GSECL

1X800MW WANAKBORI, TPS, UNIT#8

TECHNICAL SPECIFICATION

FOR CONDENSER ON LOAD TUBE CLEANING SYSTEMS (COLTCS).

Specification No. : PE-TS- 408-165-N002 (REV 01)

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
PPEI BLDG., SEC-16A, PLOT NO. 25
NOIDA – 201301 (UP)

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SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

1.0 GENERAL

The Condenser On load Tube Cleaning Systems (COLTCS) complete with all accessories shall conform to the standard technical specifications (Section-II) and Data Sheet-A enclosed herewith. In addition the requirements of this section I including customer specification attached at Annexure-IV (as applicable) shall also be complied with. However, wherever the details given in Section-II and Data Sheet-A are different, the requirements of Data Sheet-A shall prevail. Similarly in the event of contradictions between Section-I/ customer specification (Annexure-IV) / Section-II/ Data Sheet-A, the same shall prevail in the order as: customer specification (Annexure-IV), Section-I, Datasheet-A, Section-II.

Section I consists of 4 Sub-Sections viz. Sub-Sec. IA, IB and IC for Mechanical, Electrical and C&I respectively and Sub-Sec. ID for Datasheet-A, the requirements of all 4 sub-sections shall be complied with.

2.0 DESCRIPTION OF EQUIPMENTS :

2.1 **Condenser on load tube cleaning systems (COLTCS) :**

The condenser on load tube cleaning system (COLTCS) is intended to prevent formation of various forms of fouling and scaling in the condenser tubes. The cooling water system is of closed circuit type with cooling towers or open circuit type as specified. The water analysis is indicated with Datasheet-A.

3.0 SCOPE OF SUPPLY UNDER THE SPECIFICATION IN THE BIDDER'S SCOPE FOR COLTCS.

3.1 The details of COLTCS with quantities, design parameters, size and MOC's as per Data Sheet-A.

3.2 SCOPE OF SUPPLY IN THE BIDDER'S SCOPE FOR COLTCS:

3.2.1 Each set of COLTCS shall comprise following :

a) One No. Ball Separator at Condenser CW outlet pipe.
b) One No. Ball recirculation pump with drive motor.
c) One No. Ball collector.

d) One No. Manual ball sorter (Bucket type sorter with sieves to manually sort out the undersized balls by shaking the sieved bucket manually) for each set of COLTCS.

e) Differential pressure measuring system for ball separator. DP measuring system shall comprise of 2 nos. DPT +1 no. DPG for each COLTCS. Instrument shall be with *Remote seal* arrangement. Stubs for DPT and DPG shall be independent.

f) Ball monitoring system comprising an independent balls recirculation monitor and an independent balls oversize monitor. If bidder is not manufacturing Ball over size monitor then they can offer other alternatives like automatic ball sorter etc.

g) Length of Ball separator, Scope of Counter Flange, Nuts, bolts and gaskets shall be as per Datasheet-A.
Thickness of body flange and counter flange shall be as per Drg no PE-DG-999-141-MO17 enclosed at enclosures at Annexure-II of Datasheet-A.

h) Complete Pipe work, including interconnection piping, flanges/counter flanges for valves & pipes, bends, fittings, distributors, nozzles and support installation materials shall be in Bidder's scope. Bidder shall finalize the pipework to suit the layout at contract stage in such a way that no site welding is required for his pipework otherwise the same shall be carried out by bidder at site.

i) The Electrical and C&I item / accessory as specified in succeeding clause/ respective sections herein.

j) Power and Control cables between starter Panel (Switch Gear) and various drives in bidder's scope of supply.

k) Starter Panel (Switch Gear Panel) shall be as follows:

a) 2 Sets of COLTCS shall have one Common Starter Panel (Switch Gear Panel) for DCS based control system.

Switch Gear Panel should have suitable arrangement like Bus Coupler for providing redundancy to incoming supply feeder (1Working + 1 Standby feeder).

l) Control cables between field instruments and Switch gear panel.

m) All the field instruments stipulated in this specification shall be in Bidder's scope.

n) Commissioning balls and other commissioning spares on "As required basis" and to be supplied at the time of commissioning of COTCS system.

o) Set of mandatory spares as indicated in Data Sheet A. Spare balls to be supplied at the time of commissioning of COLTCS system.

p) Supporting arrangement complete with saddle support, foundation plates, anchor bolts, nuts, sleeves, inserts, all installation materials, fixing bolts, clamps and other accessories etc. for complete equipment supplied under this package.

q) Finish paints for touch up painting of equipment after erection at site, in sealed containers.

r) Set of special tools and tackles if required for maintenance and erection of the equipment supplied.

s) Various drawings, data test reports/ certificates instruction manuals for erection operation and maintenance etc. as specified in Data Sheet-C. and cables schedule indicating BOQ for power & control cables.

t) Panels & Instruments: Scope and Type as specified in C&I section wherever required.

Any item not specified but required to make COLTCS a complete package shall also be in

bidder's scope.

4.0 SCOPE OF SERVICES INCLUDED IN THE BIDDER'S SCOPE :

The bidder's scope also includes following services at site, for scope under this specification for COLTCS:

a) Installation checks (Erection in BHEL's scope).
b) Commissioning of equipment.
c) Trial run for requisite period
d) Performance Testing.

The trial run of equipment shall be generally conducted immediately after commissioning while PG testing shall be conducted at a later date. These activities for different units shall be timed separately.

- **For drawings/documents approval**
  In the event of order all drawings / documents in soft as well as hard copy shall be submitted as per NIT.

  Further on receipt of Customer comments, if required bidder's engineer shall visit BHEL/ Customer alongwith soft copy to resolve all issues and incorporate comments in the soft copy for across the table finalisation and Category-I approval.

- **Site Visits for installation check / commissioning:**

  Two site visits for four days each for installation check / commissioning of each unit in their base price for combined activities of erection checks and commissioning for COLTCS for both sets of equipments of one unit.

5.0 EXCLUSIONS :

The following are excluded from the bidder's scope.

5.1 Civil foundation works required for installation
5.2 Erection of Equipment at site.

6.0 DESIGN CONSTRUCTION :

In addition to the requirements of Section-D the following shall also be complied.

6.1 Layout Piping Arrangement Drg. is enclosed in the specifications at Annexure-III of Datasheet-A.

6.2 Thickness of body flange and counter flange of COLTCS shall be as per Drg no PE-DG-999-141-MO17 enclosed at enclosures at Annexure-II of Datasheet-A.

6.3 The materials of construction specified in Data Sheet-A are minimum requirements and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty which shall be subject to purchaser's approval during detailed engineering in the event of order.

6.4 Housing/ body of COLTCS shall be designed and manufactured as per the applicable codes for pressure vessels and to take care of force and moments as enclosed in the specification. However in no case thickness of housing/ body shall be less than connecting pipe thickness as specified in Data Sheet-A of COLTCS.

6.5 Adequate provision for future installation of Cathodic Protection for COLTCS (Sacrificial type) shall be kept by the bidder in the equipment.

6.6 Flow straightener for streamlining the CW flow in balls collecting strainer if required shall be supplied by the bidder along with mounting arrangement and the fixing details.

6.7 Velocity in the pipe work shall be less than 1.5 m/ sec for pump suction and less than 2.0 m/ sec. in other pipe work. All valves upto 150 NB shall be ball valves. For higher sizes, gate/ globe/ B.F. valves shall be provided. All instrument valves shall be needle valves.

7.0 Performance Guarantee and Bid Evaluation criteria for Condenser on Load Tube Cleaning System.

Performance Parameters to be guaranteed by bidders under demonstration category under compulsory corrections shall be as under:

i) Percentage recovery of balls (min. 90% recovery for 3 weeks with 8 hrs Operation of COLTCS per day)

ii) Life of Sponge Rubber Ball (Min. 3 weeks with 8 hrs operation of COLTCS per day**).**

iii) Max. Pressure drop in ball separator in clean condition (Test to be conducted along with commissioning) – not exceeding 0.2 MWC. The Bids shall be technically rejected for pressure drop quoted higher than 0.2 MWC.

For demonstrating the parameters at sl. No. (i) & (ii) above, the COLTCS system shall be operated 24 hrs per day for one week.

Any deviation to above balls life, percentage recovery and pressure drop will not be accepted.

In case the successful bidder fails to demonstrate any of these parameters he shall carry out modifications at his own cost, to purchaser's approval.
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.

8.0 SPARES :

8.1 **Mandatory Spares**
Mandatory Spares shall be as per Data Sheet-A or annexure enclosed with data sheet A.

9.0 Quality Plan
Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ Customer approval and customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test

certificates/ Inspection records etc. Charges for 3rd party inspection (TUV/ equivalent) for imported components wherever required shall be included by bidder in the base price itself. If BHEL or BHEL customer decides to witness the tests along with third party, the cost of travel of BHEL or BHEL customer shall be borne by BHEL or BHEL customer themselves.

10.0 DELIVERY & DRAWINGS/ DOCUMENTS DISTRIBUTION SCHEDULE :

a. Delivery of Equipment shall be as per NIT.

b. The drawings to be submitted by bidder in event of award of contract.

PACKAGE	BHEL DRG NO	DRG TITLE	Drg Sch for vendors
COLTCS	Primary Documents - affecting Manufacturing/ Delivery Directly		
	PE-V2-408-165-N001	P&ID OF COLTCS SYSTEM	R-0 within 20 days (for all except Installation plan, for Installation Plan 30 Days) from LOI/PO & subsequent revisions within 10 days of comments received from BHEL.
	PE-V2-408-165-N002	TECHNICAL DATA SHEET-COLTCS	
	PE-V2-408-165-N003	INSTALLATION PLAN-COLTCS	
	PE-V2-408-165-N004	GENERAL ARRANGEMENT OF BALL SEPERATOR	
	PE-V2-408-165-N005	DETAILS OF BR SKID,BALL INJECTION PIPE & FIXING DETAILS	
	PE-V2-408-165-N006	C&I Part-I,PANEL-TDS, I/O LIST, CABLE SCH AND CONTROL PHILOSPHY FOR COLTCS	
	PE-V2-408-165-N008	QP-COLTCS	
	Secondary Documents - NOT affecting Manufacturing/ Delivery Directly		
	PE-V2-408-165-N007	C&I Part-II, GA & WIRING DIAGRAM OF PANEL-COLTCS	R-0 within 30 days from Cat-I(or)II approval of C&I Part-I document & subsequent revisions within 10 days of comments received from BHEL.
	PE-V2-408-165-N009	O& M MANUAL -COLTCS	Within 30 days from MDCC

11.0 Sub-Vendor List is enclosed for Bought out items. In case, Bidder offer makes other than the enclosed list, the same shall be subject to approval of Customer/BHEL.

12.0 It is mandatory for the bidders to submit along with the bid the deviations if any whether major or minor in the schedule of deviations only. ***In the absence of deviations listed in***

the schedule of deviations the offer shall be deemed to be in full conformity with the specification "non-withstanding" anything else stated elsewhere in bidder's offer, data sheets etc. The implied/ indirect deviations in data sheets etc. Shall not be binding on the purchaser.

13.0 The following documents shall be furnished by the bidder with his offer :

- Compliance certificate duly signed and stamped (Enclosed at Schedules).
- Guarantee schedule duly signed and stamped (Enclosed at Schedules).

- GA drawings of following with empty/ filled-ups.
  - Balls Collecting Strainers (as applicable).
  - Balls recirculating Skids.
  - Other equipments considered necessary for Layout/ Civil.

- Electrical Load Data (Enclosed at Vol. III of Specification)
- Schedule of Deviation (Enclosed at Schedules).

The bidder to note that load requirement furnished and finalised during tender stage shall only be provided by BHEL and any changes or additional requirement of Electrical load by bidder during contract stage shall be provided by BHEL with cost repercussions to the bidder.

NOTE: Apart from above, no other drawing/ document/ data sheet etc. shall be submitted along with the offer. If any drawing/ document etc. is submitted with the offer, same shall be considered as for 'Reference' purpose only and shall not be reviewed/ commented upon and any deviation, exclusion to scope, etc. taken in documents but not highlighted in the deviation schedule shall not be taken cognizance of.

14.0 COLTCS packing procedure before dispatch

The purpose of this procedure is to outline the requirements and procedures for protecting the equipment's during shipment and preserving during the storage.

14.1 **Preparation for Packing:**

- After hydro testing, operation, all fluids e.g. water etc., shall be completely drained from all COLTCS's parts, and the equipment blown dry.
- All material shall be cleaned internally and externally to remove, scale, rust fillings and any other foreign material.
- The COLTCS shall be placed on a strong wooden base & bolted to the wooden base using the foundation holes for further transportation up to site.

14.2 **Protection of parts:**

- BALL SEPARATOR) shall be packed in properly in high grad bubble plastic wrap for transportation, and long storage at site.
- Actuators shall be packed in separate wooden box of proper sizes.
- COLTCS items (EXCEPT BALL SEPARATOR) shall be packed in proper sizes of wooden cases. High grade woods like Rubber woods, jungle wood, hard wood, mango wood, pine wood, etc. is used for packing.
- Loose material, & Electrical & Electronics items shall be packed in corrugated box and plastic bags with proper tagging and marking of handle with care in proper sizes of wooden cases

- All finished (or) machined (External C.S. Surfaces shall be protected against corrosion with corrosion resisting coating, which is easily removable (Compound shall be such that it will remain on the surface at temperature normally encountered during shipping & storage).
- All machined surfaces shall be protected from mechanical damage. All external unfinished carbon steel surfaces shall be sand blasted & shall be coated with rust preventive primer.
- Flanged opening if any shall be covered with blank flanges sealed with blank gasket of natural rubber or equivalent. Butt welded opening shall be closed with temporary closing covers. Internal threads shall be protected with metal plug sealed with Teflon tape (if applicable). External thread shall be protected with PVC sleeve.
- Wooden cases shall be covered with HDPE cloth from inside wooden box and the top. All the opening in plate heat exchanger shall be closed properly by suitably covering to prevent foreign material entering in plate heat exchanger.
- All fabricated wooden cases & crates conform to the requirement as per table given below:

Gross Weight [Kgs.]	Board Thickness	Batton / Rafter Thickness
2000 to 9000	Min. 30 mm	Min. 35 mm
9000 to 18000	Min. 50 mm	Min. 35 mm

- All the equipment shall be protected for entire period of dispatch, storage and erection against corrosion, incidental damage due to vermin, sunlight, rain, high temperature, humid atmosphere, rough handling in transit and storage. All MS parts which are not painted shall be provided with coating of grease.
- Clay Desiccant or such other moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.

14.3 **Preservation**

The equipment's shall be stored under closed/open space in packed condition until installation. The packages containing loose plates and gaskets are to be protected from extreme climatic conditions.

14.4 **Photographs**

Bidder to take photographs of all parts like Ball separators, screen, pumps, piping, valves, instruments, actuators, panel (inside & outside) and sent to engineering deptt along with all inspection reports before final dispatch.

VOLUME : IIC

SECTION-VII

CONDENSER TUBE CLEANING SYSTEM

CONTENT

VOLUME : IIC

SECTION-VII

CONDENSER TUBE CLEANING SYSTEM

1.00.00 SCOPE OF WORK

The scope of supply under On Line Tube Cleaning System shall be as below. Items not mentioned but deemed necessary by the Bidder for making the system completely reliable and efficient shall also be included along with mandatory spares.

a) Condenser On Line Tube Cleaning System consisting of -

i) One (1) no. Ball separator on each C.W. outlet pipes. Each ball separator shall consist of Carbon Steel flanged shell, ball separator screens, ball extraction arrangement, drive units for actuation of screens, differential pressure measuring system etc.

ii) One (1) no. ball re-circulation units complete with pumps, drive motors, ball collectors, etc.

iii) One (1) no. Ball Re-circulation Monitor and ball injection arrangement with nozzles.

b) All interconnecting pipes with necessary valves, fittings, pipe supports etc. for connecting ball separator section to ball re-circulating skid, re-circulating skid to injection point, drain line, vent line, drain collectors (floor level), sample points with suitable valves etc.

c) All supporting steel structures for the equipment, piping and instrument for the skid.

d) All foundation bolts and embedded inserts required for anchorage of machines, equipments, structures, and cable trays.

e) Required number of cleaning balls (normal sponge balls as well as abrasive balls) for commissioning of the system.

f) The scope of Instrumentation & Control shall include but not be limited to the following :

i) One (1) local control panel for tube cleaning system with installed local instrumentation, controls, alarms, completely wired. The control panel shall be provided with segregated power compartment. This local control panel shall be supplied with anti vibrations supports.

ii) All field and local control board mounted instruments along with accessories; their supports and all logic necessary to satisfy the requirements described in this specification.

iii) All necessary Pressure Gauges, Differential Pressure Gauges, D.P. Transmitters, Ball Monitoring Units required for the functional completeness of the above systems/equipments.

iv) Instrumentation and control cables along with accessories as necessary.

g) Cable trays, conduits, their supports and all mounting materials within the skid.

2.00.00 CODES AND STANDARDS

"The design, material, construction, manufacture, inspection, testing and performance of Condenser on-line tube cleaning system and associated equipment shall comply with the latest edition of all currently applicable standards, statutory regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the Bidder of his responsibility. In case of conflict between the standards, stringent specifications out of these standards shall govern, whereas in case of conflict between the standards and this specification, requirements of this specification shall govem. Other National standards are acceptable if they are established to be equal to or superior to the listed standards. In all such cases, however, copies of English translation of such National standards shall be attached to the tender. The tenders not complying with this requirement are liable for rejection".

The design, materials requirement, manufacture, testing and performance requirements of the condenser On Line Tube Cleaning System shall conform to the latest edition of the following codes, standards, specification and regulation:

a) Standards of the Hydraulic Institute of USA.

b) PTC 8.2 : Power Test Codes - Centrifugal pumps.

c) ASME Section VIII: Pressure Vessel Code , 2001

d) ASTM - American Society for Testing & Materials.

e) American National Standards (ANSI) on -

i) Steel Pipe Flanges and Flanged Fittings (B 16.5)

ii) Steel Fittings S.W. and Threaded (B 16.11)

iii) Butt welding ends-Pipe, valves, & fittings (B16.25).

iv) Valves – Flanged, Threaded and Welding End (B 16.34)

f) American Society for Non destructive Testing (SNT-TC-1A)

g) NEMA : National Electrical Manufacturer's Association

h)	OSHA	:	Occupational Safety and Health Act
i)	IEEE	:	Institute of Electronics and Electrical Engineers
j)	ISA	:	Instrument Society of America

Other standards such as IEC, VDI, DIN, BS, IS etc. shall also be accepted subject to the owner's approval for which the Bidder shall furnish along with the bid adequate information to justify that these standards are equivalent or superior to the standards mentioned above. For such alternate standards, which are not normally published in English, bidder shall also furnish a complete translation for them.

Technical requirements of the condenser On Line Tube Cleaning System have been indicated in the "Data Sheet" in Annexure-I of this specification. In case of any contradiction between the above standards and data sheets, the stipulations in the data sheet shall prevail and shall be binding on the Contractor.

2.01.00 **General Description**

For maintenance of degree of cleanliness of the condenser tubes, this on load ball re-circulation type tube cleaning system at CW inlet line to condenser will be employed. The on line condenser tube cleaning system shall maintain a circulation of resilient balls in a closed loop through the condenser tubes. Thus, while passing through the tubes, the balls get deformed thereby cleaning the inner surface of the tubes. The balls will be injected at the C.W. inlet pipe by ball recirculation pumps, which subsequently will be distributed evenly throughout the cross-section of the condenser tube sheet to effect uniform cleaning of tubes. The balls after passing through the tubes will be taken out of the C.W. outlet pipes. The balls are then led to the C.W. inlet pipe once again for recirculation.

3.00.00 **DESIGN AND MANUFACTURING / CONSTRUCTION REQUIREMENT**

3.01.00 **Design Considerations**

The online condenser tube cleaning system shall overcome fouling, scaling and clogging of tubes thru micro-fouling caused by sludge, corrosion products/micro-organisms etc. which may result due to increased cooling water temperature and reduction in heat transfer co-efficient particularly due to disturbances in the calcium-carbonate, carbon-dioxide equilibrium as well as by precipitation of calcium carbonate, silicate, calcium sulphate, magnesium salts etc.

Equipment/works offered shall be designed for high availability, high reliability, low maintenance and ease of operation & maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability, availability, operability and ease of maintenance. He shall also furnish details of availability records in plants stated in his experience list.

All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Where feasible common components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

3.02.00 **General Performance Requirement**

3.02.01 Performance requirements of the tube cleaning system covered by this specification are as follows :

i) The cleanliness of the condenser tubes utilising continuous operation of the system such that the contribution of the tube waterside fouling to the variation of the condenser vacuum from its design value is negligible.

ii) The pressure drop across the ball separator screens during normal cleaning operation shall be minimum (it should not be more than 20 millibar).

iii) In the automatic system, sequential operations of various equipment in tube cleaning system must be performed in such a manner that there is absolutely no loss of balls during any cleaning or washing mode of operation of the system.

iv) The online condenser tube cleaning system shall perform satisfactorily under the specified flow indicated in the technical specification (in the condenser) and shall be capable of removing the various forms of fouling & scaling from condenser tubes. The condenser back pressure / overall heat transfer co-efficient shall be guaranteed to the close limits as specified as long as the tube cleaning system is in operation.

v) The quantity of cleaning balls worn out and/or lost shall be as minimum as possible. The quantity of cleaning balls required for an operating period of one year shall be guaranteed.

vi) Bidder shall prove the guaranteed performance figures for the unit during the performance testing. The performance testing of the complete tube cleaning system will be done at site after its installation after twelve months from the initial trial.

vii) The EPC Contractor will be responsible for mechanical and chemical cleaning of the condenser when on line condenser tube cleaning system is to be commissioned and put into service for the first time. At this stage, the cleanliness of the condenser tube shall be assumed as 100%. This will ensure that condenser tubes are in clean condition when on line condenser tube cleaning system is commissioned.

viii) The temperature difference between condensate & C.W. outlet shall be measured at the time of commissioning of the system after its operation is established. On completion of twelve months operation, when the ambient condition will be more or less same as at the time of commissioning the temperature difference between condensate &

C.W. outlet will be measured and should be the same as it was at the time of commissioning, with similar ambient temperature conditions.

xi) The contractor shall prove the guaranteed performance figures during the performance guarantee test.

3.02.02 During the trial operation the temperature difference between condensate and CW outlet shall be measured after putting the unit on full load. The cleanliness of the condenser tubes shall be considered as 100% at this stage.

The operation of this system may be continuous/intermittent as mutually decided by the Owner and contractor. On completion of twelve months operation of online condenser tube cleaning system, when the ambient conditions will be more or less same as at the time of commissioning of the system, the temperature difference of condensate and CW outlet will be measured and should be same as it was at the time of commissioning, with similar ambient temperature conditions.

If the guarantees specified are not achieved by the contractor, then the contractor shall be given an opportunity to improve upon the performance & the performance shall be checked again after the corrections are carried out. If even after carrying out corrections in the system, the performance is not satisfactory, then the plant stands rejected.

3.02.03 During trial operation the cleanliness factor shall be calculated on the basis of the ratio of the heat transfer rate obtained with the tube cleaning system in service for 12 months and the available Heat transfer rate at the time of commissioning (condenser tubes at 100% clean condition) of the system with similar ambient temperature conditions.

Heat Transfer rate will be calculated as per the standard formula for the steam surface condenser.

Before commissioning and putting the online condenser tube cleaning system into service for the first time, the EPC Contractor shall do the mechanical and chemical cleaning of the condenser tubes. This will ensure that condenser tubes are in clean condition and heat transmission rate will be calculated and will be denoted by Uf.

The operation of this system may be continuous/intermittent as mutually decided by the Owner and the contractor. On completion of 12 months operation of online condenser tube cleaning system when the ambient conditions will be more or less similar to conditions as at the time of commissioning of the system, the heat transmission rate will be calculated and will be denoted by Uo.

The ratio of Uo/Uf will be calculated for the cleanliness factor Cf. The plant stands rejected in the Cf is observed to be less than 85%.

3.03.00 Constructional Features

3.03.01 General

Unless inconsistent with this specification, the supplier's standard or usual construction is desired.

The equipment shall be capable of safe, reliable and continuous operation at all conditions of circulating water flow through the condenser tubes maintaining the design cleanliness factor of the tubes.

3.03.02 Ball Separator

The design of the ball separator section shall aim at the maximum rigidity of the screens by adequate stiffening bars.

The construction of the ball extraction area shall ensure smooth and reliable removal of the balls out of the separator section.

The separator shall have flanged ends and flange drilling shall conform to AWWA C207 standard.

3.03.03 Ball Collector

The size of the ball collector shall be determined by the number of condenser tubes coming per path, the relevant ball circulation frequency and the cleaning ball diameter.

The integral non-return flap shall ensure no reverse flow in case of ball recirculation pump-motor failure thereby avoiding any loss of balls.

3.03.04 Ball injection system

The design of the injection system shall be such that it performs an even distribution of requisite cleaning balls at the C.W. inlet pipe so that each condenser tube receives a cleaning ball regularly at fairly short intervals.

3.03.05 Cleaning balls

Resilient balls of proper hardness and correct size shall be selected based on factors like tube material, nature of fouling expected, tube internal diameter and desired service life of the balls.

Only a single type of ball to cater for the entire range of tube fouling may not adequate. The supplier shall furnish different types of balls as required in sufficient quantities to take care of all possibilities like (a) normal maintenance of tube cleanliness when function of the ball is more of that of polishing than removing of scales (b) removal of comparatively hard scale formed due to non-availability of the tube cleaning system for reasons like failure of the system, long shutdown of the generation unit, etc.

3.03.06 Schedule of Materials

Materials of construction of components of various equipment covered by this specification shall be as per data specification sheet.

In selecting materials of construction of equipment, the Contractor shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal.

All materials shall be new, and shall be of the quality most suited to the proposed application.

In as far as is possible, materials shall be in accordance with national or international standard specifications and shall be used in accordance with national or international codes of practice. Where such standards or codes of practice are not available sufficient information shall be provided to allow the owner to assess the suitability of the material for the particular application.

All materials used shall have demonstrated lengthy satisfactory service in similar or more arduous conditions to those proposed by the Contractor.

3.03.07 Drive Motor

Drive motor and actuators for valves and screen shall be as per Vol. IIF of this specification.

3.04.00 **Instrumentation and Control**

Operation of the condenser on line tube cleaning system with necessary audio / visual alarm / indications will be initiated through DCS based control system . The system shall be controlled from the DCS. , either in 'Auto' or 'Manual mode, by means of a selector switch. Following are the major control logics to be provided for operation of the automatic tube cleaning system. However, the bidder may offer additional control features also, if considered necessary by him for smooth and trouble-free operation of the system. Provision for manual over-ride of any automatic operation shall be made available in the panel. Potential free contacts for START/STOP signal interfaces with the MCC shall be provided.

a) Start-up of the cleaning system after manually feeding the requisite number of balls into the collector :

The above operation & control will be achieved through steps like setting the selector switch on local control panel to "Auto" mode and pressing the push button to "system ON". Other steps will follow sequentially viz. tilting of the screens in the strainer section to "ball circulating position", starting of recirculation pump, turning the ball catching flap in the collector to "ball circulation" position, etc. In case of manual mode, all steps will be achieved manually by operating the corresponding push buttons.

b) Automatic shut-down of the cleaning system either periodically or as per operator's requirement by pressing the push button from the local control panel.

Under "Auto" mode, pushing of "System OFF" push button shall initiate the above operation, through steps like turning the ball catching flap in the collector to "ball catching" position, stopping the recirculation pump after a set period.

c) Monitoring of strainer section screen fouling by differential pressure measuring system.

d) Indicators & Alarms

The following minimum indications shall be provided :

i) Tube cleaning system ON-OFF

ii) Pump ON-OFF

iii) "Screen Operation"

iv) DP High-Normal

v) MOV "Open"-"Close"

vi) Various failure positions

The following minimum alarms shall be provided :

i) Pump tripped

ii) DP - high and very high

iii) M.O.V failure to open or close

iv) Screen Actuator failure

The above list of logics is not exhaustive and the supplier shall provide all other control logics required for the safe and trouble-free operation of the system. Necessary interlocks, (e.g. recirculation pump will not run if the strainer section is in 'screen wash' position) for proper operation of the system shall also be provided. The supplier shall furnish the write-up and logic diagrams for interlock and protection.

4.00.00 OPERATING CONDITIONS / REQUIREMENTS

4.01.00 Operational Features

The tube cleaning system shall be semi automatic and shall be operated from DCS.

4.02.00 **Ball Separator Strainer Section and Differential Pressure Measuring System**

During the normal cleaning mode the screens shall allow the circulating water leaving the condenser to pass through with very little pressure drop across the screens. However, the cleaning balls coming out of the condenser tubes will be prevented from escaping. These balls will get collected over the separator screens and are extracted from the strainer section and pumped back to the system for re-cycling.

Whenever the pressure drop across the strainer, as sensed by the differential pressure measuring system, exceeds a pre-set limit, annunciation shall appear in the local panel.

4.03.00 **Recirculation Pump and Injection Nozzles**

The recirculation pump will extract the balls from the ball separator strainer section and push them through the ball collector to the ball injection nozzles. The ball injection nozzles shall point against the direction of the C.W. flow for better ball distribution.

5.00.00 **INSPECTION AND TESTING**

The manufacturer shall conduct all tests and inspections (including stage inspections, as necessary) required to ensure that the equipment offered by him conforms to the requirement of this specification. The particulars of the proposed tests and the procedures for the tests shall be submitted to the Purchaser for approval before conducting tests.

Test certificates for all tests shall be submitted to the purchaser for approval.

5.01.00 **Material test**

All materials used for the manufacture of the equipment covered under this specification will be of tested quality. Physical and chemical tests on materials shall be done to ensure the quality of the material offered. Test procedures and sampling shall be guided by the applicable test Codes and Standards. Components for which material test has been done and approved shall be stamped for identification.

Components viz. ball separators, ball vessels, and ball recirculation pumps, fabricated main flanges and counter flanges shall be subjected to Non-Destructive Testing as per following requirement and the acceptable limits shall be guided by relevant standard(s):

5.01.01 Visual Tests

All the parts/components shall be visually inspected in full (100%) for configuration, size, surface finish etc with approved drawings and documents.

5.01.02 Liquid Penetrant and Ultrasonic Tests

i) All weldments, pressure containing parts of pumps (casing and shaft), screen shaft, fabricated main flanges and counter flanges shall be surface inspected inside and outside by means of magnetic particle or liquid penetrant test to ensure freedom from cracks and other defects. Test procedure shall be in accordance with purchaser approved procedure.

ii) Ball separator shell nozzles and flanges (>40 mm thk plate), screen shaft and pressure containing parts of pumps made from forging shall be 100% ultrasonic tested in accordance with the relevant ASTM Standards.

5.01.03 Radiography Test

All weldments of fabricated main flanges, counter flanges and screen assembly shall be 100% radiographed and butt welding joints of pipe work will be at least 10% radiographed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code and shall comply with the Standards of Section VIII of the ASME Boiler and Pressure Vessel Code

5.02.00 **Hydrostatic Testing**

Pump casing, ball separator shell and the interconnecting piping shall be hydrostatically tested at one and one-half times the design pressure.

5.03.00 **Performance Testing**

Each pump in the tube cleaning system shall be tested to determine pump performance. Prior to performance tests, the pump supplier shall furnish the procedures and methods of testing to the purchaser for approval.

6.00.00 **DRAWINGS, DATA AND MANUALS**

6.01.00 **To be submitted with the bid**

The Bidder shall submit the following along with his formal proposal besides the different information required as indicated elsewhere in this specification.

i) Piping and Instrumentation Diagram

ii) Equipment GA, Layout, interlock, Instrument List, Instrument Data Sheet Alarm List, Local Control Panel GA and Layout, Technical literature, Operational write up with logic diagram.

iii) Equipment load list and foundation design.

6.02.00 **Drawing/Document To Be Submitted After Award**

Final version of all drawings/documents listed in 6.01.00 above.

ANNEXURE-I

DATA SPECIFICATION SHEET
FOR
CONDENSER ON LINE TUBE CLEANING SYSTEM

1. **Condenser Data**

No. of condensers per generating unit		:	As per TG manufacturer's system design/configuration

2. **Material of Construction**

a)	Ball Separator Section			
	i)	Separator shell flanges	:	Carbon Steel
	ii)	Separator shell	:	Carbon Steel
	iii)	Internals	:	SS 316
	iv)	Bolts & nuts in contact with circulating water	:	SS 316
b)	Ball Recirculation pumps			
	i)	Casing/ impeller	:	CI / SA 351 CF8M
	ii)	Shaft	:	SS 316
c)	Ball Collector			
	i)	Housing	:	Stainless Steel
	ii)	Internals	:	SS-316
d)	Ball Valves			
	i)	Body	:	SA 351 CF8M
	ii)	Ball	:	SA 351 CF8M
	iii)	Stem	:	SS 316
e)	Interconnecting piping			
	i)	Interconnecting piping and fittings between ball separator section to ball re-circulating skid and re-circulating skid to injection point	:	SS 316

f) Details of cleaning balls for commissioning of the system

Normal sponge balls & abrasive balls

i)	Type	:	Spherical
ii)	Number of balls per charge per system	:	Bidder to decide
iii)	No. of charges per system	:	To suit the system
iv)	Size	:	To suit the system

SUB-SECTION – IB

SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

	TITLE:	SPECIFICATION NO.
	ELECTRICAL EQUIPMENT SPECIFICATION FOR	
	COLTCS	VOLUME NO. : **II-B**
		SECTION: I
	1 X 800 MW WANAKBORI TPS	REV NO. : **00** DATE: 07.11.2015
		SHEET: 1 OF 1

1.0 **EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:**

a) Services and equipment as per "Electrical Scope between BHEL and Vendor".

b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.

c) Supply of mandatory spares as specified in the specifications of mechanical equipment.

d) Erection and commissioning spares.

e) Erection & Maintenance tools & tackles.

f) Electrical load requirement for COLTCS.

g) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.

h) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer /BHEL approval without any commercial and delivery implications to BHEL.

i) Various drawings, data sheet as per required format, quality plans, calculations, Type test & Routine test reports & certificates, operation and maintenance manuals, Complete technical literature with catalogues etc shall be furnished as specified at contract stage. All documents shall be subject to customer /BHEL approval without any commercial implications to BHEL.

j) Motor shall meet minimum requirement of motor specification.

k) LT power & control cables shall meet minimum requirement of LT power & control cables specification.

l) Cabling, earthing & lightning protection shall meet minimum requirement of cabling, earthing & lightning protection specification.

m) The sub-vendor list for various electrical items is subject to BHEL/Customer approval without any commercial implications.

2.0 **EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:**

Refer "Electrical Scope between BHEL and Vendor".

3.0 **DOCUMENTS TO BE SUBMITTED ALONG WITH BID**

3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/ quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:

a) A copy of this sheet "Electrical Equipment Specification for COLTCS" and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.

b) List of Erection and Commissioning spares.

c) List of Erection & Maintenance tools & tackles.

d) Electrical load requirement.

e) If there is any conflict, customer motor specification will prevail over BHEL motor specification.

3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc. is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 LIST OF ENCLOSURES

4.1 Electrical scope sheet between BHEL & Vendor.
4.2 Customer Spec. for LV Motors.
4.3 General requirement of LV Motors.
4.4 Data Sheet - A for LV Motors.
4.5 Electrical Load Data Format.
4.6 Datasheet-C (to be filled by Vendor)
4.7 QP for LV motors
4.8 Customer Specification for Cables
4.9 Customer Specification for Erection Cabling, Grounding And Lightning Protection
4.10 Customer Specification for LT Switchgear

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES: COLTCS
SCOPE OF VENDOR: SUPPLY

PROJECT: 1X800 MW WANAKBORI TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC Starter cum control panel (if applicable)	BHEL Vendor	BHEL BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	 BHEL Vendor BHEL	 BHEL BHEL BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Cabling/ termination by BHEL.
4	Junction box for control & instrumentation cable	Vendor	BHEL	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc.	Vendor	BHEL	Refer scope/ C&I portion of specification for scope of fibre Optical cables if used between PLC/ micro processor & DCS.
6	Cable trays, accessories & cable trays supporting system	BHEL	BHEL	
7	Cable glands and lugs for equipment supplied by Vendor	Vendor	BHEL	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty copper lugs for power & control cables.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	BHEL	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	
10	Equipment grounding & lightning protection	BHEL	BHEL	

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES: COLTCS
SCOPE OF VENDOR: SUPPLY

PROJECT: 1X800 MW WANAKBORI TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	BHEL	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	BHEL	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Equipment layout drawings	Vendor	-	For preparation of cabling layout drawings by BHEL, vendor shall furnish Electrical equipment layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling,
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.	VERIFICATION FROM MOTOR DATASHEET (Y/N)	KKS NO
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
ANNEXURE-II																				

NOTES:
1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER
2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V
: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

LOAD DATA (ELECTRICAL)	JOB NO.	408	ORIGINATING AGENCY		PEM (ELECTRICAL)
	PROJECT TITLE	1x800 MW WANAKBORI TPS	NAME		DATA FILLED UP ON
	SYSTEM	COLTCS	SIGN.		DATA ENTERED ON
	DEPTT. / SECTION	ELECTRICAL	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE

	TITLE	SPECIFICATION NO.
	LV MOTORS	VOLUME II B
		SECTION D
	DATA SHEET-A	REV NO. 00 DATE 07/11/2015
		SHEET 1 OF 1

1.0	Design ambient temperature	:	50 ^{o}C
2.0	Maximum acceptable kW rating of LV motor	:	Upto 160KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree Of Protection	:	IP55
5.0	Cooling	:	TEFC
6.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V $\pm$ 10%
	b) Rated frequency (with variation)	:	50 Hz (Variation: +5% TO –5%)
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal box	:	50 kA for 0.25 sec
	f) LV System grounding	:	Solidly
7.0	Class of insulation	:	Class ‘F’, with temp rise limited to class B.
8.0	Minimum voltage for starting (As percentage of rated voltage)	:	80% of rated voltage
9.0	Power cables data	:	Shall be given during Detailed engg.
10.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
11.0	Space heater supply **(30KW & ABOVE)**	:	240 V, 1Φ , 50 Hz
12.0	Rating up to which Single phase motor	:	Acceptable below 0.20 Kw
13.0	TYPE OF STARTER PROVIDED IN MCC	:	DOL
14.0	Locked rotor current		
	a) Limit as percentage of FLC	:	As per IS 12615
	b) Permissible tolerance, if any	:	
15.0	Additional tests	:	As per QP
16.0	Flame-proof motor		
	a) Enclosure suitable (As per IS:2148)	:	As per requirement
	b) Classification of Hazardous area (As per IS: 5572 part-I)	:	As per requirement
	c) Degree of protection	:	IP65
17.0	Makes	:	AS PER ANNUXURE-I
18.0	Terminal box	:	Suitable to rotate at 90 degrees
19.0	Paint shade	:	Shade 632 of IS-5

	TITLE	SPECIFICATION NO.
	LV MOTORS	VOLUME II B
		SECTION D
	DATA SHEET-A	REV NO. 00 DATE 07/11/2015
		SHEET 2 OF 1

NOTE :

1. Also detail Customer spec. for Motors is to be referred as enclosed with technical spec.

CABLE SCHEDULE FORMAT

ANNEXURE III

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

ANNEXURE-I

SUB-VENDOR LIST

The list of approved make of the LT Motors are as mentioned below:

S.No.	LIST OF LT MOTORS
1.	BHARAT BIJLEE LTD.
2.	CROMPTON GREAVES
3.	ASEA BROWN BOVERI
4.	KIRLOSKAR ELECTRIC CO LTD.
5.	NGEF
6.	SIEMENS
7.	MARATHON
8.	GE-POWER
9.	RAJINDRA ELECT INDUSTRIES
10.	LAXMI HYDRAULICS PVT. LTD

However, the final list of makes for the LT Motors is subjected to BHEL/Customer approval, during contract stage, without any commercial implications.

VOLUME : IIF/1

SECTION-II

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

CONTENT

Bharat Heavy Electricals Limited PS-Mktg. Delhi

VOLUME : IIF/1

SECTION-II

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

1.00.00 SCOPE

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

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

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

2.00.00 STANDARDS

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

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

IS-325

IS-12615

IEC-34

3.00.00 SERVICE CONDITIONS

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

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

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

4.00.00 **TYPE AND RATING**

4.01.00 **A.C. Motors**

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

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

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

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

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

4.02.00 **D.C. Motors**

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

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

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

5.00.00 **PERFORMANCE**

5.01.00 **Running Requirements**

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

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

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

5.02.00 **Starting Requirements**

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

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

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

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

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

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

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

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

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

5.03.00 **Stress During Bus Transfer**

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

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

5.04.00 **Locked Rotor Withstand Time**

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

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

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

Bharat Heavy Electricals Limited PS-Mktg. Delhi

Gujarat State Electricity Corp. Ltd. GSECL P&P Vadodara 088

6.00.00 **SPECIFIC REQUIREMENTS**

6.01.00 **Enclosure**

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

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

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

6.02.00 **Cooling**

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

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

6.03.00 **Winding and Insulation**

6.03.01 All insulated winding shall be of copper.

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

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

6.04.00 **Tropical Protection**

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

6.04.02 All fittings and hardwares shall be corrosion resistant.

6.05.00 **Bearings**

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

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

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

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

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

6.05.06 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.

6.05.07 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.

6.05.08 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.

6.05.09 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.

6.06.00 **Noise & Vibration**

6.06.01 The noise level shall not exceed 85db (A) at 1.5 metres from the motor at no load condition.

6.06.02 The peak amplitude of the vibration shall be within IS/IEC specified limits.

6.07.00 **Motor Terminal Box**

6.07.01 HT Motor terminal box (Phase side) shall be Phase Segregated (PSTB) type and LT motor terminal box shall be non-phase segregated type. Both HT & LT motor terminal box shall be located in accordance with Indian Standards clearing the motor base- plate/ foundation.

6.07.02 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors and 90 Deg. for LT motors unless otherwise approved.

6.07.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.

6.07.04 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.

6.07.05 Motor main terminal box shall be located right hand side of motor body looking from driving end.

6.07.06 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.

6.07.07 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.

6.07.08 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.

6.07.09 HT motor phase side terminal box shall be phase-segregated type and HT motor neutral leads shall be brought out in a separate terminal box preferably

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

6.07.10 Motor terminal box shall be furnished with suitable cable lugs and nickel plated double compression brass glands to match with cable used.

6.07.11 The gland plate for single core cable shall be non-magnetic type.

6.08.00 **Grounding**

6.08.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.08.02 The grounding connection shall be suitable for accommodation of ground conductors as follows :

HT Motor (11kV, 6.6kV & 3.3 kV)	:	75 X 10 mm GS Flat
LT Motor above 90 KW	:	50 x 6 mm GS Flat
Motor above 30 KW up to 90 KW	:	35 x 6 mm GS Flat
Motor above 5 KW up to 30 KW	:	25 x 3 mm GS Flat
Motor up to 5 KW	:	8 SWG GI Wire

6.08.03 The cable terminal box shall have a separate grounding pad.

6.09.00 **Rating Plate**

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate :

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

b) Degree of protection.

c) Bearing identification no. and recommended lubricant.

d) Location of insulated bearings.

7.00.00 **ACCESSORIES**

7.01.00 **General**

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 **Space Heater**

7.02.01 Motor of rating 30 KW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.02.02 The space heater shall be rated 240 V, 1 phase 50 Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.03.00 **Temperature Detectors**

7.03.01 All 11000V, 6600V and 3300V motors shall be provided with twelve (12) nos. simplex type winding temperature detectors, four (4) nos. per phase. Six (6) nos. duplex type winding temperature detectors, two (2) nos. per phase shall only be acceptable for special application motors only subject to approval of owner.

7.03.02 11000V, 6600V and 3300V motor bearing shall be provided with duplex type temperature detectors.

7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.

7.03.04 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DCS connectivity.

7.03.05 Five numbers of Temperature detectors / thermisters shall be provided for L.T. motors above 90 KW (3 nos. winding temperatures & 2 nos. bearing temperatures)

7.04.00 **Indicator/Switch**

7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:

a) 11000 V, 6600V and 3300V motor bearing temperature.

b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.

7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used.

7.04.03 Alarm switch contact rating shall be minimum 0.5 A at 220V D.C. and 5A at 240V A.C.

7.05.00 **Current Transformer for Differential Protection**

7.05.01 Motor 1000 KW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure. Loose 3 nos. CT for mounting on switchgear side shall be in bidder's scope.

7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.

7.06.00 **Accessory Terminal Box**

7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.

7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit cable connections.

7.07.00 **Drain Plug**

Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 **Lifting Provisions**

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

7.09.00 **Dowel Pins**

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 **Painting**

Motor including fan shall be painted with corrosion proof paints of colour battle ship grey shade 632 of IS-5.

8.00.00 **TESTS**

Routine and Type Tests are to be conducted in presence of customer's representative as per IS:325 and required copies of test certificates are to be furnished for approval. In addition, following tests shall have to be carried out on the motors in presence of OWNER's representative on 3.3kV/6.6kV/11kV motors.

a. Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-60034, part -15 test voltages as under :

Voltage rating of motor	Impulse Test Voltage
3.3 kV	18 kV peak
6.6 kV	31 kV peak
11 kV	49 kV peak

b. Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test.

c. Polarization Index Test as per IS:7816 as routine test

d. Test for suitability of IPW– 55 (Weather proof) as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test, provided the test motor is identical to motor being supplied.

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Second numeral test shall be carried out on one motor of each type and rating.

e. Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box.

f. Test for noise level as routine test.

g. Test for vibration as routine test.

h. Tan delta measurement on coils.

i. Surge withstand test for inter turn insulation.

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

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

9.00.00 **DRAWINGS, DATA & MANUALS**

Drawings, data & manuals for the motors shall be submitted as indicated below:

9.01.00 **Along with the bid**

a) List of the motors

b) Individual motor data sheet as per format of the proposal data sheets.

c) Scheme & write up on forced lubrication system, if any

d) Type test report

9.02.00 **After Award of the Contract**

a) Dimensional General Arrangement drawing

b) Foundation Plan & Loading

c) Cable end box details

d) Space requirement for rotor removal

e) Thermal withstand curves hot & cold

f) Starting and speed torque characteristics at 80% & 100% voltage

g) Complete motor data

h) Erection & Maintenance Manual

i) Test reports

j) Data sheets to be enclosed

ANNEXURE-A
DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

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

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

2.0 RANGE OF VARIATION

A.C. Supply :

Voltage : ± 10% Frequency : ± 5% Combined Volt : 10% (absolute sum) + frequency

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage : 187 to 242 Volt

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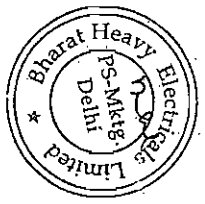
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Delhi

VOLUME : IIF/1

SECTION-III

TECHNICAL SPECIFICATION FOR ELECTRIC MOTOR ACTUATORS

CONTENT

VOLUME : IIF/1

SECTION-III

TECHNICAL SPECIFICATION FOR ELECTRIC MOTOR ACTUATORS

1.00.00 SCOPE

1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves, dampers and gates.

1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification.

2.00.00 STANDARDS

2.01.00 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.

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

i) IS-9334

ii) IS-325

3.00.00 SERVICE CONDITIONS

3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.

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

3.03.00 For actuator motor installed outdoor and exposed to direct sun rays , the effect of solar heat [manufacturer to decide] shall be considered or overhead shed shall be provided locally to avoid direct sun rays.

4.00.00 RATING

4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer.

4.02.00 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

5.00.00 **PERFORMANCE**

The actuator shall meet the following performance requirements:

5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.

5.02.00 Attain full speed operation before valve load is encountered and impart an unseating blow to start the valve in motion (hammer blow effect).

5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.

5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.

5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

6.00.00 **SPECIFIC REQUIREMENT**

6.01.00 **Construction**

6.01.01 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring. Actuator shall be non integral type.

6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy.

6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

6.02.00 **Motor**

6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service. Canopy shall be provided for outdoor service.

6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.

6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.

6.02.04 Motor leads shall be terminated in the limit switch compartment.

6.02.05 Motor actuators for valves/dampers shall be non-integral type with separate starter units and operable from remote.

6.02.06 Earthing terminals shall be provided on either side of the motor.

6.03.00 **Limit Switches**

Each actuator shall be provided with following limit switches: -

6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.

6.03.02 4 end-of-travel limit switches, two for each direction of travel.

6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.

6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.

6.04.00 **Hand Wheel**

Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.

6.05.00 Position Indicator/Transmitter

The actuator shall have:

6.05.01 One (1) built-in local position indicator for 0-100% travel.

6.05.02 One (1) position transmitter, potentiometer type, for remote indicator.

6.06.00 **Space Heater**

A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.

6.07.00 **Wiring**

All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules. All wires shall be fire resistance type.

6.08.00 **Terminal Box**

The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.

VOLUME : IIF/1

SECTION-VII

TECHNICAL SPECIFICATION
FOR
415V PMCC/MCC, 415V ACDB AND 220V DCDB

CONTENTS

VOLUME : IIF/1
SECTION-VII
TECHNICAL SPECIFICATION
FOR
415V PMCC/MCC, 415V ACDB AND 220V DCDB

1.00.00 SCOPE OF SUPPLY

1.01.01 The following equipment shall be furnished complete with all accessories :-

Power cum Motor Control Centre (PMCC)

Motor Control Centre (MCC)

AC Distribution Boards (ACDB)

DC Distribution Boards (DCDB)

1.01.02 The base channel frame with hardware and lifting angles.

1.01.03 One set of special tools and tackles.

1.01.04 Set of accessories as listed below :

a) Breaker lifting and handling trolley

b) Test cabinet with coupling cables for testing the breaker in drawout position

c) Racking in/out handle for breakers

1.01.04 Mandatory Spares.

1.01.05 All relevant drawings, data and instruction manuals

2.00.00 CODES AND STANDARDS

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

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

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

3.00.00 **DESIGN CRITERIA**

3.01.00 The PMCCs/MCCs/DBs will be used to provide power, control and protection for 415V A.C. auxiliary services (Motors & Feeders) of the generating units.

3.02.00 Duty involves direct-on-line starting of large squirrel cage motors upto 160kW. The starting current varies from 6 to 8 times rated current at very low power factor.

3.03.00 The equipment will be located in a hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.

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

3.05.00 All equipment and components thereof shall be capable of withstanding the mechanical forces and thermal stresses of the short-circuit currents without any damage or deterioration of the materials.

3.06.00 The PMCCs shall have two incomers and one bus-coupler. The MCCs / DBs shall have two incomers and one bus-coupler OR two incomers with no bus coupler. In addition to electrical interlocks, mechanical castle key interlock shall be provided between the two incomers and the bus-coupler so that any two of the three may be closed at a time.

3.07.00 Busbars of PMCCs shall be sized to carry continuously the associated transformer secondary current plus a 20% margin.

Busbars of MCC/DBs shall be sized to carry continuously the total running load of MCC/DB plus a 20% margin.

3.08.00 In cubicle of incomers & bus section breakers/MCCBs shall be identical to the associated busbar rating.

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

3.10.00 Circuit breakers shall not produce any harmful over voltage during switching off of induction motors. If required, surge protective devices shall be included in the scope of supply to limit over voltages.

3.11.00 Incomers, Buscouplers & outgoing feeders rated upto & including 400A shall be MCCB controlled. Above 400A all incomers, Buscouplers & outgoing Feeders shall be ACB controlled.

3.12.00 All motor rated above 110kW, upto & including 160kW shall be ACB controlled. Motor rated upto & including 110kW shall be contactor operated.

3.13.00 MCC & PMCC shall have sufficient number of spare modules (at least 20% of various sizes used with a minimum of 1 no. for each rating and type).

3.14.00 Outgoing feeders of PMCC shall be limited to minimum number of different sizes so that max. standardization is achieved from MCCB & contactor size point of view.

3.15.00 Incomers & bus section breakers of PMCCs shall have provisions for remote operation from control room.

3.16.00 All breaker operated motor feeder shall be supplied from PMCC.

4.00.00 **SPECIFIC REQUIREMENTS**

4.01.00 **Construction**

4.01.01 PMCC / MCC / DB shall be indoor, metal-clad, air insulated and floor mounting type. ACB modules of PMCCs/MCCs shall be fully drawout type. MCCB / Switch Fuse modules shall also be fully drawout type. The design and construction shall be such as to allow extension at either end.

4.01.02 Generally PMCC / MCC / DB shall be of double front construction. Circuit Breaker panels of PMCC / MCC / DB shall be of single front construction.

4.01.03 PMCC / MCC / DB enclosure shall be dust and splash proof, conforming to a degree of protection IP-54. Minimum thickness of sheet metal used shall be 2 mm for load bearing members & 1.6 mm for other non-load bearing members.

4.01.04 PMCC / MCC / DB assembly shall comprise a continuous line up of dead front, free-standing vertical sections, housing the control modules in multi tier formation.

4.01.05 The design shall be fully compartmentalized with metal/insulating partitions between compartments. The working height shall be limited within 450 mm to 1800 mm from floor level.

4.01.06 Each control module shall be housed in a separate compartment, complete with an individual front access door having sufficient opening with concealed type hinges. Each vertical section shall have a removal back cover. All doors and covers shall be gasketed.

4.01.07 All push buttons, lamps, indicating instruments shall be flush / semi-flush mounted on respective module compartment.

4.01.08 A full height vertical cable chamber with cable supports shall be provided in each section to facilitate unit wiring. The chamber shall be liberally sized to accommodate all cables and shall have removable cover at the front for access.

4.01.09 A horizontal wireway, extending the entire length, shall be provided at the top of each PCC / MCC / DB for inter panel wiring.

4.01.10 The width of the cable alley shall not be less than 250 mm.

4.02.00 **Bus and Bus Taps**

4.02.01 All PMCCs/MCCs/DBs provided with three phase bus bars & neutral Bus bar. All DCDBs shall be provided with two busbars. All busbar compartments shall be completely enclosed.

4.02.02 The main buses and connections shall be of high conductivity Aluminium / Aluminium alloy, sized for specified current ratings with maximum temperature limited to 90°c (i.e., 40°C rise over 50°C ambient) for plain joint and 105°c (i.e., 55°C rise over 50°C ambient) for silver plated joint.

4.02.03 Vertical busbars shall be designed for minimum current rating of 200A. Separate vertical busbars shall be provided for each vertical panel.

4.02.04 All bus connections shall be provided with anti-oxide grease. Adequate contact pressure shall be ensured by means of two-bolt connection with plain and spring washers and locknuts.

Bimetallic connector shall be furnished for connection between dissimilar metals.

4.02.05 Busbars and connections shall be fully insulated for working voltage with adequate phase/ground clearances. Insulating sleeves for busbars and shrouds for joints and tap-off points shall be provided.

Bus insulators shall be flame retardent, non-hygroscopic track-resistant type with high creepage surface.

4.02.06 Busbars shall be supported and braced to withstand the stresses due to maximum short circuit current and also to take care of any thermal expansion.

4.02.07 Busbars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear when viewed from the front of the assembly.

4.03.00 **Control Modules**

4.03.01 Drawout type control module shall have self-aligning power/control disconnects. All disconnects shall be silver plated to ensure good contacts.

4.03.02 The design shall be such as to permit easy withdrawal/reinsertion of the unit with guide rails to ensure correct alignment.

4.03.03 Control Module shall house the control components for a circuit such as switch fuse / MCCB, contactors, relays, push buttons, lamps etc. as per requirement of the control circuit.

4.03.04 The equipment layout shall provide sufficient working space in between the components.

4.03.05 Various module/compartment sizes shall be multiple of one basic unit to facilitate modifications at site. Suitable provision for this purpose should also be incorporated in the vertical bus bars.

4.03.06 Drawout type control modules of same size and type shall be electrically and physically interchangeable.

4.04.00 **Air Circuit Breaker**

4.04.01 Circuit breaker shall be three pole, single throw, air-break type with stored energy, trip-free mechanism and shunt trip.

4.04.02 Circuit breaker shall be draw-out type, having service, test & isolated position with positive indication for each position.

4.04.03 Circuit breakers of identical rating shall be physically and electrically interchangeable.

4.04.04 Circuit breakers shall be provided with motor wound spring charging mechanism. Spring charging shall take place automatically after each breaker closing operation. One open-close-open operation of the circuit breaker shall be possible after failure of power supply to the motor. In addition, facility for manual charging of spring shall be provided.

4.04.05 Mechanical safety interlock shall be provided to prevent the circuit breaker from being racked in or out of the service position when the breaker is closed. It shall not be possible to open the circuit breaker door cubicle unless the breaker is in 'OFF' position.

4.04.06 Automatic safety shutters shall be provided to cover up the stationary disconnects when the breaker is withdrawn.

4.04.07 Each breaker shall be provided with an emergency manual trip, mechanical ON-OFF indicator, an operation counter and mechanism charge/discharge indicator, and electrical anti-pumping feature.

4.04.08 In addition to the auxiliary contacts required for normal breaker operation and indication, each breaker shall be provided with the following for interlocking purpose :-

a. Position/Cell switch with 4 NO + 4 NC contacts.

b. Auxiliary switch, with minimum 6NO + 6NC contacts, mounted on the stationary portion of the breaker panel and operated mechanically by a sliding level from the breaker in SERVICE position.

Alternatively, electrically reset latching relay may be used for the purpose. The exact requirement contacts of the position/cells switch, limit switch, auxiliary switch and latching relay shall be decided by the Tenderers taking into account the scheme requirements spares. Limit/ auxiliary switches shall be convertible type, that is, suitable for changing N.O. contact to N.C. and vice-versa

4.04.09 Spring charge limit switch shall be provided for breakers with motor wound spring charging mechanism. These limit switches shall be provided with minimum 2NO + 2NC contact.

4.04.10 Limit/auxiliary switches shall be convertible type, that is, suitable for changing N.O. contact to N.C. and vice-versa.

4.04.11 Each breakers operated feeder shall be provided with protective devices as specified in Annexure–B.

4.05.00 **Switches**

4.05.01 Switches shall be triple/double pole, air break type and designed for duties as specified in Annexure-A. Motor duty switches shall be capable of safely making and breaking the locked rotor current of the associated motor circuit.

4.05.02 The switch shall have a quick-make, quick-break mechanism operated by a suitable external handle, complete with position indicator. This handle shall have provision for padlocking in ON and OFF position.

4.05.03 The compartment door shall be interlocked mechanically with the switch such that the door cannot be opened unless the switch is in OFF position. Means shall be provided for releasing this interlock at any time.

4.05.04 Switches shall be capable of withstanding the let-through fault current of back-up fuses or circuit breakers.

4.05.05 Wherever two incoming switches and one bus-section switch are provided for an assembly, these shall be mechanically/key interlocked to ensure that only two out of the three can be closed at time.

Wherever two incoming switches are provided for an assembly, these shall be mechanically/key interlocked to ensure that one of the two can be closed at time.

4.06.00 **Fuses**

4.06.01 Fuses shall be HRC, preferably link type, with a minimum interrupting capacity equal to the short circuit current of the LT system.

4.06.02 Fuses shall be furnished complete with fuse bases and fittings of such design as to permit easy and safe replacement of fuse element.

Visible indication shall be provided on blowing of the fuse.

4.06.03 Motor fuse characteristics and ratings shall be chosen to ride over starting period without blowing. The fuse on incoming feeder wherever provided, shall be chosen to provide discrimination with motor/feeder fuses.

4.07.00 **Moulded Case Circuit Breaker (MCCB)**

4.07.01 The MCCBs shall be of drawout type with trip-free operating mechanism of quick make & quick break type. Each MCCB shall be equipped with thermal release for thermal overload and magnetic release for short circuit protection on each pole.

4.07.02 MCCBs / MPCBs shall be suitable for manual closing and opening and also automatic trip on overload and short circuit. MCCB shall have intermediate position to indicate trip condition.

4.07.03 The MCCBs shall be provided with mechanical ON-OFF indicator at the front panel. The MCCB handles, after the breaker tripped due to faults, shall occupy a mean position indicating trip condition.

4.07.04 The compartment door shall be interlocked mechanically with the MCCB such that the door cannot be opened unless the MCCB is in OFF position. Means shall be provided for releasing this interlock at any time.

4.07.05 All feeders of PMCC / MCC rated up to & including 400 Amp shall be provided with MCCB. Air circuit breaker shall be provided for feeders rated above 400 Amp.

4.07.06 Motors rating above 110 KW will be operated by Air circuit breaker and protected by consolidated numerical motor protection relay.

4.08.00 **A.C. Starter**

4.08.01 Contactors

a. The contactors shall be three pole, air break type designed for duty class III - Category AC3 (for unidirectional motor) with non-bouncing silver/ silver alloy contacts. Contacts for reversible motors will be of AC4 duty.

b. Each contactor shall be provided with minimum two (2) normally open and two (2) normally closed auxiliary contacts rated 10 A at 240V A.C. The exact requirement of contacts shall be decided by the tenderer taking into account the scheme requirements & spares.

c. Reversing contacts shall be electrically and mechanically interlocked.

d. Contactors with delayed dropout feature shall be provided for some essential auxiliaries. These contactors shall not dropout on power failure if the voltage is restored within 3 seconds.

4.08.02 Thermal Overload

a. Thermal overload relays shall be three element, positive acting, ambient temperature compensated with adjustable settings.

b. Single phase preventor relay shall be provided, as an inbuilt feature of thermal overload relay.

c. Relays shall be manual reset type with two changeover potential-free contacts. Resetting of relays shall be possible with compartment door closed. Colour of the resetting button shall be BLACK.

d. Relays may be direct acting or C.T. operated, depending on current rating. C.T.s shall be included in the scope of supply.

e. Motor starters shall have type '2' co-ordination according to IEC 947-4.

4.09.00 **D.C. Starters**

4.09.01 DC starters shall be complete with switch-fuse units, contactors, resistors, relays, meters, push-buttons, lamps, etc.

4.09.02 Starters shall be furnished in totally enclosed floor-mounting, sheet steel cold rolled continuously annealed (CRCA) fabricated cubicles complete with a hinged front access door. Minimum thickness of sheet steel shall be 2 mm for load bearing members and 1.6mm for other non-load bearing members.

4.09.03 The cubicle enclosure shall provide dust and humidity protection, the degree of protection being not less than IP-54.

The resistor enclosure shall be provided with ventilating louvers and wire mesh guard and shall have a degree of protection IP-23.

4.09.04 Cubicle space heater shall be provided to maintain internal temperature above dew point. Heater shall be furnished with switch-fuse unit and thermostat control.

4.10.00 **Relays**

4.10.01 All incoming and bus-coupler circuits and circuit breaker operated outgoing feeders shall be provided with numerical relays. Breaker operated motor feeders shall be provided with numerical motor protection relay.

4.10.02 The numerical relays shall have provisions for interfacing with Plant DCS / PLC.

4.10.03 Relays shall be of drawout design with built-in testing facilities. Small auxiliary relays may be in non-drawout execution.

4.10.04 All protective relays, auxiliary relays, and timers shall be provided with hand reset operation indicator (flag).

4.10.05 Relays shall be rated for operation on 110V secondary voltage and 5 A or 1 A. Number and rating of relay contacts shall suit the job requirements.

4.10.06 Make of numerical relays for main protection shall be either Siemens / ABB / Areva.

4.11.00 **Control and Indication**

4.11.01 Circuit breakers shall be wired up for local and remote operation. Each breaker cubicle shall be equipped with the following :

i) One (1) TEST-NORMAL-TRIAL selector switch with pistol grip handle and key interlock for breakers with motor wound spring charging mechanism.

ii) Two (2) push buttons for TRIP and CLOSE

iii) Following indicating lamps on the front of the compartment :

Breaker open	-	GREEN
Breaker closed	-	RED
Breaker tripped	-	AMBER
Spring charged	-	WHITE
Trip Ckt. Healthy	-	BLUE

Motor Space heater 'ON' for motor circuit - YELLOW

4.11.02 Push button shall be heavy duty, oil tight, push to actuate type with integral escutcheon plate marked with its function.

4.11.03 Each push button shall have minimum two (2) nos. normally open and two (2) nos. normally closed contacts rated 10 A at 240 V.

4.11.04 Selectors switches shall be stay-put, rotary type with escutcheon plates marked to indicate the function and positions, and shall be lockable in each position. Selector switch contacts shall be rated for 10A at 240 V A.C.

4.11.05 Selector switches shall be provided with minimum three (3) contact blocks of 1 NO + 1 NC each.

The exact requirements of contacts shall be decided by the Tenderers taking into account the scheme requirement and spares.

4.11.06 Lamps shall be clustered LED type with series resistor and coloured lens. Lens and lamps shall be replaceable from the front. Lamps shall be located just above the associated push button/control switch

4.11.07 The general scheme of connections for control, interlock and protection is shown in the enclosed drawings. Detailed requirements of individual circuits will be intimated later to the successful Bidder, who shall develop and furnish the schemes accordingly

4.11.07 For control supply, two (2) no. 415/240V control transformers (with ±5% taps @ 2.5%) with 100% standby arrangement and auto transfer scheme shall be provided for each PCC. Control supply healthy indication shall be provided.

4.12.00 **Meters**

4.12.01 All indicating instruments (96 x 96 mm) shall be Digital type, with LED display & flush mounted type and accuracy class of 0.5. Each meter shall have in-built transducer with 4-20 mA output for hooking-up with Plant DCS / PLC.

4.12.02 Motor ammeter shall be suitable to indicate starting current (6 to 8 times full load current) for DOL starting of motor.

Motor ammeter shall be provided for motor rated 30 kW and above and for critical drives, to be finalized during detail engineering.

4.12.03 All incomers, tie feeders and circuit breaker operated motor feeders shall be provided with 3-phase multifunction, digital energy meter with pulse output and communication port for interfacing with Plant DCS / PLC.

4.12.04 Meter selector switches shall be maintained contact, stay-put type, with knob handle. Ammeter and voltmeter selector switches shall be four position type. Ammeter selector switches shall have made before break contacts, to prevent open circuiting of CT secondary.

4.13.00 **Current Transformer**

4.13.01 Current transformers shall be cast-resin type. All secondary connections shall be bought out to terminal blocks where wye or delta connection will be made.

4.13.02 Accuracy class of the current transformers shall be:

a) Class PS for differential.

b) Class 5P20 for other relaying.

c) Class 1.0 ISF < 5 for metering.

d) Class 0.5 ISF < 5 for metering (Incomer & Bus coupler of PMCC)

Other CT particulars like ratio, burden, knee point, excitation current & secondary resistance shall be decided by the tenderers.

4.13.03 CT secondary shall be rated for 1A for metering & either 5A or 1A for protection.

4.14.00 **Voltage Transformer**

4.14.01 Voltage transformers shall be cast-resin, drawout type and shall have an accuracy class of 1.0. Voltage transformer mounted on breaker carriage is not acceptable. For Incomer and bus coupler of PMCC accuracy class of voltage transformer shall be 0.5.

4.14.02 High voltage windings of voltage transformer shall be protected by current limiting fuses. The voltage transformer and fuses shall be completely disconnected and visibly grounded in fully draw out position.

4.14.03 Secondary winding MCBs, sized to prevent overload shall be installed in all ungrounded secondary leads. MCBs shall be suitably located to permit easy replacement while the switchgear/PMCC is energized.

4.14.04 Both primary side & secondary side fuse failure / voltage loss monitoring system of VT shall be provided.

4.15.00 **Transducers**

4.15.01 Transducer for conversion of AC electrical quantities such as voltage, current, KW etc. shall be supplied as required for remote connection to Plant DCS / PLC. All transducers shall be dual output type.

4.15.02 The transducers for indicating type instruments shall be of very low burden type having 4-20 mA DC linear, galvanically isolated output, compatible with secondary instruments and Plant DCS system.

4.16.00 **Secondary Wiring**

4.16.01 The PMCC/MCC/DB shall be fully wired at the factory to ensure proper functioning of control, protection and interlocking schemes.

4.16.02 Fuse and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, push buttons and other devices shall be wired upto terminal blocks.

4.16.03 Wiring shall be done with flexible, 1100V grade, fire resistance PVC insulated switchboard wires with stranded Copper conductors of 2.5 mm^2 for control, current and voltage circuits.

4.16.04 Each wire shall be identified, at both ends, with permanent markers bearing wire numbers as per Contractor's wiring diagrams.

4.16.05 Wire terminations shall be made with crimping type connector with insulating sleeves. Wires shall not be spliced between terminals. Separate colour code shall be used for AC & DC circuit wiring for easy identification.

4.17.00 **Terminal Blocks**

4.17.01 Terminal blocks shall be 660V grade box-clamp type with marking strips similar to ELMEX 10 mm^2 or equal. Terminals for C.T. secondary leads shall have provision for shorting.

4.17.02 Terminal blocks used for interface with DCS / PLC via termination cabinet shall be suitably sized to facilitate proper termination of interconnecting cables.

4.17.03 Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished.

4.17.04 Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

4.18.00 **Cable Terminations**

4.18.01 PMCC shall be designed for cable entry from bottom. MCC/DB shall be designed for cable entry both from top and bottom. Actual configuration shall be intimated later Sufficient space shall be provided for ease of termination and connection.

4.18.02 All provisions and accessories shall be furnished for termination and connection of cables, including removable gland plates, cable supports, crimp type tinned Copper/Aluminium lugs, brass compression glands with tapered washer (Power Cables only) and Terminal blocks.

4.18.03 Gland plates shall be minimum 4 mm thick. The gland plate and supporting arrangement for 1/C power cables shall be of non-magnetic material to minimize flow of eddy current.

4.18.04 Sufficient space shall be provided between the lower most power cable termination and gland plate for easy cable connection.

4.19.00 **Bus Duct Connection**

4.19.01 Bus duct connections shall be furnished along with transition panel, if required. Unless mentioned otherwise bus duct connections shall generally be from the top.

4.19.02 All connecting bus work shall have the same continuous current rating as associated PMCC bus and shall be fully braced for the LT system short circuit current.

4.19.03 All provisions such as matching flange and other accessories shall be furnished for connection to bus duct.

4.20.00 **Ground Bus**

4.20.01 A ground bus rated to carry the maximum fault current, shall extend full length of the PMCC / MCC / DB. The ground bus shall be G.I. type of minimum size 50 x 6 mm.

4.20.02 The ground bus shall be provided with two-bolt drilling with G.I. bolts & nuts at each end to receive 50 x 6 mm G.I. flats.

4.20.03 All stationary structures shall be directly connected to the ground bus for effective grounding.

4.20.04 The frames of all circuit breakers & drawout VT units shall be grounded through heavy multiple contacts at all times except when the primary disconnecting drives are separated by a safe distance.

4.20.05 The frame of draw out module shall be grounded at all times except when the power disconnects are separated by a safe distance.

4.20.06 Where ever the schematic diagrams indicate a definite ground at the switchgear, a single wire for each circuit thus grounded shall be run independently to the ground bus & connected thereto.

CT & VT secondary neutrals shall be earthed through removable links so that earth of one circuit may be removed without disturbing others.

4.20.07 All hinged doors shall be earthed through flexible copper braid wire.

4.21.00 **Nameplate**

4.21.01 Nameplate of approved design shall be provided for each control compartment and also at the top of each PMCC / MCC / DB.

4.21.02 The material of the name plate shall be anodized aluminium / lamicoid or approved equal, 3 mm thick, with white letter on black background. Name

plates shall be minimum 20 x 75 mm for instrument / devices and 40 x 150 mm for panels.

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

4.22.00 **Space Heater**

4.22.01 Each vertical section of the PCC / MCC / DB shall be furnished with thermostat controlled space heater and 5A, 3 pin plug socket.

4.22.02 In addition, motor feeders 30 KW and above shall be wired up for feeding motor space heater through starter auxiliary NC contacts.

4.22.03 Cubicle heater, Motor heater and plug socket circuit shall be provided with individual MCB/switch fuse units.

4.23.00 **A.C./D.C. Power Supplies**

4.23.01 Necessary 415V AC and 220V DC power supplies as required for control and service shall be arranged by the contractor. Single feeder shall be arranged for A.C. supply and duplicate feeder shall be arranged for D.C. supply.

4.23.02 Isolating switch fuse units shall be provided at each switchgear for the incoming supplies, 4-pole, single throw for A.C. and 2-pole, double throw for D.C. Molded case circuit breaker (MCCB) shall also be accepted as an alternative.

4.23.03 Bus-wires of adequate capacity shall be provided to distribute the incoming supplies to different cubicles. Isolating switch fuse units / MCCB shall be provided at each cubicle for A.C/D.C. supplies.

4.23.04 A.C. load shall be so distributed as to present a balanced loading on three-phase supply system.

4.24.00 **Tropical Protection**

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

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

4.25.00 **Painting**

4.25.01 All steel surfaces shall be sand blasted, grounded and pickled as required to produce a smooth, clean surface free of scale, grease & rust.

4.25.02 After cleaning, the surfaces shall be given a phosphate coating followed by two coats of high quality primer and stoved after each coat.

4.25.03 PCC / MCC / DB shall be finished in light grey (RAL 7032) with two coats of synthetic enamel paint.

4.25.04 Sufficient quantity of touch-up paint shall be furnished for application at site.

4.25.05 Caution notice plate shall be affixed at the back of each vertical panel.

5.00.00 **TESTS**

5.01.00 All equipment shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

5.02.00 **Routine Test**

The tests shall include but not necessarily be limited to the following :-

a. Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme and proper functioning of the equipment.

b. All wiring and current carrying part shall be given appropriate High Voltage Test.

c. Primary current & voltages shall be applied to all instrument transformers.

d. Routine test shall be carried out on all equipment such as circuit breakers, switch - fuse, contactors, relays, meters etc.

5.03.00 **Type Tests**

The type test certificates for the following tests carried out on an identical & similar type of switchgear shall be furnished. The date of tests shall be within the last five years.

a. Temperature rise Test

b. Short time current test on main circuit and earth circuit.

c. Verification of making and breaking capacity.

Type test certificates of any equipment shall be furnished if so designed by the purchaser/ owner. Otherwise the equipment shall have to be type tested free of charge, to prove the design. Type test performed before five(5) years are not acceptable.

6.00.00 **DRAWINGS, DATA & MANUALS**

6.01.00 To be submitted with the bid :-

a. General arrangement drawing showing constructional features, space required in front for withdrawals, power & control cable entry points etc.

b. Typical foundation plan

c. Typical control schematic

d. Bill of materials

e. Type test reports on circuit breaker

f. Board wise single line diagram.

g. Calculation of CT & VT rating.

h. Busbar sizing calculation.

i. Reports for all type tests of representative sections of panel assemblies.

j. Technical leaflets on :-

i) Circuit breaker
ii) Contactors
iii) Relays, meters, push buttons, selector switches etc.
iv) Glands/terminals blocks
v) MCCB
vi) MCB
vii) Instrument Transformers

6.02.00 To be submitted for Approval & Distribution :

a. Outline dimensional drawing showing general arrangement, space requirements and bus duct/cable entry points.

b. Boar wise Single Line Diagrams.

c. Cross-section with parts list.

d. Foundation plan & loading.

e Consolidated bill of materials

f. Control schematics.

g. Wiring Diagrams.

h. Instruction manuals of PMCC/MCC/DB and individual equipment.

i. All other relevant drawings, documents or data necessary for satisfactory installation, operation and maintenance.

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

6.03.00 The Bidder may note that the drawings, data and manuals listed herein are minimum requirements only. The Bidder shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment are submitted with his bid.

ANNEXURE-A

RATINGS AND REQUIREMENTS

1.0	General			
	Type	:	ACB Modules - Drawout type MCCB Modules – Drawout type	
	Service	:	Indoor	
	Enclosure	:	IP54	
2.0	System		AC	DC
	Voltage	:	415V ± 10%	220V (190-240V)
	Phase	:	3-phase, 4-wire	2- wire
	Frequency	:	50 Hz ± 5%	-
	Combined voltage and Frequency variation	:	10% (absolute sum)	
	System grounding	:	Solidly grounded	Ungrounded
3.0	Rating			
	Rated current	:	To be decided by the tenderers.	
	Design Ambient Temperature	:	50ºC	
	Short Circuit Current Symm.	:	50 KA	25* KA
	* Indicative only, the actual value will be decided by the tenderers.			
	S/C Withstand Time	:	1 second	
	Hi pot for 1 minute	:	2.5 kV	1.5 kV
4.0	Duty			
	Circuit Breaker	:	0-3'-CO-3'-0	
	Contactor (AC)	:	Class III - Category AC3 for unidirectional drives and AC4 for bi-directional / inching duty drives	
	Contactor (DC)	:	Class 1 – category DC2	
	MCCB / Switch Duty for		AC	DC
	Motor Feeder	:	AC23	DC22

Other Feeder	:	AC22	DC22

5.0 A.C. / D.C. Power Supply

Control Voltage for Circuit breaker	:	220V DC +10% to -15%
Control voltage for MCCB modules	:	240V AC ± 10%, 1 Ph, 50 Hz ± 5%
Service voltage	:	240V AC ± 10%, 1 Ph, 50 Hz ± 5%

ANNEXURE-B

PROTECTIONS

1.0 All Protective relays shall be microprocessor based numerical type having communication facility with Plant DCS system / PLC.

2.0 The minimum protections to be provided for different types of circuits are listed below:

a.	Incoming Feeder & Bus-coupler with ACB:	3	-	inverse time O/C relays (51) for phase fault.
		1	-	Inverse time O/C relay (51N) for Earth fault.
		3	-	Under Voltage (27), Range : 40-80% with timer
b.	Motor Feeder with ACB: (above 110 kW)	1	-	Composite Motor protection relay (99) for protection against
			-	Thermal overload
			-	Phase faults
			-	Unbalance (negative sequence)
			-	Locked rotor
			-	Excessive Start-up time and Start-Stop.
			-	Earth fault
c.	Outgoing Feeder with ACB :	3	-	Inverse time O/C relays (51) for phase fault.
		1	-	Inverse time O/C relay (51N) for Earth fault.

2.0 Apart from protection relays, each electrically operated breaker shall be provided with anti-pumping (94), trip annunciation (30), lockout (86) and trip circuit supervision (74) relays. Lockout relay shall be hand reset type.

3.0 Both primary side & secondary side fuse failure / voltage loss monitoring system of VT shall be provided..

4.0 For Auto-bus change-over as well as live bus change-over through synchronization refer enclosed Control Schematic drawings.

5.0 Each incomer shall be provided with three (3) nos. Bus Energised indicating lamps – Red/Yellow/Blue for each phase.

ANNEXURE-C

INDICATIVE LIST OF 415V PMCCs / MCCs / DBs

A.	PMCC/MCC		Quantities
1)	415 V Unit PMCC	:	1 no.
2)	415 V Station PMCC	:	2 nos.
3)	415 V Emer. PMCC	:	1 no.
4)	415 V ESP PMCC	:	6 nos.
5)	415 V Turbine Valve MCC	:	1 no.
6)	415 V Turbine Aux. MCC	:	1 no.
7)	415 V Coal Mill MCC	:	1 no.
8)	415 V Boiler Valve MCC	:	1 no.
9)	415 V Boiler Aux. MCC	:	1 no.
10)	415 V Soot Blower MCC	:	1 no.
11)	415 V CPU REGN. MCC	:	1 no.
12)	415 V STN Vent. MCC	:	1 no.
13)	415 V ESP Vent & A/C MCC	:	1 no.
14)	415 V Fuel Oil Unloading & Transfer P/H MCC	:	1 no.
15)	415 V Fire Water MCC	:	1 no.
16)	415 V Bunker Floor MCC	:	1 no.
17)	415 V Wagon Tripler PMCC	:	1 no.
18)	415 V CHP PMCC	:	1 no.
19)	415V ASH Silo PMCC	:	1 no.
20)	415V Raw Water PMCC	:	1 no.
21)	415 V Station AC MCC	:	1 no.
22)	415V CW Treatment PMCC	:	1 no.
23)	415V CW Chlorination MCC	:	1 no.
24)	415 V CWPH PMCC	:	1 no.

25)	415V Clarified Water MCC	:	1 no.
26)	415 V Water Treatment PMCC	:	1 no.
27)	415 V Switchyard PMCC	:	1 no.
28)	415V Fuel Oil Pressurizing MCC	:	1 no.
29)	415V Ash Water Recovery MCC	:	1 no.
30)	415V AHP PMCC	:	1 no.
31)	415V Ash Slurry MCC	:	1 no.
32)	415V AHP Water System MCC	:	1 no.
33)	415 V Ash Dyke MCC	:	1 no.
34)	415V DM PLANT MCC	:	1 no.
35)	415V Water Service PMCC	:	1 no.
36)	415V ETP PMCC	:	2 nos.
37)	415V Station AC MCC	:	1no.

B.	415V ACDBs		Quantities
1)	Station ACDB	:	To be decided by EPC contractor
2)	Boiler ACDB	:	To be decided by EPC contractor
3)	Turbine ACDB	:	To be decided by EPC contractor
4)	Lighting Distribution Board	:	To be decided by EPC contractor
5)	Welding Transformer Board	:	To be decided by EPC contractor
C.	240V ACDBs	:	AS Required (To be decided by EPC contractor)
D.	220V DCDBs	:	AS Required (To be decided by EPC contractor)

NOTE : Any other PMCCs / MCCs / DBs, if required, shall also be included under the Scope of EPC Contractor without any price implication.

ANNEXURE-D

MODULE SELECTION

MOTOR FEEDER

Type	Motor Rating	MCCB Rating	Contactor	Cable size
AU/AR	0 - 5.5 KW	32A	16A	3/c – 2.5 Sq.mm - Cu
BU/BR	5.6 - 11 KW	63A	32A	3/c - 16 Sq.mm - Al
CU	11.1 - 22 KW	63A	63A	3/c - 35 Sq.mm - Al
DU	22.1 - 50 KW	100A	100A	3/c - 95 Sq.mm - Al
EU	50.1 - 75 KW	200A	160A	3/c - 185 Sq.mm - Al
FU	75.1 - 110 KW	400A	300A	2 x 3/c - 185 Sq.mm - Al

NOTE :

1. MCCB, thermal overload relay with SPP, Contractor are to be co-ordinated (Type-2) with motor rating by the Contractor.

2. “U” stands for Undirectional and “R” for Reversible drives.

OUTGOING FEEDER

Type	MCCB Rating	Cable Size
AF	32A	4/c – 16 Sq.mm - Cu
BF	63A	4/c – 35 Sq.mm - Al
CF	100A	3.1/2 – 95 Sq.mm - Al
DF	200A	3.1/2 – 300 Sq.mm - Al
EF	400A	4 x 1/c – 630 Sq.mm - Al

DCDB FEEDER (SFU Unit)

Type	MCCB Rating	Fuse Rating	Cable Size
DAF	16A	16A	2/C-2.5 Sq.mm - Cu
DBF	32A	32A	2/C-16 Sq.mm - Al
DCF	63A	63A	2 x 2/C-16 Sq.mm - Al
DDF	100A	100A	4/C-35 Sq.mm - Al
DEF	200A	200A	2 x 4/C-35 Sq.mm - Al
DFF	400A	400A	2 x 1/C-630 Sq.mm - Al

NOTE : Cable size as shown above are indicative only. However actual sizes of each motor/ outgoing feeder to be decided by the EPC contractor with back up sizing calculation.

ANNEXURE-E

BUS TRANSFER SCHEME FOR PMCC

1.0 The manual bus transfer shall be arranged in such a way that any of the following modes of operation is possible.

1.1 **Manual Bus Transfer**

a) Without voltage interruption

This means by allowing momentary parallel operation of two sources.

b) With voltage interruption

i) Slow Transfer

ii) Fast Transfer

NOTE : For CHP system 'Manual bus transfer without voltage interruption' and 'dead bus transfer with voltage interruption' shall be provided.

Synchronisation of Incomer & Bus coupler for each of the 415V PMCC shall be implemented through PLC in CHP substation cum control room building (SS-2). Synchronization check relay, guard relay and auxiliary relay shall be provided in each PMCC. Synchroscope along with cut off switch, double voltmeter, double frequency meter shall be provided in the Main CHP substation building cum control room. Separate synchronization switch and trip selector switch for each of the PMCC shall also be provided in the CHP substation building cum control room (SS-2).

VOLUME : IIF/1

SECTION-VIII

TECHNICAL SPECIFICATION FOR LOCAL CONTROL BOARDS/PANELS, LOCAL ISOLATING SWITCH UNITS AND LOCAL PUSH BUTTON STATIONS

CONTENT

VOLUME : IIF/1

SECTION-VIII

TECHNICAL SPECIFICATION FOR LOCAL CONTROL BOARDS/PANELS, LOCAL ISOLATING SWITCH UNITS AND LOCAL PUSH BUTTON STATIONS

1.00.00 SCOPE OF SUPPLY

1.01.00 The following equipment shall be furnished with all accessories:

a) Complete set of Local Control Boards/Panels, an indicative list of which is given in Annexure-C

b) Local Push Button Stations: As required

c) Local Isolating Switch Units: As required

1.02.00 Furnishing, Mounting, and wiring of all equipments, devices and accessories

1.03.00 Floor Channel sill, vibration damping pad, and kick plates for all floor-mounted control boards/panels, complete with holding down bolts and nuts.

1.04.00 Mounting hardware for all control boards/panels, Local Push Button Stations, and Local Isolating Switch Units.

2.00.00 CODES AND STANDARDS

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

2.02.00 Equipment and material conforming to any other standards, which ensure equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

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

3.00.00 DESIGN CRITERIA

3.01.00 The Local Control Boards/Panels will be used for controlling incomers/ bus-section/electrically operated radial breaker feeders of the associated PMCC/MCC. Necessary indications, meters, annunciations and mimic representation shall also be provided on these control boards/panels.

Local control of all drives shall be done from Process Control Boards/Panels, as described in respective sections of mechanical specification.

The Local Control Boards/Panels shall have to be duly matched with the Process Control Boards/Panels.

3.02.00 Local Push Button (L.P.B.) stations will be used for controlling drives from local as required.

3.03.00 Local Isolating Switch (L.I.S) Units will be used for local isolation of power supply to various machines as required.

3.04.00 All equipment except L.I.S. Units and L.P.B stations, will be located in a clean but hot, humid, and tropical atmosphere. The L.I.S. Units and L.P.B. stations will be generally installed in a hot, humid, and tropical atmosphere, heavily polluted at places with fly ash and/or coal dust, and shall be suitable for outdoor service with degree of protection specified elsewhere in this specification.

3.05.00 All Control Boards/Panels, L.I.S. Units, and L.P.B. stations shall be liberally sized so as to provide spacious layout of equipment and devices with sufficient working space in between.

3.06.00 Adequate space/terminals shall be kept in the boards/panels for installing additional equipment in future.

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

3.08.00 All equipment/components thereof shall be capable of withstanding the mechanical forces and thermal stresses of the system short circuit current without any damage or deterioration of material.

3.09.00 Design, material selection, and workmanship shall be such as to present a neat appearance outside and inside with no welds, rivets, screws, or bolt heads apparent from the exterior surface of the boards/panels. All instrument cut-outs, mounting studs, and support brackets shall be accurately located.

4.00.00 SPECIFIC REQUIREMENTS

4.01.00 Construction

4.01.01 Local Control Boards/Panels

a) Local Control Boards may consist of a number of vertical panels mounted side-by-side, in which case, they shall be bolted together to form a compact unit. Where two panels meet, the joints shall be smooth, close-fitting, and unobtrusive.

b) The control boards/panels shall be totally enclosed type, conforming to degree of protection IP-54 or better.

c) Generally, the local control boards/panels shall be free-standing, floor-mounted, dead-front assemblies. In some cases, however, wall-mounted type control boards/panels may also be accepted.

d) Floor-mounted control boards/panels shall be assembled on channel/ angle base plates with anti-vibration mountings and stainless steel kick-plates.

e) Control boards/panels shall be of folded sheet steel CRCA construction, minimum 1.6 mm. thick for non-load bearing members and 2 mm for load bearing members, and free from all surface defects.

The boards/panels shall have sufficient structural reinforcement to ensure a plane surface, to limit vibration, and to provide rigidity during shipment and installation.

f) All floor-mounted panels shall have rear door.

g) Doors shall have concealed type hinges and padlocking arrangement. Doors shall be grounded by flexible copper braid.

h) All doors and removable covers shall be provided with neoprene rubber gaskets all round and latches sufficiently strong to hold them in alignment when closed.

i) Working height of the panels shall be limited between 550 mm and 1800 mm above floor level.

4.01.02 Local Push Button Stations

a) L.P.B. Stations shall be furnished in sheet steel enclosure of dust and vermin-proof, weather-proof, gasketted construction, suitable for outdoor use with or without canopy according to outdoor / indoor installation, and conforming to degree of protection IP-55 or better.

b) L.P.B. Stations shall be suitable for column/structure/wall mounting and shall be complete with push-buttons, terminal blocks, anodised aluminum inscription plate, two (2) nos. earthing terminals, removable gland plate along with crimp type tinned copper lugs and compression type glands for cable/conduit entry from top and bottom. The earthing terminals shall be suitable for connection to one (1) no. 8 SWG G.I. wire.

c) L.P.B. Stations shall be of the following basic type and equipped with:

Type-A	:	One (1) START push-button and one (1) STOP push-button.
Type-B	:	One (1) OPEN push-button, one(1) CLOSE push-button, and one(1) STOP push-button.
Type-C	:	Flame proof type as per IS-2148. one (1) START push-button and one(1) STOP push-button.
Type-D	:	One (1) STOP Lock-out switch.

Type-E : One (1) STOP Emergency PB.

Belt sway bridging Push Button shall be provided in the Local Push Button Station for all conveyor Drives.

Any other type of L.P.B. Station, if required, shall be subject to approval of the Purchaser.

d) OPEN, CLOSE, and START push-buttons shall be spring return to normal type. STOP push-buttons shall have mushroom head actuator with press-to-latch and key-to-release feature.

e) OPEN/START push buttons shall be GREEN, STOP push buttons shall be RED, and CLOSE buttons may be YELLOW.

f) All push-buttons shall have a minimum of two (2) Normally-Open and two (2) Normally-Closed electrically separate contacts, rated minimum 10 A at operating voltage.

g) Wiring shall be done by 1/C - 2.5 sq.mm. 1100V grade, PVC insulated, stranded copper conductor, cable. Each wire shall be identified at both ends by ferrules with wire designation.

h) Terminals shall have provision for connecting at least two (2) nos. 2.5 sq.mm. copper cable and shall be rated for carrying continuously minimum 10 A at 240V A.C. and 2 A at 220V D.C.

4.01.03 Local Isolating Switch Units

a) L.I.S. Units shall be furnished in sheet steel enclosure of dust and vermin-proof, weather-proof, gasketted construction, suitable for outdoor use with / without canopy according to outdoor/indoor installation, and conforming to degree of protection IP-55 or better.

b) L.I.S. Units shall be suitable for column/structure/wall mounting and shall be complete with load-break switch, terminal blocks, anodised aluminum inscription plate, two (2) nos. earthing pads, removable gland plate along with crimp type tinned copper lugs and compression type glands for cable/conduit entry from top and bottom. The earthing pads shall be suitable for connection to 25 x 3 mm G.S. flat

c) Load-break switches shall be four-pole, air break, heavy-duty type. Duty class of load-break switches shall be AC-23 for motor feeders. Motor feeder switches shall be capable of safely breaking the locked rotor current of the associated motor circuit.

d) Terminals shall be clip-on type, 10 sq.mm. minimum.

4.02.00 **Equipment Mounting**

4.02.01 All equipment shall be so mounted that removal and replacement may be accomplished individually without interruption of services to others. No equipment shall be mounted on panel door.

4.02.02 All equipment mounted inside the panels shall be so located that their terminals and adjustments are readily accessible for inspection or maintenance.

4.02.03 For Local Control Boards/Panels control components such as push buttons, indicating lamps, selector switches, indicating meters etc. shall be flush mounted on the front face of the board/panel while switch fuses, supervision relays (AC/DC) etc. shall be mounted inside.

4.03.00 **Name Plate**

4.03.01 Nameplates shall be furnished for each panel and for each instrument or device mounted on the panel. Each LPB Station shall also be provided with a nameplate.

4.03.02 The material of the nameplate shall be lamicoid or approved equal, 3 mm thick, with white letters on black background.

4.03.03 The nameplates shall be held by self tapping screws. The size of nameplate shall be approx. 20 mm x 75 mm for equipment and 40 mm x 150 mm for the panels. The size of the nameplate shall suit the overall dimensions of LPB station/L.I.S Unit.

4.03.04 Nameplates for panels shall be provided both on the front and on the rear and shall be according to final device/designation list.

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

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

4.04.00 **Mimic Diagram**

4.04.01 Mimic diagram of electrical connections shall be furnished on the front face of all electrical control panels.

4.04.02 Mimic buses shall be at least 3 mm thick and 10 mm in width, made of suitably treated metal strips or approved equivalent and colour coded to denote different voltages.

4.04.03 The mimic representation, colour and size of diagram are subject to the approval of the Purchaser.

4.05.00 **Illumination, Space Heating and Receptacles**

4.05.01 Each panel shall be provided with interior fluorescent tube with door switch, space heater with thermostat and 5A, 3-pin receptacle with plug. Third pin of the socket shall be effectively grounded through the metallic structure.

4.05.02 Tube, heater and receptacle circuits shall be suitable for available A.C. supply and furnished with individual ON-OFF switch.

4.05.03 The lamp shall be located at the ceiling and guarded with protective cage. Space heater shall be located near the floor so as not to pose any hazard to service personnel.

4.06.00 **AC/DC Power Supply**

4.06.01 Necessary A.C. and D.C. supplies as required for control and service shall be arranged by the contractor. Single feeder shall be arranged for A.C supply and duplicate feeders shall be arranged for D.C supply.

4.06.02 Isolating switch fuse units shall be provided for the incoming AC/DC power supplies and bus wires shall be run for power distribution to different panels. D.C. supply isolating switches shall be double pole, double throw with off and A.C. supply isolating switches shall be 4-pole, double throw type.

4.06.03 Fuse and link shall be provided for individual circuits for protection and also for isolation from bus wire without disturbing other circuits.

4.06.04 The fuse requirements in each panel shall be grouped in easily accessible fuse blocks or distribution panel. The grouping shall be done in a neat and orderly fashion.

4.06.05 Alarm relays with reverse flag shall be provided to annunciate failure of main incoming A.C. and D.C. power supplies and annunciation D.C. supply in each panel. Lamp indications shall be provided individually for main D.C. supply-1 fail, main D.C. supply-2 fail, and panel annunciation D.C. supply fail. A common A.C. electric bell shall be provided to give an audible alarm in case of failure of D.C. supply-1/D.C. supply-2/annunciation D.C. supply in any panel. A common push-button shall also be provided for cancellation of lamp indications and audible alarm.

4.06.06 Separate circuits shall be provided for (a) indication and alarm (b) tripping, and (c) control.

4.06.07 For lighting, auxiliary supply and space heating A.C. supply shall be used. D.C. supply shall be used for providing control supply to annunciator.

4.06.08 Bus wires of adequate capacity shall be provided to distribute the incoming supplies to different cubicles of a VDB. Isolating switch fuse units shall be provided at each cubicle for A.C/D.C supplies.

4.07.00 **Wiring**

4.07.01 The panels shall be fully wired up at the factory to ensure proper functioning of control, protection and metering schemes.

4.07.02 All spare contacts of relays and switches shall be wired up to terminal blocks.

4.07.03 Wiring shall be done with flexible, heat resistant, 1100V grade, fire resistance PVC insulated, switchboard wires with stranded copper conductor, 2.5 Sq.mm for current, control circuits and voltage circuits.

4.07.04 Each wire shall be ferruled by plastic tube with indelliable ink print at both end having terminal Block No., terminal numbers, destination number as per approved wiring drawing.

4.07.05 All wire termination shall be made with insulated sleeve solderless crimping type tinned copper lugs. Wires shall not be tapped or spliced between terminals.

4.07.06 Wiring 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 the termination.

4.07.07 Colour codes shall be used for wiring as per latest revision of IS: 375.

4.08.00 **Terminal Block**

4.08.01 Multi-way terminal blocks complete with necessary binding screws and washers for wire connections and marking strip for circuit identification shall be furnished for terminating the panel wiring and outgoing cables. Terminals shall be box-clamp type, 10 sq.mm. minimum. Terminals for C.T. secondary leads shall have provision of shorting and grounding.

4.08.02 Not more than two wires shall be connected to one terminal. If necessary, a number of terminals shall be jumpered together to provide wiring points.

4.08.03 Each terminal shall be identified with designation as per approved schematic. At least 20% of the total number of active terminals shall be furnished as spare in each panel.

4.08.04 The wiring and terminals shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

4.08.05 The terminal blocks shall be located to allow easy access and also to suit floor openings for cable entry.

4.08.06 The terminal blocks within the panels shall be mounted on vertical support brackets. The support brackets shall be tack welded to the interior sheet steel mounting plates of the cabinet. Support brackets shall not be welded directly to the walls of the enclosure. The terminal blocks shall be attached to the support brackets with round head machine screws.

4.08.07 Terminal blocks shall generally be mounted vertically with adequate spacing (not less than 100 mm) between adjacent rows.

4.08.08 The bottom of the terminal block shall be at least 200 mm above the incoming cable gland plate.

4.09.00 **Cable Entry**

4.09.01 The Control Boards/Panels shall have provisions of cable entry from the bottom. Bottom plate shall be provided to make entry dust-tight. L.P.B. stations and Local Isolating Switch Units shall have provision for cable/ conduit entry from both top and bottom. Suitable cable gland-plates shall be provided.

4.10.00 **Grounding**

4.10.01 50 x 6 mm TINNED COPPER ground bus shall be provided in each control panel extending along the entire length of the assembly.

4.10.02 The ground bus shall have two-bolt drilling with GI bolts and nuts at each end and shall be suitable for connection to 50 x 6 mm G.S. flat.

4.10.03 The ground bus shall be bolted to the panel structures and shall effectively ground the entire assembly. The cases of meters, relays and switching devices shall be grounded through the steel structure.

4.10.04 Whenever a circuit is grounded, a single wire from the circuit shall be run independently to the ground bus and connected to it.

4.11.00 **Painting**

4.11.01 Panels and Push-button Stations shall be finished with two coats of synthetic enamel paint white inside and gray (shade 631 of IS-5) outside. Panels and push-button stations shall be stoved after each spraying of finish paint. Painting process shall be of powder coating.

4.11.02 Caution Notice plate shall be affixed at the back of each vertical panel.

4.12.00 **Switches**

4.12.01 Switches shall be dust protected, heavy duty, switchboard type, complete with escutcheon plate. Contacts shall be silver surfaced and rated minimum 10A at operating voltage.

4.12.02 415V Breaker control switches shall be 3-position (TRIP/NORMAL/-CLOSE), 120^{o}, spring return to neutral with lost motion device, non-lockable, sequence device, pistol grip handle, RED/AMBER/GREEN (circuit breaker CLOSED/ TRIPPED-OR-TRIP CIRCUIT UNHEALTHY/OPEN) indicating lamps shall be provided with each breaker control switch.

4.12.03 Contact details and type of handle required for other types of switches are given below :

Sl. No.	Application	Switch description
a)	Synchronising Selector switch	180^{o}, 4-position (INCOMER-1/ BUS-SECTION / INCOMER-2/OFF), stay put type, pistol grip handle. OR 120^{o}, 3-position (INCOMER/TIE/ OFF) stayput type, pistol grip handle.
b)	Trip Selector Switch	120^{o}, 3-position (INCOMER-1/ BUS-SECTION OR TIE/ INCOMER-2), stayput type, pistol grip handle.

Sl. No.	Application	Switch description
c)	Meter Selector Switch	4-position (OFF/R/Y/B for ammeter selector switch and OFF/RY/YB/RB for voltmeter selector switch), maintained

		contact, stay-put type, knob handle. Ammeter selector switches shall have make-before- break contacts.
d)	Auto-Manual Selector switch	120^{o}, 2-position (AUTO/ MANUAL), stayput type, non-lockable, spade handle.
e)	On-off Switch/Local-Remote Selector Switch	90^{o}, 2-position (ON/OF OR LOCAL/ REMOTE), stayput type, non-lockable, spade handle

4.12.04 Any other type of switch, if required, shall be subjected to approval of purchaser.

4.12.05 Tenderer shall decide the number of switch contacts taking into account the scheme requirements and spares.

4.13.00 **Fuses**

4.13.01 Fuses shall be HRC, preferably link type, with a minimum interrupting capacity equal to the system short circuit current.

4.13.02 Fuses shall be furnished complete with fuse boxes and fittings of such design as to permit easy and safe replacement of fuse element. Visible indication shall be provided on blowing of the fuse.

4.13.03 Motor fuse characteristics and ratings shall be chosen to ride over motor starting period without blowing. The fuse on incoming feeder, wherever provided, shall be chosen to provide discrimination with motor/feeder fuses.

4.14.00 **Contactors**

4.14.01 Contactors shall be three pole, air break type, with non-bouncing silver/silver alloy contacts. Contactor duty shall be class III - category AC3 for unidirectional drives and AC4 for bi-directional and inching drives/class I - category DC2.

4.14.02 Each contactor shall be provided with minimum two (2) N/O and two (2) N/C auxiliary contacts rated 10 A at operating voltage. The exact requirement of contacts shall be decided by the Tenderers taking into account the scheme requirements and spares.

4.14.03 Contactor starters shall comply with the requirements of IS-8544 (Part - 1) in respect of co-ordination of the characteristics of contactor, overload relay, and fuse. The type of co-ordination shall be Type-C as per IS-8544.

4.15.00 **Thermal Overload**

4.15.01 Thermal overload relays shall be three elements, positive acting, ambient temperature compensated with adjustable settings.

4.15.02 Single phasing preventor shall be provided as an inbuilt feature of the thermal overload relay.

4.15.03 Overload relays shall be manual reset type with change over contacts. Resetting of relays shall be possible with compartment door closed. Colour of resetting button shall be BLACK.

4.15.04 Relays for fan motors having long starting time shall be saturable core C.T. operated.

4.16.00 **Current Transformers**

4.16.01 Current transformers shall be cast-resin type. All secondary connections shall be bought out to terminal blocks where wye or delta connection will be made.

4.16.02 Accuracy class of the current transformers shall be:

a) Class PS for differential.

b) Class 5P20 for other relaying.

c) Class 1.0 ISF < 5 for metering.

Other CT particulars like ratio, burden, knee point, excitation current & secondary resistance shall be decided by the tenderers.

4.16.03 Drives requiring current monitoring shall be provided with current transducers with calibration for full-scale reading. The output shall be 4-20 mA D.C; 4-18mA of which shall correspond to the normal range and 18-20 mA shall correspond to the suppressed range.

4.17.00 **Voltage Transformers**

4.17.01 Voltage transformers shall be cast-resin, drawout type and shall have an accuracy class of 1.0.

4.17.02 High voltage windings of voltage transformer shall be protected by current limiting fuses. The voltage transformer and fuses shall be completely disconnected and visibly grounded in fully draw out position.

4.17.03 Secondary winding MCBs, sized to prevent overload shall be installed in all ungrounded secondary leads. MCBs shall be suitably located to permit easy replacement while the switchgear/PMCC is energized.

4.17.04 Both primary side & secondary side fuse failure / voltage loss monitoring system of VT shall be provided.

4.18.00 **Push Button**

4.18.01 All push buttons shall be oil tight, heavy duty, push to actuate type, with coloured button and inscription plate marked with its function. The colour of "ON" and "OFF" push buttons shall be GREEN and RED respectively. RESET push buttons shall be coloured black.

4.18.02 Each push button shall have minimum 2 NO. + 2 NO. contacts, rated 10A at 240V AC and 2A at 220V DC.

4.18.03 Push buttons shall be shrouded type except for emergency trip/stop button, which shall be mushroom type with lockable arrangement for easy identification.

4.19.00 **Lamps**

4.19.01 All indicating Lamps shall be LED type.

4.19.02 LED lamp shall be made in accordance with InP Technology (Aluminium Indium Gallium Phosphide Technology). The body shall be made of Poly Carbonate Unbreakable Lens. LED shall be protected by inbuilt fuse with surge suppressor or leakage voltage glow protection. LED circuit shall be PCB mounted. Intensity shall be greater than 200 mcd. All Push Button lamp shall be as per LED indicating lamp.

4.20.00 **Operating Range**

All instruments shall be generally suitable for operation on 1A or 5A C.T. secondary circuit and/or 110V V.T. secondary circuit.

4.21.00 **Meters**

4.21.01 All indicating instruments shall be switchboard type, back connected, suitable for flush mounting, 96 x 96 mm with 240 Deg. scale, antiglare glass and accuracy class of 0.5. The dials shall be made of such material as to ensure freedom from warping, fading, and discolouring during the lifetime of the instruments.

4.21.02 All indicating instruments shall be enclosed in dust-tight cases suitable for tropical use.

4.21.03 Meters shall have provision for zero-adjustment from front of the panel.

4.21.04 Meters shall be compensated for temperature errors and factory calibrated to read the primary quantities directly without using a multiplying factor.

4.21.05 D.C. ammeters, wherever required, shall be provided with external shunt if the current exceeds 5A. The rated voltage drop for the shunts shall be 75mV.

4.22.00 **Annunciator System**

4.22.01 Each control panel shall be provided with an annunciator window board. The annunciator boards shall be back-connected and suitable for semi-flush mounting.

4.22.02 The annunciator system shall be solid state type with optical isolation for input signals. The functional requirements shall be as per Annexure-C.

4.22.03 Each annunciator group shall be independent, complete with its own power supply, acknowledge-reset-test buttons and other necessary accessories. Hooter for audible alarm shall be common for each control panel assembly.

4.22.04 Each annunciator group shall be provided with a common alarm relay for group alarm annunciation in remote control room. The common alarm relay will operate on actuation of any alarm point of the group.

4.22.05 The annunciator shall be non-integral type with hardware box mounted separately for easy access and maintenance.

4.22.06 Audible alarms with different tones shall be used for trip, non-trip and ring back functions.

4.22.07 The window size shall be such as to accommodate minimum three (3) lines of twelve (12) characters each. Each character shall be minimum 4.75 mm high.

4.22.08 The annunciator system shall be suitable for operation from both NO and NC type initiating contacts.

4.22.09 At least 10% spare channels and window facia shall be provided in each annunciator group.

4.23.00 **Relays**

4.23.01 Auxiliary relays shall be furnished in fixed, dust-tight, casings and mounted inside the panel.

4.23.02 The relays shall have adequate numbers of contacts to suit scheme requirements. Besides, each relay shall have spare contacts for future use.

4.23.03 Contacts shall be silver-surfaced, bounce-free, and capable of repeated operation without deterioration.

4.24.00 **Auxiliary Devices**

4.24.01 The Contractor shall furnish, install, and wire-up all auxiliary devices such as timing / switching / lockout / auxiliary relays/auxiliary contactors, etc. as required for the proper functioning of the approved schemes.

4.24.02 The Contractor shall number the various types of relays and contactors as per the numbers appearing in the approved Schematic/Wiring appearing in the approved Schematic/Wiring diagrams.

5.00.00 **TESTS**

5.01.00 All Control Boards/Panels, L.I.S. Units and L.P.B. Stations shall be completely assembled, wired, adjusted and tested at the factory prior to shipment to ensure accuracy of wiring, correctness of control scheme and proper functioning of all components.

5.02.00 **Routine Tests**

5.02.01 The tests shall include wiring continuity tests, high voltage tests, insulation measurement test both before and after high voltage test, and functional tests to ensure accuracy of wiring operation of the control/ protection/metering schemes and individual equipment. Detailed test report including procedure and drawing shall be furnished.

5.02.02 All switches, meters, relays and other devices shall be tested and calibrated in accordance with relevant IS standards.

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

6.00.00 **DRAWINGS, DATA & MANUALS**

6.01.00 **To be submitted with the Bid**

6.01.01 General Arrangement drawings and cross-section of each equipment showing constructional features, cable entry points etc.

6.01.02 Typical foundation plan.

6.01.03 Bill of Materials.

6.01.04 Technical leaflet and Catalogues of:

a) Local Control Boards and Local Starter-cum-Control panels

b) Local Isolating switch units

c) Local Push Button Stations

d) Switches and Lamps

e) Meters, relays, push buttons

f) Switch fuse units

g) Annunciator System

h) Auxiliary Devices

i) Terminal Blocks/glands.

j) Temperature Scanner

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

6.02.01 Dimensional general arrangement of all Local Control Boards, Local Starter-cum-control panels, Local Push Button Stations, and Local Isolating switch units showing equipment disposition and identification along with space requirements and cable entry points.

6.02.02 Foundation plan and loading diagram, clearly showing panel fixing arrangement, floor opening for cable entry etc

6.02.03 Cross section with parts list

6.02.04 Schedule of materials and label inscriptions.

6.02.05 Detailed Control Schematics clearly showing terminal and wire numbering

6.02.06 Wiring diagram showing all equipment and devices in their relative physical positions and all wiring upto the terminal blocks.

Equipment/Device and terminals shall be identified with designations/numbers as per approved schematic and connection diagrams.

6.02.07 Data Sheets and Instruction Manual for each piece of equipment

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

ANNEXURE-A

RATINGS & REQUIREMENTS

1.0	Local Control Board		
1.1	General		
	Type	:	Fixed type
	Service	:	Indoor
	Enclosure	:	IP-54
1.2	System		
	Voltage	:	415 Volt ± 10%
	Phase	:	3
	Frequency	:	50 Hz ± 5%
	System	:	Solidly grounded
1.3	Rated Current at 50°C		
	Bus bar	:	To be decided by the Tenderers
	Switches	:	To be decided by the Tenderers
1.4	Short Circuit Rating		
	Interrupting	:	50 KA
	Short time for 1 Second	:	50 KA
1.5	Insulation Level	:	2.5 KV for 1 min.

ANNEXURE-B

FUNCTIONAL REQUIREMENTS OF ANNUNCIATOR

TYPE

The annunciation system shall be manually reset type with ring back facility, suitable for operation from 220V DC ungrounded supply.

FUNCTION

The sequence of operation shall be similar to ISA-2A with fast/slow blinking as detailed below:

Field Condition	Visual Display	Audible Alarm	Ringback Alarm
Normal	Off	Silent	Silent
Abnormal	Fast blinking	On	Silent
Acknowledge	Steady On	Silent	Silent
Return to normal	Slow blinking	Silent	On
Reset	Off	Silent	Silent
Normal Before Acknowledge	Slow blinking	On	On
Acknowledge	Steady On	Silent	On
Reset	Off	Silent	Silent
Test	Fast blinking	On	On

ANNEXURE-C

AREA WISE INDICATIVE LIST OF LOCAL CONTROL BOARDS

Sl. No.	Description
1.	C.W. System Electrical Control Board
2.	Electrical Control Board for MCC/PMCC located in Ash-Slurry and Ash-Water Building.
3.	Electrical Control Boards for ESP PCC/PMCC
4.	Electrical Control Board for Fuel Oil Pressurising system
5.	Electrical Control Board for Fuel Oil Unloading and Forwarding MCC
6.	Electrical Control Boards for Raw water MCC

Note : The above list is indicative only. In addition to the above Electrical Control Boards, necessary local panels/remote panel shall be provided for respective system/equipment/drive, e.g., BFP, Hydrogen-seal Oil system for Generator, ESP, etc. as described in respective sections of mechanical specification.

ANNEXURE-D

LOCAL CONTROL PANEL / LOCAL STARTER PANEL FOR COAL HANDLING PLANT

1.00.00 DESIGN CRITERIA

1.01.00 Stacker/Reclaimer MCC & Control Desk

The power supply from 6.6 KV CHP switchgear shall be achieved through one (1) number land mounted load break isolator, one (1) number fuse cum junction box located near centre or travel, one (1) number machine mounted load break isolator, line P.T with voltmeter on 6.6 KV side, L.T Air Circuit Breaker, Ammeter with selector switch, Voltmeter with selector switch etc.

Power CRD shall be connected to isolator panel mounted on the machine. H.T. fuses for the primary side of the transformer shall be housed inside the isolator panel on machine. Fuses shall be provided with the striker pin mechanism.Specification of Load break isolator is governed by HT Switchgear Specification

1.01.01 a) One number Stacker-Reclaimer MCC shall be provided on the mobile Stacker-Reclaimer. This MCC shall receive power at 433V, 50 Hz, from the output of a 6.6 KV/433V, dry type cast resin power transformer located on the mobile machine, through suitable cables.

b) Power shall be received at the panel by means of ACB unit. The ACB shall be series trip type with short circuit and ground fault releases having adjustable settings. Necessary CT ammeter, ammeter selector switch; voltmeter; voltmeter selector switch; R/Y/B indication lamps shall be available on the MCC. Power supply for indication of breaker including load break isolator shall be derived from the UPS of PLC. The specification requirement of MCC is guided by respective 415V PMCC/MCC specification.

c) Stacker/Reclaimer is PLC controlled. Under manual local operation it shall only be possible to run individual equipment by passing all process interlock. Under manual remote operation it shall be possible to run the entire system through PLC with process and safety interlock in place. The selector switch, remote/local shall be housed in control desk.

d) Specification requirement of PLC has been detailed under main PLC specification with the exception of 100% hot standby mode and redundancy.

e) Control desk shall accommodate annunciation windows, selector switches, ammeter, voltmeter and indicating lamps for incomer, ammeter for outgoing motor feeder rated 30 KW and above.

f) Panel door shall be interlocked with the incoming switch such that the panel door can not be opened when the switch is `ON'. However, necessary door interlock defeat feature shall also be provided for

testing purpose. Rating of components shall conform to the rating indicated in the enclosed component selection chart.

g) Audio visual annunciation system shall have at least but not limited to the following annunciation points complete with Accept/Test Preset P.B.:

i) Transformer winding temperature high.
ii) 415 V Incomer breaker tripped
iii) Boom Conveyor zero speed switch operated
iv) Boom Conveyor belt sway operated
v) Boom Conveyor pull cord switch operated
vi) Boom Conveyor brake not released.
vii) Boom Conveyor Motor overload/SPPR fault
viii) Back up limit switch operated.
ix) Wind velocity high.
x) Wind velocity very high.
xi) Slew limit switch operated.
xii) Slew drive fault.
xiii) Slew motor overload.
xiv) Slew drive lubrication system fault.
xv) Hydraulic oil temperature high.
xvi) Oil level low in hydraulic tank.
xvii) Hydraulic system filter clogged.
xviii) Bucket wheel brake not released.
xix) Bucket wheel zero speed switch fault.
xx) Bucket wheel motor overload/SPPR fault.
xxi) Power CRD motor overload.
xxii) Power CRD over tension switch operated.
xxiii) Control CRD motor overload.
xxiv) Control CRD over tension switch operated.
xxv) Travel drive brake not released.
xxvi) Travel drive motor overload/SPPR fault.
xxvii) Travel limit switch operated.
xxviii) Rail clamp not released.
xxix) DS motor overload/SPPR fault (to be provided for each motor).
xxx) HT load brake switch operated.

Annunciation system shall be similar to that of main Control Panel with 20% spare windows.

h) Separate cable reeling drum shall be provided for power & control cable. Combined trailing cable shall have 24C X 2.5 mm^2 (cu) control cable and 8 pair 1.5 mm^2 (cu) screened cable for signal and communication.

1.02.00 ON/OFF operation of Wagon tipplers shall be achieved from the respective Wagon tippler Control desk through PLC based logic. Control desk shall be provided in each Wagon tippler Control room for Control, Operation, Indication & Annunciation of Wagon Tippler equipment. Control desk shall interface with PLC for the entire operation and shall accommodate annunciation windows, ammeter, voltmeter, selector switches and indicating lamps for incomer, ammeter for outgoing motor feeder rated 30 KW and above. Other features as described above for the control desk of Stacker Reclaimer shall also be considered for Wagon Tippler.

1.03.00 MCC/DB/Local Starter Panel for Dust Suppression, Dust Extraction, Sump Pump, Coal Sampler, Bunker Level and other Panels

1.03.01 The Local Starter Panel shall be fixed type with compartmentalized execution. One (1) number 415 V ± 10% 3 phase 4 wire 50 Hz ± 5% power supply feeder shall be provided for each panel. Power shall be received through an incoming SFU having R/Y/B indication lamps, voltmeter with selector switch, ammeter with selector switch. Individual motor feeder shall have their switch fuse, power contactor, overload relay-cum-single phasing preventor (hand reset type), stop/ start push button, auto/manual selector switch, Red/Green/ Trip indication lamp, auxiliary relays, timers, etc. The stop push button shall be lockable type. Necessary interlock, annunciation, 415/240 V Transformers for control supply, space heating as applicable to meet system requirement shall also be provided and in no case derive any power supply from its main feeder. Separate feeders shall also be provided for brakes and rail clamp as applicable. Facility shall be provided for resetting the motor overload relay from outside without opening the panel door. Panel door shall be interlocked with the incoming Switch such that the door can not be opened when Switch is ON.

Specification requirement of the above including module selection chart will be governed by 415 V MCC/PMCC Specification.

1.03.02 Interlock, control, indication, annunciation etc. shall be achieved by relay logic

1.03.03 Isolation of individual circuit in the MCC/DB/Local Starter Panel shall be provided through individual Fuse.

1.03.04 Control features as described under relevant mechanical section shall be considered for interlocking and preparation of control schematic.

1.03.05 Thermostatically control space heater shall be provided.

1.03.06 Necessary door interlock defeat feature shall also be provided for testing purpose. Wherever necessary, the panels shall be designed for outdoor and of weather proof/rain protection type. Ratings of components shall be as per module selection chart indicated under 415 V PCC/PMCC/MCC Specification.

1.03.07 Travelling Tripper DB cum Control Panel

In addition to indication to be provided for drives, following indications shall also be provided in local panel:

i) Brakes applied
ii) Rail clamps applied
iii) Flap Gate position
iv) Travel driver over speed
v) Travelling tripper – Forward/Reverse
vi) Cable Reeling Drum on

Travelling tripper position on bunker shall be provided in the PLC.

Control features as described under relevant mechanical portion shall be considered for interlocking and preparation of control schematic.

Cable reeling drum shall be provided for power & control cable. Apart from meeting the requirements in respect of control , indication & annunciation and telecommunication following spare cores shall be provided:

i) 4 pair core (Sheilded) for communication.
ii) 4 Core for control.

1.03.08 Sump Pump Control Panel

Sump Pump Control Panel shall be provided with level controller, necessary contacts to start pumps in auto mode when level reaches high. Further, very high level shall cause hooter to blare and the same shall stop after sometime delay. In manual mode it shall be possible to start individual pump. However, in manual mode and auto mode of operation, pump shall be tripped when level in the sump pit reaches low.

In addition to other indicating lamps level high indication lamp shall also be provided in local panel.

1.03.09 Miscellaneous Control Panels

Miscellaneous control panel i.e. dust suppression panel, ventilation panel, etc. shall have individual starter feeder for individual drive. Other features as specified above shall also be provided. Equipment such as Vibrating Grizzle feeders, Magnetic separators, Metal detectors, Dust suppression, Ventilation, Dust extraction, Coal Sampler, Bunker Level, Hoists etc. shall have individual starter-cum-control panels to suit individual requirements. The panels shall include all necessary feeders, start stop PB, indicating lamp, annunciation system, 415/240V control transformers for control supply and space heating as applicable to meet system requirement. For Magnetic Separators, separate panels shall be provided. One panel shall accommodate transformer & rectifier and the other panel shall accommodate incomer and other controlling items.

The requirement of 4-20 mA signals for Belt Weigher and bunker level indicator have been spell out in Mechanical Specification and accordingly the same shall be provided.

2.00.00 SPECIFIC DESIGN REQUIREMENT

2.01.00 Construction

a) Stacker/Reclaimer/ Wagon Tippler Control Desk

Ammeters and annunciation facia shall be mounted on the vertical portion of the panel and all push button; selector switches; indication lamps etc. shall be mounted on the desk portion. The front desk shall be with top inclined downward towards front. A removable type front door shall be provided on the desk portion along with a lockable and lift-off rear door for the panel portion of the desk-cum-panel.

Travelling Tripper/Magnetic Separator/Metal Detector/Dust Extraction/ Dust Suppression/Ventilation/Coal Sampler/Bunker Level indication, Hoist/MCC/DB/Starter-Cum-Control Panel, Misc. Control Stations, Push Button Stations & Local Information Boards.

These panels/stations shall be furnished in sheet steel enclosures suitable for wall/column/floor mounting.

2.02.00 General

a) Design, material selection and workmanship shall be such as to present a neat appearance outside and inside with no marks of welds, rivets, screws or bolt heads apparent from the exterior surface of the frames.

b) Panels shall be of folded sheet steel construction, assembled on channel/angle base plates. Anti-vibration mountings shall be provided for moving equipment.

c) The panels shall be fabricated of not less than 14 SWG sheet steel free from all surface defects. The panels shall have sufficient structural reinforcement to ensure a plain surface, limit vibration and provide rigidity during despatch and installation. Vertical panels shall be freestanding type.

d) Sufficient inter-component spacing shall be available for easy maintenance, replacement, ventilation etc. of the components. A minimum spacing of 50mm is recommended for the same.

e) All doors, covers etc. shall be properly gasketted to make the panel effectively vermin and dust proof. Door hinges shall be concealed type. Special dust protection measures shall be taken for panels located in dusty area.

f) All hardware for the complete installation of the equipment including foundation and fixing bolts, nuts, washers etc. shall be supplied to suit

the requirement. All bolts, nuts etc. exposed to external atmosphere shall be cadmium plated or zinc passivated.

g) The panels shall be liberally sized so as to provide spacious layout of equipment and devices with sufficient working space in between.

h) Shock absorbers shall be provided for panels mounted on mobile machines.

i) Maximum and minimum height of the operating devices on all panels except Local Control Stations shall be restricted to 1800 mm and 750 mm respectively from the floor level.

VOLUME : IIF/2

SECTION-IX

TECHNICAL SPECIFICATION
FOR
ERECTION - CABLING, GROUNDING AND LIGHTNING PROTECTION SYSTEM

CONTENT

ATTACHMENTS

SECTION-IX

TECHNICAL SPECIFICATION FOR ERECTION - CABLING, GROUNDING AND LIGHTNING PROTECTION SYSTEM

1.00.00 SCOPE OF WORK

1.01.00 The scope of work covers complete and efficient design, supply, erection, testing and commissioning of Plant lightning protection system, all cabling and electrical grounding works. The scope shall broadly cover, but not be limited to :

1. Main Power House Building
2. Boiler area, ESP stack
3. Transformer yard
4. All auxiliary buildings (including electrical rooms of respective buildings) and structures as details in the Lead Specification.
5. Overhead interplant cable trestle and pipe cum cable trestle.
6. All electrical equipment as described in Volumes II-F/1 & II-F/2.

1.02.00 The scope of work shall also include all civil and structural works necessary for successful installation and commercial operation of all electrical equipment to be erected under this specification.

2.00.00 SCOPE OF SUPPLY

2.01.00 The scope of supply shall include but not be limited to the followings

2.01.01 Timely procurement and transportation to site in properly packed condition of all materials and miscellaneous items required to complete the erection work under this specification.

These materials and miscellaneous items shall include but not be limited to the following :

a) Galvanised steel pre-fabricated cable trays, coupler plates, nuts, bolts & washers, reducers, covers, wall brackets, hanger clamps, straight run, elbows, bends, etc.

b) Galvanised steel rigid/flexible conduits and accessories, ferrules, lugs, glands, terminal blocks, galvanised sheet steel junction boxes, cable fixing clamps, nuts & bolts, etc. as required.

c) Cable termination and jointing kits as necessary.

d) All necessary erection materials, consumables and sundry items including arc welding rods to complete the installation for satisfactory and trouble free operation.

e) Mild steel rods, galvanised steel flats, galvanised steel rods, lead coated copper tube suitably brazed with galvanised steel Bend ring galvanised steel wires, etc. required for grounding and lightning protection system shall be supplied in standard lengths.

f) Fire Stop mortal seal, fire retardant cable coating system .

g) Any item of works or erection materials which have not been specifically mentioned but are necessary to complete the work involved shall be deemed to be included in the scope of this specification and shall be furnished by the contractor without any extra charge to the Purchaser.

2.01.02 a) Main Ground Mat

Laying underground conductors and arc welding the conductors at each crossing and straight run (lap joint). The conductors at the periphery of the mat shall be 1 no. 40 mm diameter M.S. rod and the internal cross conductors of the mat shall be 1 No. 40 mm diameter M.S. rod. Suitable pigtails shall be provided .Diameter of the ground grid conductors as indicated above is minimum . However bidder shall select the actual diameter of conductor with supporting calculation.

b) Grounding Electrode

Fabrication and driving into ground 40 mm. diameter 3000 mm long M.S. rod and connecting them to the grounding mat by arc welding.

c) Column Grounding

i) Concrete Columns

Erection of 1 no. 40 mm. dia. M.S. rod from grounding mat to all concrete columns including necessary fixing, welding of one end of the rod with ground mat and the other end with the column above ground by welding with a short GS flat to edge angles.

ii) Steel Columns

Erection and connection of 1 No. 40 mm diameter M.S. rod from grounding mat to all steel columns including necessary fixing, welding of one end with ground mat and the other end with the column above ground with a short GS flat.

Diameter of the Earth Electrode as indicated above is minimum. However bidder shall select the actual diameter of conductor with supporting calculation

d) Risers

Erection and connection of all risers from underground mat to above ground levels where the ends will be left free for connecting to the equipment. Each riser will be 1 No. 40 mm dia. M.S. rod and Minimum 300 mm above grade level/concrete floor level.

Diameter of the Earth Riser as indicated above is minimum. However bidder shall select the actual diameter of conductor with supporting calculation

e) Electronic Equipment Grounding

Internal ground connection of electronic panels shall be insulated from the enclosure, frame, chasis and to be terminated to an insulated ground bus.

Insulated ground bus (400x100x10mm) of all electronic panels shall be connected by insulated wire to an insulated common electronic ground bar as shown in the Grounding Notes and details drawing.

All connection made above shall be in the form of a radial distribution system without any parallel ground paths.

Electronic equipments and systems, metal enclosures of all electronic panels shall be connected to a grounding system with which is isolated and separate from the electrical equipment grounding system. Separate Earth pit shall be made of 3M X 3M min 40 mm dia ground rod.

f) All other ancillary works in connection with the items of work described above which are not specifically mentioned but are necessary to complete the work, shall be under the scope of this specification.

2.01.03 a) Air Terminal

Installation of vertical 20mm dia galvanised steel rod (except for chimney). The projected length of the rod shall be as required to protect the object. (on which the rod is fixed from lightning stroke).

Installation of air terminal at top the stack/chimney for lightning protection shall be 20mm dia coated solid copper rod.

b) Horizontal Air Terminal

Erection of horizontal air terminal of 75X 10 mm GS flat conductor in such a way that no part of of the roof will be more than nine meters from the nearest roof conductor.

c) Down conductor

Erection of down conductor 75 X 10 mm GS Flat and 25 X 3 mm GS flat (Conveyor Gallery) conductor. one end of this down conductor connected with air terminal rod/ horizontal conductor at the top of roof/structure and other end connected to the nearest 40mm dia MS

rod riser through test link located at approximately 1500mm above ground level.

d) Electrode (for Lightning protection)

Fabrication and driving into ground 40 mm. diameter 3000 mm long M.S. rod and connecting them to the grounding mat by arc welding.

e) Risers (for Lightning protection)

Erection and connection of all risers from underground mat to above ground levels where the ends will be left free for connecting to the equipment. Each riser will be 1 No. 40 mm dia. M.S. rod and Minimum 300 mm above grade level/concrete floor level.

Diameter of the Earth Riser as indicated above is minimum. However bidder shall select the actual diameter of conductor with supporting calculation

f) Shielding Mast

Erection of shielding mast at the top of steel columns cap plates of power house building.

g) All other ancillary works in connection with the items of work described above which are not specifically mentioned but are necessary to complete the work, shall be under the scope of this specification.

2.02.00 All materials and accessories to be supplied by the Bidder shall be brand new ones of reputed make.

2.03.00 Necessary drawings, data sheets and Technical leaflets on each piece of material.

2.04.00 **Scope of Services**

The scope includes but is not limited to the followings;

2.04.01 Furnishing of all erection tools and tackles, testing equipment, implements, supplies, hardware and transport for timely and efficient execution of the erection work.

2.04.02 The items of erection work shall be performed with respect to the following equipment/materials :

a) Power Cables

b) Cables laid directly buried in ground

c) Control, instrument and special cables

d) Supply and erection of entire cable tray and cable shaft arrangements indoor as well as outdoor area and all associated civil and structural works including foundation and cable trenches for complete plant.

e) Supply and Erection of Grounding system.

f) Supply and Erection of Lightning Protection system.

3.00.00 GENERAL REQUIREMENTS

3.01.00 Codes and Standards

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

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

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

3.02.00 Erection Schedule

3.02.01 The entire erection work shall be carried out in a phased manner. A schedule of the work showing the sequence of erection shall be submitted by the tenderer for this purpose.

3.02.02 The erection schedule, as approved by the Owner's Engineer shall be strictly followed by the contractor. If, for any reason beyond the control of the Contractor, the work is held-up then the Contractor shall bring it to the notice of the Owner's Engineer without any delay.

4.00.00 DESIGN CRITERIA

4.01.00 Grounding System

4.01.01 Grounding shall follow the relevant standards/codes amended till date as below:

a) Indian Electricity rules

b) National Electrical Code

c) Code of Practice of Earthing IS 3043

d) Protection of building and allied structures against lightning IS 2309

e) IS- 732, IS 226, IS 2629, IS 2633 & IS 4759

f) IEEE -80 ,IEEE-665

The station grounding system shall be an interconnected network of MS conductor and MS ground rods. The system shall be provided to protect plant personnel and equipment from the hazards, which can occur during power system faults and lightning strikes

4.01.02 The main objectives of grounding system are to :

a) Provide safety to personnel from contact of dangerous potential caused by ground fault.

b) Ensure sufficient grounding current for effective relaying.

c) Stabilize circuit potential with respect to ground.

Design Basis

The station grounding system shall be designed in compliance with the IEEE-80/ IEEE- 665 considering fault current of 50kA for 1 sec. and shall be subject to approval of owner.

Actual soil resistivity measurement shall be carried out at proposed site for new units during dry season.

The surface Resistivity shall be considered as 3000-ohm meter for Gravel and 1000 ohm-meter for concrete.

a) Major items of equipment, such as generator, switchgear, transformer, motor, relay panels and control panels etc shall have integral ground buses or connection points which shall be connected to the under ground grid.

b) Electronic panels and equipment, where required, shall be grounded utilizing an insulated ground wire connected in accordance with the manufacturer's recommendations. Where practical, electronics ground loops shall be avoided. Where this is not practical, isolation transformers shall be furnished. All indoor and outdoor electrical equipment and associated non current carrying system, metal works, support structures, buildings columns, fence, neutrals, masts, arrestors, etc shall be connected to the plant ground system.

c) Instrumentation cable screens shall be single point bonded to the instrument earth network to minimize the effects of electrical interference.

d) For Signal/case/intrinsically safe signal, grounding of control room instruments, separate earth pit not connected to main ground grid shall be used. Control cabinets shall be connected to this separate earth pit.

e) A grounding conductor (steel wire armor) shall be routed parallel to all power conductors operating above 240 volts.

f) All ground wires installed in conduits shall be uninsulated.

g) Embedded grounding grid of 75x10mm GI flat at basement/grade slab as well as upper floor/suspended slabs shall be provided.

h) In addition mild steel ground pads at different locations i.e. on wall/floor/ceiling inside the buildings/tunnels/trenches shall be provided. These pads will be in turn connected to below ground level earth mat

through galvanized steel flat or riser. Each ground pad shall have provision for connection of at least two 75x10mm GI flats.

i) Treated earth pit shall be provided for system earthing at locations where generator and transformer neutrals are grounded. Two pits shall be provided for each neutral.

j) Dedicated treated earth pit shall be provided for lightning protection system.

k) Clean earthing for instrumentation shall be provided with dedicated earthing system and separate treated earth pits below the main control room, feed water pump house in turbine house etc.

l) Connection between the equipment earth lead and the grid conductor shall be welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint.

4.01.03 In order to meet the above objectives, ground grid mesh will be provided for the main plant complex, viz., switchyard, transformer yard adjacent to power house building, power house building and boiler area up to stack, auxiliary buildings, etc.

All electrical equipment, non current carrying metal parts, structures, building steel, lightning protection system, generator/transformer neutrals will be connected to this station ground grid.

The major aspects to be considered for grounding system design are given below :

4.01.04 Ground Grid Conductor

a) Ground grid conductor of mild steel rod shall be used.

b) The minimum conductor section is determined on the basis of ground fault current. This section is then increased by an allowance to account for the soil corrosion loss of 0.3 mm per year over the design life of 30 years. However, the minimum size shall be one (1) no. 40 mm dia mild steel conductor.

4.01.05 Underground Grid

a) The ground grid mesh is designed to keep the touch and step voltages within safe limits as per recommendation of IEEE 80 & IEEE665.

b) The ground grid conductors will be buried in earth at a minimum depth of 1000 mm. The length of ground conductors below earth will be sufficient to ensure a ground resistance less than 0.5 ohm.

c) The ground grid conductor will be so laid as to provide short and direct connection to building steel and major electrical equipment.

d) Ground rods shall be provided at the points where system neutrals/lightning protections are connected to the ground grid.

e) All ground grid conductor connections will be welded type.

f) Main Plant ground grid shall be connected with the other auxiliary building /area ground grid at least at two (2) points.

g) For test pits, the Electrode will be 100 mm dia. Heavy duty C.I. pipe with perforations. Electrodes installed in test pits will have disconnecting facilities

4.01.06 Above Ground Connections

a) Galvanised steel flats shall be used for all connections above earth.

b) Inside building, ground conductors will be run for each floor supported on building steel and/or cable trays. These ground conductors in turn will be connected to the station ground grid through riser (at least two) coming up along building columns/cable shafts.

c) Two separate and distinct ground connections will be provided for each electrical equipment in compliance with I.E. Rules.

d) All connections above ground will be welded type except connection to equipment/structures which shall be bolted type.

4.01.07 Equipment Ground Lead

Equipment ground connections will be sized to carry the available ground fault current. Considerations shall also be given to mechanical ruggedness of the connections and to limit the number of sizes.

4.01.08 Electronic Equipment Grounding

Internal ground connection of electronic panels shall be insulated from the enclosure, frame, chasis and to be terminated to an insulated ground bus.

Insulated ground bus of all electronic panels shall be connected by insulated wire to an insulated common electronic ground bar.

All connection made above shall be in the form of a radial distribution system without any parallel ground paths.

Electronic equipments and systems, metal enclosures of all electronic panels shall be connected to a grounding system with which is isolated and separate from the electrical equipment grounding system. Separate Earth pit shall be made by 3M X 3M MS Rod.

4.01.09 The minimum ground conductor sizes for various equipment and structures are given in Annexure-B.

4.01.10 Entire erection of grounding work shall be carried out in such a way as to be capable of withstanding the intended services of carrying full short circuit level currents to ground mat without any damage/deformation.

4.02.00 **Lightning Protection System**

Lighting protection system design shall be as per IS:2309

4.02.01 The main purposes of lightning protection system are to :

a) Provide protection to structures from lightning strokes.

b) Provide a low resistance-conducting path to lightning discharge.

4.02.02 Lightning protection shall be provided for Power House building, auxiliary building , chimney, cooling tower and other structures.

4.02.03 Lightning protection will also be provided for building/ structures where the overall rise factor exceeds 10^{-6} as per IS:2309.

4.02.04 For metal structures which are electrically continuous down to the ground level, no lightning protection is required except adequate grounding connections.

4.02.05 System Design

a) Air termination network with down conductors and earthing electrodes will be provided on the basis of IS Code of Practice.

b) Horizontal air termination shall be so laid out that no part of the roof will be more than 9 meters from the nearest conductor.

c) Shielding angle for one vertical air termination shall be 45 degrees. For more than one rod, shielding angle between the rods shall be taken as 60 Degrees.

d) Down conductors will run along the outer surfaces of the building and shall have a test joint about 1500 mm above ground.

e) An earth electrode will be provided at the connection point of the down conductor with the station ground.

f) Galvanised steel rods and flats will be generally used for air termination and connections. All connections will be welded type.

g) For air terminals of chimney, lead coated copper tube suitably brazed with G.S. Band ring shall be provided.

4.03.00 **Cabling System**

4.03.01 Erection of cabling work shall be carried out in such a way as to provide a reliable and assured electric power supply system to all station auxiliaries.

4.03.02 Cable routing will be done on unit basis as far as possible.

4.03.03 Cables will generally be laid on cable trays, cable trench, cable rack, overhead supported from building steel/structures or cable bridge/cable trestle. Cables shall be run in concrete trenches in transformer yard and in those electrical rooms at ground level, which are without any spreader room below. However cable trench shall be avoided as far as possible in outdoor areas. Cables buried directly in ground are not acceptable.

In indoor pumps, mechanical equipment areas overhead cable trays shall generally be used.

4.03.04 For outdoor area cable shall be laid both in cable trench and cable trays within overhead pipe bridge. However cable trench shall be avoided as far as possible in outdoor areas and cable rack shall be used in Pipe Bridge for outdoor area cable interconnection

4.03.05 For underground crossing of railways, road, etc. additional protection shall be provided in form of hume pipe or concrete encased rigid steel conduits (duct bank).

4.03.06 A.C. and D.C. circuit will not be run in same cable. Further, separately fused circuit will run in separate cables.

4.03.07 Cables for redundant equipment system shall be run in separate trays, as far as possible.

4.03.08 Erection of cabling work shall be executed keeping in view all necessities and requirements of fire fighting codes for Generating Stations having an adverse industrial environment.

4.03.09 Suitable embedded steel inserts shall be provided on wall/floor/ ceiling surfaces for welding of cable tray bracket in order to make the cable tray system withstand horizontal/vertical accelerations due to seismic forces for indoor trays and also wind load for outdoor trays such as on Boiler platforms in addition to normal tray cable loadings.

4.04.00 All erection work to be carried out under this specification shall conform to the notes and details given in Annexure-A & drawing attached to this specification.

5.00.00 SPECIFIC REQUIREMENTS - SUPPLY

5.01.00 Equipment and Material

5.01.01 Equipment and material shall comply with description, rating, type and size as detailed in this specification, drawings and annexures.

5.01.02 Equipment and materials furnished shall be complete and operative in all details.

5.01.03 All accessories, fittings, supports, hangers, anchor bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished.

5.01.04 All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.

5.02.00 Pre-fabricated Cable Trays

5.02.01 Cable trays shall be pre-fabricated ladder type sheet steel with hot dip galvanising furnished in standard length of 2.5 metres.

5.02.02 Cable trays shall be of standard width specified in Annexure-A and drawings.

5.02.03 Cable trays shall be complete with all necessary hot dip galvanised sheet steel accessories such as coupler plates, ground continuity connections, nuts, bolts, washers, hangers, clamps, etc. Also horizontal/ vertical bends, horizontal/ vertical Tee, Reducers, Horizontal cross-pieces, protective covers shall be supplied along with straight runs in order to take care of cable tray alignments in different routes.

5.02.04 All fittings like horizontal/ vertical elbow, horizontal crosspiece, reducer, horizontal tee, etc. should be prefabricated.

5.02.05 Cable trays, fittings & accessories as well as elbows, reducers, tees, crosses, etc. shall be fabricated out of 14 gauge (2 mm thick) hot rolled mild steel sheets.

5.02.06 Contractor shall supply 16 gauge (1.6 mm thick) perforated type hot rolled mild steel sheet covers for vertical cable shafts up to a height of 2.5 metres from floor level. The perforated covers used for the vertical raceways may be of one or more pieces along the width of the raceway, depending on the width of the raceway and shall be bolted to the structural framework of the raceway.

5.02.07 The cable trays, fittings and accessories including all bolts, nuts, screws, washers, etc. shall be hot dip galvanised after fabrication as per IS:2629. Galvanising shall be uniform, clear, smooth and free from acid spots. Should the galvanising of the samples be found defective, the entire batch of steel will have to be regalvanised at Contractor's cost.

The amount of zinc deposited shall not be less than 610 gms per square metre of surface area and in addition the thickness of the zinc deposit at any spot whatsoever, shall not be less than 75 microns. The Owner reserves the right to measure the thickness of zinc deposit by Elcometer or any other instrument and reject any component, which shows thickness of zinc at any location to be less than 75 microns.

5.02.08 Each 2.5M long section of all types of cable trays & each fittings like elbow, tees, crosses, etc. shall be provided with two nos. hot dip galvanised side coupler plates & associated bolts, nuts and washers on each side.

5.02.09 The Contractor shall perform all tests necessary to ensure that the material and workmanship conform to the relevant standards and that such tests are adequate to demonstrate that the equipment will comply with the requirement of this specification.

The tolerance on dimensions shall be in accordance with appropriate Indian Standards. The extent of the tests to be performed by the contractor shall include but not be limited to the following:

Deflection Test

A 2.5 metre straight section of each type of cable trays shall be simply supported at the two ends. A uniformly distributed load of 100 Kg per metre will be applied along the length of the tray. The maximum deflection at mid span shall not exceed 7 mm.

5.02.10 For other details refer CABLING NOTES AND DETAILS annexed to this specification.

5.03.00 **Conduits and Accessories**

5.03.01 Conduits shall be of rigid steel, hot-dip galvanised, furnished in standard length of 5 metres, threaded at both ends.

5.03.02 Conduits diameter upto and including 25mm size shall be of 16 SWG and conduits above 25 mm diameter shall be of 14 SWG. Minimum diameter of conduits shall be 20 mm.

5.03.03 Each piece of conduit shall be straight, free from blister and other defects, internal surface shall be of smooth finish and covered with capped bushings at both ends.

5.03.04 The contractor shall provide and install all rigid steel conduits, mild steel pipes, flexible conduits rigid PVC pipes, etc. complete with accessories such as tees, bends, adopters, locknuts, pull boxes, conduit plugs, caps, etc as required for the cabling work.

5.03.05 Steel conduits with interior coating of silicon epoxy ester for ease of wire/cable pulling shall be seamed by welding and flo-coat metal conduit/hot-dip galvanised. These shall be supplied in standard length of 5M with minimum wall thickness as specified in IS:9537. In chemical handling areas, Battery Room, etc., the exterior surface shall be further coated with chromate and polymer for better resistance to corrosion. Conduits, fittings & accessories shall have ISI mark.

5.03.06 For sizes above 63 mm mild steel pipes with necessary fittings & accessories shall be provided and installed by the contractor. Pipes shall be manufactured by electric welding process. These pipes shall be of heavy duty class as per IS:1239 and shall have ISI mark. Pipes shall be supplied in lengths of approximately 5 metres. Pipes, fittings & accessories shall be hot dip galvanised both on inside and outside.

5.03.07 Flexible conduits shall comply with IS:3480. They shall be made with bright, cold-rolled, annealed and electro-galvanised mild steel strips. Flexible conduits shall be used between embedded conduits/pipes and the motor terminals. Flexible conduits shall also be used between fixed conduit and any equipment terminal boxes where vibration is anticipated or equipment that require regular removal.

5.03.08 Rigid PVC conduits conforming to IS:4985 shall generally be used for control & instrumentation cables in some areas where cable trays do not exist and where the runs are straight ones generally the PVC pipes with special Bell Mouthing shall be of 110 mm,160 mm & 200 mm outside diameter and shall be suitable for working pressure of 6 kg/sq. cm. The length of each pipe shall be 5 to 6 metres. Necessary fittings & accessories as may be required for the installation shall also be provided.

5.04.00 **Junction Boxes**

5.04.01 Glass Fibre Reinforced Junction Boxes

1. No. of Ways:12 / 24 / 36 / 48 with 20% spare terminals.

2. Design:

Junction boxes shall be Glass Fibre Reinforced with saturated polyester informing to standards like DIN 16911 type 803 / 16913 type 834, 5 self extinguishing in accordance with ASTM D 635 / UL 94 VO.

Junction boxes for use in outdoor or damp locations shall be sturdy construction. Temperature resistance between – 10 to 100 deg C. Impact resistance shall be greater than 7 Nm, (EN 50 014). Protective insulation shall be in line with VDE 0100, dielectric strength shall be greater than 10 KV/ mm, halogen free toxicity, the enclosure and door cover shall be painted and electrostatically powder coated (preferably in RAL 7032). Earth connection (studs size shall be M 6) shall be provided on the cover as well as door.

Doors:

With integrated viewing window of 3 mm resistant plexi – glass or equivalent. The doors shall have industrial heavy – duty hinges. The doors shall be easily but firmly lockable with quick release fastener.

a) Protection Class :

Protection Category shall be IP 66 to EN60 529. There shall be guaranteed perfect seal to meet Protection class IP 66 providing sealing arrangement like highly elastic foamed in special type seal like polyurethane / chloroprene. The sealing rubber shall not have aging effect and shall retain its sealing characteristics for more than 20 yrs. Bidder shall indicate this in data sheet. The rubber seal should be pasted at its place with pasting technology for like more than 20 yrs (double sealing arrangement is preferred).

b) Mounting clamps and accessories :

Suitable for mounting on walls, columns and structure. Brackets, bolts, nuts, screws, glands and lugs required for erection shall be of brass. The accessories like mounting plants etc. of steel shall be powdered coated. The support rails for terminal box shall be zink coated.

c) General :

i) JBs shall have small canopy at the top.

ii) There shall be rainwater collection arrangement from top and side of the outer ages to ensure that any leakage in to the junction box shall be avoided and it shall fall outside.

iii) Cable entry shall be from bottom side only.

iv) Ensure gland plate sealing perfect. It shall be of the same quality and arrangement as that of door to cover arrangement.

5.04.02 Steel Junction Boxes :

a) No. of Ways:12 / 24 / 36 / 48 with 20% spare terminals.

b) Design :

Junction boxes shall be designed in accordance with NEC, articl 370, paragraph 18, 20 or equivalent standards.

c) Enclosure :

Junction boxes for use in outdoor or damp locations shall be sturdy steel construction. The enclosre and door cover shall be surface finished clean, degreased, fospheted, deep coated primed (preferably in RAL 7044) and electrostatically powder coated (preferably in RAL 7032). Earth connection (studs size shall be M 6) shall be provided on the cover as well as door. The sheath steel thickness shall be minimum 2 mm.

d) Doors :

The doors shall be hinged and lockable. The doors shall have industrial heavy – duty hinges. The doors shall be easily but firmly lockable with quick release fastener.

e) Protection Class :

Protection Category shall be IP 66 to EN60 529 / 10.91 complies with NEMA 4. There shall be guaranteed perfect seal to meet Protection class IP 66 providing sealing arrangement like highly elastic foamed in special type seal like polyurethane. There shall be an arrangement like multifold protection channel for additional stability and prevention of ingress of dust and water when the enclosure is open.

The sealing rubber shall not have aging effect and shall retain its sealing characteristics for more than 20 yrs. Bidder shall indicate this in data sheet. The rubber seal should be pasted at its place with pasting technology for like more than 20 yrs (double sealing arrangement is preferred).

f) Mounting clamps and accessories:

Suitable for mounting on walls, columns and structure. Brackets, bolts, nuts, screws, glands and lugs required

5.04.03 The junction boxes shall have the following indelible marking

- Circuit nos. on top by white-stenciled paint at site.
- Circuit nos. with ferrules (inside) as per approved drawing.
- Danger sign in case of 415V circuit.

5.05.00 **Terminals**

5.05.01 Multiway terminal blocks of approved type, complete with screws, nuts; washers and marking strips shall be furnished for connection of incoming/outgoing wires.

5.05.02 Each control cable terminal shall be suitable for connection of 2 nos. 2.5 sq.mm. stranded copper conductors without any damage to the conductor or looseness of conductors.

5.06.00 **Cable Termination & Jointing Kits**

5.06.01 The Bidder shall supply cable termination and jointing kits in requisite quantity for H.T. Power Cables, L.T. Power, Control Cables, Instrumentation Cables, etc. along with all accessories & consumables required for making termination and joints complete. All the materials and components of the termination/joints shall be suitable and compatible with the type of cables for which the terminals/ joints are intended.

5.06.02 The straight through joints of H.T. and L.T. cables shall be of Tapex/ Paracast/Parawrap type. The end termination kits for H.T. cables shall be of Raychem/3M/Elastimold type. Cable joint or end terminations on Electrical equipment shall be suitable for Indoor & Outdoor use, as the case may be.

5.06.03 Glands and lugs required for termination of H.T., L.T. and instrumentation cables shall be supplied by the Contractor in required quantity.

5.07.00 **Cable Glands**

Cable glands shall be tinned brass gland, double compression type complete with necessary armour clamp and tapered washer, etc. Cable glands shall match with the sizes of different HT/LT/Control cables.

5.08.00 **Cable Lugs**

Cable lugs shall be suitable for termination of different cross-sections of H.T./L.T./Control/Instrumentation cables and shall be of following types :

i) Aluminium tubular terminal end for solderless crimping to aluminium conductors.

ii) Copper tubular terminal end for solderless crimping to copper conductors.

Solderless crimping of terminals shall be done by using corrosion inhibiting compound. The cable lugs shall suit the type of terminals provided on the equipment. Lugs for control/instrumentation cables shall be PVC insulated/sleeved type.

iii) Cable lugs for control cable termination shall be insulated. These lugs shall be pin type/flat type/ring type/U type to suit the terminals provided in the panels.

5.09.00 **Consumables and Hardware**

5.09.01 The Contractor shall furnish all erection materials, hardware and consumables required to complete the installation.

5.09.02 The materials shall include but not be limited to the following :

Consumables : Welding rods & gas, oil and grease, cleaning fluids, paints, electrical tape, soldering materials, etc.

Hardware : Bolts, nuts, washers, screws, brackets, supports, clamps, hangers, saddles, cleats, sills, shims, etc. 5.09.03 Supply of cement, sand, stone, etc. required for the execution of the contract shall be the responsibility of the Contractor.

5.10.00 **Testing Equipment**

5.10.01 The major testing equipment that are required to be provided by the Contractor are listed below :

a) Insulation Tests

i) Power operated Meggar - 1 KV and 10 KV grade

ii) Hand operated Meggar - 1 KV grade

b) Hand driven earth Resistance Meggar, range 0-1/3/30 ohms.

c) High potential testing set - roller mounted type

d) Tong testers of suitable ranges.

e) Contact resistance measuring set for micro-ohms.

f) Torque wrench of various sizes.

g) Multimeters, test lamp, field telephone with buzzer set, different gauges, etc.

5.10.02 The list of equipment is indicative only. Any other test equipments required will be arranged by the Contractor.

6.00.00 **METHODS AND WORKMANSHIP**

6.01.00 All work shall be installed in a first class, neat workmanlike manner by mechanics/ electricians skilled in the trade involved.

6.02.00 The erection work shall be supervised by competent supervisors holding relevant supervisory license from the Government.

6.03.00 All details on installation shall be electrically and mechanically correct.

6.04.00 The installation shall be carried out in such a manner as to preserve access to other equipment installed.

7.00.00 **INSTALLATION**

7.01.01 Installation work shall be carried out in accordance with good engineering practices and also as per manufacturer's instructions/ recommendations where the same are available.

7.01.02 Equipment shall be installed in a neat workmanlike manner so that it is level, plumb, square and properly aligned and oriented.

7.01.03 Cable installation work shall mean erection of cable trays/racks, supports, hangers, junction boxes, conduits, laying of cables either in ground or on trays inside trenches tunnels/overhead trays in conduits, etc. dressing and clamping, jointing and termination inclusive of supply of necessary jointing/ termination kits, lugs, glands, ferrules, tapes, etc. and other accessories, grounding of cable armour. In case of direct laying in ground, all excavation work, necessary back-filling, supply of bricks and protective concrete slabs, removal of excess earth shall be part of the installation work.

7.01.04 Grounding installation work shall mean erection, jointing/ brazing/ welding, connection and painting, testing of ground conductors including supply of necessary steel/copper.

7.01.05 Lightning protection system installation work shall mean erection, jointing, welding, connection and painting, testing of air termination network, down conductors, shielding masts, connection to ground grid, electrodes, risers, horizontal conductors, etc. of lightning protection system.

7.02.00 **Cable Trays**

7.02.01 Pre-fabricated cable trays and accessories shall be assembled & erected at site. Adequate spaces will be provided to facilitate installation of cable system and to allow routine inspection and modification after installation.

7.02.02 Cable trays either inside concrete trenches or inside buildings and racks inside cable shafts shall be aligned and leveled properly. All tray runs shall be installed parallel to the trench/building walls and floors except otherwise noted in the approved drawings.

7.02.03 As far as practicable, cable trays shall be supported from one side only in order to facilitate installation and maintenance of cables from the other side.

7.02.04 The cable trays shall be supported in general at a span of exceeding 1.25 metres horizontally and 1.0 metre vertically.

7.02.05 Sufficient spacing not less than 250 mm shall be provided between trays and maintained to permit adequate access, for installing & maintaining the cables.

7.02.06 Complete cable tray support structure after installation shall be inspected/ tested for welding strength, straightness, accuracy, use of proper sizes and compliance to drawings.

7.02.07 Complete cable tray and accessory installation work shall be inspected/tested for proper alignment, leveling, use of proper accessories, high quality workmanship, etc.

7.02.08 The Contractor shall remove the RCC/steel trench covers whenever required and shall again place the same in their positions after the erection work in the particular area is completed or when further work is not likely to be taken up for some time.

7.02.09 Whenever any pipe/conduit/cable tray emerges out or enters into a building care should be taken to ensure that no water enters into the building.

7.02.10 Cable trays in areas subject to excessive coal dust, oil spillage, mechanical damage or accessible to personal contact shall be provided with raised sheet metal tray covers, installed on upper tray in horizontal run and front in vertical run.

7.02.11 Cable trays/racks shall be so arranged that they do not obstruct or impair clearances of passage way.

7.02.12 Cable tray/conduit system will be so designed as to accommodate maximum pulling tension and minimum bending radius of cable.

7.02.13 Cable tray/conduit system will be constructed to prevent drainage of water into equipment or building.

7.02.14 Cable tray/conduit system shall be electrically continuous and grounded.

7.02.15 Different voltage grade cables will be laid in separate trays when trays are run in tier formation. Power cables will normally be on top trays and control/instrumentation cable on bottom trays.

7.03.00 **Cable and Conduits**

7.03.01 The Contractor shall install, terminate and connect up all cable and conduits as per drawings and cable schedules.

7.03.02 The drawings shall be strictly followed except where obvious interference occurs. In such cases, the routing shall be changed as directed and/or approved by the Engineer.

7.03.03 Approximate lengths of cable and conduit runs will be shown by the contractor in the cable schedule for guidance only. Before commencement of work the Contractor shall take actual measurements and prepare his own cable-cutting schedule to reduce wastage to a minimum.

7.03.04 The Contractor shall also maintain and submit when requested, a record of cable insulation value when drawn from store, after laying, before and after termination/jointing.

7.03.05 Where direct heat radiation exists, heat isolating barriers, shall be adopted for cabling system.

7.03.06 Cabling/wiring in offices, laboratories, control rooms etc. shall be taken through concealed G.I. or rigid PVC pipes as directed by the owner's Engineer.

7.03.07 At certain places where hazardous fumes/gasses may cause fire to the cables, cable trenches after installation of cables shall be sand filled.

7.04.00 **Conduit and Accessories**

7.04.01 Conduit/pipes shall be used only in short lengths in certain areas where required and/or as directed by the Engineer.

7.04.02 The Contractor shall furnish all conduits complete with accessories as required.

7.04.03 Conduits shall be flexible type in general. However, rigid type steel conduit if required shall also be supplied by the Contractor.

7.04.04 Except for inside an enclosure wherever the cable enters or leaves the conduit, the conduit end shall be sealed by suitable sealing compound, having fire withstand capability.

7.04.05 The entire metallic conduit system, when embedded or exposed shall be electrically continuous and grounded.

7.04.06 Where it is possible for water or other liquids to enter conduits, sloping of conduit runs and drainage of flow points shall be considered.

7.04.07 Pull boxes will be installed between termination points where required to facilitate cable pulling, but at a maximum interval of 30 meters.

7.04.08 Conduits shall be firmly fastened within 900 mm of each junction box/pull box/cabinet/fitting, etc. Conduits shall be supported at least every 2000 mm.

7.05.00 **Cables : Storage and Handling**

7.05.01 Cable drums shall be stored on hard and well-drained surface so that they may not sink. In no case shall the drum be stored on the flat, i.e., with flange horizontal.

7.05.02 Rolling of drums shall be avoided as far as practicable, for short distance, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum.

7.05.03 In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cable.

7.05.04 For unreeling the cable, the drum shall be mounted on jacks or on cable wheel. The spindle shall be strong enough to carry the weight without bending.

7.05.05 The drum shall be rolled on the spindle slowly so that the cable should come out over the drum and not below the drum.

7.05.06 While laying cable, cable rollers shall be used at an interval of 2000 mm. The cables shall be pushed over the roller by a gang of people positioned in between rollers over a suitable distance. Care shall be taken so that kinks and twists or any mechanical damage does not occur in cables. Only approved cable pulling grips or other devices shall be used. Cables shall not be dragged on ground or along structure while laying out from cable drums.

7.05.07 Cable shall not be pulled from the end without having intermediate pushing arrangement. Bending radius of the cable during installation shall not be less than what is specified by the manufacturer.

7.05.08 Empty cable drums shall be returned to the owner.

7.06.00 **Cable Laying**

7.06.01 Cable shall generally be installed in ladder type prefabricated trays except for some short run in rigid/flexible conduit for protection or crossings.

7.06.02 Cables laid on trays and risers shall be neatly dressed and clamped with self-locking type fire resistant nylon ties at an interval of 750 mm. for horizontal and vertical runs, in case of both power, control and instrumentation cables.

7.06.03 All single core power cables for 3 Ph. AC circuits shall be laid in trefoil formation and suitably clamped with self-locking type fire resistant nylon ties at an interval of 750 mm.

7.06.04 All H.T. multicore power cables and L.T. multicore power cables with cross-sectional area including & above 95 sq.mm shall be clamped individually by self-locking type fire resistant nylon ties.

7.06.05 L.T. power cables of cross sectional area less than 95 sq. mm. and all control and Instrumentation cables shall be clamped in bunches with self-locking type fire resistant nylon ties. The number of cable in one bunch shall not exceed eight (8).

7.06.06 Prior to laying of cables inside the indoor and outdoor trenches, the contractor shall properly clean the trenches.

7.06.07 In outdoor areas, buried cables shall be laid and covered with sand/riddled earth and protected from damage by bricks at sides and precast slab at top.

7.06.08 When buried cables cross road/railway track, adequate protection shall be provided in the form of hume/galvanised iron pipes laid at a minimum depth of 1 meter below ground.

7.06.09 After completion of installation and prior to connection, all power cables shall be subjected to a high potential test.

7.07.00 **Cable Tags & Markers**

7.07.01 Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedules. Cables and conduits shall be tagged at their entrance, bends, every 30.0M and exit from any equipment, junction box. When a cable/conduit passes through a wall, tags shall be fitted on both sides of the wall.

7.07.02 The tags shall be of aluminium with the number punched on it and securely attached to the cable by not less than two turns of 16 SWG G.I. wire. For single core cable the wire shall be of non-magnetic material.

7.07.03 The location of cable joints, if any, shall be clearly indicated with cable marker with an additional inscription 'cable-joint'.

7.07.04 The Contractor shall furnish and install all tags and markers stated above.

7.07.05 For buried cable, the marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change of direction.

7.08.00 **Cable Termination and Connection**

7.08.01 The termination and connection of cables shall be done strictly in accordance with manufacturer's instruction, drawings and/or as directed by the Engineer.

7.08.02 The work shall include all clamping, fitting, fixing, soldering, tapping, compound filling, cable jointing, crimping, shorting and grounding as required for the complete job. All equipment required for all such operations shall be of Contractor's procurement.

7.08.03 Furnishing of all consumable materials such as soldering material, electrical tape, sealing material as well as cable jointing kits shall be included in the offer.

7.08.04 Cable joint kits for all cables shall be supplied by Contractor under this specification. Responsibility for proper termination shall lie on the contractor. Guarantee for termination shall also have to be given by Contractor.

7.08.05 The equipment will be generally provided with blank bottom plates for cable/conduit entry and cable end box for power cables.

7.08.06 The Contractor shall perform all drilling, cutting on the blank plate and any minor modification work required to complete the job.

7.08.07 If the cable end box or terminal enclosure provided on the equipment is found unsuitable and requires major modification, the same shall be carried out by the contractor.

7.08.08 Control/instrumentation cable cores entering control panel/ switchgear/ MCC, etc. shall be neatly bunched and served with PVC perforated tape to keep it in position at the terminal block.

7.08.09 The Contractor shall put ferrules on all control cable cores in all junction boxes and at all terminations. The ferrules shall carry terminal numbers as per drawings. All ferrules shall be coloured, plastic & interlocked type.

7.08.10 Spare cores shall be similarly ferruled, crimped with lug and taped on the ends. Spare cores shall be ferruled with individual cable number.

7.08.11 Termination and connection shall be carried out in such a manner as to avoid strain on the terminals.

7.08.12 All cable entry Points shall be properly sealed and made vermin and dust proof. Unusual opening, if any, shall be effectively closed. Sealing work shall be carried out with approved sealing compound having fire withstand capability for at least three hours.

7.09.00 **Termi-point Connection**

a) The conductor (solid or stranded) is forced against the contact area of the 2.4 x 0.8 mm or 1.6 x 0.8 mm connection pin by means of a

tin-coated bronze clip, which maintains a constant pressure. In the Maxitermi-point method, 2.4 x 0.8 mm pins is used without exception.

b) The conductor is "shot" onto the pin together with the clip. The resulting friction causes both the wire and the contact area of the pin to be cleaned and any oxide layers to be penetrated.

c) Apart from this the wire and the clip are deformed in such a way that a gas-tight connection with very good electrical and mechanical properties is established.

d) A special manually or pneumatically driven gun is required. Up to 3 adjacent connections can be "shot" onto one pin. In most cases only one clip at the base of the pin is attached. The sections above usually remain vacant. Any part of a connection pin may be reused several times after removal of the existing clip connection. Contact areas below existing connections that have become vacant can be reused by pushing the connections above the vacant space downwards, so that the new connection can be "shot" on above the top connection. The single jumper wires need not be specially prepared as the end insulation is stripped within the tool.

e) This connection method requires special insulation of the wires. The diameter of solid conductors is 0.8 mm the cross-section of stranded conductors 0.5 Sq.mm.

f) The conductor is deformed greatly when attached and is to be shortened by 3 mm when disconnected and reused.

g) Strips and special tools for termi-point connection shall be supplied by the Contractor.

7.10.00 **Cable Joints**

7.10.01 Cable shall be installed without joints as far as practicable.

7.10.02 If however jointing becomes necessary, it shall be made only by qualified cable jointer and strictly in accordance with manufacturer's recommendation.

7.11.00 **Grounding**

7.11.01 The Contractor shall carryout the interconnection among various peripheral earthing grids/mats, steel structures, lightning protection system as well as grounding of all electrical equipment, etc. The grounding work shall be carried out as per provisions of I.E. rules Indian standards and enclosed grounding and lightning protection notes and details.

7.11.02 The grounding shall be done by conductors of adequate sizes (size shall be selected by the bidder with supporting calculation) and the same shall be connected to the risers of main ground mat.

7.11.03 For fabricated cable trays, a separate ground conductor (50x6 mm G.S. flat) shall run along the entire length of each route of cable tray being suitably clamped on the cable tray. Individual cable trays of each section shall be

connected to above ground conductor through 50x6 mm G.S. flat to maintain continuity of ground path.

7.11.04 All ground conductor connections shall be made by electric arc welding/ brazing unless otherwise specified. Ground connections shall be made from nearest available station ground grid risers. The rods/connection shall be coated with cold galvanizing /weather resistance anti corrosive paints.

7.11.05 All ground conductors shall be painted black for easy identification.

7.11.06 Equipment ground connections, after being checked and tested by the Engineer, shall be coated with anti-corrosive paint.

7.11.07 Whether specifically shown or not, all conduits, trays, cable armour and cable end box, electrical equipment such as motors, switchboards, panels, cabinets, junction boxes, lockout switches, fittings, fixtures, etc. shall be effectively grounded.

7.11.08 If there is no provision to ground the L.T. transformer neutral at transformer end, to make an effectively earthed 415V system the neutral bus of all 415V distribution boards shall be connected to ground grid at two different and distinct points.

7.11.09 The underground mat will be made of mild steel rods laid underground in length and breadth of the area at a depth of minimum 1 metre below grade level. All crossings and straight run shall be arc welded for good electrical continuity. Ground conductors, when crossing underground trenches, directly laid underground pipe and equipment foundation, if any, shall be at least 300 mm below the bottom elevation of such trenches/pipes as shown in the relevant drawing.

The Contractor will plan and organise works to lay the grounding mat in the same sequence in which the building and equipment foundation is being done.

7.11.10 Ground Electrode

Ground electrodes will be 40 mm dia (minimum) and 3 metre long M.S. rod. These are to be fabricated and driven into the ground by the side of mat conductor. All connections to the conductors shall be done by are wilding process.

7.11.11 Risers

Risers are required for connecting the equipment and structures with the ground mat. These will be 1 No. 40 mm dia (Minimum) M.S. rod. laid from ground mat to above ground level properly clamped or supported along the outer edge of the concrete foundation. Connection to the ground mat shall be done by arc welding and the other end is to be kept free at least 300 mm above grade level/concrete floor level unless otherwise shown.

7.11.12 Column Grounding

All columns are required to be grounded by 1 no. 40 mm dia (Minimum) M.S. rod from ground mat. Laying, supporting along with foundation, connecting at

ground mat are within the scope of this specification. At least 300 mm length of the above rods shall be left free above the grade level/concrete floor level for connection with columns.

7.11.13 Electronic Equipment Grounding

Internal ground connection of electronic panels shall be insulated from the enclosure, frame, chasis and to be terminated to an insulated ground bus.

Insulated ground bus of all electronic panels shall be connected by insulated wire to an insulated common electronic ground bar.

All connection made above shall be in the form of a radial distribution system without any parallel ground paths.

Electronic equipments and systems, metal enclosures of all electronic panels shall be connected to a grounding system with which is isolated and separate from the electrical equipment grounding system. Separate Earth pit shall be made by 3M X 3M MS Rod.

7.12.00 **Painting**

7.12.01 The Contractor shall paint steel fabrications at site with two (2) coats of red oxide primer and two (2) coats of battleship grey (shade no. 632 of IS:5) synthetic enamel paint.

7.13.00 **Galvanising**

7.13.01 The galvanising shall be uniform, clean, smooth, continuous and free from acid spots. Should the galvanising of the samples be found defective, the entire batch of steel has to be regalvanised, at Contractor's cost. The amount of zinc deposit shall not be less than 610 grams per square metre of surface area and in addition, the thickness of the zinc deposit at any spot whatsoever shall not be less than 75 microns. The Owner reserves the right to measure the thickness of zinc deposit by Elkometer or any other instrument and reject any component which shows thickness of zinc at any location less than 75 microns.

7.14.00 **Excavation and Back Filling**

7.14.01 The Contractor shall perform all excavation and backfilling as required for buried cable and ground connections.

7.14.02 Excavation shall be performed up to the required depth. Such sheeting and shoring shall be done as may be necessary for protection of the work.

7.14.03 The Contractor shall make use of his own arrangements for pumping out any water that may be accumulated in the excavation.

7.14.04 All excavation shall be backfilled to the original level with good consolidation.

7.15.00 **Steel Fabrication**

7.15.01 All racks, trays, supports, hangers & brackets wherever necessary shall be fabricated by the Contractor.

7.15.02 Steel for fabrication shall be straightened and cleaned of rust and grease. All fabrication shall be free of sharp edge and burns so as not to cause any damage to personnel or cables.

7.16.00 **Cleaning up of Work Site**

7.16.01 The Contractor shall, from time to time, remove all rubbish resulting from execution of his work. No materials shall be stored or placed on passage or drive ways.

7.16.02 Upon completion of work, the Contractor shall remove all rubbish, tools, scaffoldings, temporary structures and surplus materials etc. to leave the premises clean and fit for use.

8.00.00 **TESTS**

8.01.00 Shop Tests

8.01.01 All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant Indian Standards at manufacturer's works.

8.01.02 Tests on panels/junction boxes shall include :

a) Wiring continuity tests.

b) High voltage and insulation tests.

c) Operational tests.

8.02.00 **Site Tests**

8.02.01 Contractor shall thoroughly test and meggar all cables, wires and equipment to prove the same are free from ground and short circuit.

8.02.02 If any ground or short circuit is found, the fault shall be rectified or the cable and/or equipment replaced.

8.02.03 All power cables after installation and prior to connections shall be subjected to High Potential tests. Also the insulation resistance values shall be measured both before and after Hipot test for comparison. The leakage current shall also be measured during the Hipot test at site.

Cable cores shall be tested for :

a) Physical damage

b) Continuity

c) Correctness of connections as per relevant wiring diagram

d) Insulation resistance to earth

e) Insulation resistance between conductors

f) Proper earth connections of cable glands, cable boxes, cable armour, screens etc.

8.02.04 All equipment shall be demonstrated to operate in accordance with the requirements of this specification.

8.03.00 **Test Certificates**

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

9.00.00 **DRAWINGS, DATA & MANUALS**

9.01.00 To be submitted with the Bid

9.01.01 Make, type and catalogue number of different electrical items and accessories along with technical leaflets, data sheets etc.

9.01.02 Typical General arrangement drawings showing constructional features, fixing arrangement of pre-fabricated cable trays.

9.01.03 Bill of Materials for cable trays and accessories, conduits & accessories.

9.01.04 Layout of Grounding system & lightning protection system showing connection and other details along with backup design calculations and detailed write up.

9.01.05 Bill of materials for grounding and lightning protection system.

9.01.06 Drawing showing details of equipment grounding.

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

9.02.01 Make, type & catalogue number of cable termination kits, joints & accessories.

9.02.02 Detail dimensional drawings showing constructional features, grounding, fixing arrangement etc.

9.02.03 Bill of Materials for Pre-fabricated cable tray and accessories, Conduits & accessories.

9.02.04 Dimensional G.A. drawings and data sheets for different equipment and items supplied under this specification.

9.02.05 Layout drawing of Grounding system and Lightning protection system showing connection details along with backup design calculation and detailed write up.

9.02.06 Bill of material for grounding system and lightning protection system.

9.02.07 Drawing showing details of equipment grounding system.

ANNEXURE-A

NOTES AND DETAILS FOR CABLING SYSTEM

1.00.00 **GENERAL**

1.01.00 These notes and details shall be read and construed in conjunction with Specification and the drawings meant for cable tray details and supporting arrangements in Trench, Racks etc., enclosed elsewhere. In case of conflict between these notes and drawings, the latter shall prevail.

1.02.00 The Cabling System installation work shall conform to the requirements of the latest revisions of the following standards/codes

a) Indian Electricity Rules, 1956, with up to date amendment.

b) I.S. Code of Practice.

2.00.00 **CABLE ROUTING/LAYING**

2.01.01 Cables shall generally be laid on ladder type cable trays either in trenches or overhead supported from building steel/structures except in some cases cables may have to be laid underground and for short runs in conduits for protection or crossing.

2.01.02 For interplant connections, the cables may be directly buried or routed through an overhead cable bridge or cable trenches/tunnels selection being dependent on site constraints.

2.01.03 For underground crossing of railways, roads etc. hume pipes shall be used and shall be laid at a depth of minimum 1000 mm such that cables shall not be damaged.

2.01.04 In boiler area, trench will be avoided as far as practicable. The cable racks shall be supported from Boiler structure in vertical configuration with suitable cover to avoid deposition of coal dust as far as practicable.

2.01.05 Different voltage grade cables shall be laid in separate trays when trays are arranged in tiers. Power cables shall be on top trays and Control/Instrumentation cables on bottom trays, and it is recommended that trays for cables of different voltage levels be stacked in descending order with higher voltage level above.

2.01.06 Cables for redundant equipment/system shall be run in separate trays in separate route.

2.01.07 Cables from two different services viz. supply from station board and supply from unit board shall be fully segregated to prevent simultaneous damage due to fire in one of the services.

2.01.08 Low level signal cables and other special Instrumentation and Control cables shall run in separate trays. In general, a minimum of 1500 mm clearance shall be maintained between these cables and noise generating equipment (large motors, generators, transformers etc.).

2.01.09 The cable spreaders of each unit shall be compartmentalized by provision of fire proof partition wall.

2.01.10 The floor of the cable spreader rooms will have to be made water proof so that water does not percolate to lower levels in the event of fire fighting operations. Adequate arrangement for efficient drainage of water shall be provided. The cable raceways should also be suitably curved to avoid water entry through this place.

2.01.11 Cabling System for CHP

a) Cable in CHP area shall be generally routed through the conveyor gallery / tunnel, TP / Buildings by separate supporting structures, Pipe cum cable bridge. The cables shall be laid in vertical trays.

b) In substation & Switchgear room cable shall be laid in horizontal cable trays installed in cable vault room.

c) Cables may also be routed through hume pipes to enter into various buildings from the nearest overhead cable trestle/substation building..

d) Overhead cable trestle/cable bridge shall be provided for routing of cables between the following Sub-Stations/buildings:

i) Main CHP Substation Building and Crusher House.

ii) Main CHP Substation Building and Pump House.

iii) Wagon Tippler Substation Building and TP.

The bottom of the steel supporting structure shall be generally at 2.5m above the grade level except for road crossing and rail crossing where the same shall be 6.5 m and 9.0m respectively above grade level.

e) Cable trays shall be laid out horizontally in sub-station buildings and pump-house whereas the same shall be installed vertically inside transfer points, crusher house, conveyor gallery/tunnel etc. The cable trestle shall have a minimum 600mm clear walk way all along its routes and shall have maintenance platforms as required.

f) Separate trays shall be provided for H.T., L.T., control and instrumentation cables. LT mutlicore Power cables shall be laid touching each other in single layer & touching formation and single core cable in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil centre lines and clamped at every two meter while control and instrumentation cables shall be laid in maximum of two layers formation. Single core HT power cables shall be laid on trefoil formation with a distance of four times the diameter of cable between trefoil centre lines and clamped at every two meter and Multi core power cables shall be laid in single layer & touching formation. Normally cable trays shall be designed with 70%

fill-in criteria and conduit 40% fill-in criteria. Same cable laying philosophy shall be considered in other areas of the plant, if not specifically mentioned.

2.02.00 **Cable Trays/Supports**

2.02.01 Cable trays and covers shall be pre-fabricated type, constructed from minimum 14 SWG sheet steel for trays and 16 SWG for covers and hot-dip galvanized after fabrication.

2.02.02 Cable tray supports shall be cantilever type for each installation. All supports and hardware shall be hot-dip galvanised.

2.02.03 Standard cable tray width shall be 600 mm. However, trays with 450, and 300, 150 mm width may be used in some places considering the requirement and space restrictions. For instrumentation and control purpose, some perforated type cable trays of width 150 and/or 100mm may be used particularly in Boiler Platform area, and 600, 450, 300 mm perforated trays may be used depending on site requirement.

2.02.04 Cable trays shall be ladder type with 250 mm rung spacing, 100 mm depth and rung width not less than 50 mm.

2.02.05 All weld for cable tray supports shall have a min. throat thickness of 6 mm.

2.02.06 Cable trays in areas subjected to excessive coal dust, or mechanical damage will have hot-dip galvanised sheet metal tray cover installed on front tray in vertical run and inverted `V' type on upper tray in horizontal run.

Where covers are used on trays containing power cables, consideration should be given to ventilation requirements. Areas where corrosive chemicals are likely to be handled, cable tray and covers shall be epoxy painted.

2.03.00 **Conduits**

2.03.01 Conduits shall be rigid steel coated type; minimum size of conduit shall be limited to 19mm.

2.03.02 Steel conduits with interior coating of silicon epoxy ester for ease of wire pulling shall be seamed by welding and flo-coat metal conduit/hot-dip galvanised. These shall be supplied in standard length of 5M with minimum wall thickness as specified in IS:9537 Part-II. In chemical handling areas, Battery room etc., the exterior surface shall be further coated with chromate and polymer for better resistance to corrosion.

2.03.03 Conduit runs shall be supported at an interval of 750 mm for vertical run and 1000 mm for horizontal run.

2.03.04 Conduits shall be sized so that conduit fill (ratio of total cable area to conduit area) shall not exceed the following :

One Cable	:	53%
Two Cable	:	31%
Three Cables & Up	:	40%

2.03.05 Conduit runs shall be provided with necessary bends as required.

2.04.00 **Installation**

2.04.01 The Contractor shall install terminate and connect up all cables and conduits with supporting arrangements as per drawings, cable schedules and interconnection chart/drawings.

2.04.02 The HV power cables of 11 KV/6.6/3.3 KV shall be laid in trays or racks as follows :

a) In single layer only.

b) Multi core cables to be laid in touching with each other.

c) Single core cables to be laid in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil centerlines and clamp every two meter.

2.04.03 1100V grade power cables shall be laid in single layer in trays.

2.04.04 1100V grade mutlicore power cable shall be laid in touching formation to each other.

2.04.05 1100V grade Single core cables to be laid in trefoil formation shall be laid with a distance of four times the diameter of cable between trefoil centerlines and clamp every two meter.

Control and Instrumentation cables can be laid up to a maximum of two layers in each tray.

2.04.06 Normally cable trays shall be designed with 70% fill-in criteria and conduit 40% fill-in criteria. Same cable laying philosophy shall be considered in other areas of the plant, if not specifically mentioned.

2.04.07 The trays shall be run with a vertical spacing of 300 mm for overhead cable trays as well as inside cable trenches. A minimum of 225 mm clearance shall be provided between the top of tray and beams, cold piping, 500 mm clearance for hot piping/object to facilitate installation of cables in tray.

2.04.08 Adequate pull boxes shall be provided in conduit run to facilitate cable pulling in long runs and also to ensure that there will be no more than 270 Deg. bends between pull points.

2.04.09 Cable tray/conduit system shall be installed to accommodate cable manufacturer's recommended maximum pulling tension and minimum bending radius.

2.04.10 All openings in the floor and wall for cable access shall be sealed after installation of the cable system with non-inflammable materials, as follows :

i) Fire stop/Penetration seal shall be installed in the cable spreaders and cable raceways.

ii) Similarly in the trenches fire stop/penetration seals shall be provided at suitable interval to avoid spread of fire.

iii) For all H.T., L.T., Relay and Control panels, Control desk, instrumentation panels, battery charger, D.C. Dist. boards and other miscellaneous panels, fire-stops should be provided below base plate.

2.04.11 All floor/wall openings for cable entry to the electrical equipment and accessories shall be sealed with non-inflammable materials, after completion of cable installation. Thickness of such materials shall be equal to the thickness of floor/wall unless specified otherwise.

2.04.12 The portion of galvanised steel, which, if required, undergoes any welding at site shall be coated with two (2) coats of cold galvanising anti-corrosive paint after welding.

2.04.13 Refer Clause No. 3.00.00 below for details of fire-proof sealing and fire protection coating.

2.05.00 **Identification**

2.05.01 The complete cabling system shall be properly identified. Methods for identification of cabling system shall be furnished to the successful EPC Contractor shall strictly adhere to the said methods.

2.05.02 Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedule.

2.05.03 Location of cables laid directly underground shall be clearly indicated with cable marker made of galvanised iron plate, projected above ground level.

2.05.04 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, at each bend and at every thirty (30) metres in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, MCC, control & relay panels etc. wherever required for cable identification, such as where a number of cables enter together through a gland plate.

3.00.00 FIRE-PROOF SEALING / FIRE PROTECTION COATING SYSTEM

3.01.00 The Fire proof sealing / fire stop system / fire protection coating system is required to prevent spreading of fire from one placed to other place (or one zone to other zone) through the openings in wall / floor, cables laid in trays / racks and openings below Electrical Switchgear / MCC / Distribution boards / Cabinets / Panels, etc.

3.02.00 **Scope of Work**

3.02.01 The scope of work includes but is not limited to the following supply and services:

i) Fire Stops in wall / floors.

ii) Fire stops below switchgear / MCC / Switchboards, junction boxes / panels / cabinets, etc. which are floor mounted type.

iii) Fire retardant coating to be applied for installed cables.

iv) Minor civil / structural works for installation of the entire work.

v) All necessary erection materials, consumables and sundry items to complete the entire work for satisfactory and trouble free operation.

vi) Any special tools & tackles.

vii) Conducting the type test of fire proof sealing system in presence of Owner's engineers.

viii) All relevant Drawings, Data sheets and instruction manuals.

ix) Fire proof barrier walls.

x) Fire proof doors.

3.03.00 **Design Criteria**

3.03.01 Fire Proof Sealing System

The material / components used for fire-proof sealing system shall be provided to meet the following requirements:

i) Life expectancy should not be less than 30 years from the date of installation.

ii) Free from shrinkage or cracking or asbestos in composition and should achieve smoke and gas tightness during fire and should be modifiable.

iii) Not to generate toxic gas and harms to the personnel handling the system.

iv) Prohibition of production of acid or alkali during gas generation.

v) Will not produce suffocating / corrosive gas.

vi) Repellant to paste / rodent / termite.

vii) Expansion co-efficient - very low which is to be comparable with masonry concrete.

viii) Not soluble / reactive to acid, water, alkali.

ix) Thermal conductivity - low.

x) The material in contact with the cables in the fire-proof sealing system shall be compatible with the material used for outer sheath of cables.

xi) It should not have any adverse effect on the cables and should not alter the current carrying capacity of the cables.

xii) Retrofit in design to accommodate not less than 15% more addition of cables depending upon the size of cables, physically and chemically stable.

xiii) Capable of withstanding vibrations, drop-loads, foot traffics, mechanical loads, etc.

xiv) The F.P.S. system shall maintain its integrity and perform satisfactory even after

a. Remaining in water for a long time.

b. Accelerated thermal aging.

c. Sustaining vibrations.

xv) The design and construction of F.P.S. system shall specifically take into account the fact that under seismic disturbances, normal load, short circuit and fire conditions, the cable / cable trays will be subject to movement, expansion and oscillation and this shall not result in any damage or cause dislocation of the F.P.S. system or the material constituting the FPS System.

xvi) Non-hygroscopic, non-inflammable and shall not get affected over a period of time due to humidity, moisture and ozone etc. and should not contain volatile solvents which may cause a fire hazard during application.

xvii) The fire rating shall not be less than two (2) hours and the system shall be stable after applicable of water jet in the exposed side in order to extinguish fire.

3.03.02 Fire Protection coating to be applied on installed Cables:

The cables shall be coated with fire protection material of 2 mm dry thickness at the strategic locations as follows so as to limit the spread of fire:

i) At fire stops in walls and floors on either side upto 500 mm length.

ii) At fire stop below Electrical Switchgears/ MCCs/ Panels/ Cabins, etc. on one side coating of 500 mm length, i.e., on the cable vault side / cable trench side.

iii) Length of 500 mm on all sides of the junction/crossing of cabling work in open cable routes/ cable trench.

iv) In fire risk areas and where specified at suitable intervals as decided upon side conditions in open cable routes.

v) Where necessary and specified at site intervals along cable routes in cable trenches.

vi) The coating shall be applied evenly on the cables only.

3.03.03 The fire protection coating shall have the following properties/composition:

i) Asbestos free, non-volatile, not eatable by vermin, harmless and non-irritant to skin of human.

ii) Not affecting the current carrying capacity of the cables and the properties of the installed cables.

iii) It shall delay fire damage to cables and prevent flame spreading meeting the requirement of IEEE - 383.

iv) Coating material shall show no signs of cracking and peeling when the coated cable is bent to the radius of minimum 12 times the diameter of the maximum size cable at 180°C.

v) The limiting oxygen index of the material shall not be less than 60% as per ASTMD - 2863.

vi) Life expectancy equivalent to the cable installations.

3.03.04 The various openings in the cable vault, vertical/ horizontal raceways of cables penetrating walls/ floors and the bottom of Electrical switchgears/ MCCs/ distribution boards/ Cabinets/ Panels shall be provided with fire stop systems. Cables passing through the openings at various locations are laid on various tiers of the cable trays/ racks in the bunch formation. Bidder shall visit the site to assess and get acquainted with the type of cable installation where fire stops and fire protection coating are to be provided. In case steel frames are required to be fabricated and fixed in the openings, the fabrication of frame & fixing of the same shall have to be done by the Contractor without any extra cost. The necessary steel section for fabrication of frames shall be supplied by the Contractor without any extra cost. Any civil works required to be done in the openings shall be carried out by the Bidder. Bidder shall also include one set of tools & accessories required for addition or removal of cables after the seal is made.

3.04.00 The bidder shall quote the unit rates for provision of supply, installation, testing & commissioning of the fire proof seals as given in the specification. Bidder is requested to quote the unit rates per square metre (i.e., area) basis of the area of the fire sealing material.

3.05.00 **Type Test On Penetration Seals**

3.05.01 The type tests for fire proof/ penetration seal for floor and wall opening/ fire stop system for bottom of electrical switchgear/ MCC/ panel base are as under:

i) Fire rating test.

ii) Hose Stream test.

iii) Accelerated aging test.

iv) Fire rating test on the penetration seal system built out of accelerated aged components followed by hose stream test.

v) Temp. rise test for cable in the fire stop.

vi) Water absorption test followed by fire rating test.

vii) Flame Resistance test for fire retardant coating material.

viii) Anti-rodent test.

3.05.02 Fire Rating Test

This test shall be carried out to prove the guaranteed power rating duration of the system in respect of stability, integrity and insulation characteristics of the complete system. The penetration seal system as a whole conforming to ASTM 814 and as per BS:476 Part-8 shall be built with the necessary component. The fire test shall be built with the necessary component.

The test specimen of the penetration seal built with 9-10 nos. armoured cables of various sizes passing through the seal shall be fitted to the gas fired furnace and shall form the upper most face of the furnace. The gas fired furnace shall have provision to achieve standard time temperature characteristics for fire tests as mentioned in BS-476 Part-8, according to which the temperature required to be maintained are as under:

Heating time in minutes	**Temperature in the furnace**
30 minutes	821°C
90 minutes	886°C
120 minutes	1029°C
150 minutes	1062°C
180 minutes	1090°C
210 minutes	1113°C
240 minutes	1133°C

The pressure inside the furnace at the time of test shall be more than 2 mm water gauge. The penetration shall be subjected to fire test with surface exposed to controlled fire in the furnace conforming to time / temperature characteristics as mentioned above. During the test, the temperature of both the faces of the penetration seal i.e. one which is exposed to fire and the other unexposed, shall be measured by calibrated thermocouples after regular interval of 5 minutes. At least 3 thermocouples shall be provided for temperature measurement of each face.

3.05.03 The results at the end of the tests shall be interpreted or failure criteria as under:

i) The system is deemed to have failed to maintain stability if there is a total collapse of the penetration seal.

ii) In case cracks are seen on the face of the penetration seal or cracks through the sealing system through which the flame / or gas can pass,

the system is deemed to have failed to maintain integrity. The development of crack is characterized by ignition cotton wool held near the seal on the unexposed surface at a distance of about 30 mm from the aperture.

iii) In case the mean temperature rise of unexposed surface of seal exceeds 140°C above the initial temperature or temperature of unexposed surface exceeds 180°C, the system shall deemed to have failed in respect of insulation characteristics.

iv) Temperature measurement on the unexposed side of the penetration seal specimen shall be measured by the thermocouple on the surface of penetrating items and on fire stop material in accordance with ATME-814/UL 1479 at a distance of 25 mm from fire stop material and penetration items respectively.

3.05.04 Hose Stream Test:

The intention of the hose stream test is to ascertain whether the penetration seal assembly maintains its stability on application of water jet after withstanding the fire for 3 hours i.e. the guaranteed fire rating duration.

The test apparatus for this test shall be similar to the one used for carrying out the fire rating test. The penetration seal system shall be subjected to the action of hose stream at the nozzle pressure of 30 psi supplied for a duration of 1.5 sec./ sq.ft. of exposed area. The hose stream shall be applied with 1.1/ 8" dia. nozzle at a perpendicular distance of approximately 17 ft. from the centre of the assembly on a line approximately 270 deg. from the line normal to the centre for the test assembly. The water stream shall be applied within 4 minutes and 30 seconds after completion of fire rating test.

However, this period shall not exceed more than 10 minutes in case of practical difficulties experienced by testing stations. The application of water stream shall be maintained through out the test duration and shall traverse the complete fire stop system.

The fire stop assembly is deemed to have passed the hose stream test successfully if no through projection of water is noticed on the unexposed surface of the seal. Further on completion of hose stream test, the appearance of the penetration seal system shall not alter substantially indicating thereby that the stability of the system ahs been maintained.'

3.05.05 Accelerated aging test

The intention of accelerated aging test is to ascertain whether the artificial aging of the systems and components thereof results into change in the mechanical properties or in the form. In order to simulate aging, artificial aging shall be resorted to.

For the purpose of subjecting the penetrations seal system components to accelerated aging, the system / components shall be stored for 336 hours in air furnace where the temperature of the inside air, shall be maintained at 100 degree centigrade. However, for system components in pliable form, system component shall be stored for 448 hours in air furnace where temp. of air inside the furnace shall be maintained at 75°C. It is assumed that the changes occurring during test period would roughly correspond to the effect on aging over a period of about 40 years.

After completion of 336 hours / 448 hours, the mechanical properties such as tensile strength element, elongation and hardness of the material (as may be applicable) shall be tested. This results shall be compared with corresponding values before subjecting to accelerated aging test.

The change in the form of system / components shall also be compared with the form before the tests to ascertain whether the system / components thereof have undergone any permanent change.

In case the mechanical properties before and after the accelerated aging do not indicate substantial change, the system shall be deemed to have passed the accelerated aging test. Similarly the variation in the form of the system components at the end of the test shall not indicate permanent deformation which is likely to affect the ceiling properties of the system.

3.05.06 Fire Rating test After Accelerated Aging:

Intention to this test is to ascertain whether the penetration seal built out of components already subjected to accelerated aging still passes the fire rating test for guaranteed fire rating duration.

The test apparatus for this test shall be similar to the one used for fire rating test mentioned above. The assembly or the penetration seal shall be carried out with the components which were subjected to accelerated aging test based on the test procedure mentioned above. In case there is a problem of co-ordination with the test station, the prototype assembly may be subjected to aging in manufacturer's works under the conditions mentioned above and live fire test should be carried out at manufacturer's works in presence of Owner's representative.

In live fire test, the temperature of fire shall be of the order of 1000 deg.C at the end of 3 hours. The test shall be carried out at atmospheric pressure.

The interpretation of test results for failure shall be similar to those mentioned under fire rating test/live fire test at (1) - (c) above.

3.05.07 Temperature rise test for cable in the fire stop:

This test shall be carried out to ascertain whether due to inadequate dissipation of heat at the location of fire stop, the temperature of cable conductor or outer sheath in contact with the fire stop, rises beyond the acceptable limits due to which whether any derating is required for cables.

Fire stop systems hall be erected with, at least 8-10 armoured cables, specially power cables. While laying the cable through penetration seal, thermocouple shall be placed on the outer surface of cable in contact with the fire stop system. The location shall be selected where there exists possibility of inadequate dissipation of heat from cables to the atmosphere due to fire stop components. Two thermocouples shall also be located on the two surfaces of the fire penetration seal system. Similarly thermocouples shall also be placed on the other surface of cables where there exists contact of free air without any obstruction so as to enable adequate nature cooling.

In case the temperature of outer surface of the cable in contact or inside the fire stop system does not exceed 75 degree centigrade, it is inferred that no derating of cable is required for cable when used in conjunction with the particular fire stop system.

Test shall be repeated with reduced current till the temperature of cable outer surface in contact with fire stop system is limited to 75°C. The rate of the current so guaranteed by the cable manufacturer as free air rating shall be the derating factor.

3.05.08 Water Absorption Test:

The test specimen shall be immersed in fresh clean water at a temp. of 20°C. The test specimen must be separated from the bottom and sides of the soak tank by at least 10 mm and it shall be covered by approximately 25 mm of water. At the end of the 24 hours soak period, the specimen shall be removed from the water and moped up with a damp cloth.

Fire rating test after water absorption is to ascertain whether the penetration seal subjected to water absorption still passes the fire rating test for guaranteed fire rating duration.

The test apparatus for this test shall be similar to the one used for fire rating test at Sr. No.1. In case there is problem of coordination with test stations, the prototype assembly may be subject to water absorption test at manufacturer's works followed by live fire test which should be carried out at manufacturer's works in presence of Owner's representative. In line fire test, the temp. of furnace shall be of the order of 1000°C at the end of 3 hours. The test shall be carried out at atmospheric pressure.

3.05.09 Flame Resistance Test for fire Retardant Coating Material:

Sample strips shall be of ½ " wide, 12" long and approximately 70 mills in thick (without any reinforcement). Each strip shall be held vertically (clamped at the top) in a natural gas burner flame, (blue cone of flame touching bottom edge of sample) for 10 minutes. The flame shall then be removed and observation shall be recorded. In case, any flaming of the samples should cease after the removal of gas burner. White charred length of the sample should not exceed 1 & ½".

3.05.10 Anti-Rodent Test:

Physical tests:

a) This test shall be carried out to ascertain the anti-rodent properties of the components of the Fire proof sealing system.

b) This test shall be carried out at approved test station performing sealing system tests on pharmaceutical products. The complete Fire Proof sealing system shall be subjected to attack of inspect / vermin such as rate for about 20 days.

c) At the end of the test condition of the surface of Fire Proof sealing system the test material shall be compared with the surface condition before commencement of the test. The fire stop shall be deemed to have passed this test in case no marks of growth are seen on the surface.

3.05.11 Test Certificates

Certified copies of all tests carried out at works and at site shall be furnished in requisite number of copies.

Test reports shall be complete with all details and shall also contain limit valves specified in the relevant standards, wherever applicable, to facilitate review of Test Report/ Certificates.

The fire proof sealing system shall be installed only after receipt of approval of the test reports.

3.05.12 Testing Charges

The bidder has to indicate that unit rates for conducting the type test successfully alongwith the offer, which will be considered for evaluation of tender.

ANNEXURE-B

NOTES & DETAILS FOR GROUNDING & LIGHTNING PROTECTION SYSTEM

1.00.00 **GENERAL**

1.01.00 These notes and details shall be read and construed in conjunction with grounding and lightning protection drawings and specification. In case of conflict between these notes and drawings, the latter shall prevail.

1.02.00 The grounding and lightning protection system installation work shall conform to the requirements of the latest editions of the following standards/codes :

a) Indian Electricity Rules, 1956.

b) National Electrical Code, 1985.

c) Code of Practice for Earthing (IS: 3043)

d) Protection of Buildings and Allied Structures Against Lightning (IS: 2309)

e) IEEE 80

2.00.00 **GROUNDING SYSTEM**

2.01.00 **Main Grounding Mat/Grid**

2.01.01 The main ground grid shall be buried in earth at a minimum depth of 1000 mm below finished grade level unless stated otherwise. The size of ground grid conductor shall be bare 40 mm dia. mild steel rod (minimum). The actual diameter of ground grid conductor shall be selected by EPC contractor with back up calculation.

2.01.02 A minimum earth coverage of 300 mm shall be provided between the ground grid conductor and the bottom of trenches, tunnels, underground pipes, foundations, railway tracks etc. The ground grid conductor shall be re-routed in case it fouls with equipment foundations.

2.01.03 In some cases, it may happen that the construction work of cable trench, foundation and laying of underground pipes are being taken up after the grounding mat has been laid. It may be required to cut a portion of grounding conductor to avoid fouling with cable trench, equipment foundations, underground pipes etc. In this case, the ground conductor shall be properly rerouted and rejoined/reconnected with the main grounding mat during the construction/laying of above underground objects and good electrical continuity of grounding conductor shall be ensured.

2.01.04 Grounding conductors crossing the road may have to be laid at greater depth to suit the site conditions.

2.01.05 Grounding conductor around the building shall be buried in earth at a minimum distance of 1200 mm from the outer boundary of the building.

2.02.00 **Grounding Electrodes**

2.02.01 The ground electrodes shall be 40 mm dia, 3000 mm long mild steel rod. These shall be fabricated and driven into the ground by the side of grounding mat conductors and connected to the ground mat conductors.

2.03.00 **Risers**

2.03.01 All risers/pigtail from the ground grid shall be 40 mm dia mild steel rod and shall be projected 300 mm above grade level/concrete floor level unless otherwise shown.

2.04.00 **Earthing Conductor**

2.04.01 75x 10 mm galvanised steel flats shall be run as main earthing conductors above ground along building columns, walls, steel structure, etc. for equipment and other structures earthing.

2.04.02 These earthing conductors shall be interconnected between them and to the main ground grid through risers/pigtail. The connection between earthing conductor and riser shall be made above ground.

2.04.03 Earthing conductors along their run on column, wall etc. will be supported by suitable welding/clamping at intervals set exceeding 750 mm.

2.04.04 Earthing conductors shall be embedded in concrete floor of the building without having direct contact with the reinforcement rods.

2.04.05 At the crossing of building walls, floors etc. the earthing conductor shall be passed through galvanised conduit sleeves. Both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.

2.05.00 **Grounding of Equipment And Structures**

2.05.01 All indoor and outdoor electrical equipment and associated non-current carrying metal works, supporting structures, building/ boiler columns, fence, system neutrals, lightning masts/arresters shall be connected to the plant ground system.

2.05.02 Two separate and distinct ground connections shall be provided for grounding electrical equipment frameworks in compliance with I.E. rules.

2.05.03 All Electrical equipment will be furnished with two (2) separate ground pads with tapped holes, bolts and spring washers. The connection between these ground pads and the grounding grid shall be made by short and direct earthing conductors free from kinks and splices.

2.05.04 Miscellaneous devices such as junction boxes, pull boxes, pushbutton stations, lockout switches, cable end boxes, lighting fixtures, receptacles, switches etc. shall be effectively grounded whether specifically shown or not.

2.05.05 The generator neutrals, transformer neutrals, earthing terminals of lightning arresters, coupling capacitor shall be directly connected to rod electrodes through riser which in turn, shall be connected to station grounding mat.

2.05.06 Grounding mat comprising closely spaced conductors shall be provided below the operating handles of isolator and circuit breaker operating box located in outdoor high voltage substation. The operating handles shall be properly bonded with flexible conductors.

2.05.07 Metallic conduits and pipes shall not be used as earth continuity conductor. These shall be grounded at both ends.

2.05.08 a) The cable trays inside the cable trenches shall be grounded thru' one (1) no. 40 mm dia M.S. Rod at an interval of ten (10) metres. One end of this rod is connected with riser from grounding mat and the other end which is projected inside the cable trench shall be connected with one (1) 50 x 6 mm G.S. flat which runs horizontally along the cable trench. This earthing conductor shall be securely attached to each tray section of cable tray/trays forming a solidly grounded tray system through 50 x 6 mm G.S. flats.

b) A continuous 50 x 6 mm G.S. flat earthing conductor shall run along the supporting structure of overhead cable trays/cable shafts. This earthing conductor shall be attached to each section of cable tray/trays through 50 x 6 mm G.S. flats.

2.05.09 Fence within the ground grid shall be bonded to the plant ground system at regular interval not exceeding ten (10) metres. Fence gate shall be separately grounded with flexible connection to permit movement.

2.05.10 The street lighting poles, junction boxes mounted on the poles, flood light supporting structures etc. shall be connected to ground grid at minimum two points.

2.05.11 The steel columns, metallic stairs, hand-rail etc. of the building where electrical equipment are located shall be connected to the nearby ground mat by earthing conductor. Electrical continuity shall be ensured by bonding the different sections of handrails and metallic stairs.

2.05.12 The railway tracks within plant area shall be bonded across fish plates and the rail tracks shall be connected to grounding grid at different locations. The rail tracks leaving the plant boundary shall be made electrically discontinuous from the rail tracks inside the plant area by providing suitable arrangements at fish plate joints.

2.05.13 The overhead crane rails shall be grounded at both ends. In addition all joints shall be bonded to provide electrical continuity.

2.05.14 The flexible earthing connection of jumpering wire shall be provided where flexible conduits are connected to rigid conduits to ensure continuity.

2.06.00 **Earthing of Cable**

2.06.01 The metallic sheaths, screens and armour of cables shall be earthed at both switchgear/MCC/DB and equipment ends.

2.07.00 **Jointing And Connection**

2.07.01 All ground conductor connections below ground level shall be done by electric arc welding with low hydrogen content electrode. The contact surfaces shall be thoroughly cleaned to provide good electrical continuity.

2.07.02 The bending of the large diameter ground conductor where necessary shall be done by gas heating.

2.07.03 The projected portion of riser/pigtail above ground shall be coated with two coats of bitumen paints (anti-corrosive paints) with a minimum thickness of 1 mm after connection.

2.07.04 The connections between the riser/pigtail and earthing conductors (galvanised steel flats) and between the earthing conductors above ground level shall be made by electric arc welding.

2.07.05 The portion of galvanised steel flats, which undergoes welding at site, shall be coated with two (2) coats of cold galvanising anti-corrosive paint after welding.

2.07.06 The earthing connections to equipment grounding pads/terminals and some removable structures shall be bolted type with GI bolts and nuts. The contact surfaces shall be thoroughly cleaned (to free from scale, paint, enamel, grease, rust) before connection to ensure good electrical contact.

2.07.07 Equipment/structures ground connections after properly checked and tested shall be coated with weather resistant paints/cold galvanising paints.

2.08.00 The sizes and materials of ground conductors used in grounding system are listed below :

	Description	**Size**	**Material**
a)	Main Grounding Grid Conductor	40 mm dia Rod (Min)	Mild Steel
b)	Riser/Pigtail From Grounding Grid/Mat	40 mm dia Rod (Min)	- Do -
c)	Electrode	40 mm dia Rod (Min) 3000 mm long.	- Do -

Description		Size	Material
d)	Conductor used for connection of various equipment/structures as listed below		
	i) E.H.V. Substation quipment	Flats 75x 10 mm	Galvanised Steel
	Generator Frame & Gen Neutral	75 x 10 mm Flat	- Do -
	Generator Exciter Frame	75 x 10 mm Flat	- Do -
	GT, ST, UT Frame	75 x 10 mm Flat	- Do -
	GT, ST, UT Neutral	75 x 10 mm Flat	- Do –
	Aux. Power Transformer Frame	75 x 10 mm Flat	- Do -
	ii) 11 kV/3.3kV Equipment	75 x 10 mm Flat	- Do -
	iii) 11 kV/3.3kV Switchgear	75 x 10 mm Flat	- Do –
	iv) 415 V PMCC	75 x 10 mm Flat	- Do -
	v) Structures, Bus Duct Control Panels, Cable Trays etc.	75 x 10 mm Flat	- Do -
	vi) 415V Motor Control Centres, Distribution Boards etc.	75 x 10 mm Flat	- Do -
	vii) Local Panels, Lighting Panels	50 x 6 mm Flat	- Do -
	viii) Motors :		
	All HT Motors	75 x 10 mm Flat	- Do -
	LT Motor Above 90 kW	50 x 6 mm Flat	- Do -
	LT Motors Above 30 kW Upto 90 kW	35 x 6 mm Flat	- Do -
	Above 5 kW Upto 30 kW	25 x 3 mm Flat	- Do -
	Upto 5 kW	8 SWG Wire	Galvanised Iron
	ix) Miscellaneous Items, viz. Push Button Station, Junction Boxes etc.	8 SWG Wire	- Do -

Note: Sizes of GS Flat as indicated above are minimum. However Bidder shall calculate each of them and submit for approval.

3.00.00 LIGHTNING PROTECTION SYSTEM

3.01.00 Air Terminations

3.01.01 The vertical air terminal rods shall be installed at the roof of buildings (including power house main building), at the top of chimney and cooling towers to protect these objects from lightning strokes.

3.01.02 The vertical air terminal except for chimney shall be made of 20 mm dia galvanised steel rod. The projected length of the rod shall be as required to protect the object (on which the rod is fixed) from lightning stroke.

3.01.03 The air terminal rods provided at the top of chimney/stack for lightning protection shall be 20 mm dia lead coated solid copper rod.

3.01.04 The air terminal rod shall be properly fixed on the top of the building/structure to withstand very high wind pressure. In case the air terminal rod is embedded at the top of roof of building: the portion embedded inside the concrete shall not touch the reinforcement bars and shall be duly insulated from them.

3.01.05 All the vertical air terminal rods shall be electrically connected together by means of horizontal conductors of size 75 x 10 mm galvanised steel flats.

3.01.06 The shielding angle for one vertical air termination shall be 45 degrees. For more than one rod, shielding angle between the rods shall be taken as 60 degrees.

3.01.07 Horizontal air termination (i.e. G.S. Flat conductor) shall be so laid that no part of the rood will be more than nine (9) metres from the nearest roof conductor.

3.02.00 Shielding Masts

3.02.01 The shielding mast for lightning protection shall be installed at the top of steel columns cap plates of power house main building.

3.02.02 The shielding mast shall be made of galvanised steel pipe and the height of the same shall be decided considering the zones to be protected.

3.02.03 Each shielding mast shall be connected to grounding grid by a down conductor 75 x 10 mm. Galvanised steel flat run along the building column. In addition all power house building columns joints shall be electrically bonded.

3.03.00 **Down Conductors**

3.03.01 The down conductors shall be 75 x 10 mm galvanised steel flats. The sizes of down conductors and horizontal conductor provided for lightning protection of conveyer gallery shall be 25 x 3 mm galvanised steel flats. One end of this shall be connected with air terminal rod/horizontal conductor at the top of roof/structure and other end connected to the nearest 40 mm dia. mild steel rod riser from ground electrode.

3.03.02 Each down conductor shall have an independent earth termination. In no case conductors of the lightning protection system shall be connected with the conductor of grounding system above ground level.

3.03.03 The connection between each down conductor and rod electrode (by means of 40 mm mild steel rod riser) shall be made via test link located at approximately 1500 mm above ground level.

3.03.04 The down conductor shall be laid straight and sharp bends shall be avoided as far as practicable. These shall be cleated on outside of the building wall and column/structure at about 750 mm intervals unless stated otherwise in the drawing.

3.03.05 At all supports for down conductor along the column/wall of the buildings; chimney etc. the portion embedded inside the building concrete should not touch the reinforcement bars.

3.03.06 All exposed metallic parts of the buildings shall be bonded to the down conductors. Such parts shall include ladders, balconies, conduits etc.

3.03.07 The down conductors shall be protected at the ground level against mechanical injury by means of non-metallic pipes, viz. PVC pipes filled with bituminous compound.

3.04.00 **Electrodes (for Lightning Protection)**

3.04.01 The electrodes shall be 40 mm diameter 3000 mm long mild steel rod. These shall be driven into the ground.

3.04.02 All the electrodes shall be interconnected by means of one (1) 40 mm dia mild steel rod which will be laid under ground at a minimum depth of 1000 mm below finished grade level unless stated otherwise. This ground mats/electrode in turn shall be connected to main grounding grid.

3.05.00 **Riser (for Lightning Protection)**

3.05.01 All risers connected to grounding mat shall be 40 mm mild steel rods and shall be projected 300 mm above grade level unless stated otherwise.

3.06.00 **Jointing & Connection**

3.06.01 All ground conductor connections below ground level shall be done by electric arc welding with low hydrogen content electrode.

3.06.02 The projected portion of riser above ground shall be coated with two (2) coats of bitumen paints (anti-corrosive paints) with a minimum thickness of 1 mm after connection.

3.06.03 The joints in the lightning conductors shall be kept to a minimum and there shall be no joint in the underground portions of conductors.

3.06.04 All the joints shall be done by arc welding process overlapping of the conductors at straight joints shall not be less than 150 mm. The contact surfaces shall be cleaned properly before jointing.

3.06.05 The portion of galvanised steel flats, which undergoes welding at site, shall be coated with two (2) coats of cold galvanising anti-corrosive paint after welding.

3.06.06 The bolted joint of the test link shall be covered with thick coating of bitumen paint after successful testing.

3.06.07 The air terminal rods and shielding mast shall be coated with weather resistant anti-corrosive paint (zinc chromate followed by two coats of aluminium paint).

3.06.08 The steel to copper connection shall be brazed type.

3.07.00 **Lightning Protection of 400kV GIS & Other areas**

3.07.01 The lightning protection of outdoor switchyards/substation shall be done by lightning masts on the top of steel towers. In addition, shield wires shall be used where required. The shield wire shall be strung across the top of the steel tower and/or powerhouse structure.

3.07.02 The shield wire which shall be brought down up to bottom of steel tower shall be connected to the earthing conductor (50 x 6 mm galvanised steel flat) which in turn connected to the riser (from the main grounding mat/grid).

3.07.03 The lightning protection of inflammable liquid storage tanks wherever required, shall be provided with horizontal conductors strung between tall poles covering the entire zones or with air terminal rods mounted on top of poles/structure. These horizontal conductors/vertical air terminal rods shall be connected to rod electrodes, which in turn shall be connected to station ground mat.

3.07.04 The lightning protection of conveyor gallery shall be provided with horizontal conductors (25 x 3 mm G.S. Flat) run along the length of the conveyor gallery at the top of gallery roof. This conductor shall be connected to riser and grounding electrode (40 mm dia G.S. Rods) at an approximate interval of 30 mm through two down conductions (each 25 x 3 mm G.S. Flats).

3.08.00 The sizes and materials of earthing conductors to be used in lightning protection system are listed below :

	Description		**Size**	**Material**
a)	Vertical Air Termination		20 mm dia Rod (Chimney)	Lead Coated Copper rod.
b)	Vertical Air Termination (Except Chimney)		20 mm dia Rod	Galvanised steel
c)	Horizontal Conductor	i)	75 x 10 mm Flat	- Do -
		ii)	25 x 3 mm Flat	- Do -
d)	Down Conductors	i)	75 x 10 mm Flat	- Do -
		ii)	25 x 3 mm Flat	- Do -
e)	Riser From Electrode/ Grounding Mat		40 mm dia Rod	Mild Steel
f)	Electrode for Lightning Protection		40 mm dia Rod 3000 mm long	- Do -

Note :

In addition to above, all materials as required such as G.I. pipes of appropriate length, diameter and thickness will be provided for lightning masts of Power House building and Switchyard.

SUB-SECTION – IC

SPECIFIC TECHNICAL REQUIREMENTS (C &I)

CONDENSER ON LOAD TUBE CLEANING SYSTEM & SELF CLEANING STRAINER - C&I REQUIREMENTS		
S.NO.	**PROJECT**	**1X800MW WANAKBORI**
1.00	**SYSTEM**	COLTCS
2.00	**COMMON / PER UNIT**	REFER NOTE -9,14
3.00	**CONTROL SYSTEM**	DCS with Local Control Panel
3.10	**PROCESSOR CONFIGURATION FOR PLC SYSTEM**	NA
4.00	**LOCATION OF CONTROL SYSTEM**	EER
4.10	**CONTROL SYSTEM SCOPE (BIDDER/ BHEL/ CUSTOMER)**	DCS:-BHEL LCP:-Bidder
5.00	**HARDWIRED INTERFACE WITH DCS (Y/N)**	NA
5.10	**PURPOSE OF HARDWIRED INTERFACE WITH DCS**	CONTROL & MONITORING
5.11	***a) COMMAND FROM LCP(Y/N)***	Y
5.12	***b) STATUS FEEDBACK TO LCP(Y/N)***	Y
5.13	***c) GROUP FAULT ALARM TO DCS (Y/N)***	Y
6.00	**SOFTLINK TO DCS (Y/N)**	NA
6.10	**PURPOSE OF SOFTLINK TO DCS**	NA
6.11	***a) COMMAND INTERFACE WITH DCS (Y/N)***	NA
6.12	***b) STATUS MONITORING IN DCS (Y/N)***	NA
7.00	**PROTECTION CLASS FOR PLC / RIO PANEL**	NA
8.00	**CONTROL FROM PB's ON LCP/OWS**	PB's ON LCP
9.00	**ANNUNCIATION ON LCP (Y/N) -- IF Y, MIN NO. OF HARDWIRED ALARMS / INDICATIONS**	YES- BIDDER TO PROPOSE MIN. NO. OF ALARMS/INDICATIONS
9.10	**MIMIC ON LCP (Y/N)**	Y
10.00	**CONTROL FROM DCS IN CCR (Y/N)**	Y

CONDENSER ON LOAD TUBE CLEANING SYSTEM & SELF CLEANING STRAINER - C&I REQUIREMENTS		
S.NO.	**PROJECT**	**1X800MW WANAKBORI**
11.00	**TYPE OF SOFTLINK (TP/OFC)**	NA
11.10	**COMMUNICATION CABLE SCOPE (BIDDER/ BHEL)**	NA
11.20	**REDUNDANT CABLE (Y/N)**	NA
11.30	**PROTOCOL**	NA
12.00	**RIO / RPU (Y/N)**	NA
13.00	**## NO. OF OWS / LAPTOP/LCD**	NA
13.10	**SIZE OF OWS/ CRT OR LCD**	NA
14.00	**NO. OF PRINTER**	NA
14.10	**PRINTER SIZE AND TYPE**	NA
15.00	**POWER SUPPLY AVAILABLE FOR BALL MONITOR (24V DC / 110 V AC UPS / 230 V AC UPS)**	230 V AC UPS
15.10	**&& POWER SUPPLY AVAILABLE FOR PLC PANEL (3PHASE, 415 V AC/ 1PHASE, 110 V UPS/ 1PHASE, 230 V UPS)**	NA
15.20	**REDUNDANT FEEDERS (R) / NON-REDUNDANT (NR) FEEDERS FOR POWER SUPPLY**	NA
15.30	****UPS BATTERY CONFIGURATION (1X100% / 2X100%)**	NA
15.40	**BATTERY TYPE (LEAD ACID/ Ni-Cd)**	NA
15.50	**BATTERY BACK-UP TIME (in minutes)**	NA
16.00	**ACTUATOR WITH INTEGRAL STARTER (Y/N)**	N
17.00	**PG/ DPG/ PS/ DPS/ PT/ DPT per Balls Collecting Strainer/DF/SCS**	DPT = 2 nos. DPI = 1 no.(ACROSS EACH BALL SEPARATOR)
19.00	**PROJECT SPECIFIC INFO**	Y

CONDENSER ON LOAD TUBE CLEANING SYSTEM & SELF CLEANING STRAINER - C&I REQUIREMENTS

S.NO.	PROJECT	1X800MW WANAKBORI
20.00	REMARKS	
21.00	**NOTES:**	
	1. $$ THIS IS APPLICABLE FOR DCS CONTROLLED SYSTEMS ONLY.	
	2. && THIS IS APPLICABLE FOR PLC CONTROLLED SYSTEMS. ALL POWER SUPPLY REQUIREMENTS FOR INDIVIDUAL SUB-SYSTEMS/ COMPONENTS EG. BALL MONITOR, SOL VALVES ETC SHALL BE DERIVED BY THE VENDOR FROM THIS POWER SUPPLY.	
	3. ** THE UPS FOR PLC & OWS SHALL BE IN BIDDER'S SCOPE. ITS CONFIGURATION SHALL BE 2X100% CHARGERS / INVERTERS.	
	4. IN CASE OF DCS CONTROLLED SYSTEMS, BIDDER TO TERMINATE ALL INSTRUMENTATION AND CONTROL ELEMENTS IN JUNCTION BOXES FOR FURTHER CABLING TO DCS BY BHEL/CUSTOMER. BIDDER TO PROVIDE INPUT/OUTPUT LIST, DRIVES LIST, JUNCTION BOX SCHEDULE AND TERMINATION DETAILS, RECOMMENDED CONTROL LOGICS / WRITE-UP ETC. DURING DETAILED ENGINEERING	
	5. IN CASE OF PLC CONTROLLED SYSTEMS, ALL CABLES & CABLE ENGINEERING SHALL BE IN BIDDER'S SCOPE.	
	6. ## FOR PLC BASED CONTROL SYSTEM WHERE OWS IS PROVIDED, THE OWS SHALL HAVE PROGRAMMING & CONFIGURATION FACILITY. LAPTOPS SHALL BE OF LATEST CONFIGURATION WITH PROGRAMMING SOFTWARE & COMMUNICATION CABLE.	
	7. FOR THE PROJECTS IN WHICH CONTROL ARE ENVISAGED WITH DCS CONTROL SYSTEM FOR COLTCS/SCS/DEBRIS FILTER - 2 SETS OF COLTCS/SCS/DEBRIS FILTER SHALL HAVE ONE COMMON STARTER PANEL (SWITCH GEAR PANEL).	
	8. FOR THE PROJECTS IN WHICH CONTROL ARE ENVISAGED WITH PLC BASED CONTROL SYSTEM FOR COLTCS/SCS - 2 SETS OF COLTCS/SCS SHALL HAVE ONE COMMON STARTER PANEL (SWITCH GEAR PANEL) CUM PLC PANEL.	
	9. FOR THE PROJECTS IN WHICH CONTROLS ARE ENVISAGED WITH PLC BASED CONTROL SYSTEM, 2 SETS OF COLTCS SHALL HAVE ONE COMMON PLC CONTROL SYSTEM WITH SEPARATE LCP PROVIDED FOR EACH SET OF COLTCS.	
	10. COLOUR OF STARTER PANEL SHALL BE RAL 7035 FOR EXTERIOR & BRILLIANT WHITE FOR INTERNAL.THIS SHALL BE DECIDED DURING DETAIL ENGINEERING	
	11. INSTRUMENT RACK AND JUNCTION BOXES SHALL BE IN BIDDER'S SCOPE OF SUPPLY. FURNITURE FOR PLACING OWS & PRINTER SHALL BE IN BIDDER'S SCOPE.	
	12. BIDDER TO FURNISH ELECTRICAL LOAD DATA DURING DETAILED ENGINEERING.	
	13. ALARM FACIA SHALL BE UNDER BIDDER'S SCOPE. NO. OF FACIA SHALL BE DECIDED DURING DETAILED ENGINEERING.	
	14. FOR PROJECTS WHERE PLC BASED CONTROL SYSTEM IS ENVISAGED FOR COLTCS & SCS , SEPARATE PLC'S SHALL BE PROVIDED FOR COLTCS & SCS. PLC SYSTEM SHALL BE PROVIDED UNIT WISE.	
	LEGEND:	
	DCS- DISTRIBUTED CONTROL SYSTEM	
	PLC- PROGRAMMABLE LOGIC CONTROLLER	
	RPU - REMOTE PROCESSING UNIT	

GENERAL & SPECIFIC TECHNICAL REQUIREMENT

GENERAL REQUIREMENT

1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems.

2.0. The quantity of instruments for auxiliary system shall be as per tender P &ID, wherever provided, for the respective system as a minimum for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe &reliable operation of plant, bidder shall supply the same without any price implication.

3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering.

4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc. for external connection including spare contacts shall be wired out to suitably located junction boxes.

5.0 In case of any contradiction most stringent clause/condition shall prevail.

Specific Technical Requirements (C&I):

1) The control of COLTCS shall be DCS based. The operation and control philosophy of COLTCS shall be as per design memorandum given elsewhere in the specification. Bidder to provide Local Control Panel for COLTCS. The motorized valves,ball separator,ball recirculation pump etc. shall be operated from Lamp /Pushbuttons, selector switches etc. located on the Local Control panel.

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

3) The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

4) Power supply shall be provided by BHEL at a single point. Further distribution to various instruments shall be in Bidder's scope. Bidder to include necessary power distribution board (ACDB)(as per details attached elsewhere in this specification) in his scope. Any power supply other than the above, if required by any instrument/device, has to be derived by the Bidder from the above supply and all necessary hardware for the same shall be in bidder's scope. Bidder to furnish UPS power requirement along with the bid.

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

6) All the instruments/drives shall be terminated on JBs/Panels in field. JBs/Panels shall be in Bidder's scope. RTD's shall be of duplex type.

7) Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification. Any cable in Bidder's scope shall be as per specification.

8) At least 10% spare channels and window facia shall be provided in each annunciator group in the local control panel.

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

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

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

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

13) The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.

C&I DELIVERABLES LIST

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT						
1X800 MW WANAKBORI TPP						
DOCUMENT NUMBER PE-GL-408-145-I100						
Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CUSTOMER	FROM	USER	REMARKS
INSTRUMENTATION						
1	PE-V9-408-XXX-I901	INSTRUMENT DATA SHEETS	-	VENDOR	C&I	
2	PE-V9-408-XXX-I902	INSTRUMENT SCHEDULE	-	VENDOR	C&I	
3	PE-V9-408-XXX-I903	INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS	-	VENDOR	C&I	
5	PE-V9-408-XXX-I905	INSTRUMENT QP/CHECK LIST	-	VENDOR	C&I	
LOCAL CONTROL PANEL						
1	PE-V9-408-XXX-I950	LOCAL CONTROL PANEL DATASHEET	A	VENDOR	C&I	
2	PE-V9-408-XXX-I951	WIRING DIAGRAM	-	VENDOR	C&I	
3	PE-V9-408-XXX-I952	PANEL GA DRAWINGS	-	VENDOR	C&I	
8	PE-V9-408-XXX-I956	BILL OF MATERIAL	-	VENDOR	C&I	
13	PE-V9-408-XXX-I957	LOCAL CONTROL PANEL QUALITY PLAN	`	VENDOR	C&I	
14	PE-V9-408-XXX-I958	LOCAL CONTROL PANEL O&M MANUAL	-	VENDOR	C&I	
19	PE-V9-408-XXX-I925	MANDATORY SPARES BILL OF MATERIAL	A	VENDOR	C&I	
	Notes:	408 - Project No.				
		XXX -MAX Package Code				
		$$ -Approval by BHEL if Vendor BBU Item. Approval by Customer if Customer BBU Item				

SPECIFICATION FOR MOTORISED VALVE ACTUATOR

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-ID-408-145-I902 VOLUME II B SECTION D REV. NO. 00 DATE: 04.04.15 SHEET 1 OF 3

Data Sheet A & B

408

		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
GENERAL*	* PROJECT		
	OFFER REFERENCE		
	* TAG NO. SERVICE		
	* DUTY	☐ ON / OFF ☐ INCHING	
	* LINE SIZE (inlet/outlet): MATERIAL		
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY	
	* OPENING / CLOSING TIME		
	* WORKING PRESSURE		
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%	
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY	
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY	
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY	
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IPW:55	
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL	
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.	
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.	
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER **FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.**	
HANDWHEEL	* REQUIRED	■ YES ☐ NO	
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED	
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.		
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY	
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY	
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT-INCLUSIVE OF **I.S.** TOLERANCE	
	ACTUATOR APPLICABLE WIRING DIAGRAM	■ ENCLOSED (BIDDER TO CONFIRM) A: ☐ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ☐ DRG. NO. 3-V-MISC-24283 R00 D: ■ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram	
	COLOUR SHADE	☐ BLUE (RAL 5012) ☐ ..... (TO BE DECIDED BY BHEL DURING DETAIL ENGG.)	
	PAINT TYPE **(## Refer Notes)**	☐ ENAMEL ☐ EPOXY ☐ ..... (TO BE DECIDED BY BHEL DURING DETAIL ENGG.)	
	SHAFT RPM	BIDDER TO SPECIFY	
	OLR SET VALUE	BIDDER TO SPECIFY	
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY	
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY	

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-ID-408-145-I902 VOLUME II B SECTION D REV. NO. 00 DATE: 04.04.15 SHEET 2 OF 3

Data Sheet A & B

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		DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC	
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ■ 110 V	
	@ ENCLOSURE CLASS OF MOTOR	■ IP 65 ☐ FLAME PROOF	
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B	
	@ WINDING TEMP PROTECTION	■ THERMOSTAT (3 Nos.,1 IN EACH PHASE) ■ ---THERMOSTAT- 1 NO+1 NC CONTACT ----------	
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED	
INTEGRAL STARTER	INTEGRAL STARTER	☐ REQUIRED ■ NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	☐ CONTACTORS ☐ THYRISTORS	
	TYPE	☐ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)	
	IF SMART		
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED	
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐……	
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC	
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED	
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐.....	
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED	
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP	
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED	
	STEP DOWN CONT. TRANSFORMER	☐ REQUIRED	
	OPEN / CLOSE PB	☐ REQUIRED ☐ NOT REQUIRED	
	STOP PB	☐ REQUIRED ☐ NOT REQUIRED	
	INDICATING LAMPS	☐ REQUIRED ☐ NOT REQUIRED	
	LOCAL REMOTE S/S	☐REQUIRED ☐ NOT REQUIRED	
	STATUS CONTACTS FOR MONITORING	☐ REQUIRED ☐ NOT REQUIRED	
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)	
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	☐ INTERPOSING RELAY ☐ OPTO COUPLER ☐ EITHER	
	QUANTITY	☐ 2 NOs. ☐ 3 NOs.	
	DRIVING VOLTAGE	■ 20.5 – 24V DC ☐ _____V DC	
	DRIVING CURRENT	■ 125mA MAX ☐ _____mA MAX	
	LOAD RESISTANCE	■ > 192 ohms - <25 k ohms ☐ > _____ohms - < _____ohms	
TORQUE SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN / CLOSE	■1 No. ☐2Nos. / ■1 No. ☐2Nos	
	CONTACT TYPE	2 NO + 2 NC	
	RATING	5A 240V AC AND 0.5A 220V DC	
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE	
	ACCURACY	+3% OF SET VALUE	

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-ID-408-145-I902 VOLUME II B SECTION D REV. NO. 00 DATE: 04.04.15 SHEET 3 OF 3

Data Sheet A & B

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

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LIMIT SWITCH (Not Applicable for Smart Actuator) **($$ Refer Notes)**	MFR & MODEL NO.	BIDDER TO SPECIFY					
	OPEN : INT : CLOSE	☐1 No ■2 Nos.	2 Nos. (ADJ.)	☐1 No. ■2Nos.			
	CONTACT TYPE	2 NO + 2 NC					
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC					

POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	■ REQUIRED ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	■ ELECTRONIC (2 WIRE) R/I CONVERTER ☐ ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	■ 24V DC ☐ ……	
	OUTPUT	■ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	230V AC,1 PH.,50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING	decided as per load data received tender stage	
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@☐ IP 68 @☐……	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET(9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	☐ REQUIRED ☐ NOT REQUIRED☐ ☐ 2 NOS. ☐ ----------	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE: decided as per load data received tender stage	
	@ SPACE HEATER CABLE GLAND	SIZE: decided as per load data received tender stage	
	OTHER CONTROL CABLE GLANDS-1	☐ 1No. for BFV of CW PUMP(Cable size 2Px1.5mm2)	
	OTHER CONTROL CABLE GLANDS-2	QUANTITY & SIZE :----------	

FORM NO. PEM-6666-0

BHEL	**SPECIFICATION FOR MOTORISED VALVE ACTUATOR**	SPECIFICATION NO.: PE-ID-408-145-I902 VOLUME II B SECTION D REV. NO. 00 DATE: 04.04.15 SHEET 4 OF 3

Data Sheet A & B

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

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WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.

NOTES:

1. **SCOPE**: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
2. **CODES & STANDARDS**: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATION STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
   IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722
3. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
4. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
5. THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION.THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
6. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
7. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.
8. CANOPY FOR OUTDOOR SERVICES SHALL BE PROVIDED.

$$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.

EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.

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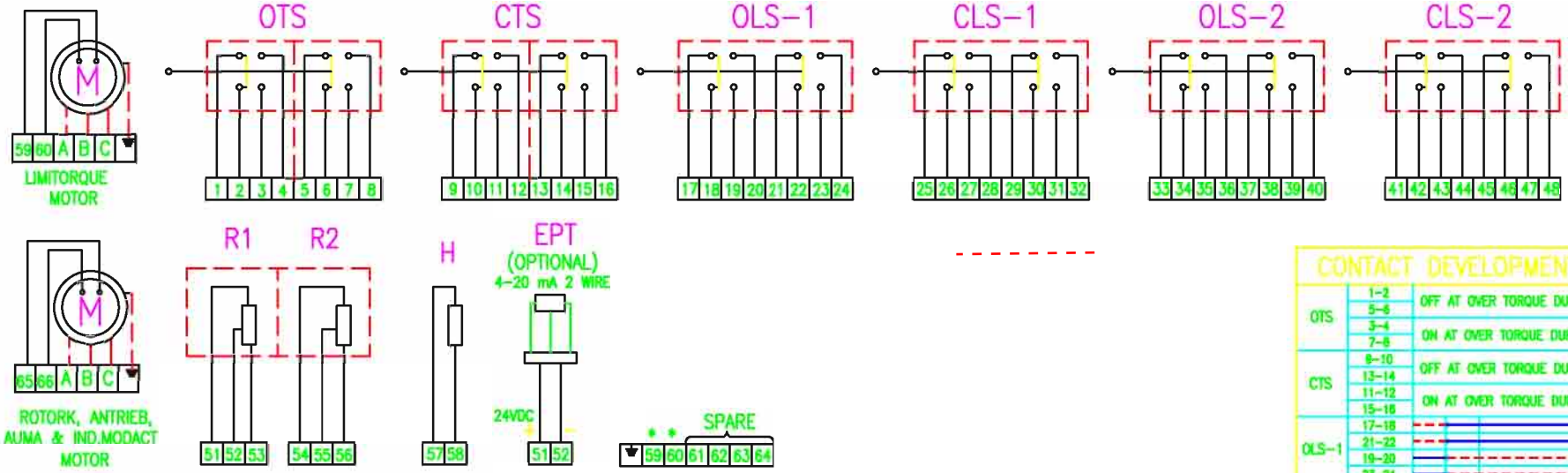
	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
NAME				NAME
SIGNATURE				SIGNATURE
DATE				DATE

NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @= TO BE FILLED BY ES



* - SPARE FOR ROTORK, AUMA, ANTRIEB & IND.MODACT

SWITCHES - ALL ARE POTENTIAL FREE AND TWO PAIR OF CONTACTS CAN BE USED FOR DIFFERENT SUPPLY

THERMOSTAT - 65-66 (ROTORK, AUMA, ANTRIEB & IND.MODACT), 59-60 (LIMITORQUE).

EPT - ELECTRONIC POSITION TRAMSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)

THERMOSTAT TERMINALS - TERMINATED IN MOTOR TB IN ANTRIEB & IND.MODACT AND IN MAIN TB IN OTHER MAKES

CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE) - 2 NO+2 NC

OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN) - 2 NO+2 NC

OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN - 2 NO+2 NC

CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE - 2 NO+2 NC

OTS, CTS - TWO INDEPENDENT SWITCHS IN ANTRIEB & LIMITORQUE

OLS-2 & CLS-2 - CAM DISC IN ROTORK & ANTRIEB

R1-R2- POTENTIOMETER 2 x 100 OHMS

H - SPACE HEATER 1ø 240V AC SUPPLY

M - MOTOR 3ø 415V 50 Hz AC SUPPLY

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

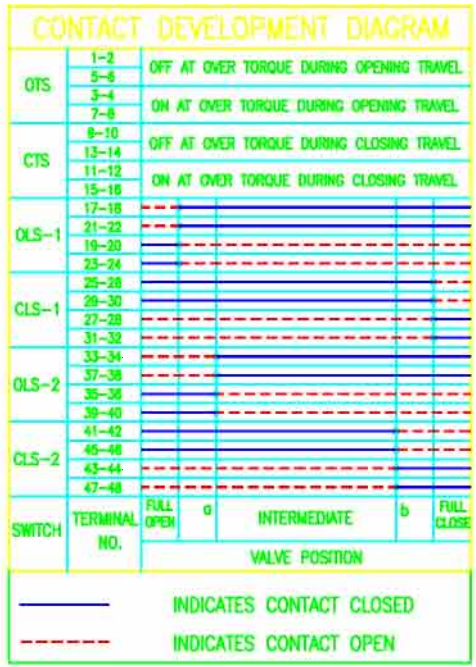
VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS	CTS	❶

❶ - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

NOTE:

1. BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)
2. CONNECT THERMOSTAT WITHOUT FAIL IN THE STARTER CIRCUIT

CONTACT DEVELOPMENT DIAGRAM



CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

REV	DATE	CHED	APPD	DESCRIPTION
11	09.09 2000			CONTACT DEV. FIG.ADDED.

BHARAT HEAVY ELECTRICALS LTD.
UNIT: HIGH PRESSURE BOILER PLANT.
TIRUCHIRAPALLI 620014.

365-139

DRAWN	N.P.ESWAR
CHECKED	K.ARUNACHALAM
APPROVED	P.LOGANATHAN
DATE	09.09.2000

TITLE

INTERNAL WIRING DIAGRAM FOR ELECTRICAL VALVE ACTUATORS (AC)

(DRAWN FOR INTERMEDIATE POSITION OF VALVES)

DRAWING No. 4-V-MISC-90271 REV 11

RETRACED WITH REVISION 11

CONTENT

VOLUME : IIF/1

SECTION-III

TECHNICAL SPECIFICATION FOR ELECTRIC MOTOR ACTUATORS

1.00.00 SCOPE

1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves, dampers and gates.

1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification.

2.00.00 STANDARDS

2.01.00 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.

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

i) IS-9334

ii) IS-325

3.00.00 SERVICE CONDITIONS

3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.

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

3.03.00 For actuator motor installed outdoor and exposed to direct sun rays , the effect of solar heat [manufacturer to decide] shall be considered or overhead shed shall be provided locally to avoid direct sun rays.

4.00.00 RATING

4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer.

4.02.00 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

5.00.00 **PERFORMANCE**

The actuator shall meet the following performance requirements:

5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.

5.02.00 Attain full speed operation before valve load is encountered and impart an unseating blow to start the valve in motion (hammer blow effect).

5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.

5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.

5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

6.00.00 **SPECIFIC REQUIREMENT**

6.01.00 **Construction**

6.01.01 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring. Actuator shall be non integral type.

6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy.

6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

6.02.00 **Motor**

6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service. Canopy shall be provided for outdoor service.

6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.

6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.

6.02.04 Motor leads shall be terminated in the limit switch compartment.

6.02.05 Motor actuators for valves/dampers shall be non-integral type with separate starter units and operable from remote.

6.02.06 Earthing terminals shall be provided on either side of the motor.

6.03.00 **Limit Switches**

Each actuator shall be provided with following limit switches: -

6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.

6.03.02 4 end-of-travel limit switches, two for each direction of travel.

6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.

6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.

6.04.00 **Hand Wheel**

Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.

6.05.00 Position Indicator/Transmitter

The actuator shall have:

6.05.01 One (1) built-in local position indicator for 0-100% travel.

6.05.02 One (1) position transmitter, potentiometer type, for remote indicator.

6.06.00 **Space Heater**

A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.

6.07.00 **Wiring**

All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules. All wires shall be fire resistance type.

6.08.00 **Terminal Box**

The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.

7.00.00 **ACCESSORIES**

As required for the driven equipment, the actuator shall be furnished with starting equipment mounted on the actuator. This shall include:

7.01.00 One (1) triple pole MCCB for local isolation near the actuator

7.02.00 One (1) reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC auxiliary contacts for each contactor.

7.03.00 One (1) remote-local selector switch.

7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights.

7.05.00 415/240 V or 415/110V control transformer with primary protected by fuse & secondary protected by Miniature Circuit Breaker (MCB).

8.00.00 **TEST**

The actuator and all components thereof shall be subject to tests as per relevant Standards. In addition, if any special test is called for in equipment specification, the same shall be performed.

9.00.00 **DRAWINGS, DATA & MANUALS**

9.01.01 To be Submitted with Bid

Data sheet for each type of actuator shall be furnished along with internal wiring diagram, suggested control schematic and torque limit switch contact development and manufacturer's catalogues.

9.01.02 To be Submitted after Award of Contract

a) Actuator Data Sheet

b) Internal wiring diagram and suggested control schematic

c) Torque switch and limit switch contact development

d) Manufacturer's Catalogue

e) Instruction manual indicating clearly the installation methods, check ups and tests to be carried out before commissioning of the equipment.

f) Any other relevant drawings, documents or data necessary for satisfactory installation , operation and manufacturing.

9.02.00 The Bidder may note that the drawings, data and manuals listed herein are minimum requirements only. The Bidder shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment are submitted with his bid.

SPECIFICATION FOR FIELD INSTRUMENTS

f) ½" NPT cable gland

1.02.00 Differential Pressure Transmitter / Flow transmitter

01.	Working Principle	:	Smart (HART compatible)
02.	Type	:	2-Wire
03.	Output signal	:	4-20 mA DC.
04.	Signal Processing Unit	:	Silicon solid-state electronic circuitry
05.	Measuring element	:	Capsule/Diaphragm
06.	Element material	:	AISI-316 (Stainless Steel) or better
07.	Static Pressure/ Overload Pressure	:	Maximum line (or static) pressure on either side without permanent deformation or loss of accuracy
08.	Turn-down ratio	:	60 : 1 minimum
09.	Span and Zero	:	Locally adjustable, non-interacting
10.	Enclosure class	:	IP-65
11.	Zero suppression / elevation	:	At least 100% of Span
12.	Output Indicator	:	LCD type
13.	Nameplate	:	Tag number and Service engraved in SS tag plate
14.	Body	:	Forged Carbon Steel for air and flue gas application and SS for other application
15.	Ambient temperature	:	0 - 50 ^{O}C
16.	Operating Voltage	:	16 - 48 Volts DC
17.	Load	:	600 Ohms (min.) at 24 Volts DC
18.	Performance:-		
	i) Accuracy	:	±0.1 % of span or better
	ii) Repeatability	:	± 0.05 % of span or better
	iii) Response time	:	100 msec or better
19.	Sealing / Isolation	:	Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.
20.	Accessories	:	a) Universal mounting bracket suitable for 2" pipe mounting. b) High tensile carbon steel U-bolts. c) Siphon for steam and hot water services. d) Companion flange with nuts, bolts and gaskets. e) ½" NPT cable gland

f) ½" NPT generally 5-valve stainless steel manifold, constructed from SS316 bar stock. 3 valve manifold for DP application in flue gas and air.

1.03.00 Displacer Type Level Transmitters

01.	Type	:	Smart (HART compatible)
02.	Stages of operation	:	Continuous
03.	Material -		
	i) Displacer	:	AISI 316 SS
	ii) Suspension wire	:	AISI 316 SS
	iii) Torque tube housing	:	Carbon steel or SS as per application
	iv) Torque tube	:	Inconel
	v) Displacer chamber	:	CS or SS as per process application
	vi) Transmitter Housing	:	Die cast aluminium or better
04.	Operating Voltage	:	16-48 Volts D.C.
05.	Transmission	:	2-wire
06.	Output Signal	:	4-20 mA DC.
07.	Signal processing	:	Solid-state electronic circuitry
08.	Static / overload pressure	:	Maximum static pressure without permanent deformation or loss of accuracy.
09.	Turn-down ratio	:	10 : 1 or better
10.	Zero & Span	:	Easily accessible (local zero & span adjustment and non-interactive type)
11.	Enclosure Class	:	IP-65
12.	Output Indicator	:	LCD type
13.	Nameplate	:	Tag number and Service engraved in stainless steel tag plate
14.	Ambient Temperature	:	0 - 50 ^{O}C
15.	Load Impedance	:	600 Ohms at 24 Volts (minimum)
16.	Process Connection	:	2" Companion flange with nuts, bolts and gaskets
17.	Performance -		
	Accuracy	:	$\pm$ 0.5 % of span or better
18.	Accessories	:	a) Counter Flange, nuts, bolts, gaskets etc.
			b) Weights for 5 point calibration of instruments.
			c) Vent and drain plugs
			d) Special calibration tool/configurator,if any.
			e) ½"NPT cable gland

19.	Preferred Features	:	a) Test plug connection and cutout terminals physically separated from other electronics. b) Electronic Damping facility (adjustable).

1.04.00 Mass Flow meter

1.04.01 Sensor

01.	Measuring Principle	:	Coriolis Mass flow.
02.	Primary Element	:	Flow Tube of 316SS or better
03.	Heating Arrangement	:	Integral.
04.	Temperature Control	:	For heavy fuel oil application.
05.	Process Connection	:	Flanged of rating as per process requirement.
06.	Drain	:	Self-draining facility
07.	Enclosure	:	Stainless steel
08.	Accessories	:	Counter flanges, Mounting nuts, bolts, gaskets etc.

1.04.02 Transmitter

01.	Measured quantities	:	Mass Flow rate, Total Mass Flow, Density.
02.	Input Signal Processing	:	Digital Processing.
03.	Display	:	Digital Display (LCD).
04.	Output	:	2 off. isolated 4-20mA DC output.
05.	Load	:	< 750 ohms.
06.	Power supply	:	240V AC, 50 Hz.
07.	Turn Down	:	100:1
08.	Accuracy	:	$\pm$ 0.2 % of measured value
09.	Housing	:	IP 65
10.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
11.	Accessories	:	a) Handheld configurator b) Mounting U-bolts, nuts, bolts, prefab cable etc. c) ½"NPT cable gland

1.05.00 Pressure Gauge and Differential Pressure Gauge

01.	Type	:	Bourdon/Bellows/Diaphragm
02.	Sensing & Socket	:	AISI-316 SS
03.	Movement Material	:	AISI-304 SS
04.	Case Material	:	Stainless steel. IP-65.
05.	Dial Size	:	Generally 150 mm
06.	Scale	:	Black lettering on white in 270 ^{O} arc.

07.	Window	:	Shatterproof glass
08.	Range Selection	:	Normal process pressure: 50~70 % of range
09.	Over-range Protection	:	125% of maximum range by internal stop. External stop at zero.
10.	Adjustment	:	Micrometer screw for zero. Internal micrometer screw for range.
11.	Element Connection	:	Argon welding
12.	Process Connection	:	1/2" NPT (M) Bottom for local, back for panel mounting.
13.	Performance	:	Accuracy of ± 1.0 % of span or better.
14.	Operating ambient	:	0 - 50 ^{O}C
15.	Safety Feature	:	Blow out disc /diaphragm at the back
16.	Accessories	:	a) Snubbers and Glycerin filled for pulsating fluid applications and at pump discharge. b) Stainless steel Diaphragm seals for viscous fluids. c) 3-Way SS316 Gauge cock for pressure gauges. d) 5-valve SS316 manifold from barstock for differential pressure gauge. e) Siphons for steam and hot water services.
17.	Applicable standard	:	IS-3624 / 1996
18.	Nameplate	:	Tag number, service engraved in stainless steel tag plate

1.06.00 Temperature Gauge

01.	Type	:	Bimetallic or gas filled.
02.	Sensing Element Material	:	Bourdon - AISI-316 SS
03.	Capillary Armoring	:	Stainless steel flexible
04.	Movement Material	:	AISI 304 SS
05.	Bulb / Stem Diameter	:	12 mm
06.	Bulb / Stem Material	:	AISI 316
07.	Capillary	:	Stainless Steel
08.	Connection to well	:	½" NPT
09.	Case Material	:	Stainless steel
10.	Dial Size	:	150 mm in general
11.	Scale	:	Black lettering on white in 270 ^{O} arc.
12.	Mounting	:	Surface/Panel
13.	Over range Protection	:	125 % of range or more

CCTV network configuration shall be built on the Stackable Managed Ethernet switches for better control of data traffic & performance and future expansion. Switch configuration shall be redundant with seamless changeover without any upset in the CCTV operation. MTBF of the switch shall be more than 20 Years. Configuration shall be automatic.

3.00.00 CONTROL PANEL/DESK MOUNTED INSTRUMENTS AND ELECTRICAL SYSTEM ACCESSORIES

3.01.00 Coupling Relay

01.	Type	:	Octal base plug-in type/ DIN rail Mounting
02.	Coil voltage	:	24 V D.C. in general / other as required
03.	Contact	:	2 NO & 2 NC (Minimum)
04.	Contact rating	:	250 V/5A (A.C)/220V/2A (D.C)
05.	Operating range	:	70 to 110% of rated voltage.
06.	Insulation	:	2 KV for 1 minutes between terminal & earth.
07.	Mechanical life	:	20 million operations
08.	Coil protection	:	Diode
09.	Indication	:	Coil on LED
10.	Enclosure	:	Transparent cover
11.	Connection	:	Screw terminals.
12.	Mounting	:	Projection mounting inside panel / DIN rail mounting

3.02.00 Bar graph Indicator

01.	Type	:	Bar graph
02.	Number of channels	:	One / Two (as required)
03.	Input	:	4-20 mA/1-5 V/Thermocouple/RTD
04.	Indication	:	Green LED / LCD
05.	Scale	:	100 mm vertical one for each channel graduated in engineering unit (linear scale)
06.	Readable Distance	:	3 meters (minimum)
07.	Mounting	:	Flush panel
08.	Face Dimension	:	36(W) x 144(H) mm (approx) / 72 x 144 (H) mm
09.	Resolution	:	1% of scale or better
10.	Power Supply	:	240V, 1 Phase, 50 Hz AC
11.	Operating Conditions :-		
	a) Temperature	:	0-50 ^{O} C
	b) Relative Humidity	:	5%-95%
	c) Supply Voltage	:	-15% to +10%
12.	Connection between		

	Indicator and Tray	:	Prefab Cable
13.	Accessories	:	i) Mounting Tray ii) Engraved phenolic nameplate affixed to front flange to identify each indicator by tag number and each point by measured variables.
14.	Alarm Facility	:	1 HI and 1 LO for each channel independently adjustable over span. Voltage free outputs
15.	Reference Junction Compensation	:	Built-in cold junction compensation for thermocouple inputs
16.	Feature	:	i) Alarm level indication by flashing cursor ii) Green Digital display of parameter value in front panel with a 3.1/2 digit display.

3.03.00 Valve Position Indicator

01.	Input	:	4-20 mA DC/1-5 Volts DC
02.	Indication	:	Pointer and Scale. Moving Coil Meter
03.	Readable Distance	:	3 meters (minimum)
04.	Pointer Deflection	:	90 Deg Sector or linear
05.	Mounting	:	Flush Panel (Horizontal/vertical)
06.	Accuracy	:	$\pm$1% or better
07.	Protection Class	:	IP-42
08.	Operating Ambient Temp.	:	0-50 ^{O}C
09.	Scale	:	0-100%
10.	Bezel Size	:	DIN Standard

3.04.00 Digital Indicator

01.	Type	:	Four and half digit LED seven-segment display with sign.
02.	Face Dimension	:	72 x 144 mm / 48 x 96 mm (as applicable)
03.	Display Character	:	13.8 mm, Green (LED)
04.	Accuracy	:	0.1% of reading, $\pm$2 digit
05.	Input	:	4-20mA DC/1-5 V DC/RTD/Thermocouple
06.	Mounting	:	Flush Panel
07.	Power Supply	:	240V $\pm$10%, 50 $\pm$2.5 Hz
08.	Output Contact	:	2 nos SPDT, contact rating 5A at 240V AC/ 0.25A at 220V DC
09.	Power/Signal Connection	:	Screwed

Large Display (150x300 mm) indicators shall be provided for MW, MVAR and frequency indications.

3.05.00 Push Button

01.	Type	:	Shrouded square format
02.	Face Dimension	:	32 x 32 mm (maximum)
03.	Contact Configuration	:	2 NO + 2 NC
04.	Contact Addition	:	Add-on block up to 4 each with 2 pairs of contacts
05.	Contact Material	:	Hard Silver Alloy
06.	Contact Rating	:	500V / 10 A
07.	Utilization Category	:	AC11 / DC11
08.	Insulation Voltage	:	2 KV for 1 minute between terminals and earth
09.	Mechanical Life	:	1 million operation
10.	Construction	:	Aluminum shrouding with plastic lens
11.	Colors	:	Red, Green, Yellow, Black, etc.
12.	Connection	;	Screw terminals
13.	Enclosure Class	:	IP-52
14.	Legend	:	Engraving

3.06.00 Illuminated Push Button

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

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

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

3.10.00 Indicating Meters (D.C)

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

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

3.11.00 Auxiliary Relay

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

3.12.00 Electrical Transducer

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

3.13.00 Synchroscope

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

4.00.00 **CONTROL VALVES, ACTUATORS & ACCESSORIES**

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

a) Bidder shall exercise caution in selecting severe service control valves like BFP recirculation valves, HP & LP bypass valves, superheater & reheater attemperator valves, PRDS valves for Boiler & Turbine, Soot blower steam pressure control valve, control valves whose down stream are connected to vacuum such as HP/LP heater emergency level control, condenser make up water control valve, separator level control and CEP minimum flow control valve. For such critical applications, Bidder shall offer valves which are proven for similar application. Above valves shall have leakage class equal or better than class-V with metal-to-metal seating.

b) Wherever, steam conditioning calls for Pressure reducing & desuperheating, combined PRDS type valves shall be offered.

c) Bidder shall provide redundant control valves for Main condensate flow control, Superheat attemperation control and Reheat attemperation control as a minimum for high availability. For other application, if the availability criteria for the plant cannot be met even with the best established product, redundant control valves shall be provided.

d) Control valves shall be located near floor or platform for ease of access and with adequate clearances for maintenance and lay-down and shall be placed as station with upstream motorized isolating valve, down-stream isolating valve, inching duty motorized bypass valve and manual drain valves. Each redundant control valve shall have its upstream motorized and down-stream manual isolating valves. Where quick shut off requirement is foreseen such as in case of SH & RH attemperation valves, upstream isolation valve shall be pneumatic type.

4.01.00 General

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

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

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

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

4.01.05 Valve Body / End Connections

4.09.00 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 ± 5% length. Drum shall be anti rodent, anti termite and smooth finish. Both end of cable shall be capped by means of non hygroscopic sealing material.

9.05.00 Thermocouple Extension & Compensating Cable

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

09.	Drain wire	:	Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm)
10.	Inner Sheath	:	Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties) HR PVC Type ST2 of IS-5831,1984 Thickness as per IS-1554Part-I 1976
11.	Rip Cord	:	Non metallic under sheath
12.	Armouring	:	GI wire / strip as per IS 3975
13.	Outer Sheath	:	Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties) HR PVC Type ST2 of IS-5831,1984 Thickness as per IS-1554Part-I 1976
14.	Filler	:	Non hygroscopic with FRLS property
15.	Temperature Range	:	Up to 85 °C
16.	Insulation at 20^0 C	:	100 MOhms/Km [Min]
17.	Capacitance at 800 Hz	:	120 nf/km
18.	Cross talk	:	60 dB
19.	Attenuation	:	1.2 dB/Km
20.	Codes & Standards	:	a) IEC 332-1 b) ANSI MC 96.1 c) IS-8784-1987
21.	Tests	:	a) Oxygen Index: Min.29 at room temp. (ASTM-D-2863) b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I c) Temp Index : Min 250 DEG C at 21Oxy. Ind. (ASTM-D-2863) d) Smoke Density Rating : Max.60% (ASTM-D-2843). e) Flammability Test : as per IEC 332 Part-I /IEEE-383 Swedish Chimney Test - SS-424-1475 F3 f) High voltage test Core to core- 1.5 KV for 1 min. Core to screen- 1.0 KV for 1 min. g) Insulation Resistance 100 M Ohm / Km Min

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

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

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

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

9.06.00 Instrumentation multi Paired Signal Cable

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

    * Analog signals- Individual pair & overall shield to be considered.
    * Binary signals- overall shield to be considered.

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

h) High voltage test

Core to core- 1.5 KV for 1 min.

Core to screen- 1.0 KV for 1 min.

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

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

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

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

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

9.08.00 Control & power Cable

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

10.00.00 **ERECTION HARDWARE**

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

10.01.00 Electrical Accessories

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

a) Rigid Steel Conduit

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

ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.

iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with ANSI C 80.1 and UL6. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.

iv) All conduit fittings shall conform to the requirements of ANSI C 80.4 and UL-514 where these standards apply.

b) Flexible Conduit

i) Flexible conduit shall be of three layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material.

ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/Sq. cm and temperature up to 200 °C.

c) Special Fittings

i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed.

ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.

10.02.00 Electrical Junction Box

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

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

10.03.00 Cable Gland

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

10.04.00 Cable Tray

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

10.05.00 Process Hook Up Accessories & specification

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

10.05.01 Seamless Stainless Steel Pipe

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

10.05.02 Stainless Steel Pipe Fittings

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

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

10.05.03 Seamless Stainless Steel Tube

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

10.05.04 Stainless Steel Tube Fittings

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

10.05.05 C.S. Pipe

1.	Reference	: ASTM-A 106 Gr. C
2.	Material	: Cold drawn seamless black C.S.
3.	Type	: Seamless / Plain ends
4.	Size	: ½" NB
5.	Schedule	: 80, 160, XXS as required
6.	Standard Length	: 5 meter

10.05.06 C.S. Pipe Fittings

1.	Reference	: ASTM-A 105 / ANSI B16.11
2.	Type	: Forged
3.	Rating	: 3000 lbs / 6000 lbs / 9000 lbs
4.	Size	: ½" NB
5.	End connection	: Generally socket weld
6.	Type of Fittings	: Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

10.05.07 A.S. Pipe

1.	Reference	: ASTM-A 335 P22 AS PER ANSI B 36.10
2.	Material	: Cold drawn seamless A.S.
3.	Type	: Seamless / Plain ends
4.	Size	: ½" NB
5.	Schedule	: XXS
6.	Standard Length	: 5 meter

10.05.08 A.S. Pipe Fittings

1.	Reference	: ASTM-A 182 F22 AS PER ANSI B 16.11
2.	Type	: Forged
3.	Rating	: 9000 lbs
4.	Size	: ½" NB
5.	End connection	: Generally socket weld

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

10.05.09 Carbon Steel Globe Valve

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

10.05.10 Stainless Steel Globe Valve

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

	9.	Handwheel	: Carbon steel
	10.	Design standard	: As per ANSI B 16.34

10.05.11 Alloy Steel Globe Valve

	1.	Reference	: ASTM A-182 F22
	2.	Type	: Globe
	3.	Construction	: Forged Body
	4.	End Connection	: ½" Socket Weld
	5.	Rating	: CL. 2500
	6.	Material	: Body - Alloy steel
			: Stem - Hardened Steel
			: Plug - AISI 316 SS
			: Seat- Stainless steel stellited
	7.	Packing	: Grafoil as required
	8.	Yoke	: ASTM A182 F22
	9.	Handwheel	: Carbon steel
	10.	Design standard	: As per ANSI B 16.34

10.05.12 Condensate Pot

	1.	Reference	: ASTM A182 F22 /ASTM A105
	2.	Material	: Alloy steel / carbon steel as per application
	3.	Construction	: Drilled from barstock
	4.	End connection	: 3 nos. ½" socket weld end
	5.	Accessories	: Vent valves

10.05.13 Instrument Valve Manifold

	1.	Type	: Two valve manifold
			: Five valve manifold
	2.	Mounting	: Remote 2" Pipe Mounting
	3.	Construction	: Single block (bar stock)
	4.	Material	: Forged body and bonnet AISI 316 stainless

steel

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

10.06.00 Pneumatic Hook Up Accessories

10.06.01 Air Header

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

10.06.02 Seamless Stainless Steel Tube

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

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

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

11.01.00 Bidder shall supply a complete set of new, unused and reliable type of special tools and tackle and test equipment which are necessary or convenient for erection, commissioning, maintenance and overhaul of the plant and equipment provided under this specification.

11.02.00 The tools & tackle and Test Equipment shall be shipped in separate container, clearly marked with names of the equipment for which they are intended.

11.03.00 Bidder shall furnish list of tools & tackle and test equipment proposed to be supplied along with the bid.

material with suitably colored lettering engraved on the back.

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

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

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

8.00.00 **METERING BASES AND CHART UNITS**

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

i)	Pressure	: Kg/cm^2
	Differential Pressure	: mm of H_2O column / Kg/cm^2
ii)	Draught	: mm of H_2O column
iii)	Vacuum	: Kg/cm^2 (abs)/mm of Hg column
iv)	Temperature	: Degree Celsius (^{O} C)
v)	Flow (Steam, Water)	: Tonnes / hr, M^3/Hr
vi)	Flow (Oil)	: M^3 / Hr, Litter/Hr
vii)	Flow Air	: Tonnes / hr / M^3 / Hr.
viii)	Density	: gms / c.c.
ix)	Level	: mm /%
x)	Conductivity	: µS / cm or mS/cm
xi)	Gas Analyzer	: Percentage by weight or as specified in respective case.
xii)	Dissolved Oxygen / Silica / Sodium	: ppm /ppb

9.00.00 **PROCESS CONNECTION & INSTRUMENT HOOK UP**

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

9.02.00 Each instrument shall have its own independent connection to the process except for instruments located on standpipe. Each instrument shall be connected independently to the standpipe through isolation valve.

9.03.00 Isolation and blowdown drain valves adequate for duty and capable of withstanding continuous design condition of main process shall be provided. Instrument blow down valve near to the instrument shall be of gradual opening type. For process pressure equal or above 40 kg/ sq.cm double blowdown valves shall be used connecting to blowdown header. Instrument manifold / gauge valve shall be installed close to the instrument.

9.04.00 The nominal size of the takeoff connections on line shall not be less than NPS ½" for source conditions not in excess of either 900 psi or 425OC and NPS ¾" (for adequate physical strength) for design conditions exceed either of these limits. Where the size of the main is smaller than the limits given above, the takeoff connections shall not be less than the size of the main line.

9.05.00 Process connection for instruments lines and vessels shall be in accordance to standards such as ASME or other recognized international standards. Table below indicates the type of connection generally to be used.

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

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

9.06.00 Size of impulse pipe for pressure measurement in air and flue gas duct path of boiler shall not be less than ¾" NB.

9.07.00 Separate stubs and take-off points with thermo well / root vlves shall be provided for performance guarantee test.

9.08.00 Impulse pipes shall be clamped at suitable interval not exceeding 1.5 meter. Process pipe shall not be used for supporting the impulse pipe.

9.09.00 Fittings shall conform to ANSI B 16.11. Threads of piping component shall be of tapered construction.

9.10.00 Instrument blowdown header shall in no case be lower than the material grade ASTM A 106 Gr. C.

9.11.00 Impulse pipe shall be laid at least with slope of gradient 1:10 to avoid any air pocket or water accumulation.

9.12.00 Expansion loop shall be provided at least at every 2.5 meter interval without affecting the gradient of slope in long run impulse pipe to avoid stress on the piping.

9.13.00 Siphon shall be provided in the impulse pipe or tube to protect the instruments where fluid temperature is 100 OC or more.

9.14.00 Orientation of tappings shall be as follows :

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

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

c) For steam service within 45 ^{O} at upper half of the pipe horizontal plane.

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

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

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

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

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

10.00.00 **POWER SUPPLY SYSTEMS**

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

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

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

b) 24V / 48 VDC Supply for DCS

11.00.00 **ENVIRONMENTAL CONSIDERATIONS**

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

11.01.00 Temperature

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

11.02.00 Humidity

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

CONTROL PANELS SPECIFICATION

7.12.00 Panels, Cubicles and Enclosures

7.12.01 General

a) All panels, cubicles and enclosures shall be furnished complete with integral piping, internal wiring, convenience outlets, internal lighting, grounding, ventilation, space heating, vibration isolating pads and other accessories.

b) Unless otherwise specified cable entry for panels / desks / cabinets shall be through bottom via glanding plate. Fireproof seal shall be used to seal the bottom to prevent entry of dust.

c) Panels and cabinets shall be constructed from steel sheet reinforced as required to provide true surface and adequate support for devices mounted thereon. Thickness of the steel plate shall conform to the requirements of UL 50 or equivalent standard. Panels and cabinets shall be of adequate strength to support mounted components during shipment and to support a concentrated load of 100 Kilograms on their top after erection.

d) Panel /cabinet shall have eyebolt on top for lifting.

7.12.02 Surface Preparation and Painting

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

a) Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale. Oil, grease and salts etc. shall be removed from by one or more solvent cleaning methods prior to blasting.

b) Two spray coats of epoxy primer surfacer shall be applied to all exterior and interior surfaces, each coat of primer surfacer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades:

i) Exterior – RAL 7032.

ii) Interior - Brilliant White.

c) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections shall not be acceptable.

7.12.03 Wiring

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

a) All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks.

b) Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized print shall be used with cross- identification.

c) Wire termination shall be made with insulated sleeve and crimping type lugs. All external connections shall be made with one wire per terminal. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs shall not be used.

d) Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables.

e) Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring.

f) All low-level signal cables shall be separately bundled from control cable.

g) Wires shall be dressed and run in troughs with clamp-on type covers. Wirings shall be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.

h) Shield wires shall be terminated on separately.

i) Common connections shall be limited to two wires per terminal.

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

k) Wiring shall be arranged to enable instruments or devices to be removed and/or serviced without disturbing the wiring. No wire shall be routed across the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices.

l) Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.

m) Panels /cabinets /desks shall be provided with removable gasketted cable gland plates and cable glands. Split type grommets shall be used for prefab cables.

n) Wire shall be multistranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-1981.

o) Wire sizes used for internal wiring shall not be lower than the followings :

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

p) Identification of conductors shall be done by insulation color-coding identified on drawings or by printed wiring lists.

7.12.04 Grounding

a) System cabinet AC and DC ground shall be electrically isolated from each other and also electrically isolated from the Instrumentation signal ground. All the above ground shall be individually connected to the single point on the ground pit. Dedicated redundant earth pit shall be provided which shall be away from the HV equipment. This earth pit shall not be shared with other electrical equipment ground and shall also be insulated from other electrical system ground to ensure single point grounding of the system. Grounding resistance shall be better than 1.0 ohm. IEEE guideline shall be followed while designing the grounding system.

b) Panels and cabinets shall be provided with a continuous tinned copper ground bus bar of minimum 25 mm x 3 mm cross section, extending along the entire length of the panel / desk / cabinet assembly. The ground bus shall be bolted to the panel structure and effectively ground the entire structure.

c) The panel /desk /enclosure /JB ground shall have two (2) bolt drilling with GI bolts and nuts at each end to connect to GI/ copper flat ground riser by means of insulated copper ground cable of required cross section with lug.

d) Circuits requiring grounding shall be individually and directly connected to the panel ground bus.

e) For electronic system cabinets, the electronic system ground bus shall be similar but insulated from the cabinet and shall be separately connected to the system ground. Signal cable shields shall be grounded at the panel end only and shall not be left open. The ground in between panels of a shipping section shall be firmly looped.

f) Electrical meters, relays, transmitters and switching devices, operating at a voltage less than 50V may be grounded through the steel structure.

7.12.05 Panel / Cabinet/ Desk/Enclosures Environmental Protections

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

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

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

7.12.06 Terminal Blocks

a) Terminals shall be chromated galvanized DIN rail mounted screwless cage clamp type. Terminals shall have screwed connection for conductor cross-section above 2.5 mm^2. Terminal blocks shall conform to IEC 947-7-1.

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

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

ii) Self-loosening protection.

iii) Resistant to thermal aging and vibration.

iv) Low and constant voltage drop

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

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

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

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

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

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

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

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

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

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

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

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

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

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

7.12.07 Nameplates and Labels

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

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

material with suitably colored lettering engraved on the back.

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

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

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

8.00.00 METERING BASES AND CHART UNITS

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

i)	Pressure	: Kg/cm^2
	Differential Pressure	: mm of H_2O column / Kg/cm^2
ii)	Draught	: mm of H_2O column
iii)	Vacuum	: Kg/cm^2 (abs)/mm of Hg column
iv)	Temperature	: Degree Celsius (^{O} C)
v)	Flow (Steam, Water)	: Tonnes / hr, M^3/Hr
vi)	Flow (Oil)	: M^3 / Hr, Litter/Hr
vii)	Flow Air	: Tonnes / hr / M^3 / Hr.
viii)	Density	: gms / c.c.
ix)	Level	: mm /%
x)	Conductivity	: µS / cm or mS/cm
xi)	Gas Analyzer	: Percentage by weight or as specified in respective case.
xii)	Dissolved Oxygen / Silica / Sodium	: ppm /ppb

9.00.00 PROCESS CONNECTION & INSTRUMENT HOOK UP

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

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

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

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

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

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

10.00.00 **POWER SUPPLY SYSTEMS**

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

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

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

b) 24V / 48 VDC Supply for DCS

11.00.00 **ENVIRONMENTAL CONSIDERATIONS**

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

11.01.00 Temperature

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

11.02.00 Humidity

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

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

11.03.00 Atmospheric Contamination

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

11.04.00 Vibration

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

11.05.00 Lightning

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

12.00.00 **SECURITY**

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

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

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

13.00.00 **ACCEPTANCE TESTS**

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

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

(a) Factory Acceptance Test (FAT)

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

The FAT shall include the following activities:

- Complete hardware inspection;

	SPECIFICATION FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS –999- 145 –054A	
		VOLUME II B	
		SECTION D	
		REV. NO. 03	DATE : 16-09-2013
		SHEET 1	OF 6

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.

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

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.

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.

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, corrossion, incidental damage due

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

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL PANELS	SPECIFICATION NO.: PES-145-054A
		VOLUME
		SECTION
		REV. NO. 01 DATE: 22.03.2011
		SHEET 1 OF 2

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

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL PANELS	SPECIFICATION NO.: PES-145-054A
		VOLUME
		SECTION
		REV. NO. 01 / DATE: 22.03.2011
		SHEET 2 OF 2

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)

* TO BE CO-ORDINATED WITH PEM ELECTRICAL

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

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL PANELS	SPECIFICATION NO.: PES-145-054A
		VOLUME
		SECTION
		REV. NO. 01 / DATE: 22.03.2011
		SHEET 2 OF 2

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		☐ FOLDED ☐ 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)			

	PREPARED BY	**CHECKED BY**	**APPROVED BY**	COMPANY SEAL
NAME	Shiv Kumar	Anisha B Singhal	Anisha B Singhal	NAME:
SIGNATURE				SIGNATURE:
DATE				DATE:

APPLICABLE CODES AND STANDARDS

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

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

5.00.00 **PROVEN PRODUCT**

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

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

Latest system from following vendors

M/s Siemens

M/s Yokagawa

M/s Honeywell

M/s ABB

Ovation.

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

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

6.00.00 **CODES AND STANDARDS**

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

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

1) Temperature Measurement

a) Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).

b) Temperature Measurement - Thermocouples - ANSI - MC 96.1 - 1982.

c) Temperature Measurement by electrical resistance thermometers - IS: 2806

d) Thermometer-element-Platinum resistance - IS: 2848 / DIN 43760.

2) Pressure Measurement

a) Instrument and apparatus for pressure measurement - ASME PTC 19.2 (1964).

b) Bourdon tube pressure and vacuum gauges - IS: 3624/1996.

3) Flow Measurement

a) Instruments and apparatus for flow measurement - ASME PTC 19.5 (1972) Interim supplement, Part-II

b) Measurements of fluid flow in closed conduit - BS 1042.

4) Electronic Measuring Instruments and Control Hardware

a) Automatic null balancing electrical measuring instruments -ANSI C 39.4 (Rev. 1973), IS 9319

b) Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 / 1974.

c) Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1: ANSI MC 12.1 / 1975.

d) Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975) - ISA -S26 (1968).

e) Surge withstand capability (SWC) tests - ANSI C 37.90A (1989), IEC-255.4.

f) Printed circuit boards - IPC TM-650, IEC 326C.

g) General requirements and tests for printed wiring boards - IS-7405 (Part-I)/1973.

h) Edge socket connectors - IEC 130-11.

i) Requirements and methods of testing of wire wrap terminations--DIN 41611 Part-2.

j) Dimensions of attachment plugs and receptacles- ANSI C73-1973.(Supplement ANSI C73a – 1980)

5) Instrument Switches and Contacts

a) Contact Rating - AC services NEMA ICS Part-2 125, A-600

b) Contact Rating - DC services NEMA ICS Part-2 125, N-600

6) Enclosures

a) Enclosures for Industrial Controls and Systems–NEMA ICS-6-110.15 through 110.22

b) Racks, panels and associated equipment -EIA: RS-310-B-1983 (ANSI C83.9 - 1972).

7) Apparatus, Enclosures and Installation Practices in Hazardous Area

a) Classification of hazardous area - NEMA Article 500, Volume-6, 1978.

b) Electrical Instruments in hazardous dust locations - ISA-RP 12.11.

c) Intrinsically safe apparatus - NFPA Article 493 Volume-4 1978.

d) Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Article 496 Volume-4, 1978.

8) Sampling System

a) Stainless Steel material of tubing and valves, for sampling system - ASTM A 269-79 GRTO-316.

b) Submerged helical coil heat exchangers for sample coolers -- ASTM D11-98.

9) Annunciators

a) Specifications and guides for the use of general-purpose annunciators - ISA RP 18.1.

b) Surge withstand capability tests -ANSI C37.90 a -1971 and IEEE Standard 472-1974.

10) Interlocks, Protections

a) Relays and relay system associated with electric power apparatus - IEEE Standards 3.13.

b) Surge withstand capability tests - ANSI C37.90 a - 1971 and IEEE Standard 472-1974.

c) General requirements and tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I)/1973.

d) Turbine water damage prevention - ASME-TDP-1-1980.

e) Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.

11) UPS System

a) Practice and requirements for semi-conductor power rectifiers - ANSI C34.2.

b) Relays and relay systems associated with electrical power apparatus IEEE Standard - 3.13.

c) Surge withstand capability tests - ANSI C 70.90 A/1971, IEC-255.4.

d) Recommended practice for sizing large lead storage batteries for generating stations and sub-stations - -IEEE-485.

12) Control Valves

a) Control valve sizing (Incompressible fluids) - ISA-S39.2 / 1972.

b) Control valve sizing (Compressible fluids) - ISA-S39.4 / 1972.

c) Control Valve seat leakage – ANSI / FCI 70.2

d) Face to face dimensions of Control Valves - ANSI B16.10

e) Control Valve Capacity Test Procedure – ISA – S75.02

13) Instrument Tubing

a) Seamless Carbon Steel Pipe - ASTM-A-106.

b) Forged carbon steel fittings - ASTM-A-105.

c) Dimensions of fittings - ANSI-B16.11.

d) Code for pressure piping, welding, hydrostatic testing - ANSI-B 31.1.

e) Nomenclature for instrument tube fittings - ISA-RP 42.1 / 1982.

f) Seamless Stainless Steel Tube ASTM A-213 TP 316 / ASTM A-269 TP 316

g) Seamless Alloy Steel Pipe ASTM A 335 P22

h) Seamless Stainless Steel Pipe ASTM A-312 TP 316

14) Cables

a) Thermocouple extension wires / cables - ANSI MC96.1.

b) Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy-IPCEA S-61-402

c) Guide for design and installation of cable system in power generating station (insulation, jacket materials) -IEEE Standard 422.

d) Requirements of vertical tray flame test - IEEE 383

e) Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B33.

15) Electronic Cards, Subassemblies and Components

a) Unpackaged

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

b) Packaged

Vibration, Drop & Static Compression - NSTA.

c) Electromagnetic Compatibility

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

16) Cable Trays, Conduits

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

b) Galvanizing of carbon steel cable trays - ASTM A-386.

7.00.00 DESIGN CRITERIA

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

7.01.00 General Requirements

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

a) Stable in spite of temperature fluctuations.

b) Able to withstand high humidity.

c) Weather proof.

d) Dust proof.

e) Corrosion resistant.

f) Erosion resistant.

DRAWINGS

NOTES :

1..PROVISION OF SINGLE OR DOUBLE ROOT VALVE AND DRAIN VALVE SHALL BE IN ACCORDANCE WITH THE PRESSURE/TEMPERATURE REQUIREMENT. FOR LINE PRESSURE EQUAL TO OR GREATER THAN 40 KG/SQ.CM 2 NOS ROOT VALVE AND 2 NOS DRAIN VALVE SHALL BE REQUIRED.

2..MATERIAL, SIZE AND RATING OF THE PROCESS HOOK UP ITEMS SHOWN IN THE DRAWING ARE INDICATIVE ONLY. ACTUAL REQUIREMENT SHALL BE AS PER PROCESS CONDITION & SPECIFICATION VOL.II–E.

3..DRAIN PIPE IN RACK AND ENCLOSURE SHALL BE 2" NB SCH 80.

PRELIMINARY
TENDER PURPOSE ONLY

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

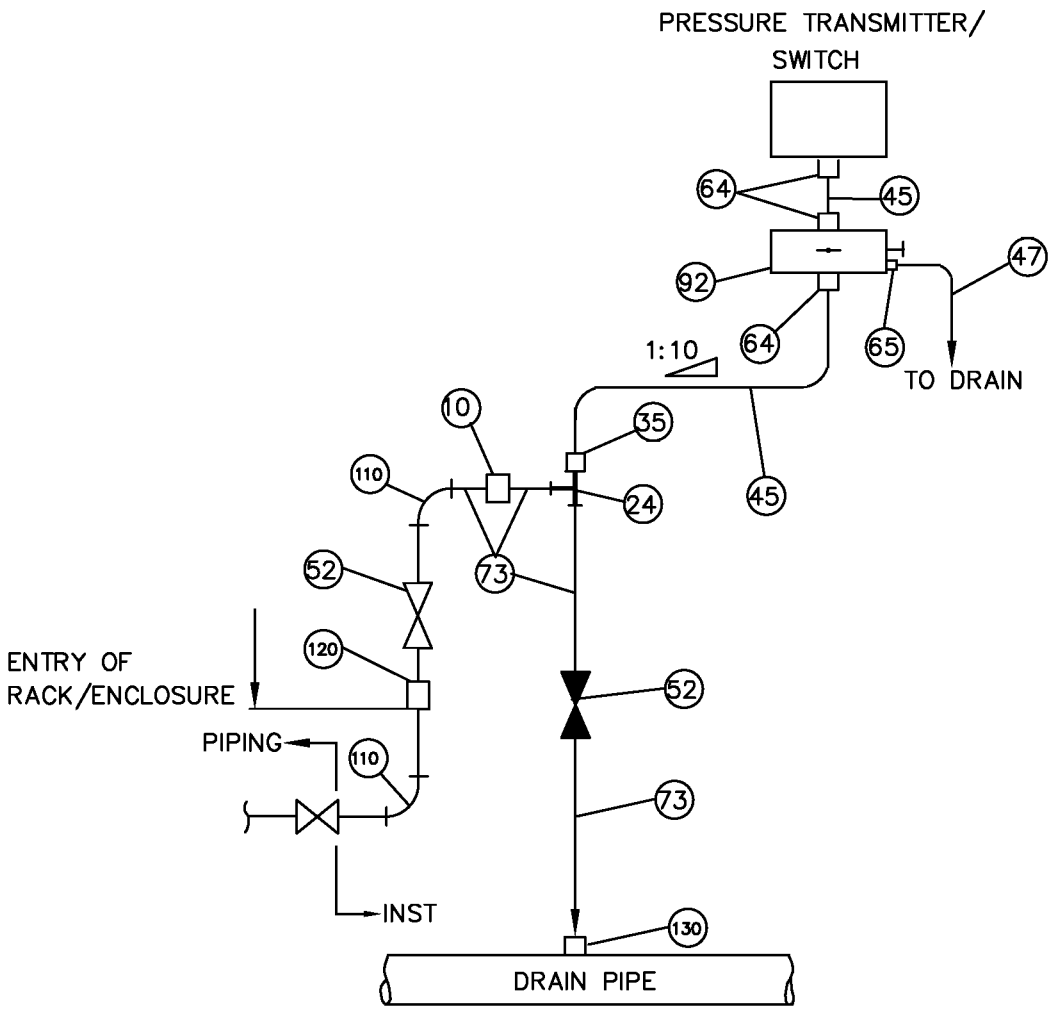
						TYPICAL INSTRUMENT INSTALLATION DIAGRAM
						1x800MW SUPER CRITICAL THERMAL POWER PROJECT (UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)
GP	AT	SD		0	21.04.10	GUJARAT STATE ELECTRICITY CORPORATION LIMITED VADODARA, GUJARAT
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE	

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

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

DWG. NO. K9213R–DWG–I–0060 | REV. 0

PRESSURE TRANSMITTER/PRESSURE SWITCH MOUNTED ABOVE SOURCE POINT



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

SERVICE : CONDENSER PRESSURE, INSTRUMENT AIR ETC.

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

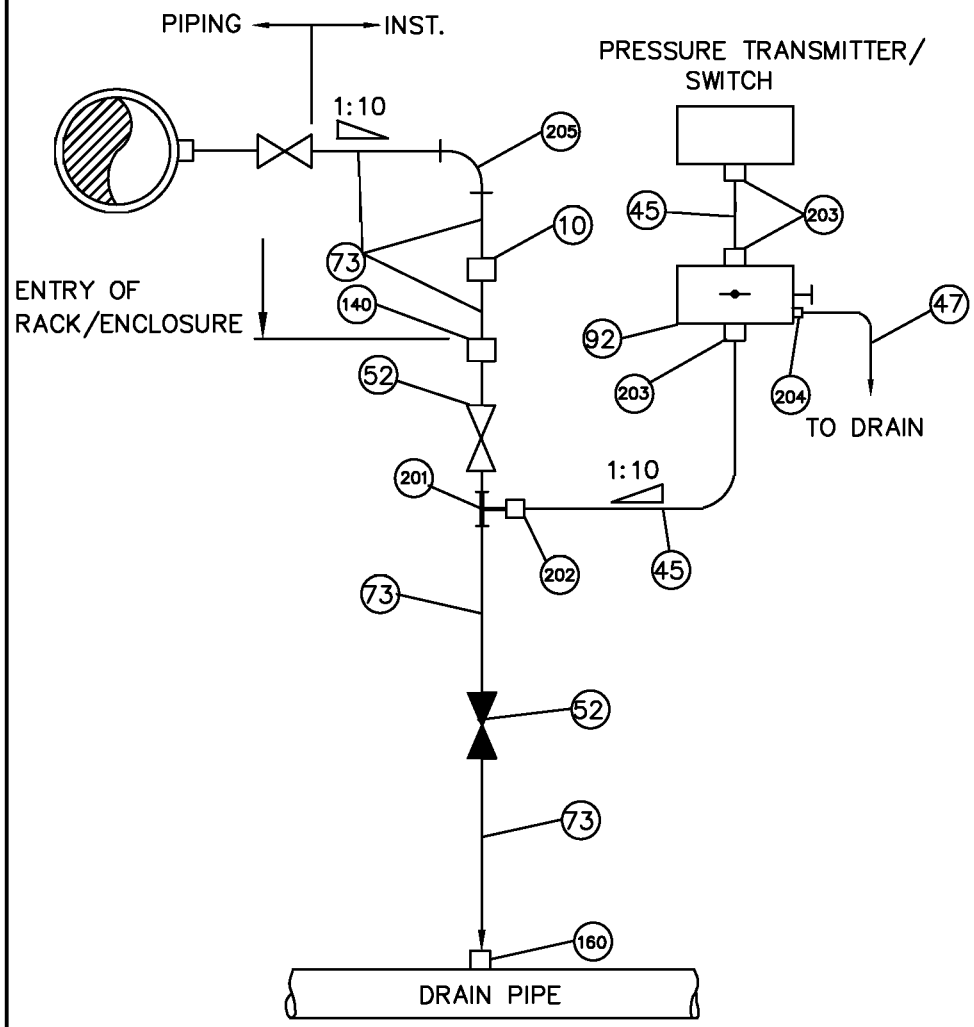
JOB NO. DCPL-K9213R | SCALE NIL | SHT. 3 OF 20

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

K9213-DWG-I-0060-3-20-REV-0

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

PRESSURE TRANSMITTER/PRESSURE SWITCH MOUNTED BELOW SOURCE POINT



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

SERVICE : CONDENSATE, FEED WATER ETC.

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

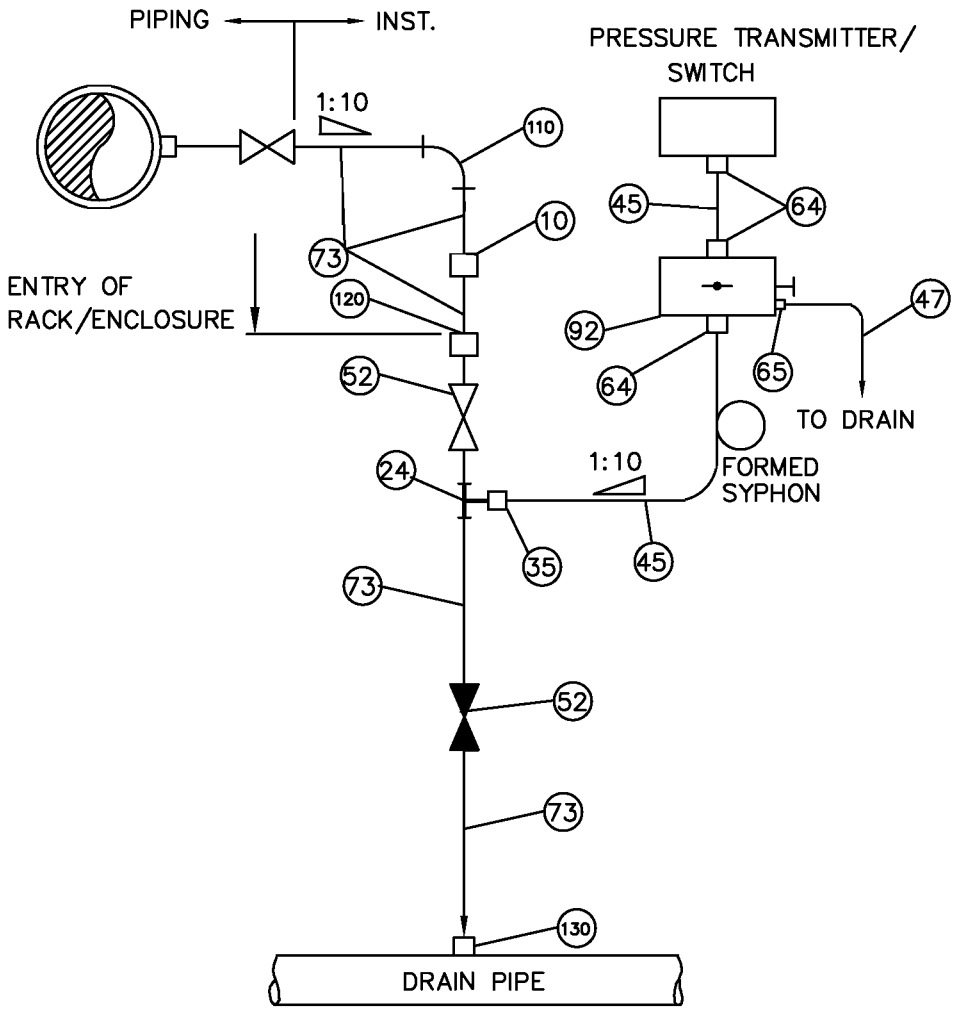
JOB NO. DCPL-K9213R | SCALE NIL | SHT. 4 OF 20

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

K9213-DWG-I-0060-4-20-REV-0

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

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



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

SERVICE : LOW PRESSURE STEAM

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

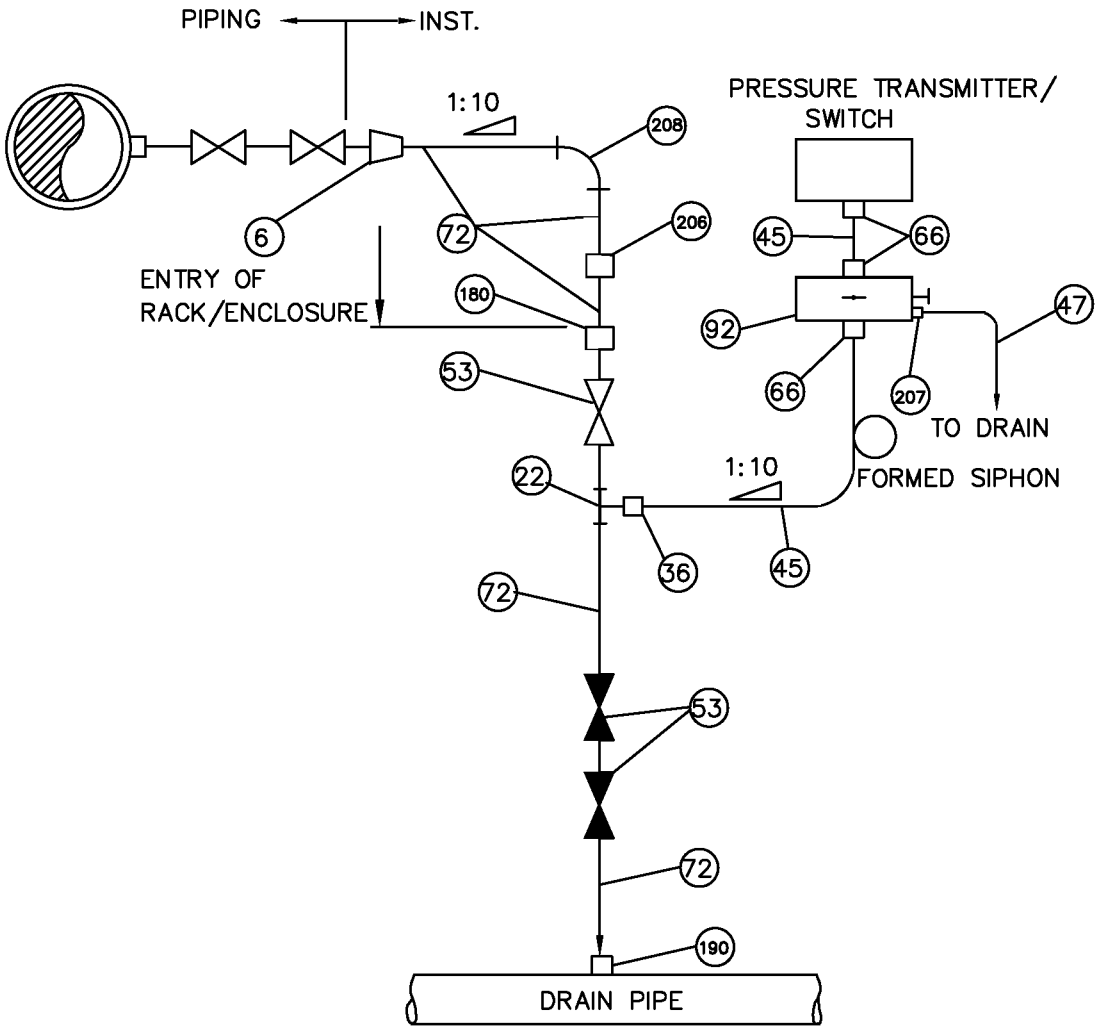
JOB NO. DCPL-K9213R | SCALE NIL | SHT. 5 OF 20

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

K9213-DWG-I-0060-5-20-REV-0

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

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



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

SERVICE : MEDIUM & HIGH PRESSURE STEAM

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

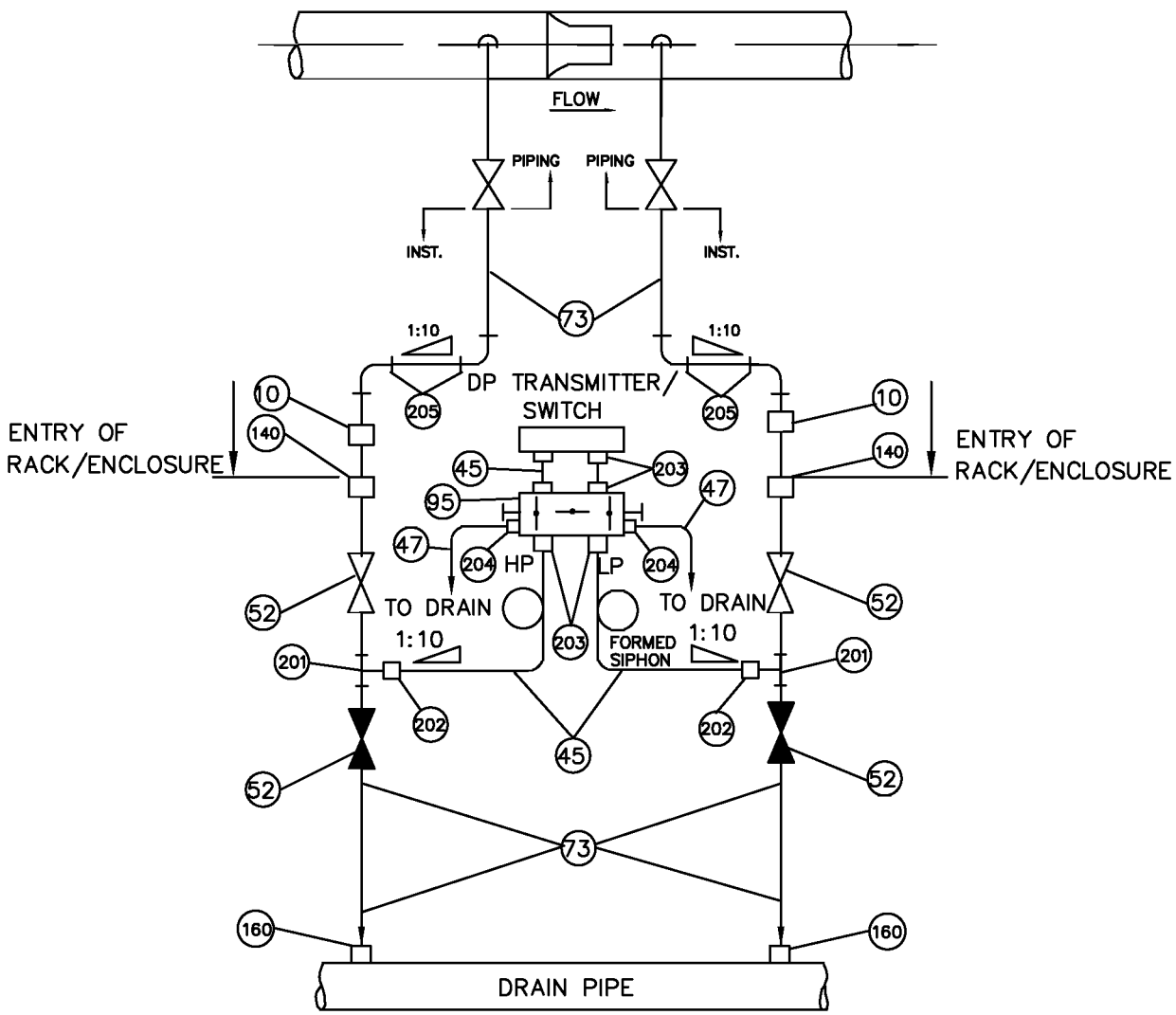
JOB NO. DCPL–K9213R | SCALE NIL | SHT. 6 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

A4_H (08–'06) [297 x 210]

K9213-DWG-I-0060-6-20-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

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

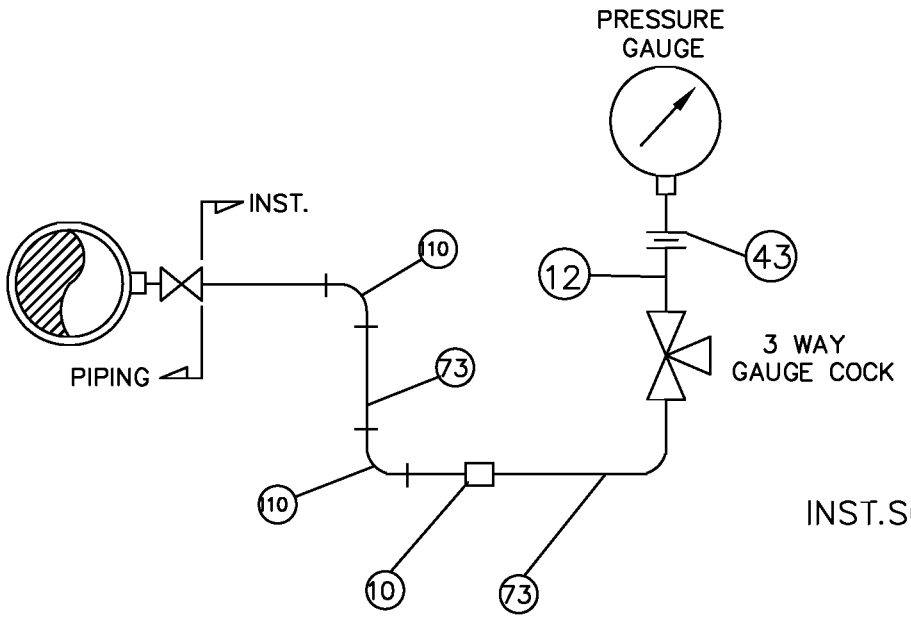
DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

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

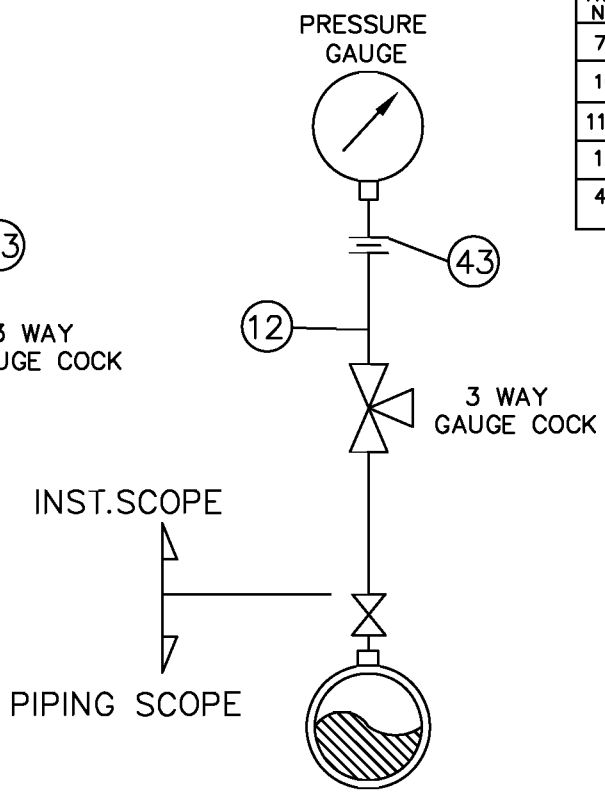
DWG. NO. K9213R-DWG-I-0060 | REV. 0

K9213-DWG-I-0060-7-20-REV-0

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



REMOTE MOUNTING



ON TAP MOUNTING

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

SERVICE : WATER, CONDENSATE ETC.

PRELIMINARY
TENDER PURPOSE ONLY

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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

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

DWG. NO. K9213R–DWG–I–0060 | REV. 0

K9213-DWG-I-0060-11-20-REV-0

A4_H (08–'06) [297 x 210]

SUB-SECTION – ID

DATASHEET-A

	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 : I	
		SECTION-ID	
		REV. NO. 01	DATE: 14.06.16
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		*Clarified Water as per Analysis* Attached along with project information in section B.
1.3	Size of COLTCS	Nb	*2700 NB*
1.4	Length of Ball Separator	MM	4350 (excluding counterflange) Note: 1. Scope of counter flange in purchaser's scope. 2. Scope of nuts, bolts & gaskets in vendor's scope. 3. Ball separator shall be mounted directly on the existing Butterfly valve. 4. Flap of butterfly valve shall be extended to 1350 mm inside the Ball separator (GA of Butterfly valve has been enclosed).
2.0	**DESIGN**		
2.1	Operating pressure at Condenser inlet flange	kg/cm2 (g)	Approx 1.5 to 2.5
2.2	Design Pressure for ball separator	kg/cm2 (g)	5.5 kg/cm² (g) & vacuum 0.1 kg/cm² (abs)
2.3	Design Mechanical Temperature	Deg. C	60
2.4	Condenser Details		
	a) Type of condenser		*Single pass*
	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		
	• 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	**CONNECTING PIPE DETAILS**		
3.1	Condenser inlet pipe		
	a) Material		*Carbon Steel to IS – 2062 Gr. B rolled & welded conforming to IS:3589*
	b) O.D. X Thickness	mm x mm	*2740 X 20*
3.2	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	**MATERIALS OF CONSTRUCTION**		
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**		
	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.
	➢ 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 ii) Ball iii) Stem		 SA 351 CF8M SA 351 CF8M 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.
	c) Gaskets		Min 4 mm thick rubber (In Bidder's scope).
6	**OTHER FLANGES/ COUNTER FLANGES (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	**PAINTING**		
8.1	**INTERNAL SURFACE**		

	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	**EXTERNAL SURFACE**		
	a) Surface preparation		SA-2.5 of Swedish Specn. SIS-05-5900-1967
	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	The tube cleaning system shall be designed for following operation modes		
	a) Automatic start up initiated by push button		YES
	b) Automatic shut down with ball collection effected by : i. Push button ii. Adjustable timer		YES

	iii. Ball monitoring system		
	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

	i) Whether the ball monitoring system is designed to perform the following functions : 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
	j) Whether the electronic processor of the ball monitoring system is provided with the following : 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
	k) Whether provision for self-testing and self-calibration are made		YES
12.0	Mandatory Spares to be supplied under this specification.		Quantity for one unit

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	**Electrical Spares**		
5.1	**415 Volt Motor (above 30KW Rating upto 160KW)**		
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)**		

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.		
13.0	Documents enclosed for bidder’s reference		
	❖ Water Analysis		Attached as per Annexure-I.
	❖ Counter Flange details		Attached as per Annexure-II
	❖ GA of CW piping in TG hall		Attached as per Annexure-III
	❖ GA drg of Butterfly Valve		Attached as per Annexure-IV

ANNEXURE-1

CLARIFIED WATER ANALYSIS

Sl no.	Particulars	Units	Value
1	pH	---	8.42
2	TSS	ppm	15 ppm
3	Conductivity	Micro S/cm	440
4	Calcium Hardness	ppm as CaCO3	52
5	Magnesium hardness	ppm as CaCO3	82
6	Sodium	ppm as CaCO3	79
7	Iron in solution	ppm as Fe	Nil
8	Manganese in solution	ppm as CaCO3	Nil
9	Total Cations		213
10	Bicarbonate	ppm as CaCO3	152
11	Carbonate	ppm as CaCO3	2
12	Hydroxide	-----	Nil
13	Sulphate	ppm as CaCO3	13
14	Chloride	ppm as CaCO3	46.48
15	Nitrate	ppm as NO3	Nil
16	Fluoride	ppm as CaCO3	Nil
17	Total Anions		213
18	Reactive Silica as SiO2	ppm	22
19	Colloidal Silica as SiO2	ppm	Nil.

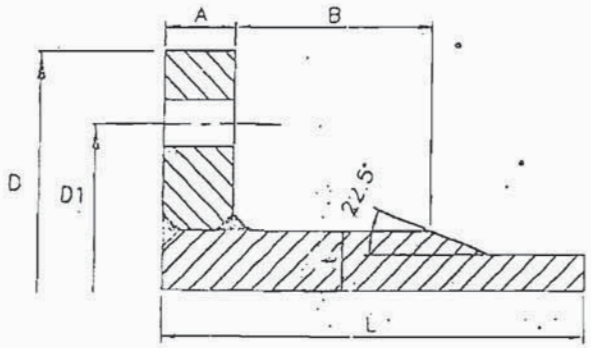
*** Note: Other parameters not indicated above considering as Nil.**

Cycle of concentration for CW system is "5".

FIRST ANGLE PROJECTION ALL DIMENSIONS ARE IN MM

DRAWING NO. PE-DG-999-141-M017

ANNEXURE-II



NOTES:-

Flonge thicknesses listed are for Design pressure=5Kg/cm²(g) and Flange dimensions as given in the table. Final thickness of the flonge is to be checked for actual OD/Bolting PCD/Neck dimensions.

PIPE SIZE	PIPE THK.	FLANGE OD 'D'	Bolt PCD 'D1'	WELD NECK FLANGE				SLIP-ON FLANGE THICKNESS
				FLANGE THK. 'A'	NECK THK. 't'	NECK Length 'B'	Appx. Total Length 'L'	
1200	10-12	1465	1380	40	24	70	200	90
1400	14	1675	1590	50	24	70	200	100
1600	14	1915	1920	60	32	80	220	110
1800	14-16	2115	2020	70	32	90	250	120
2200	18	2550	2420	80	36	100	300	140
2300	20			90	38	110	325	150
2500	20			90	38	110	325	150
2700	20			90	38	110	325	150

DRAWING FOR BAL. SEPARATOR COUNTER FLANGE

REV.	DATE	ALTD	CHD	APPD

JOB NO. 999
STATUS -
DISTRIBUTION

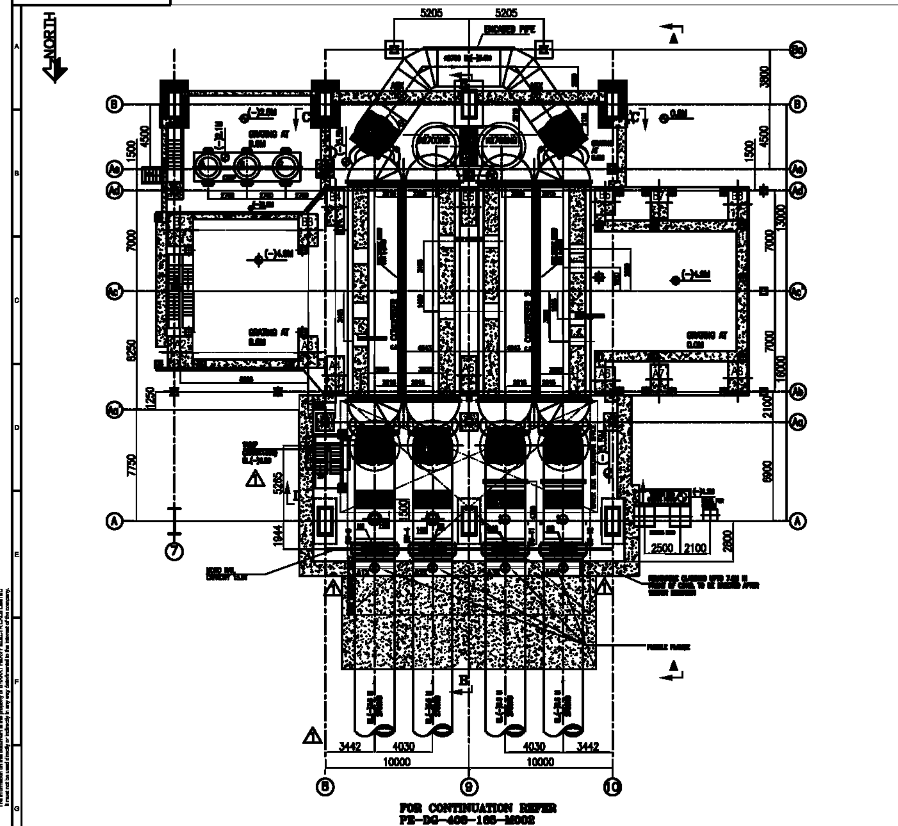
BHARAT HEAVY ELECTRICALS LTD
POWER GROUP
PROJECTS ENGINEERING MANAGEMENT
PPEI, NOIDA

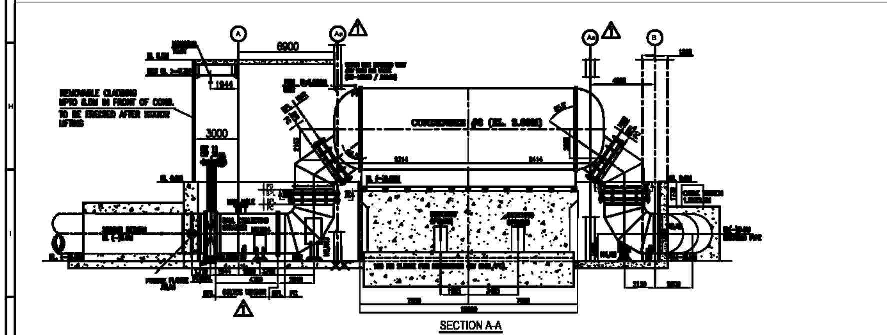
DEPT CODE		NAME	SIGN	DATE
	DRN	PM		25.06.07
	DSGN	PM		25.06.07
	CHD	SPV		25.06.07
	APPD	SM		25.06.07

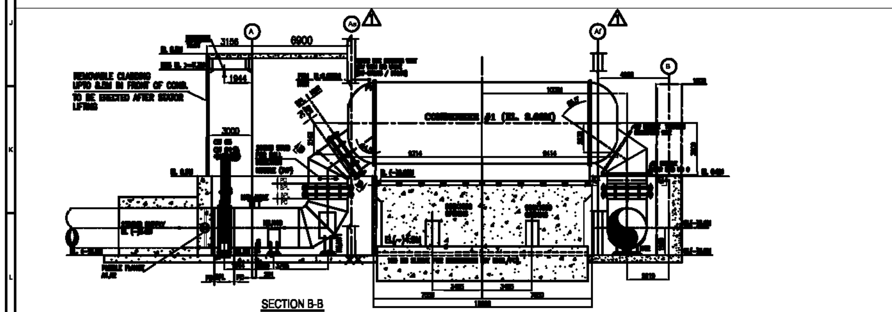
TITLE
COUNTER FLANGE DETAILS

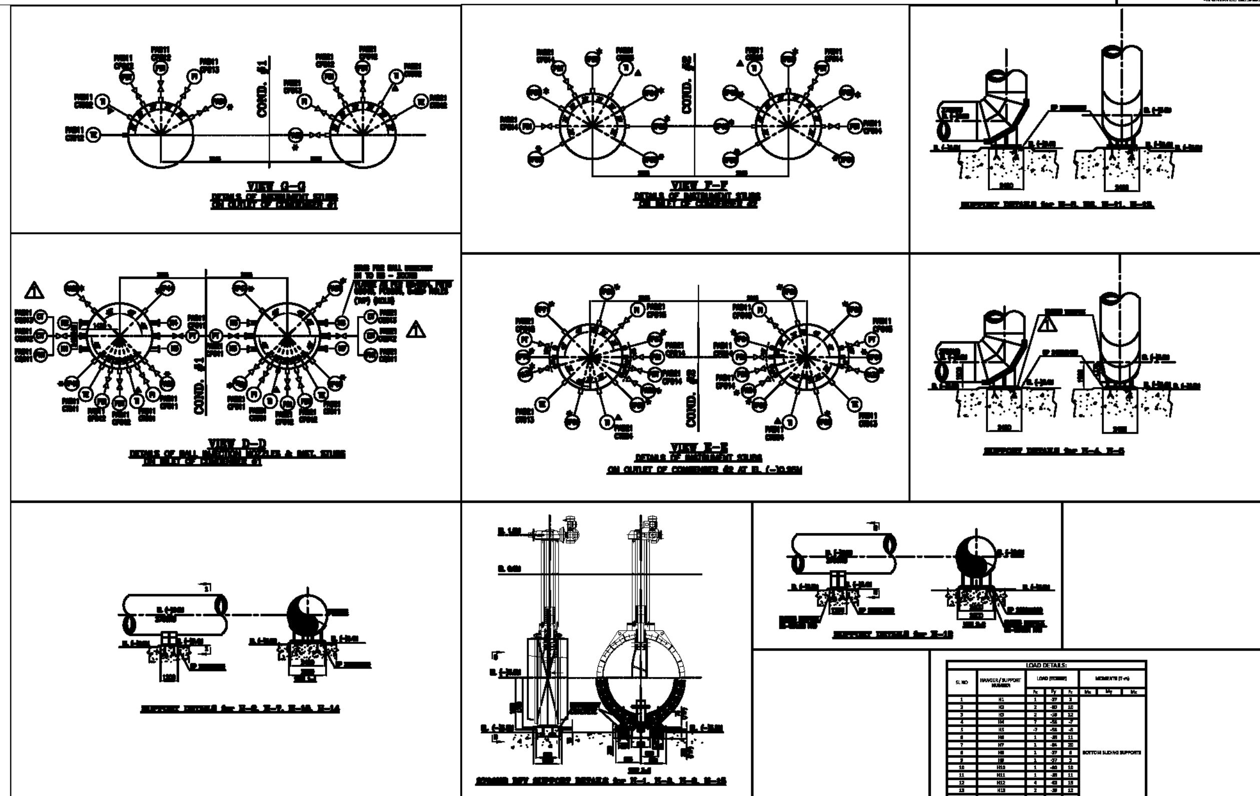
DRAWING NO
PE-DG-999-141-M017

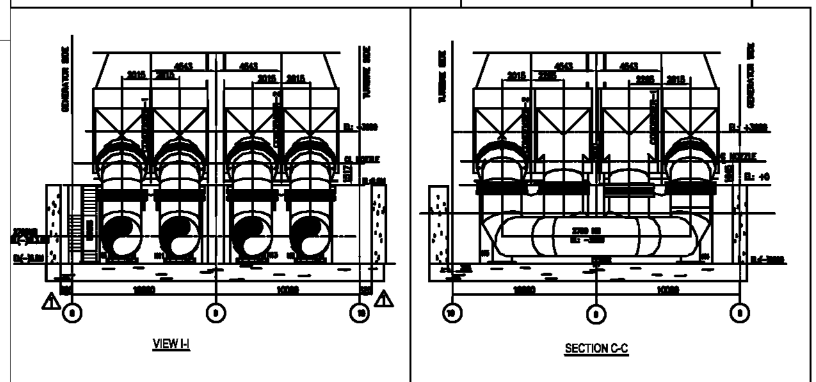
SHEET 01 OF 01 REV 00

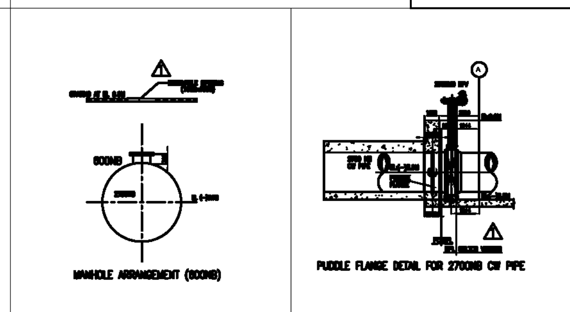












LOAD DETAILS:

REFERENCE DRGS:			
[illegible]	[illegible]	[illegible]	[illegible]
1	TG EQUIPMENT PLAN AT EL 0.0 M	PE-DG-408-100-M003	PEM
2	P & ID CW AND ACW SYSTEM	PE-DG-408-165-M001	PEM
3	PG TEST INSTRUMENTATION SCHEME	PE-DG-408-100-M208	PEM
4	CONDENSER ASSY. (G.A.)	0-180-10-70008-C-177	HWR
5	ARRGT. OF 2700NB B.F. VALVE (CW NEAR COND. OUTLET)	–	BPL
6	INSTRUMENT STUB DETAIL (PRES/TEMP)		PEM
7	G.A. OF R.E. JOINT (COND. W/BOX SIDE)	2-17053-41036	BPL
8	G.A. OF R.E. JOINT (PIPING SIDE)	2-17053-41035	BPL
9	G.A. OF COLTCS PIPING INSTALLATION PLAN	–	COLTCS VENDOR/PEM
10	G.A. CW PIT	-	PEM
11	G.A. CEP PIT	-	PEM
12	CW PIPING OUTSIDE TG HALL	PE-DG-408-165-M002	PEM

HOLD:–

JOB NO. 408
STATUS CONTRACT
DISTRIBUTION

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

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

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

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

TITLE: LAYOUT OF CW PIPIING LOCAL TO CONDENSER

DRAWING NO. PE-DG-408-165-M001
SHEET 1 OF 1 REV. 01

SIZE-A0

DRAWING No. PE-DG-408-165-M001

NORTH

5205 5205

ENCASED PIPE

ø2700 El(-)3.6M

A5X A6X

ø2700NB ø2700NB

(-)2.5M (-)2.1M (-)5.5M 0.0M

GRATING AT 0.0M

CEP

(-)4.9M

CONDENSER 1 CONDENSER 2

DOOR 900X1800

PIPE SLEEVE 150NB BOS (-)3.5M

GRATING AT 0.0M

SUMP (2000X1300) EL.(-)6.50

(-)5.5M

WATER BOX WITHDRAWAL SPACE

TRENCH FOR COLTCS PIPING (-)1.2M

PANEL FOR COLTCS

COLTCS SKID

MONO RAIL CAPACITY 15.0T

TUBES WITHDRAWAL SPACE

REMOVABLE CLADDING UPTO 7.0M IN FRONT OF COND. TO BE ERECTED AFTER STATOR ERECTION

PUDDLE FLANGE

EL.(-)3.6 M 2700NB

FOR CONTINUATION REFER
PE-DG-408-165-M002

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 095138007771

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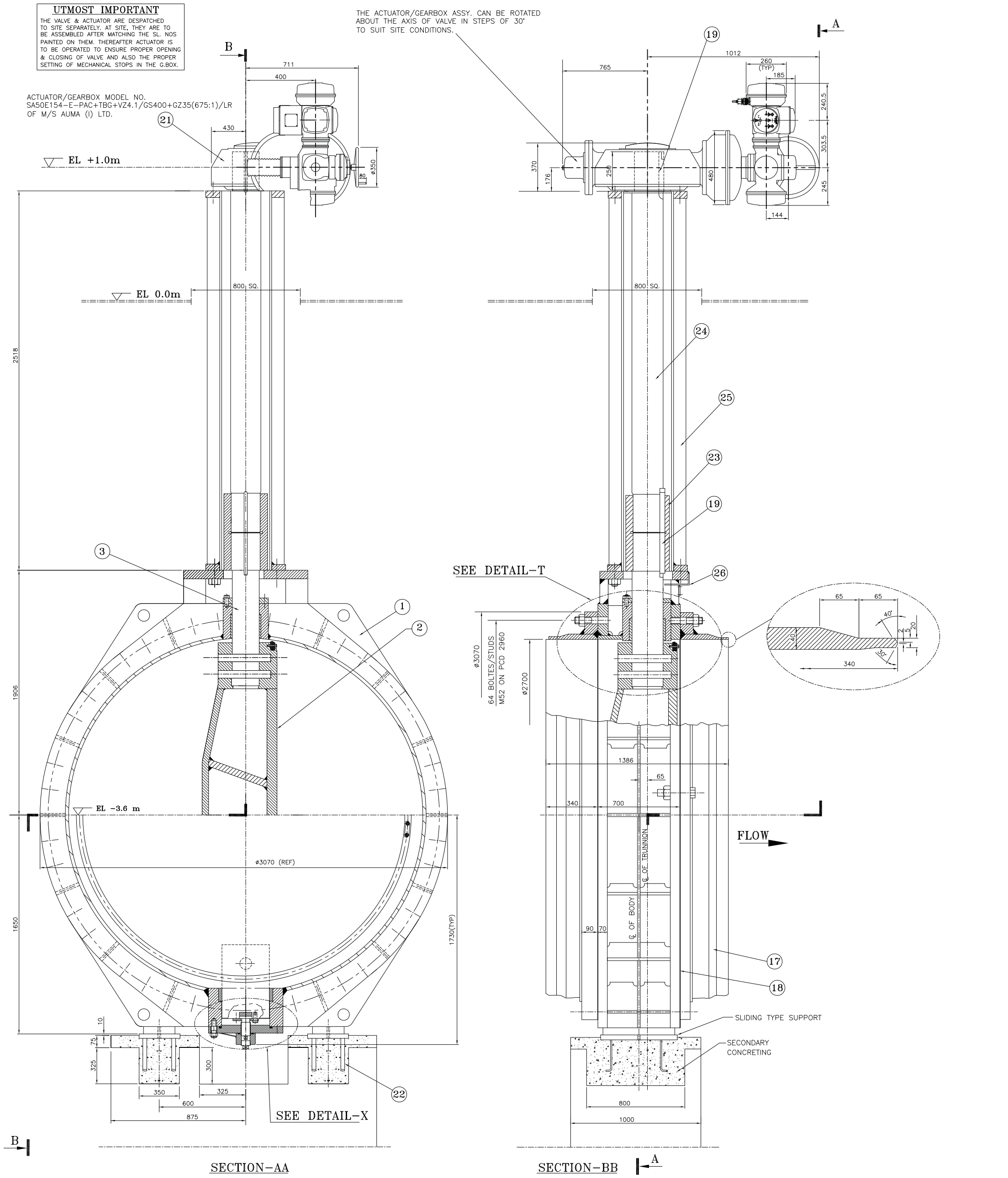
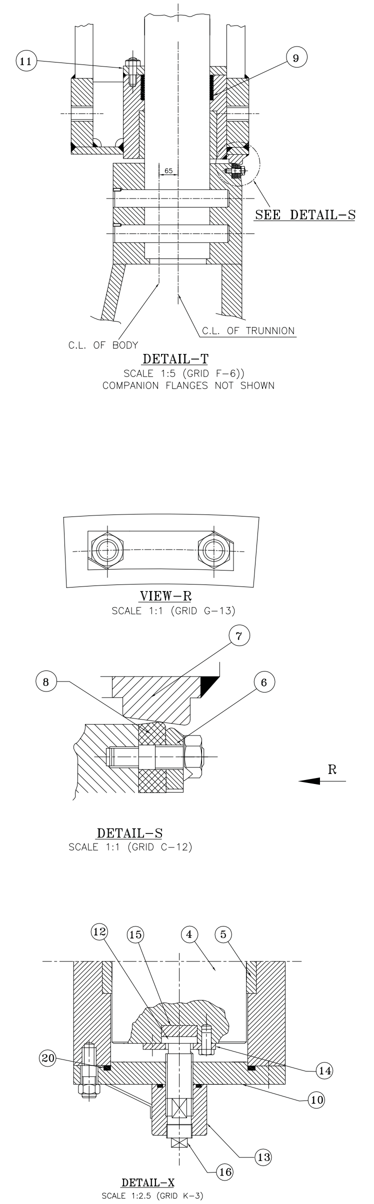
UTMOST IMPORTANT

THE VALVE & ACTUATOR ARE DESPATCHED TO SITE SEPARATELY. AT SITE, THEY ARE TO BE ASSEMBLED AFTER MATCHING THE SL. NOS PAINTED ON THEM. THEREAFTER ACTUATOR IS TO BE OPERATED TO ENSURE PROPER OPENING & CLOSING OF VALVE AND ALSO THE PROPER SETTING OF MECHANICAL STOPS IN THE G.BOX.

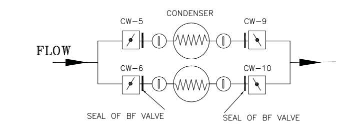




ANNEXURE-IV
SHEET 1 OF 2

TECHNICAL REQUIREMENTS

1. VALVE INTERNAL HARDWARES : STAINLESS STEEL (ASTM A479 TP 316)
2. VALVE EXTERNAL HARDWARE : HTS
3. TAPED HOLES ON BODY FLANGES SHALL BE GREASED
4. DESIGN PRESSURE = 5.5 kg/sq cm(g) & FULL VACUUM.
5. TEST PRESSURE:–
   VALVE BODY/DOOR – 11 kg/sq cm (g) FOR 10 MIN. DURATION.
   VALVE SEAL – 5.5 kg/sq cm (g) FOR 5 MIN. DURATION
6. AFTER DOOR HAS BEEN TESTED, FOR SOUNDNESS , VALVE DOOR SEAL (ITEM 8) TO BE RESET DROP TIGHT AT THE SEAL TEST PRESSURE.
7. ALL HARDWARES (EXCEPT S.S. HARDWARES) ARE TO BE ZINC PLATED HAVING PLATING THICKNESS 10–14 MICRONS.
8. PAINT AND PROTECT AS PER APPROVED SPECIFICATION.
9. SPECIFICATION:–
   a) MAXIMUM FLOW = 58500 cub. m/hr.
   b) DESIGN WATER TEMP. = 60°C
   c) VALVE OPENING/CLOSING TIME = 50 TO 60 sec.
   d) DESIGN STD:– VALVES ARE GENERALLY AS PER AWWA C504.
10. TESTING AND INSPECTION TO BE DONE AS PER AGREED QUALITY PLAN.
11. a). WEIGHT OF VALVE WITH OPERATOR : 14760 KG (Approx).
    b). WEIGHT OF ACTUATOR : 800 KG (Approx).



SCHEMATIC LOCATION OF BF VALVE SEALS & MANHOLES

IT IS RECOMMENDED TO PROVIDE A SUITABLE MANHOLE IN THE PIPELINE ON SEAL SIDE OF THE VALVE TO ATTEND TO THE SEAL

ITEM NO.	DESCRIPTION	MATERIAL	SPECIFICATION	QUANTITY
026	POINTER 3.15 tk.	MILD STEEL	IS 513	1 NO.
025	ACTUATOR STAND	CARBON STEEL	FABRICATED	1 NO.
024	EXTENSION SHAFT	ALLOY STEEL	IS 4367 40Ni6Cr4Mo3	1 NO.
023	SLEEVE	ALLOY STEEL	IS 4367 40Ni6Cr4Mo3	1 NO.
022	SOLE PLATE	CARBON STEEL	IS 2062 GrB	2 NOs.
021	ELEC. ACTUATOR WITH SEC. GEARBOX	Mfr's STANDARD	PURCHASED	1 NO.
020	RUBBER CORD	ACRY. NITRILE RUBBER		1 NO.
019	KEY	ALLOY STEEL	IS 5517 40Ni6Cr4Mo3	3 NOs.
018	GASKET	NON–ASBESTOS		1 NO.
017	COMPANION FLANGE	CARBON STEEL	IS 2062 GrB	2 NOs.
016	PLUG SQ HD	CARBON STEEL	–	1 NO.
015	DISC	PHOSPHOR BRONZE	IS 7811	1 NO.
014	RETAINING PLATE	STAINLESS STEEL	ASTM A240 TP316	1 NO.
013	CAP NUT	STAINLESS STEEL	IS 6603 Gr20 Cr13	1 NO.
012	JACKING BOLT	STAINLESS STEEL	IS 6603 Gr20 Cr13	1 NO.
011	COVER PLATE	CARBON STEEL	IS 2062 GrA	1 NO.
010	END COVER	CARBON STEEL	IS 2062 GrA	1 NO.
009	GLAND PACKING	PTFE – TEFLON		1 NO.
008	DOOR SEAL	ACRY. NITRILE RUBBER (BUNA–N)		1 NO.
007	VALVE SEAT	STAINLESS STEEL	ASTM A240 TP316	1 NO.
006	DOOR SEAL CLAMPING RING	STAINLESS STEEL	ASTM A240 TP316	1 NO.
005	BEARING/BUSH	SELF LUBRICATING	FERROFORM/THORPLAS	2 NOs.
004	TRUNNION (NON DRIVING SIDE)	STAINLESS STEEL	BS970 Gr431S291	1 NO.
003	TRUNNION (DRIVING SIDE)	STAINLESS STEEL	BS970 Gr431 S291	1 NO.
002	DOOR	CARBON STEEL	IS 2062 Gr.B	1 NO.
001	BODY	CARBON STEEL	IS 2062 Gr.B	1 NO.

PRILIMINARY GA DRAWING OF BFV IS ENCLOSED FOR REFERENCE.
FINAL DRG SHALL BE PROVIDED DURING DETAILED ENGINEERING.

CUSTOMER	RAICHUR POWER CORPORATION LIMITED
CUSTOMER'S CONSULTANT	STEAG ENERGY SERVICES (INDIA) PVT. LIMITED, NOIDA
TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT	2X800 MW YERMARUS TPP

ADDITIONAL INFORMATION

STATUS OF DRAWING

DISTRIBUTION OF PRINTS
CDE – 2 TGX – 1
STM – 5

BHARAT HEAVY ELECTRICALS LTD. BHOPAL

	NAME	SIGN	DATE
DRN	SARVESH	सर्वेश	10.12.12
CKD	H.K.LAVVANSHI	लववंशी	10.12.12
APPD	MAYANK JAIN	[signature]	10.12.12

NO. OF VAR. 00

REV. | DATE | ALTERED | CHECKED | APPD.

DEPT. PSE | CODE 412 | UNTOL. DIMS. GR. | SCALE 1:10 | WEIGHT(K.G.) – | REF.TO ASSY.DRG. – | ITEM NO. – | NO.OF ITEMS 026

TITLE: ARRGT. OF ø2700 B.F.V. WITH ELECT. ACTUATOR AND EXT. SHAFT (TAG NO. CW–5,6,9,10)

DRAWING NO. 0 951 38 00771 | REV. 00

SHT. NO. 01 | NO. OF SHT. 01

A0 SIZE

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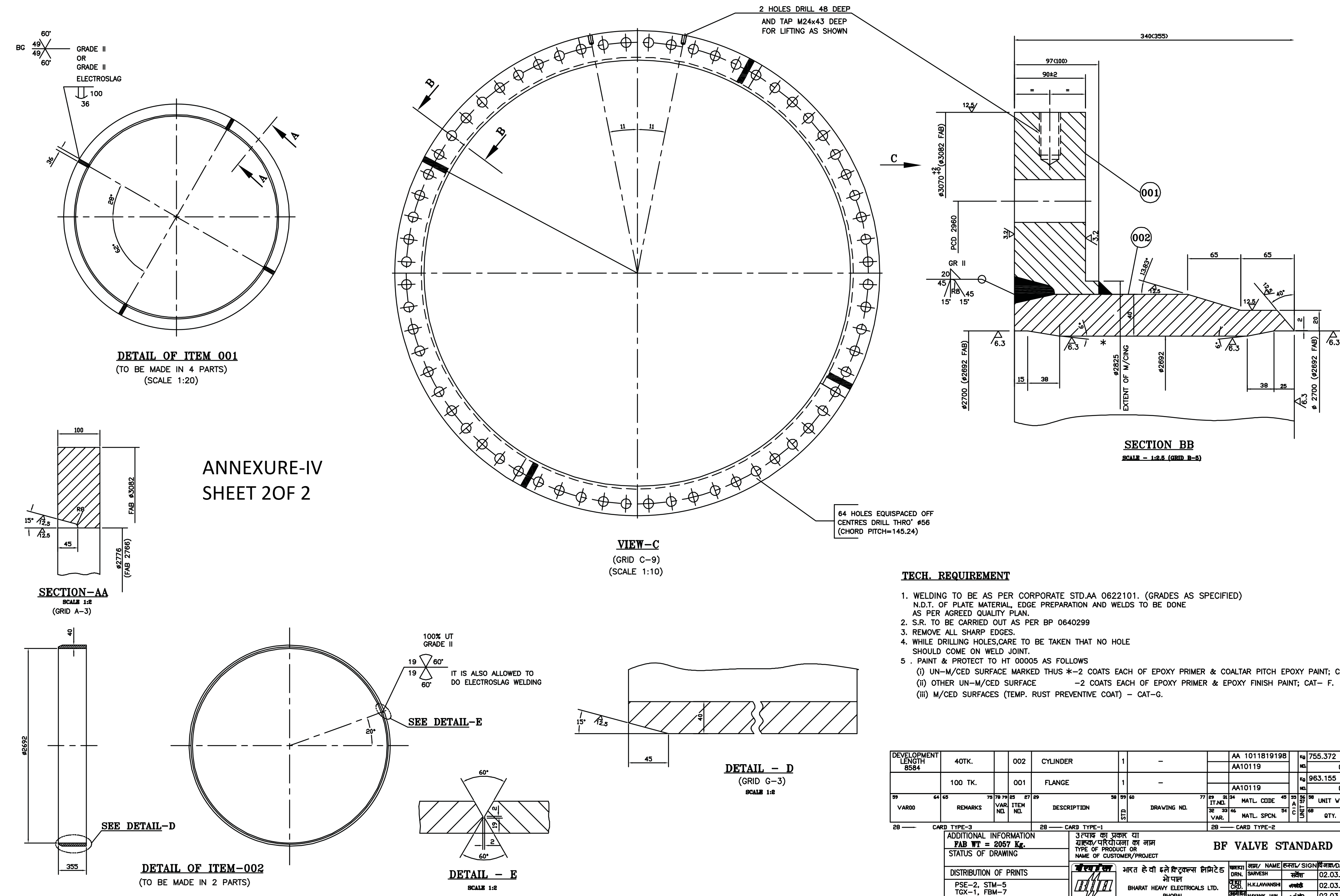
IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

FIRST ANGLE PROJECTION

DRG. NO. 29513800055

(ALL DIMENSIOMS ARE IN mm)

ANNEXURE-IV
SHEET 2OF 2



TECH. REQUIREMENT

1. WELDING TO BE AS PER CORPORATE STD.AA 0622101. (GRADES AS SPECIFIED) N.D.T. OF PLATE MATERIAL, EDGE PREPARATION AND WELDS TO BE DONE AS PER AGREED QUALITY PLAN.
2. S.R. TO BE CARRIED OUT AS PER BP 0640299
3. REMOVE ALL SHARP EDGES.
4. WHILE DRILLING HOLES,CARE TO BE TAKEN THAT NO HOLE SHOULD COME ON WELD JOINT.
5. PAINT & PROTECT TO HT 00005 AS FOLLOWS
   (i) UN–M/CED SURFACE MARKED THUS ✱–2 COATS EACH OF EPOXY PRIMER & COALTAR PITCH EPOXY PAINT; CAT–C.
   (ii) OTHER UN–M/CED SURFACE –2 COATS EACH OF EPOXY PRIMER & EPOXY FINISH PAINT; CAT– F.
   (iii) M/CED SURFACES (TEMP. RUST PREVENTIVE COAT) – CAT–G.

DEVELOPMENT LENGTH	REMARKS	VAR NO.	ITEM NO.	DESCRIPTION	STD	DRAWING NO.	IT.NO. / VAR.	MATL. CODE / MATL. SPCN.	UNIT	UNIT WT. / QTY.
8584	40TK.		002	CYLINDER	1	–		AA 1011819198 / AA10119	Kg	755.372 / 001
	100 TK.		001	FLANGE	1	–		AA10119	Kg	963.155 / 001
VAR00										

ADDITIONAL INFORMATION
FAB WT = 2057 Kg.
STATUS OF DRAWING

DISTRIBUTION OF PRINTS
PSE–2, STM–5
TGX–1, FBM–7

उत्पाद का प्रकार या ग्राहक/परियोजना का नाम
TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT
BF VALVE STANDARD

भारत हेवी इलेक्ट्रिकल्स लिमिटेड भोपाल
BHARAT HEAVY ELECTRICALS LTD. BHOPAL

	NAME	SIGN	DATE
DRN.	SARVESH		02.03.13
CHD.	H.K.LAWANSHI		02.03.13
APPD.	MAYANK JAIN		02.03.13

DEPT. PSE
CODE 412
UNTOL. DIMS. GR. 3-200-00-49014
SCALE 1:10
WEIGHT (KG) 1719
REF. TO ASSY. DRG. –
ITEM NO. –
NO. OF VAR. 00
NO. OF ITEM 002

TITLE: COMPANION FLANGE ø2700
DRAWING NO. 29513800055
REV. 00
SHT. NO. 01 NO. OF SHT. 01

A1

PRILIMINARY GA DRAWING OF COUNTERFLANGE ENCLOSED FOR REFERENCE.
FINAL DRG SHALL BE PROVIDED DURING DETAILED ENGINEERING.

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	Appron & 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 Sl 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
					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
					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
					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
					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)			
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		Trichy/ HWR/ HYD/ BAP/ PC Chennai/ EDN
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 10%of each type(at least 1 no. of each type) whichever is higher.	For applicable		EDN
CCTV	Lot price for applicable items in the list of items indicated below		Trichy/ EDN
2 (two) numbers of cameras and fixing accessories.			Trichy/ EDN

SUB-SECTION - IIA

STANDARD TECHNICAL SPECIFICATION (MECHANICAL)

STANDARD TECHNICAL SPECIFICATION FOR COLTCS

STANDARD QUALITY PLANS

1.00.00 **GENERAL**

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.

2.00.00 **CODES AND STANDARDS**

2.01.00 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.

2.01.01 IS/BS/DIN/US Standards regarding pressure vessels, pumps, piping, flanges and others as necessary.

2.01.02 IS/BS/DIN/ASTM Standards for materials specification and testing procedures.

2.01.03 IS/BS/DIN/AWWA Standards for valves and the testing.

2.02.00 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.

3.00.00 **DESIGN AND CONSTRUCTION**

3.01.00 General Requirements

3.01.01 Unless otherwise necessary, manufacturer's standard and proven models of the tube cleaning system shall be supplied.

3.01.02 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.

3.01.03 Suitable Corrosion allowance shall be provided whenever necessary. Adequate provision for future installation of cathodic protection shall be provided.

3.01.04 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.

3.02.00 DELETED

3.03.00 **Operational Requirements**.

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 :

- 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 :

- 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.

3..04.00 **Ball Separator**

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 tappings 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 seperating 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 hand wheels shall be provided to enable manual swivelling of strainers / screens.

3.05.00 **Ball Recirculating Pump**

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.

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 **Ball Collector**

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. The ball collector shall be designed and manufactured as per the applicable codes for pressure vessels.

3.06.02 Ball collector shall be provided with an inspection window/sight glass for visual inspection of the cleaning balls.

3.06.03 Ball collector shall be provided with suitable ports with covers for ball feeding and removal.

3.06.04 The ball collector shall be provided with vent and drain connections with isolating valves.

3.06.05 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.

3.06.06 If specified in Data Sheet -A, ball collector body shall be lined with suitable resilient material.

3.06.07 The differential pressure measuring system shall be provided with D.P. transmitter ,DPS & DPGof remote seal arrangement.

3.07.00 **Differential Pressure Measuring System.**

3.07.01 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.

3.07.02 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.

3.07.03 The differential pressure measuring system shall be with remote seal arrangement .

3.08.00 **Ball Monitoring System**

3.08.01 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 :

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.

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.

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.

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
- ♦ required basic ball charge.
- ♦ recirculating ball quantity.
- ♦ oversized ball quantity.

b) Time counters for
- ♦ 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 **Cleaning Balls**

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 100^0C. 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 **Piping, Valves, Distributors and Injection Nozzles.**

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 , 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 **Actuators**

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 **Electric Motors**

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 **Instrumentation and Control System.**

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 guages 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 **Other Accessories.**

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 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.

4.00.00 DELETED

5.00.00 **SHOP INSPECTION AND TESTS**

5.01.01 **General**

5.01.01 Manufacturer shall conduct all tests and stage inspections as per the approved 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.

5.01.02 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.

5.01.03 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.

5.01.04 Qualification of welding procedures and welders shall be as per ASME B&PV code, Section - IX / applicable codes.

5.2.00 **Ball Separator**

5.02.01 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.

5.02.02 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.

5.02.03 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.

5.03.00 **Ball Recirculating Pump**

5.03.01 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.

5.03.02 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.

5.03.03 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.

5.03.04 Wear rings shall be subjected to penetrant test as per ASTM-E165.

5.03.05 Pump impellers and rotor assembly shall be statically and dynamically balanced as per ISO-1940

5.04.00 **Ball Collector**

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 **Piping, Valves, Distributors, and Injection Nozzles.**

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 **Rubber Lining (as applicable)**

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 **Flanges**

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.

5.08.00 **Dimensional Checks.**

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.

5.09.00 **Hydrostatic Test**

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.

5.10.00 **Leakage Test**

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.

5.11.00 **Performance Test on Recirculating Pump**

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.

5.12.00 **Functional Tests**

Various assembles / equipments / components of the tube cleaning system shall be subjected to functional tests and the following shall be checked.

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 **TESTING AT SITE**

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.

7.00.00 **QUALITY ASSURANCE & QUALITY PLAN**

7.01.00 The tube cleaning system and other accessories to be supplied, shall have assured quality and workmanship.

7.02.00 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.

8.00.00 **NAME PLATE AND TAG NUMBERS**

8.01.00 Ball separator, recirculating pump, ball collector shall be provided with a permanently attached brass or stainless steel plate indicating the following details :-

a) Design and maximum flow rates.
b) Design and test pressures.
d) Design temperature.
e) Empty and operating weights.

8.02.00 Each valve in the tube cleaning system shall be provided with a name plate indicating the following :-

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.

8.03.00 Each motor shall be provided with a name plate indicating the following details:

a) Supply conditions.
b) KW Rating.
c) Make.

	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. 01	DATE :10.05.2015
		SHEET 1 OF 2	

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

After the award of contract, the following drawings, data and information is to be submitted for review / approval of BHEL.

1.01.00 The drawings to be submitted by bidder in event of award of contract shall be as per NIT.

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.

12.2.03 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.

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.

Manufacturer's Name & Address	STANDARD QUALITY PLAN	BHEL Doc No.:	PE-QP-999-165-N008 REV-01
	Vendor Q.P. NO.	PROJECT:	
	INDEX	PACKAGE : COLTCS	CUSTOMER:
	Date :	PURCHASER:	
	Page 01 of 15	CONSULTANT:	
		P.O. No.	

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 indentified with "STAR" shall be essentially included by contractor in QA Documentation.

** M :Manufacturer / Manufacturer's Sub-contractor
C : Contractor O : Owner

Indicate : "P" - Perform, "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor	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	
							Vendor Q.P. NO:		PROJECT:					
					Item : Ball Separator		PACKAGE : COLTCS		CUSTOMER:					
		P.O. No.							PURCHASER:					
							Date :		CONSULTANT:					
							Page 02 of 15							
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**	**D***	**	**10**		**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 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		
		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 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	Mill Test Certificate	*	P	V	V		
[c]	Main Flange	Chemical properties & Physical properties	Major	Chemical Analysis & Mechanical test	One sample/cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's Test Certificate	*	P	V	V		
		Heat treatment (Normalising)	Major	Verification	HT Chart	Approved drg/Data sheet	Approved drg/Data sheet	Manufacturer's Test Certificate	*	P	V	V	if casting	
		Surface defects	Critical	Magnetic particle test	100%	Approved drg/Data sheet	Approved drg/Data sheet	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 drg/Data sheet	Approved drg/Data sheet	Mill Test Certificate / Lab test report/Raw material flow sheet	*	P	V	V		
			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		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
		Vendor Q.P. NO:	PROJECT:
P.O. No.	**Item : Ball Separator**	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	D*	Agency M	Agency C	Agency O	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	Welding procedure already approved by BHEL/LRQA/GL/DNV/TUV shall be employed for this job.
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	Welders already qualified by BHEL/LRQA/GL/DNV/TUV shall be employed for this job.
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	–	BHEL to witness > 20mm thick butt joint
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	--	--	

LEGEND

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C : Contractor O : Owner

Indicate : "P" - Perform, "W" - Witness and "V" - Verification

Manufacturer / Sub-Contractor	Contractor	Reviewed By	Name & Sign. Of approving authority & Seal
Signature			

BHEL	Manufacturer's Name & Address	**STANDARD QUALITY PLAN**		BHEL Doc No.: PE-QP-999-165-N008
			Vendor Q.P. NO:	PROJECT:
	P.O. No.	**Item : Ball Separator**	PACKAGE : COLTCS	CUSTOMER:
			Date :	PURCHASER:
			Page 04 of 15	CONSULTANT:

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	D*	Agency M **	Agency C	Agency O	Remarks
1	2	3	4	5	6	7	8	9	D*	**	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	

LEGEND

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Manufacturer / Sub-Contractor	Contractor	Reviewed By	Name & Sign. Of approving authority & Seal
Signature			

	BHEL	Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:				PE-QP-999-165-N008	
							Vendor Q.P. NO:		PROJECT:					
		P.O. No.			Item : Ball Separator		PACKAGE : COLTCS		CUSTOMER:					
							Date :		PURCHASER:					
							Page 05 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	D*	**	10		11	
1.3.0	**Rubber Lining for ball Seperator 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. Thickness0hardness 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		
				LEGEND										
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				contractor in QA Documentation.										
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				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	
							Vendor Q.P. NO:		PROJECT:					
		P.O. No.			**Item : WORM GEAR & ACTUATORS**		PACKAGE : COLTCS		CUSTOMER:					
							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**
										M	**C**	**O**	
1	2	3	4	5	6	7	8	9	D*	**	10		11
1.4.0	**Complete Unit of Worm gear**	Reduction Ratio	Critical	Functional Test	100%	Approved Data Sheet	Approved Data Sheet	Manufacturer test certificate	*	P	V	V	
		Angle of Rotation											
		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%	Supplier catalogue	Supplier catalogue / ADS	Inspection Report	_	P	--	--	
		Assembly check alongwith ball valves	Major	Visual	100%								
		Functional check alongwith settings/auxillary contacts	Major	Visual	100%								
		Note: ADS - APPROVED DATA SHEET											
			LEGEND										
			* Records indentified with "STAR" shall be essentially included by contractor in QA Documentation.										
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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	
							Vendor Q.P. NO:		PROJECT:					
		P.O. No.			**Item : Ball Recirculation Skid & Ball Vessel**		PACKAGE : COLTCS		CUSTOMER:					
							Date :		PURCHASER:					
							Page 07 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	D*	**	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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			** 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	
							Vendor Q.P. NO:		PROJECT:					
		P.O. No.			Item : Ball Vessel & Ball Injection Pipe		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		
			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		Contractor	Indicate : "P" - Perform, "W" - Witness and "V" - Verification					Reviewed By		Name & Sign. Of approving authority & Seal				
Signature														

		Manufacturer's Name & Address			STANDARD QUALITY PLAN				BHEL Doc No.:				PE-QP-999-165-N008	
							Vendor Q.P. NO:		PROJECT:					
		P.O. No.			Item : RECIRCULATING PUMP		PACKAGE : COLTCS		CUSTOMER:					
							Date :		PURCHASER:					
							Page 9 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	D*	**	10			11
2.3.0	**Raw material control**													
2.3.1	Casing	Chemical,Physical properties	Major	Chemical & Physical analysis	One Sample/Cast / Heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's Test Certificate	*	P	V	V		
		Surface defects	Minor	Visual	100%	Approved drg/ Data sheet	Approved drg/ Data sheet	MTC / Inspection report	–	P	V	V		
2.3.2	Impeller, Sleeve	Physical,and Chemical properties	Major	Physical and Chemical analysis	One Sample/Cast / Heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's Test Certificate	*	P	V	V		
2.3.3	Shaft	Physical,and Chemical properties	Major	Physical and Chemical analysis	One Sample/Cast / Heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Manufacturer's Test Certificate	*	P	V	V		
		Sub-Surface defects	Major	Ultrasonic Test	100%	ASME SA 745	ASME SA 745	MTC / Inspection report	*	P	V	V	Only for shaft >= 50mm	
2.3.4	**In-process control**													
2.3.5	Casing	Leak tightness	Critical	Hydro,test @ 1.5times design pr. (positive) (Duration 30 minutes)	100%	Manufacturing Standard	No Leakage	Inspection report	*	P	V	V		
2.3.6	Shaft	Surface defects	Critical	Penetrant test	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	*	P	V	V		
2.3.7	Impeller	Residual,static, dynamic unbalance	Major	Static,dynamic balancing	100%	ISO:1940	ISO:1940, Gr 6,3	Inspection report	*	P	V	V		
2.3.8	All components	Workmanship, finish and dimensions	Major	Measurement, visual examination	100%	Manufacturing drawing	Manufacturing drawing	Log book / job card	–	P	--	–		
2.3.9	**Assembly, control, final inspection / test**													
	Performance Test	a) Q Vs. Head, Q Vs. Pumps efficiency / overall efficiency, Q Vs. Power, Vibration and Noise	Critical	Performance test	100%	Approved curve, approved data sheet, IS:5120	Approved data sheet	Inspection report, plotted curves	*	P	V	V		
		b) Dimensions, workmanship and finish	Major	Measurement, visual	100%	Data sheet	Data sheet							
		c) Noise level	Major	–	–	–	85 db at 1 meter distance							
2.3.10	Complete pump	Completeness, correctness, cleanliness	Major	Visual examination	100%	Approved data sheet / Mfg. Drg.	Approved data sheet / Mfg. Drg.	Check list / inspection report	*	P	V	V		
				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		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
	Vendor Q.P. NO:	PROJECT:
P.O. No.	Item : BALL VALVES / PACKAGE : COLTCS	CUSTOMER:
	Date :	PURCHASER:
	Page 10of 15	CONSULTANT:

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record	D*	Agency M	Agency C	Agency O	Remarks
1	2	3	4	5	6	7	8	9	D*	**	10		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	

LEGEND

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Manufacturer / Sub-Contractor	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	
							Vendor Q.P. NO:		PROJECT:					
		P.O. No.			**Item : RECIRCULATING PUMP MOTOR**		PACKAGE : COLTCS		CUSTOMER:					
					V PIECE		Date :		PURCHASER:					
							Page 11 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	
2.5.0	**Motor**	Routine test, No 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 / 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	
							Vendor Q.P. NO:		PROJECT:					
		P.O. No.			**Item : BaIII Monitoring System (Ball Oversize Monitor)**		PACKAGE : COLTCS		CUSTOMER:					
							Date :		PURCHASER:					
							Page 12 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	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

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Signature				

		Manufacturer's Name & Address			**STANDARD QUALITY PLAN**				BHEL Doc No.:				PE-QP-999-165-N008	
							Vendor Q.P. NO:		PROJECT:					
					Item : Pressure Gauge, DP Gauge, DP Switch, DP Transmitter		PACKAGE : COLTCS		CUSTOMER:					
		P.O. No.					Date :		PURCHASER:					
									CONSULTANT:					
					Cleaning Balls									
					All components & Equipments		Page 13 of 15		**PACKAGE : COLTCS**					

Sl. No.	Component / Operation	Characteristics Checked	Class	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Record		Agency M	Agency C	Agency O	Remarks
1	2	3	4	5	6	7	8	9	D*	** 10			11
5.0.0	**In process quality control**	Make, Range and Model	Critical	Visual	100%	Approved Data Sheet	Approved Data Sheet	Manufacturer test certificate	*	P	V	V	
		Calibration	Critical	Calibration test	100%	Approved Data Sheet	Approved Data Sheet	Manufacturer test certificate	*	V	V	V	
		Degree of Protection	Critical	-	Type.Test Certificate	Approved Data Sheet	Approved Data Sheet	Manufacturer test certificate	*	V	V	V	For Pressure guage, DP Guage, DP Switch
6.0.0	**Cleaning Balls**												
	– Normal balls – Abrasive balls	Dimensions	Critical	Measurement	Random	Approved Data	Approved Data Sheet	Manufacturer's test certificate	*	P	V	V	Quantity and type of balls to be checked with datasheets
		Type				Sheet							
		Size											
7.0.0	**All Components / Equipments**	Painting Dry film thickness and visual	Major	Measurement	Random	Painting schedule	Painting schedule	Inspection report	*	P	V	V	
		Packing	Major	Measurement	100%	MFG. Procedure	MFG. Procedure	Inspection report	*	P	V	_	

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Signature			

		Manufacturer's Name & Address			**STANDARD QUALITY PLAN**					BHEL Doc No.:				PE-QP-999-165-N008
					Item : Starter Panel		Vendor Q.P. NO:			PROJECT:				
							PACKAGE : COLTCS			CUSTOMER:				
		P.O. No.					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	--	--	ISI Marked wire	
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**									P	--	--		
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	for enclosure	
08.3.5	IR - HV - IR	Electrical	Critical	Electrical	100%	Approved Procedure	Approved Pocedure	Inspection report	_	P	V	V		
08.3.6	Functional & Continuity	Functional	Major	Functional	100%	Appd Drawing	Appd Drawing	Inspection report	*	P	W	W		

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Manufacturer / Sub-Contractor	Contractor
Signature	

Name & Sign. Of approving authority & Seal

BHEL	Manufacturer's Name & Address	STANDARD QUALITY PLAN	BHEL Doc No.: PE-QP-999-165-N008
		Vendor Q.P. NO:	PROJECT:
	P.O. No.	Item : FASTENERS / 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 M	Agency C	Agency O	Remarks
1	2	3	4	5	6	7	8	9	D*	**	10		11
9.1.0	**Internal Fasteners (Duplex Steel)**	Chemical & Physical properties	Major	Chemical & Mechanical analysis	1 Per heat/HT Batch	Approved drg/Data sheet	Approved drg/Data sheet	Mfr TC / Lab report	*	P	V	V	
		Visual & workmanship finish	Major	Visual	Sample	Approved drg/Data sheet	Approved drg/Data sheet		_	P	V	V	
		Dimensions	Major	Measurement	Sample	Approved drg/Data sheet	Approved drg/Data sheet		_	P	V	V	
9.2.0	**Main Fasterners**	Visual	Major	Visual	Sample	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report / Mfr TC	*	P	V	V	
		Dimensions	Major	Measurement	Sample	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report / Mfr TC	*	P	V	V	
		Chemical & Physical properties	--	Chemical & Physical test a) Tensile b) Yield c) Elongation d) Proof load	1 sample per heat	Approved drg/Data sheet	Approved drg/Data sheet	Mfr TC/Lab report	*	P	V	V	

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Manufacturer / Sub-Contractor	Contractor	Reviewed By	Name & Sign. Of approving authority & Seal
Signature			

SUB-SECTION - IIB

STANDARD TECHNICAL SPECIFICATION (ELECTRICAL)

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

1.0 INTENT OF SPECIFIATION

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 machnines
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.

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 mimimum 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: 4691and 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.

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.

4.9 **General**

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	**VOLUME II B**
	DATA SHEET - C	**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			

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 ≥ 55KW)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

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

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

BHEL	PARTICULARS	BIDDER/VENDOR	
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	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			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 P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2	
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. .	MANUFR'S DRG.	-DO-	3	-	2	FOR MV MOTOR INSULA-TION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2	

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

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	QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
		BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 5 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			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-	RELEVENT SPEC./ ASTM-E165	MANUFR'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
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	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 6 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	FOR MV MOTOR
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	THREE DIPS TO BE GIVEN

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
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	QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
		BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 7 OF 9	SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	VERIFICATION FOR MV MOTOR ONLY
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1	

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

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11

NOTES:

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

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

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

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

Legends for Inspection agency

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

P. PERFORM
W. WITNESS
V. VERIFY

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

	QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE			
	SHEET 1 OF 2		SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3

BHEL	**PARTICULARS**	**BIDDER/VENDOR**
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	SIGNATURE	

	QUALITY PLAN	CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :			
		BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION : TITLE :			
	SHEET 2 OF 2	SYSTEM		ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10	10	10	11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	

NOTES:

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

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

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

Legends for Inspection agency

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

P. PERFORM
W. WITNESS
V. VERIFY

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

SUB-SECTION - IIC

STANDARD TECHNICAL SPECIFICATION (C &I)

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 verifid 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 :

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. When material corelation are not available manufacturer's compliance to be provided.
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 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			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		V	V	V	
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
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 :

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. When material corelation is not available, MFR's compliance to be provided
5. 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 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			P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR	ONE / LOT		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 :

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.

PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	1 OF 7

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

LEGEND:
* CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.
1 - BHEL; 2 - Vendor; 3 - Sub-vendor

PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	2 OF 7

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

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PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	3 OF 7

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

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PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
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SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	4 OF 7

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $			Remarks
									P	W	V	
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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PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.:	**PE-QP-999-145-I056**
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 22-02-2008
SHEET	5 OF 7

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

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PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

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

Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency $ P	Agency $ W	Agency $ V	Remarks
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	
		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	

At Random by BHEL, based on 100 % internal test reports by Mfr.

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PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

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

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

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SECTION III

DOCUMENTS TO BE SUBMITTED BY BIDDER

	TITLE : SCHEDULE OF PERFORMANCE GUARANTEES FOR CONDENSER ON LOAD TUBE CLEANING SYSTEM (COLTCS)	SPEC. NO. PE-TS- 408-165-N002
		VOLUME : III
		Sheet 1 of 1 Date- 14.06.2016

S.NO.	DESCRIPTION	UNITS	PROJECT NAME
1.	Pressure drop across the ball collecting Strainers (i.e. between inlet & outlet nozzle) under clean condition and Normal flow condition	MWC	
2	Percentage of ball recovery	%	
3	Life of sponge rubber balls	Weeks	

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

	TITLE : COMPLIANCE CERTIFICATE FOR COLTCS	SPEC. NO.	PE-TS- 408-165-N002
		DATE:	14.06.2016
	PROJECT: 1 x 800 MW WANAKBORI	SHEET	1 OF 2

COMPLIANCE CERTIFICATE

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

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

b) There are no other deviations w.r.t. specification other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'

c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ Customer/Customer's Consultant approval and customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. Charges for 3rd party inspection (TUV/ equivalent) for imported components wherever required shall be included by bidder in the base price itself.

d) Any drawing/ document/ data-sheet/ calculation/ Quality plan/ Instrumentation etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ Customer/Customer's Consultant approval in the event of order.

e) The offered materials shall be either equivalent or superior to those specified in the specification. For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

f) The commissioning spares including balls shall be supplied on 'As Required Basis' and to be supplied at the time of commissioning of COLTCS system & prices for same included in the base price itself.
Prices for special tools & tackles, if any, shall also be included in the base price.
Recommended spares for 3 years shall be quoted separately with price indicated separately.

g) Charges for Installation Checks, Commissioning of equipments, Trial runs and Performance Testing at site shall be included by bidder as per the price format.

h) The main flanges for Ball separator shall be suitable for the forces and moments as per the specification.

j) Injection nozzles – 2/4 numbers of stubs of 100 NB or size as informed by bidder shall be provided by BHEL. The injection nozzles, counter flanges for the stubs along with nuts, bolts and gaskets shall be supplied by the bidder.

k) Number of balls (Normal as well as abrasive) for COLTCS shall be as specified i.e Number of balls per charge shall be @ 10% of no. of tubes per condenser section.

l) The hydrostatic test pressure shall be 1.5 times the design pressure.

m) All sub - vendors shall be subject to BHEL/ Customer/Customer's Consultant approval in the event of order.

n) The Performance guarantees of equipments shall stand valid till the satisfactory completion of performance testing & its acceptance by BHEL/ Customer/Customer's Consultant.

o) The orientation of piping around COLTCS shall be finalised during detailed Engg.

p) Electrical/ C&I :

- All selected motor ratings have minimum 15 % margin over maximum continuous demand of the driven equipment including voltage and frequency variations, temperature rise and other factors.
- Supply of electrical viz. LT power cables, instrumentation and control cables, cable glands, lugs, cable trays etc. shall be as per specification. Their erection shall be done by BHEL
- The junction boxes for termination of DPT/ DPS/ Actuator LS/ solenoid valves/ Ball oversize monitor/ Ball recirculating monitor are included in bidders scope. The instrumentation cable and cabling from instruments/ actuators to junction boxes is also included in bidders scope.
- Valve actuators and controls shall be provided as specified in Data Sheet-A and Project specific requirements as specified in Section C-2 & Section C-3
- Alarms/ annunciations/ instruments shall be finalised during detailed engineering in the event of order which shall be subject to BHEL/ Customer/Customer's Consultant approval and shall be without any commercial implications to BHEL.

BHEL	Title: DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)	SPECIFICATION NO: PE-TS-999-165-N001 VOLUME III PART A SHEET 1 OF 13

INSTRUCTION TO BIDDER
1. This data sheet shall be read in conjunction with Specification No PES-179-01 Section - D, Volume - IIB.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
1.0	General :		
1.1	Number of Tube Cleaning System sets being supplied.	Nos.	
1.2	Type		
1.3	Liquid handled		
1.4	Manufacturer		
1.5	Country of origin		
2.0	Design :		
2.1	Design Pressure	Bar (g)	
	a) Ball Separator		
	b) Ball Recirculating Pump		
	c) Ball Collector		
	d) Piping		
	e) Valves		
	f) Distributors		
	g) Injection Nozzles		
2.2	DesignTemperature	°C	
2.3	Operating pressure at condenser inlet	Bar (g)	
2.4	Design differential pressure	Bar (g)	
2.5	Flow rate through ball seperator	M^3/hr	
	a) Normal		
	b) Maximum allowable		
2.6	Flow rate through ball collector	M^3/hr	
	a) Normal b) Maximum allowable		

Name of Bidder/ Vendor					
Revision Number	0	1	2	3	4
Signature of Bidder/ Vendor Authorised Representative					
Date					

BHEL	Title: DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)	SPECIFICATION NO: PE-TS-999-165-N001 VOLUME III PART A SHEET 2 OF 13

INSTRUCTION TO BIDDER
1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
3.0	Guaranteed Performance		
3.1	Whether condenser back pressure/ overall heat transfer coefficient is guaranteed that it will be permanently maintained as long as the tube cleaning system is in operation.		YES/NO
3.2	Pressure drop across the ball separator (i.e. between inlet and outlet connections).		
	a) Normal flow condition		
	b) Maximum allowable flow condition		
3.3	Power consumption by ball recirculating pump during :	KW	
	a) Normal operation b) Ball collection operation c) Ball sorting operation		
3.4	Quantity of cleaning balls required per set for an operating period of one year	Nos.	
4.0	Operation :		
	Whether tube cleaning system is designed for the following operation modes :		
4.1	Automatic start-up initiated by push button.		YES/NO
4.2	Automatic shut-down with ball collection effected by :		
	a) Push button		YES/NO
	b) Adjustable timer		YES/NO
	Ball monitoring system		YES/NO

Name of Bidder/ Vendor					
Revision Number	0	1	2	3	4
Signature of Bidder/ Vendor Authorised Representative					
Date					

BHEL	Title: DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)	SPECIFICATION NO. PE-TS-999-165-N001 VOLUME III PART A SHEET 3 OF 13

INSTRUCTION TO BIDDER
1 This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.
2 Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
4.3	Automatic backwashing of ball separator with ball collection effected by :		
	a) Differential pressure measuring system		YES/ NO
	b) Adjustable timer		YES/ NO
	c) Push button		YES/ NO
4.4	Automatic emergency backwashing of ball separator effected by differential pressure measuring system.		YES/ NO
4.5	Automatic flushing of differential pressure measuring system.		YES/NO
4.6	Automatic ball sorting initiated by push button.		YES/NO
4.7	Whether provision for manual operation of the complete tube cleanaing system is made in case of control system failure.		YES/NO
5.0	**Ball Separator :**		
5.1	Make		
5.2	Nos. provided per set	Nos.	
5.3	Code/ Standard		
5.4	Body outer diameter	mm	
5.5	Body thickness	mm	
5.6	Manhole type & size	mm	
5.7	Whether sight glass is provided		
5.8	No. of screens/ strainers provided per each ball separator	Nos.	
5.9	Type of arrangement provided to prevent lodging of the debris at the entrance of ball extraction pipes.		

Name of Bidder/ Vendor					
Revision Number	0	1	2	3	4
Signature of Bidder/ Vendor Authorised Representative					
Date					

BHEL	Title: DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)	SPECIFICATION NO PE-TS-999-165-N001 VOLUME III PART A SHEET 4 OF 13

INSTRUCTION TO BIDDER
1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
5.10	Clearance between screen/ strainer bars.		mm
5.11	Materials :		
	a) Body/ Housing		
	b) screen/ Strainer section		
	c) Screen/ Strainer shaft		
	d) Hardware for fixing the screen/ Strainer		
	e) Other internal hardware		
	f) External hardware		
5.12.	Lining material (if applicable)		
6.0	**Ball Recirculating Pump :**		
6.1	Make		
6.2	Nos. provided per set		Nos.
6.2	Design discharge flow		M^3/hr
6.4	Design discharge pressure		Bar
6.5	Design pump Speed		RPM
6.6	Design pump efficiency		%
6.7	Seal for the pump		
6.8	Materails :		
	a) Casing		
	b) Impeller		
	c) Shaft		
7.0	**Ball Collector :**		
7.1	Nos. provided per set		Nos.

Name of Bidder/ Vendor					
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Signature of Bidder/ Vendor Authorised Representative					

BHEL	Title: DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)	SPECIFICATION NO. PE-TS-999-165-N001 VOLUME III PART A SHEET 5 OF 13

INSTRUCTION TO BIDDER
1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
7.2	Code/ Standard		
7.3	Whether inspection window/ sight glass is provided.		YES/ NO
7.4	Materials :		
	a) Shell/ Body		
	b) Internals		
7.5	Lining material (if applicable)		
7.6	Whether provision for separating and collecting the undersized balls, is made		YES/ NO.
8.0	**Differential Pressure Measuring System:**		
8.1	Differential Pressure Switch/ Transmitter		
	a) Type		
	b) Make and Model		
	c) Range		
	d) Accuracy		
	e) Material of sensing element		
	f) No. of contacts	Nos.	
	g) Contact rating		
	h) Enclosure		
	i) Mounting		
8.2	Whether differential Pressure gauge is provided for manual observation.		
8.3	Diffrential Pressure Gauge :		
	a) Type		
	b) Make and Model		
	c) Range		

Name of Bidder/ Vendor					
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Signature of Bidder/ Vendor Authorised Representative					

BHEL	Title: DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)	SPECIFICATION NO: PE-TS-999-165-N001 VOLUME III PART A SHEET 6 OF 13

INSTRUCTION TO BIDDER
1. This data sheet shall be read in conjunction with Specification No PES-179-01 Section - D, Volume - IIB.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
	d) Accuracy		
	e) Material of sensing element		
	f) No. of contacts	Nos.	
	g) Dial size	mm	
	h) Enclosure		
	i) Mounting		
8.4	Whether the contacts for differential pressure gauge and switch/ transmitter are independent.		YES/ NO
9.0	**Timer for Backwashing**		
9.1	Timer make		
9.2	Range of duration setting		
9.3	Range of frequency		
10.0	Ball Monitoring System		
10.1	Type		
10.2	Maake & Model		
10.3	Whether ball monitoring system is designed to perform the following functions :		
	a) Continuously counting the balls in circulation and giving an alarm calling for investigation of ball losses, when the number of circulating balls falls below a set value		YES/ NO
	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 value.		

Name of Bidder/ Vendor					
Revision Number	0	1	2	3	4
Signature of Bidder/ Vendor Authorised Representative					
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BHEL	Title: DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)	SPECIFICATION NO: PE-TS-999-165-N001 VOLUME III PART A SHEET 7 OF 13

INSTRUCTION TO BIDDER
1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
10.4	Whether electronic processor of the ball monitoring system is provided with the following		
	a) Indicators for		
	• Required basic ball charge		YES/ NO
	• Recirculating Ball quantity		YES/ NO
	• Oversized ball quantity		YES/ NO
	b) Time counters for		
	• Total cleaning system operating hours		YES/ NO.
	• Cleaning system operating hours with sufficient number of oversized balls		YES/NO
	c) Recorder for ball consumption		YES/NO
10.5	Whether provision for Self-testing and Self Calibration are made		YES/NO
11.0	**Cleaning Balls :**		
11.1	Type		
11.2	Size	mm	
11.3	Specific gravity		
11.4	Material		
11.5	Hardness		
11.6	Total Ball recirculation quantity per set	Nos.	
11.7	abrassive coated ball recirculation quantity per set - (if any)	No.s	
12.0	**Piping :**		
12.1	Ball Extraction Piping		

Name of Bidder/ Vendor					
Revision Number	0	1	2	3	4
Signature of Bidder/ Vendor Authorised Representative					

BHEL	Title: DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)	SPECIFICATION NO. PE-TS-993-165-N001 VOLUME III PART A SHEET 8 OF 13

INSTRUCTION TO BIDDER
1 This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.
2 Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
	a) OD x thicknes	mm x mm	
	b) Material		
	c) Length of piping being supplied	M	
12.2	Ball Transport Piping		
	a) OD x thicknes	mm x mm	
	b) Material		
	c) Length of piping being supplied	M	
12.3	Differential pressure measuring system flushing piping		
	a) OD x thicknes	mm x mm	
	b) Material		
	c) Length of piping being supplied	M	
12.4	Any other		
13.0	**Valves (Indicate Type of Valves)**		
13.1	Sizes	: mm	
13.2	Nos. provided per set	Nos.	
13.3	Materials		
	a) Body		
	b) Disc/ Trim		
	c) Shaft		
.0	**Distributors**		
.1	Nos. provided per set	Nos.	
.2	Materials :		
	a) Body		
	b) Sight glass		
	c) Sight glass flanges		
	d) Internal parts		

Name of Bidder/ Vendor

Revision Number	0	1	2	3	4
Signature of Bidder/ Vendor Authorised Representative					
Date :					

BHEL	Title: DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)	SPECIFICATION NO. PE-TS-999-165-N001 VOLUME III PART A SHEET 9 OF 13

INSTRUCTION TO BIDDER
1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
14.3	Lining material (if applicable)		
15.0	Injection Nozzles :		
15.1	Nos provided per each CW inlet pipe	Nos.	
15.2	Size of the stubs to be provided in CW inlet pipe for installing the injection nozzles.	mm	
15.3	Material		
15.4	Lining material (if applicable)		
16.0	Actuators :		
16.1	Actuators for ball separator :		
	a) Nos. provided per ball separator	No.s	
	b) Type & make		
	c) Motor rating	KW	
16.2	Actuators for ball collector		
	a) Nos. provided per ball collector.	No.s	
	b) Type & make		
	c) Motor rating	KW	
16.3	Actuators for Valves:		
	a) Nos. provided per set	No.s	
	b) Type & motor		
	c) Motor rating	KW	
16.4	Any other		

Name of Bidder/ Vendor					
Revision Number	0	1	2	3	
Signature of Bidder/ Vendor Authorised Representative					
Date :					

BHEL	Title: DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)	SPECIFICATION NO. PE-TS-999-165-N001 VOLUME III PART A SHEET 10 OF 13

INSTRUCTION TO BIDDER
1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
17.0	Electric Drive Motors		
17.1	Drive motor for recirculating pump :		
	a) Type and make		
	b) Rating	KW	
17.2	Drive motor for differential pressure measuring system flushing pump (if applicable)		
	a) Type and make		
	b) Rating	KW	
17.3	Any other.		
18.0	Control Panel		
18.1	Type		
18.2	Model & Manufacturer		
18.3	Operating Voltage/ frequency	V/ Hz	
18.4	Control Voltage/ frequency	V/ Hz	
18.5	Materials of housing and door		
18.6	Protections/ interlocks provided for :		
18.7	Class of Protection		
18.8	Control Hardware		
18.8	Alarms/ Annunciations provided for :		
18.9	Indicators provided for :		
18.10	Whether interconnecting control and power cabling between the control panel and various drive is included in the offer.		
19.0	Pressure gauges :		
19.1	Manufacturer & Type, Model		

Name of Bidder/ Vendor					
Revision Number	0	1	2	3	4
Signature of Bidder/ Vendor Authorised Representative					
Date					

	Title	SPECIFICATION NO.
BHEL	DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)	PE-TS-999-165-N001
		VOLUME III PART A
		SHEET 11 OF 13

INSTRUCTION TO BIDDER
1 This data sheet shall be read in conjunction with Specification No. PES-179-01 / Section - D, Volume - IIB.
2 Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
19.2	Nos. provided per set	Nos.	
19.3	Location		
19.4	Dial size	mm	
19.5	Range & Accuracy		
19.6	Materials of construction :		
	a) Sensing element b) Movement c) Casing		
19.7	Enclosure		
19.8	Mounting		
20.0	Counter Flanges :		
20.1	Whether counter flanges complete with gaskets, bolts and nuts etc. for all terminal points are included in the offer.		YES/ NO
20.2	Type		
20.3	Rating		
20.4	Materials		
	a) Flanges b) Bolts and Nuts c) Gaskets		
20.5	Code/ Standard		
21.0	Whether lifting arrangement is provided for various equipments.		YES/ NO.
22.0	Whether ball recirculating pump, ball collector with interconnecting piping and valves are mounted on a single frame.		YES/ NO
23.0	Whether supports (wherever necessary) complete with foundation plates, bolts, nuts, inserts etc. are included in the offer.		YES/ NO

Name of Bidder/ Vendor

Revision Number	0	1	2	3	
Signature of Bidder/ Vendor Authorised Representative					
Date :					

	Title	SPECIFICATION NO.
BHEL	DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)	PE-TS-999-165-N001 VOLUME III PART A SHEET 12 OF 13

INSTRUCTION TO BIDDER
1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.
2. Items which deviate from Specification shall be marked with an asterisk (*).

SL.NO. PARTICULARS	ITEM		UNIT
24.0	**Shop Inspection and Tests**		
24.1	Whether all the tests and inspections as detailed in the specification/ quality plan are carried out.		YES/ NO
24.2	Hydrostatic Test :		
	a) Test Pressure	Bar (g)	
	• Ball Separator • Recirculating Pump • Ball Collector • Distributors • Injection nozzles • Piping & Valves		
	a) Test duration	Minutes	
24.3	Lekage Test :		
	a) Test Pressure b) Test duration	Bar (g) Minutes	
25.0	**Painting :**		
25.1	External Surfaces :		
	a) Surface Preparation b) Primer a) Finish		
25.2	Internal Surfaces :		
	a) Surface Preparation b) Primer a) Finish		
26.0	**Weights :**		
26.1	Empty Weight	Kg.	
	a) Ball Separator		

Name of Bidder/ Vendor					
Revision Number	0	1	2	3	4
Signature of Bidder/ Vendor Authorised Representative					
Date					

	Title	SPECIFICATION NO.
BHEL	DATA SHEET - B CONDENSER ON LOAD TUBE CLEANING SYSTEM (SPONGE RUBBER BALL TYPE)	PE-TS-999-165-N001 VOLUME III PART A SHEET 13 OF 13

INSTRUCTION TO BIDDER
1. This data sheet shall be read in conjunction with Specification No. PES-179-01 Section - D, Volume - IIB.
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO. PARTICULARS	ITEM		UNIT
	b) Recirculating pump c) Ball collector d) recirculating unit		
26.2	Operating weight a) Ball Separator b) Recirculating pump c) Ball collector d) recirculating unit	kg	
26.3	Weight of the heaviest equipment/ assembly to be handled.	kg.	
27.0	**Overall Dimensions**		
27.1	Ball Separator		
27.2	Recirculating Unit		
28.0	Other information (if any)		

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Name of Bidder/ Vendor					
Revision Number	0	1	2	3	4
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