAGE : COLTCS		CUSTOMER:				
									Date :		PURCHASER:				
							Page 15 of 15		CONSULTANT:						
Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	Agency			Remarks			
1	2	3	4	5	6	7	8	9	D*	**	M	C	O	10	11
9.1.0	Internal Fasteners (Duplex Steel)	Chemical & Physical properties	Major	Chemical Mechanical analysis	& 1 Per heat/HT Batch	Approved sheet drg/Data	Approved sheet drg/Data	Mfr TC / Lab report	*	P	V	V			
		Visual workmanship finish	Major	Visual	Sample	Approved sheet drg/Data	Approved sheet drg/Data		-	P	V	V			
		Dimensions	Major	Measurement	Sample	Approved sheet drg/Data	Approved sheet drg/Data		-	P	V	V			
9.2.0	Main Fasteners	Visual	Major	Visual	Sample	Approved sheet drg/Data	Approved sheet drg/Data	Inspection report / Mfr TC	*	P	V	V			
		Dimensions	Major	Measurement	Sample	Approved sheet drg/Data	Approved sheet drg/Data	Inspection report / Mfr TC	*	P	V	V			
		Chemical & Physical properties	-	Chemical & Physical test	1 sample per heat	Approved sheet drg/Data	Approved sheet drg/Data	Mfr TC/Lab report	*	P	V	V			
				a) Tensile											
				b) Yield											
				c) Elongation											
				d) Proof load											
			LEGEND												
			* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.												
			** M :Manufacturer / Manufacturer's Sub-contractor												
			C : Contractor O : Owner												
Manufacturer / Sub-Contractor Signature		Contractor		Indicate : "P" - Perform, "W" - Witness and "V" - Verification											
									Reviewed By			Name & Sign. Of approving authority & Seal			



**TITLE : TECHNICAL SPECIFICATION
FOR
CONDENSER ON LOAD TUBE CLEANING
SYSTEMS (COLTCS)**

SPEC. NO. PE-TS- 408 165-N002

VOLUME : IIB

SECTION : D

REV. NO. 0

DATE : 27.05.2015

SHEET 1 of 1

**SECTION D2
STANDARD TECHNICAL SPECIFICATION
FOR
ELECTRICAL SYSTEMS**



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

1.0 INTENT OF SPECIFICATION

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

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

2.0 CODES AND STANDARDS

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

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

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

3.0 DESIGN REQUIREMENTS

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

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

3.3 Starting Requirements

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

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



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

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

3.3.3 The following frequency of starts shall apply

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

3.4 **Running Requirements**

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

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

3.5 **Stress During bus Transfer**

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

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

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

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


4.0 **CONSTRUCTIONAL FEATURES**

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

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

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

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

	TITLE :	SPECIFICATION NO.
	GENERAL TECHNICAL REQUIREMENTS	PE-SS-999-506-E101
	FOR	VOLUME NO. : II-B
	LV MOTORS	SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 3 OF 4

- 4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.
- 4.5. Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.
- 4.6. In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.
- 4.7 Terminals and Terminal Boxes**
- 4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.
- Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".
- 4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.
- 4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.
- 4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.
- 4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.
- 4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.
- 4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.
- 4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.
- 4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.
- 4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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


- 4.9.1 Motors provided for similar drives shall be interchangeable.
- 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.
- 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.
- 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.
- 4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.
- 4.9.6 Name plate with all particulars as per IS: 325 shall be provided
- 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 INSPECTION AND TESTING

- 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.
- 5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.
- 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.
- 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.


6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

- a) OGA drawing showing the position of terminal boxes, earthing connections etc.
- b) Arrangement drawing of terminal boxes.
- c) Characteristic curves:
(To be given for motor above 55 kW unless otherwise specified in Data Sheet).
 - i) Current vs. time at rated voltage and minimum starting voltage.
 - ii) Speed vs. time at rated voltage and minimum starting voltage.
 - iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
 - iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

	TITLE	SPECIFICATION NO.
	LV MOTOR DATA SHEET - C	VOLUME II B
		SECTION D
		REV NO. 00 DATE
		SHEET 1 OF 2

S. No.	Description	Data to be filled by successful bidder
A.	General	
1	Manufacturer & country of origin	
2	Motor type	
3	Type of starting	
4	Name of the equipment driven by motor & Quantity	
5	Maximum Power requirement of driven equipment	
6	Rated speed of Driven Equipment	
7	Design ambient temperature	
B.	Design and Performance Data	
1	Frame size & type designation	
2	Type of duty	
3	Rated Voltage	
4	Permissible variation for	
5	a) Voltage	
6	b) Frequency	
7	c) Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)	
9	Synchronous speed & Rated slip	
10	Minimum permissible starting voltage	
11	Starting time in sec with mechanism coupled	
12	a) At rated voltage	
13	b) At min starting voltage	
14	Locked rotor current as percentage of FLC (including IS tolerance)	
15	Torque	
	a) Starting	
	b) Maximum	
16	Permissible temp rise at rated output over ambient temp & method	
17	Noise level at 1.0 m (dB)	
18	Amplitude of vibration	
19	Efficiency & P.F. at rated voltage & frequency	
	a) At 100% load	
	c) At 75% load	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE	SPECIFICATION NO.
	<p style="text-align: center;">LV MOTOR</p> <p style="text-align: center;">DATA SHEET - C</p>	VOLUME II B
		SECTION D
		REV NO. 00 DATE
		SHEET 2 OF 2

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	Constructional Features	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	Characteristic curves/ drawings (To be enclosed for motors of rating $\geq 55KW$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.
NAME	SIGNATURE	DATE		



QUALITY PLAN

SHEET 1 OF 9

CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
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

1	2	3	4	5	6	7	8	9	10			11
									P	W	V	
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

SHEET 2 OF 9

CUSTOMER :

PROJECT

SPECIFICATION :

BIDDER/ VENDOR

QUALITY PLAN

NUMBER :

NUMBER PED-506-00-Q-007, REV-03

SPECIFICATION :

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			REMARKS
									P	W	V	
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	
1.6	SPACE HEATERS, CONNNECTORS, 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

SPECIFICATION :

BIDDER/ VENDOR :

QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03

NUMBER :

SPECIFICATION : TITLE

SHEET 3 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			REMARKS
									P	W	V	
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. 2. OTHER CHARACTERISTICS	MA MA	VISUAL TEST	100% SAMPLE	- MANUF'S SPEC.	NO VISUAL DEFECTS MANUF'S SPEC.	INSPT. REPORT LOG BOOK AND OR SUPPLIER'S TC	3 3	- -	2 2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND. 2. DIMENSIONS INCLUDING BURS HEIGHT 3. ACCEPTANCE TESTS	MA MA MA	VISUAL MEASUREMENT ELECT. & MECH TESTS	100% SAMPLE -DO-	- MANUFR'S DRG. . MANUF'S SPEC./ RELEVANT IS	NO VISUAL DEFECTS (FREE FROM BURS) MANUFR'S DRG. RELEVANT IS	LOG BOOK -DO- SUPPLIER'S TC	3 3 3	- -	- 2 2	
1.9	CONDUCTORS	1. SURFACE FINISH 2. ELECT. PROP, & MECH. PROP	MA MA	VISUAL ELECT. & MECH. TEST	100% SAMPLES	- RELEVANT IS/ BS OR OTHER STANDARDS	FREE FROM VISUAL DEFECTS RELEVANT IS/ BS OR OTHER STANDARDS	LOG BOOK SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3* 3	- -	2* 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.
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE			BIDDER'S/VENDORS COMPANY SEAL						



QUALITY PLAN

SHEET 4 OF 9

CUSTOMER :

PROJECT

SPECIFICATION :

BIDDER/ VENDOR

QUALITY PLAN
NUMBER PED-506-00-Q-007, REV-03

NUMBER :

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			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
		1.MAKE & TYPE	MA	VISUAL	100%	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

SHEET 5 OF 9

CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
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			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ ASTM-E165	MANUF'R'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINING	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

SHEET 6 OF 9

CUSTOMER :

PROJECT
TITLE

SPECIFICATION :
NUMBER :

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			REMARKS	
									P	W	V		
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	-	-	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE	
		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		
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	-	-		
2.6	IMPREGNATION	6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		FOR MV MOTOR
		1.VISCOSITY	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

SHEET 7 OF 9

CUSTOMER :

PROJECT

SPECIFICATION :

BIDDER/
VENDOR

QUALITY PLAN
NUMBER PED-506-00-Q-007, REV-03

NUMBER :
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			REMARKS	
									P	W	V		
1	2	3	4	5	6	7	8	9	10			11	
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION 1.COMPACTNESS & CLEANLINESS	MA MA	-DO- VISUAL	-DO- 100%	-DO- -DO-	-DO- -DO-	Log Book Log Book	2 2	- -	1 -		
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS 2.SOUNDNESS	CR CR	-DO- MALLETT TEST & UT	-DO- -DO-	-DO- -DO-	-DO- -DO-	Log Book Log Book	2 2	- -	- 1		
2.9	COMPLETE ROTOR ASSEMBLY	3.HV 1.RESIDUAL UNBALANCE	MA CR	ELECT. TEST DYN. BALANCE	-DO- -DO-	-DO- MFG SPEC./ ISO 1940	-DO- MFG. DWG.	Log Book Log Book	2 2	- -	1 1	VERIFICATION FOR MV MOTOR ONLY	
2.10	ASSEMBLY	2.SOUNDNESS OF DIE CASTING 1.ALIGNMENT 2.WORKMANSHIP 3.AXIAL PLAY 4.DIMENSIONS 5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE 6. RTD, BTD & SPACE HEATER MOUNTING.	CR MA MA MA MA MA MA	ELECT. (GROWLER TEST) MEAS. VISUAL MEAS. -DO- VISUAL	-DO- -DO- -DO- -DO- 100%	-DO- -DO- -DO- MFG.DRG./ MFG SPEC. MFG SPEC. RELEVANT IS	-DO- -DO- -DO- MFG. DRG/ RELEVANT IS MFG SPEC. RELEVANT IS	Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2	- - - - -	- - - - -	1 1 1 -	
BHEL			PARTICULARS		BIDDER/VENDOR								
			NAME										
			SIGNATURE										
			DATE										
									BIDDER'S/VENDORS COMPANY SEAL				



QUALITY PLAN

SHEET 8 OF 9

CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
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			REMARKS
									P	W	V	
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

SHEET 9 OF 9

CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
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			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11

NOTES:


- 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.
- 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.
- 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED.
- 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.

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 :			
			BIDDER/ VENDOR :			TITLE			NUMBER :			
SHEET 1 OF 2		SYSTEM			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION VOLUME III			
1	2	3	4	5	6	7	8	9	P	W	V	REMARKS
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

SHEET 2 OF 2

CUSTOMER :

PROJECT

SPECIFICATION :

BIDDER/ :

TITLE

NUMBER :

VENDOR

QUALITY PLAN
NUMBER PED-506-00-Q-006, REV-01

SPECIFICATION :

SYSTEM

ITEM AC ELECT. MOTORS BELOW 55KW (LV)

TITLE :

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			REMARKS
									P	W	V	
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	-	
<p>NOTES:</p> <p>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</p> <p>2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.</p> <p>3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.</p> <p><u>Legends for Inspection agency</u></p> <p>1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)</p> <p>P. PERFORM W. WITNESS V. VERIFY</p>												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			



**TITLE : TECHNICAL SPECIFICATION
FOR
CONDENSER ON LOAD TUBE CLEANING
SYSTEMS (COLTCS)**

SPEC. NO. PE-TS- 408 ·165-N002

VOLUME : IIB

SECTION : D

REV. NO. 0

DATE : 27.05.2015

SHEET 1 of 1

**SECTION D3
STANDARD TECHNICAL SPECIFICATION
FOR
C&I SYSTEMS**



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

CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks	
				M	C	B		
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V		
	1.1 MODEL NO/TAG NO							
	1.2 RANGE							
	1.3 END CONN							
	1.4 NO. OF CONTACT							
2	CALIBRATION				P	V	V	
	2.1 REPEATABILITY							
	2.2 SET POINT ADJUSTMENT							
	2.3 DIFFERENTIAL							
3	OVER PR & LEAK TEST				P	V	V	
4	ELECT. INSULATION/HV TEST	ONE		P	V	V		
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V		
	5.1 SENSOR							
	5.2 MOVEMENT							
	5.3 PROCESS CONNECTION							
	5.4 HOUSING							
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V		
7	REVIEW OF TC OF MICROSWITCH	FOR LOT		V	V	V		

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

Note :

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



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

CHECK LIST FOR TRANSMITTER

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

Legend :

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

Note :

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



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

CHECK LIST FOR PRESSURE & DP GAUGE

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

Legend :

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

Note :

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



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

CHECK LIST FOR LEVEL GAUGE

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

Legend :

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Note :

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



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

CHECK LIST FOR ANNUNCIATORS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
	FACIA DETAILS						
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE			P	W	V	

Legend :

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Note :

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



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DATE:	22-02-2008
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	3	---	2	
		2. Bend Test	CR	Mech. test	Sample	IS:1079 IS:513	IS:1079 IS:513	Log Book	2	---	---	
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---	
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---	
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1	
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	IS:2062	IS:2062	Log Book	2	---	---	
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---	
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---	
		4. Mill marking	MA	Visual	100%	IS:2062	IS:2062	Log Book	2	---	1	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	

LEGEND: * CR - Critical characteristics
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V - Agency Verifying the Test.

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 2. Verification of Test Certificates 3. Operation / Functional check 4. I.R. 5. H.V. 6. Calibration 7. Pick up / Drop off Voltage	CR CR CR MA MA MA MA	Visual Scrutiny of Type / Routine T.Cs. Electrical Electrical Electrical Electrical	Sample 100% Sample+ 100% 100% 100% 100% 100%	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2	---	---	+ for relay & contactors only @ for all components except relays & contactors. 1

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Surface defects after bending	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---	
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency [§]			Remarks
									P	W	V	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	

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

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

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

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