MAHAGENCO

1 X 660 MW BHUSAWAL

TECHNICAL SPECIFICATION

FOR DEBRIS FILTER (DF)

Specification No. : PE-TS- 415-165-N003 (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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THIS TECHNICAL SPECIFICATION CONSISTS OF FOLLOWING SECTIONS:

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Note : In case there is conflict in different clauses of specification, most stringent clause (as decided by BHEL / end customer) shall be followed, if no specific deviation is taken by bidder and accepted by BHEL during tender stage in that regard.

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SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

1.0 GENERAL

1.1 This enquiry covers the design, manufacture, assembly, inspection and testing at manufacturer's and / or his sub-contractors works, proper packing for delivery installation checks, commissioning, Trail run and PG test for DEBRIS FILTER (DF) with mandatory spares complete with all accessories as per the requirements specified in this specification.

The DEBRIS FILTER (DF) 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 (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 (as applicable) / Section-II/ Data Sheet-A, the same shall prevail in the order as: customer specification (as applicable), Section-I, Datasheet-A, Section-II. In case of any contradiction with other clauses of Section-IA, the stringent most requirement is to be complied.
The decision of BHEL shall be final in case of any discrepancy.

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.

1.2 The omission/ addition of specific reference to any component / accessory necessary for the proper performance of the equipment's shall not relieve the supplier of the responsibility of providing such facilities to complete the supply within the quoted prices.

1.3 The bids shall be evaluated as per NIT.

1.4 Bidder to quote for items as per price schedule attached in NIT.

2.0 DESCRIPTION OF EQUIPMENTS:

2.1 Debris Filter (DF):

The debris filter (DF) is intended to prevent accumulation of debris in CW Pipe before entering into the condenser. 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 DEBRIS FILTER.

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

3.2 SCOPE OF SUPPLY IN THE BIDDER'S SCOPE FOR DEBRIS FILTER:

3.2.1 Each set of Debris Filter shall comprise as following:

a) Flushing pump with drive Motor (if required) - 1 No.

b) 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.
Equipments & valves along with its Flanges/ Counter Flanges/ Gaskets/ Nuts & Bolts shall be in Bidder's Scope.

c) Filter body/ housing Vent and drain connections along with their isolating valves.

d) Maximum Length of Debris Filter, complete with scope of bolts, nuts and gaskets shall be as per Datasheet-A. Thickness of body flange shall be as per Drg no PE-DG-999-141-MO17 enclosed at enclosures at Annexure-iv of Datasheet-A.:

e) Differential pressure measuring system for debris filter. DP measuring system shall comprise of 2 Nos. DPT + 1 No. DPG for each DF and shall be with Remote seal arrangement. Stubs for DPT and DPG shall be independent.

f) The Electrical & C&I items/ accessories as specified in succeeding clause/ respective sections herein.

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

h) Local Control cum Starter Panel (Switch Gear Panel) shall be as follows:

(i) Each set of Debris Filter shall be supplied with its own local control cum starter panel (Switch Gear Panel) and its MIMIC and annunciator for its operation. Extent of MIMICs and annunciators shall be decided during detailed engg.

For 2 Debris Filters, BHEL shall provide 1 Working and 1 standby feeders, i.e. 1 Working and 1 standby feeders for two Debris Filters. Each Switch Gear Panel should have suitable arrangement like Bus Coupler for providing redundancy to incoming supply feeder (1Working + 1 Standby feeder).

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

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

k) Set of commissioning spares, on "As required basis".

l) Set of mandatory spares as indicated in Data Sheet A.

m) 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

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

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

p) 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.

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

Any item not specified but required to make DF 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 Debris Filter:

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

The trial run & PG Test of equipment shall be generally conducted immediately after commissioning. 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 Cl. No. 10.0.

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

- **Site Visits for installation check / commissioning/ trail run/PG Test:**

  Bidder to include cost of one site visit for four days for installation check, commissioning, trial run and PG testing for unit i.e 2 nos of DF .

  In case of non-completion of above activities in site visits stipulated above, for any reasons not attributable to vendor, vendor shall complete above activities in subsequent site visits for which cost shall be borne by BHEL on pro-rata basis on price of site visit quoted by bidder in price schedule.

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 The typical flow diagram applicable for the project specified herein for Debris Filter is enclosed (Annexure-II of Datasheet-A) with scope demarcation for bidder's compliance.

6.2 Location of Debris Filter shall be Approx. 15M Outside TG Hall 'A' Row in Transformer Yard. Final Layout drawing shall be provided during Detailed Engineering.

6.3 Thickness of body flange and counter flange of Debris Filter shall be as per Drg no PE-DG-999-141-MO17 enclosed at enclosures at Annexure IV of Datasheet-A.

6.4 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.

6.5 Housing/ body of Debris Filter 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 Debris Filter.

6.6 Provision to be given for Cathodic Protection.

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 for Debris Filters.

Performance Guarantee Parameters shall be as under:

- Max. Pressure drop in Debris Filter in clean condition (Test to be conducted along with commissioning) – not exceeding value as per S.No. 3.1 (a) of Datasheet A (Sub-Section ID). The Bids shall be technically rejected for pressure drop quoted higher than the indicated value in the referred Clause.

Any deviation to above pressure drop will not be accepted.

In case the successful bidder fails to demonstrate above parameter, he shall carry out modifications at his own cost, to purchaser's approval.
In case bidder fails to demonstrate above parameter to purchaser's satisfaction even after modification carried by him at site, the purchaser has the right to reject the equipment out rightly and bidder is liable to resupply the equipment meeting the contractual performance parameters within time period mutually agreed upon without any cost implication to BHEL/Customer.

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 and Drg./Doc. submission schedule shall be as per NIT.

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

- Technical Data Sheets, P&ID, Installation Plan.
- GA drawings, Details of Flushing Skid (if any) and C& I Document (Part-I & II) of DF as applicable.
- Quality Plan.
- O & M Manual.

c. Drawings submission schedule after the award of contract shall be as below:

BHEL DRG NO	DRG TITLE
PE-V3-415-165-N001	P&ID - OF DF SYSTEM
PE-V3-415-165-N002	TECHNICAL DATA SHEET-DF
PE-V3- 415-165-N003	INSTALLATION PLAN- DF
PE-V3- 415-165-N004	GENERAL ARRANGEMENT OF DF
PE-V3- 415-165-N006	C&I Part-I, PANEL-TDS, I/O LIST, CABLE SCH & CONTROL PHILOSOPHY
PE-V3- 415-165-N008	QP-DF
PE-V3- 415-165-N005	GA & FOUNDATION OF FLUSHING PUMP AND SADDLE SUPPORT (If Applicable)
PE-V3- 415-165-N007	GA & WIRING DIAGRAM OF PANEL-DF
PE-V3- 415-165-N009	O&M MANUAL-DF

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

11.0 The makes of various bought out items shall be subjected to purchaser's (BHEL & Customer) approval in the event of order.

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 Section III).
- Guarantee schedule duly signed and stamped (Enclosed at Section III).

- GA drawings of following with empty/ filled-ups.
  - Debris Filter body/ housing (as applicable).
  - Flushing Skid (if any).
  - Other equipment considered necessary for Layout/ Civil.

- Electrical Load Data.
- Schedule of Deviation.

The bidder to note that load requirement furnished and finalized 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 **<u>Debris Filter packing procedure before dispatch</u>**

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 **<u>Preparation for Packing:</u>**

- After hydro testing, operation, all fluids e.g. water etc., shall be completely drained

from all DF'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 DF 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:

- DF Shell shall be packed in properly in high grade bubble plastic wrap for transportation, and long storage at site.
- Actuators shall be packed in separate wooden box of proper sizes.
- DF items (EXCEPT DF Shell) 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 Debris Filter shall be closed properly by suitably covering to prevent foreign material entering in Debris Filter.
- 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 Debris Filter Shell, Screen, pumps (if any), piping, valves, instruments, actuators, panel (inside & outside) and sent to engineering deptt along with all inspection reports before final dispatch.

15.0 Following to be complied by the bidder:

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a. Supplier to submit detailed 'Bill of Material' (BoM) at the time of drawing/ document submission after placement of PO. Each item of the BoM to be uniquely identified with item code no. or item serial no.

.

b. Supplier to ensure that all items which will find separate mention in the packing list are covered in this detailed BoM.

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c. Supplier to give following undertaking in the BoM"

"The BoM provided herewith completes the scope (in content and intent) of material supply under PO no.----------, dated ----------.

Any additional material which may become necessary for the intended application of the supplied items(s)/package will be supplied free of cost in most reasonable time."

1.0 SCOPE OF WORK

The scope of supply under On Line Condenser Tube Cleaning System for Condenser 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.

1.1 Condenser On Line Tube Cleaning Systems shall include but not be limited to the following:

1.1.1 One (1) Ball separator on the C.W. outlet pipes. The Ball separator shall consist of Carbon Steel flanged shell, ball separator screens, ball extraction arrangement, drive unit for actuation of screens, differential pressure measuring system etc.

1.1.2 One (1) ball re-circulation unit complete with pumps, drive motors, ball collectors, etc.

1.1.3 One (1) Ball Re-circulation Monitor and ball injection arrangement with nozzles.

1.1.4 One (1) Debris Filter in the C.W. inlet lines. Debris Filter shall consist of Carbon Steel flanged shell, filter screen, debris flushing and extraction assembly, drive units for operation of debris flushing assembly, differential pressure measuring system etc.

1.1.5 One (1) set of debris flushing and discharge system complete with flushing pumps, drive motors, debris discharge butterfly valves with electric actuators, etc.

1.1.6 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,~~ Debris Filter to debris discharge point on the C.W. outlet pipes at down stream of ball separator, all integral piping for debris flushing system and ~~ball re-circulating skid~~, drain line, vent line, drain collectors (floor level), sample points with suitable valves etc.

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

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

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

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

(a) ~~One (1) local control panel for each 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.

(b) One (1) local control panel for each debris filtration unit with installed local instrumentation, controls, and alarms, completely wired. The control panel shall be provided with segregated power compartment. This local control panel shall be supplied with anti vibrations supports.

(c) 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.

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

(e) Instrumentation and control cables along with accessories as necessary.

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

2.0 CODES AND STANDARDS

The design, material, construction, manufacture, inspection, testing and performance of ~~Condenser On Line Tube Cleaning System and~~ Debris Filter for Auxiliary 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 govern. 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 Datasheet-A. 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.

2.1 GENERAL DESCRIPTION

For maintaining degree of cleanliness of the condenser tubes, this on load ball re-circulation type tube cleaning system and debris filters 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.

3.0 DESIGN AND MANUFACTURING / CONSTRUCTION REQUIREMENT

3.1 DESIGN CONSIDERATIONS

The On Line Condenser Tube Cleaning System shall overcome fouling, scaling and clogging of tubes 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. Wherever feasible, common components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

3.2 GENERAL PERFORMANCE REQUIREMENT

3.2.1 Performance requirements of the Tube Cleaning System and Debris Filter covered by this specification are as follows :

(a) 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.

(b) The pressure drop across the ball separator screens and debris filter screens during normal cleaning operation shall be minimum (it should not be more than 30 millibar).

(c) 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.

(d) The On Line 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 and 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.

(e) 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.

(f) Bidder shall prove the guaranteed performance figures 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.

(g) The Owner will do the 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.

(h) 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

~~CONDENSER ON LINE TUBE CLEANING SYSTEM AND~~ DEBRIS FILTER

DATASHEET – A

SR. NO.	ITEM	UNITS	
1.0	CONDENSER DATA		
1.1	Number of condensers		As per TG manufacturer's system design/configuration
2.0	MATERIAL OF CONSTRUCTION		
2.1	BALL SEPARATOR SECTION		
(a)	Separator shell flanges		Carbon Steel
(b)	Separator shell		Carbon Steel
(c)	Internals		SS 316
(d)	Bolts & nuts in contact with circulating water		SS 316
2.2	BALL RECIRCULATION PUMPS & DEBRIS FLUSHING PUMPS		
(a)	Casing/ impeller		CI / SA 351 CF8M
(b)	Shaft		SS 316
2.3	BALL COLLECTOR		
(a)	Housing		Stainless Steel
(b)	Internals		SS-316
2.4	DEBRIS FILTER		
(a)	Debris Filter shell		Carbon Steel

SR. NO.	ITEM	UNITS	
(b)	Debris Filter shell flanges		Carbon Steel
(c)	Screen basket		SS 316
(d)	Bolts & nuts in contact with circulating water		SS 316
2.5	BALL VALVES		
(a)	Body		SA 351 CF8M
(b)	Ball		SA 351 CF8M
(c)	Stem		SS 316
2.6	INTERCONNECTING PIPING		
(a)	Interconnecting piping & fittings between Debris Filter to debris discharge point on the C.W. outlet pipes		Carbon Steel
(b)	Interconnecting piping and fittings between ball separator section to ball re-circulating skid André-circulating skid to injection point		SS 316
2.7	DETAILS OF CLEANING BALLS FOR COMMISSIONING OF THE SYSTEM (NORMAL SPONGE BALLS & ABRASIVE BALLS)		
(a)	Type		Spherical
(b)	Number of balls per charge per system		Bidder to decide

SUB-SECTION – IB

SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER

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 same shall be provided by the bidder without any extra charge.
c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
d) Electrical load requirement for DEBRIS FILTER (DF).
e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
f) 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
g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
h) Motor shall meet minimum requirement of motor specification.
i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
j) Cable BOQ worked out based on routing of cable listing provided by the vendor for "both end equipment in vendor's scope" shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.
k) Technical requirements shall be as per specifications listed in Clause 4.1, 4.2, 4.3, 4.4 ,4.5, 4.6, 4.7 & 4.8 below.

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 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.

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 between BHEL & vendor (Annexure-A).
4.2 Technical specification for Motors DG/BSL U-6/2011/T-1
4.3 Data Sheet- A along with Annexure-I.
4.4 Conduits and pipes specification & constructional details of cables.
4.5 Load data format (Annexure-B).
4.6 BHEL cable listing format (Annexure –II)
4.7 Explanatory notes for cable routing
4.8 Quality Plan

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES: DEBRIS FILTER (DF)

SCOPE OF VENDOR: SUPPLY

PROJECT: 1X660MW BHUSAVAL THERMAL POWER STATION, UNIT-6

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 (FOR EPC PROJECTS)

PACKAGES: DEBRIS FILTER (DF)

SCOPE OF VENDOR: SUPPLY

PROJECT: 1X660MW BHUSAVAL THERMAL POWER STATION, UNIT-6

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.

1.0 SCOPE

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

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

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

2.0 STANDARDS

2.1 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.

2.2 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

(a) IS-325

(b) IS-12615

(c) IEC-34

3.0 SERVICE CONDITIONS

3.1 The motors will be installed in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash canopy to be provided to all outdoor install motors.

3.2 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.

3.3 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

4.0 TYPE AND RATING

4.1 A.C. MOTORS

4.1.1 Motors shall be general purpose, constant speed, squirrel cage, three phase, induction type.

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

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

4.1.4 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.

4.1.5 All LT motors used in this project are proposed to be energy efficient type suitable for EFF1 efficiency rating.

4.1.6 The motor name plate rating shall have at least 10% margin over the input power requirement of the HT driven equipment and 15% for LT driven equipments at rated duty point.

4.1.7 Motors located in hazardous area shall be flame proof type.

4.2 D.C. MOTORS

4.2.1 D.C. Motor provided for emergency service shall be shunt/compound wound type.

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

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

4.3 For equipment installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in determining the design ambient temperature.

5.0 PERFORMANCE

5.1 RUNNING REQUIREMENTS

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

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

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

5.1.4 Motor shall not be stalled if the supply voltage drops to 70% of the rated voltage for 2 seconds duration.

5.2 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 auxiliaries except boiler feed pump where the starting current shall be limited to 4.5 times. No further tolerances are applicable on starting current specified above for HT motors

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

5.2.2 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 75% rated voltage. Minimum starting requirement for mill motor (double cage) shall be 85% rated voltage at motor terminals.

5.2.3 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.

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.

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.

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

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

5.3 STRESS DURING BUS TRANSFER.

5.3.1 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.

5.3.2 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.

5.4 LOCKED ROTOR WITHSTAND TIME

5.4.1 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.

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

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

6.0 SPECIFIC REQUIREMENTS

6.1 ENCLOSURE

6.1.1 All indoor motor enclosures shall conform to the degree of protection IP-55 unless otherwise specified and outdoor motor enclosure shall confirm to degree of IPW-55.Motor for outdoor or semi-outdoor service shall be of weather-proof construction.

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

6.2 COOLING

6.2.1 The motor shall be self ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air- cooled (CACA).

6.2.2 In case water cooling is required for very large motors, prior approval of the customer is to be obtained before proceeding ahead with design & manufacture.

6.3 WINDING AND INSULATION

6.3.1 All insulated winding shall be of copper.

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

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

6.4 TROPICAL PROTECTION

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

6.4.2 All fittings and hardwares shall be corrosion resistant.

6.5 BEARINGS

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

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

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

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

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

6.5.6 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.

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

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

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

6.6 NOISE & VIBRATION

6.6.1 The noise level shall be as per statutory acceptance (IS/IEC).

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

6.7 MOTOR TERMINAL BOX

6.7.1 Motor terminal box shall be phase segregated (PSTB) type and located in accordance with Indian Standards clearing the motor base- plate/ foundation.

6.7.2 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.

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

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

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

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

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

6.7.8 For 11kV and 3.3kV motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.

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

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

6.7.11 Due to any reason, if the terminal box is found to be not suitable for the approved cable size for either HT/LT motors, then the bidder shall arrange necessary adopter box to facilitate the termination of cables. The adopter box shall be of the same short circuit rating and specifications as the main terminal box. The adopter box shall be located as near as possible to the main terminal box. The interconnecting cabling between adopter box and main terminal box along with providing suitable cable glands and termination kits as applicable shall also be done by the bidder.

6.8 GROUNDING

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

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

Motor above 90 kW	:	75 x 10 mm GS Flat
Motor above 30 kW up to 90 kW	:	50 x 6 mm GS Flat
Motor above 5 kW up to 30 kW	:	25 x 6 mm GS Flat
Motor up to 5 kW	:	8 SWG GS Wire

6.8.3 The cable terminal box shall have a separate grounding pad

6.9 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.

6.10 CONSTRUCTION

6.10.1 Stator Core

The Stator Core Lamination shall be made of high-grade silicon/magnetic steel sheet varnished on both sides and pressed to form rigid core.

6.10.2 Rotor

The rotor construction shall be such that in case of dislodging of the rotor bar from the end ring, it should not come out and hit the stator core/stator winding and damage.

7.0 ACCESSORIES

7.1 GENERAL

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

7.2 SPACE HEATER

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

7.2.2 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.

7.3 TEMPERATURE DETECTORS

7.3.1 All 11kV and 3.3kV motors shall be provided with twelve (12) nos. Simplex type winding temperature detectors, four (4) nos. per phase.

7.3.2 11kV and 3.3kV motor bearing shall be provided with duplex type temperature detectors.

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

7.3.4 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.

7.3.5 Five numbers of Temperature detectors / thermisters shall be provided for L.T. Motors above 90 kW (3 nos. Winding temperatures & 2 nos. bearing temperatures).

7.4 INDICATOR/SWITCH

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

(a) 11kV and 3.3kV motor bearing temperature

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

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

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

7.5 CURRENT TRANSFORMER FOR DIFFERENTIAL PROTECTION

7.5.1 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.

7.5.2 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.

7.6 ACCESSORY TERMINAL BOX

7.6.1 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.

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

7.7 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.

7.8 LIFTING PROVISIONS

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

7.9 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 PAINTING

Motor including fan shall be painted with corrosion proof paints of colour shade (RAL-7032).

8.0 TESTS

8.1 ROUTINE AND TYPE TEST:

Tests are to be conducted for HT and LT motors 60kW and above in presence of Mahagenco representative and contractor as per IS: 325 and required copies of test certificates are to be furnished for approval and despatch clearance. In addition, following tests shall have to be carried out on the motors in presence of MAHAGENCO representative & contractor on LT & HT motors. For Motors below 60kW type and routine test conducted as per IS325 shall be witnessed by contractor and test certificate shall be submitted for review of Mahagenco & Dispatch clearance

8.1.1 FOR HT MOTORS:

(a) Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-671/IS 14422,1995 test voltages as under

Voltage rating of motor		Impulse Test Voltage
3.3 kV	:	18 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) Tan delta measurement on coils

(e) Surge withstand test for inter turn insulation.

(f) Test to diagnose rotor bar failure during manufacture.

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

8.1.2 FOR HT & LT MOTORS:

(a) Test for suitability of IP55/ IPW– 55 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. Second numeral test shall be carried out on one motor of each type and rating.

(b) 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 within last three years.

(c) Test for noise level as routine test.

(d) Test for vibration as routine test.

(e) Overspeed test as type test.

8.2 TEST WITNESS:

Test shall be performed in presence of Owner/Purchaser's representative so desired by the Owner/Purchaser. The Contractor shall give at lest fifteen (15) days advance notice of the date when the tests are to be carried out.

AC & DC MOTOR

DATASHEET – A

SR. NO.	ITEM	UNIT	
1.0	**AUXILIARY POWER SUPPLY**		
1.1	H.T. SUPPLY		
	11kV, 3Ø, 3W, 50 Hz non-effectively earthed		Motors rated 1000 kW and above
	Fault level 44 kA symm		
	3.3kV, 3Ø, 3W, 50 Hz, non-effectively earthed		Motors above 160 kW and below 1000kW
	Fault level 40 kA symm		
1.2	L.T. SUPPLY		
	415V, 3Ø, 3W, 50 Hz effectively earthed		Motors below and including160kW
	Fault level 50 kA symm		
	240V, 1Ø, 2W, 50 Hz effectively earthed		Lighting, space heating, A.C. control & protective devices
1.3	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**		

SR. NO.	ITEM	UNIT	
2.1	A.C. SUPPLY:		
	Voltage		± 10%
	Frequency		± 5%
	Combined Voltage & frequency		± 10% (absolute sum)
	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		
2.2	D.C. SUPPLY		
	Voltage		198 to 240 Volt

GENERAL TECHNICAL REQUIREMENTS
OF
CONDUITS AND PIPES
SPECIFICATION NO. PES-507-27
REV 0

1.0 GENERAL

1.1 This specification covers the manufacture, inspection & testing at vendor's works and delivery to site of conduits, pipes and their fittings for electrical installation.

2.0 CODES AND STANDARDS

2.1 The material, constructional features and various processes involved in manufacture shall comply with currently applicable Indian Standards.

2.2 The following Indian Standards shall be applicable, in general. However if Data Sheet A specifies conformance to other international standards, the equivalent IEC/BS/other standards shall be considered.

a) IS:9537 (All Parts) Conduits for electrical installation.

b) IS:3480 Flexible steel conduits for electrical wiring.

c) IS:6946 Flexible non-metallic conduits for electrical installation.

d) IS:1239 Mild steel tubes, tubulars and other wrought steel fittings. (for size above 63mm dia of rigid conduits)

e) IS:2667 Fittings for rigid steel conduits for electrical wiring.

f) IS:3837 Accessories for rigid steel conduits for electrical wiring.

g) IS:3419 Fittings for rigid non-metallic conduits.

h) IS:6005 Code of practice for phostating iron & steel.

i) IS:2629 Recommended practice for hot dip galvanizing on iron and steel.

j) IS:4759 Specification for hot dip zinc coatings on structural steel and allied products.

k) IS:6745 Methods for determination of mass of zinc coating on zinc coated iron and steel articles.

3.0 DESIGN REQUIREMENTS AND CONSTRUCTIONAL FEATURES

The conduit and conduit accessories shall include conduit plugs & caps, gaskets and box cover etc in addition to any specific requirement given in Data Sheet A. The diameter of conduits and accessories shall be uniform throughout the length.

3.1 Rigid Conduits and Fittings

3.1.1 Rigid conduits shall generally conform to the requirements of IS:9537 (Part I & Part II). However conduits above 63mm diameter shall conform to the requirements of IS:1239. Unless specified otherwise in Data Sheet A, all conduits and pipes shall be of medium duty.

3.1.2 The rigid conduits shall be hot dip galvanized inside and outside. Weight of zinc shall be as per IS:4759. Conduits shall be thoroughly cleaned and pretreated, conforming to IS:6005.

3.1.3 Conduits shall be supplied in approximate length as specified below

a) Rigid Conduits 5 metres

b) Flexible Conduits 10 - 30 metres

3.1.4 Each end of conduit length shall be threaded. The ends of conduits shall be sealed with protective caps to prevent damage to threaded portions and entrance of moisture and foreign material.

3.1.5 The inside surface of all conduits shall be smooth and suitable for pulling insulated cables and wires without damage.

3.1.6 Conduit fittings shall be made out of tube or cast to the shape as to match with corresponding conduit sizes and meet their purpose without any special adjustment.

3.1.7 All fittings shall be screwed type and hot dip galvanized inside and outside.

3.2 Flexible Metallic Conduits and Fittings

3.2.1 Flexible metallic conduits shall generally conform to the requirements of IS:3480.

3.2.2 Flexible conduits shall be made of strip steel which shall be of cold rolled mild steel. The strip shall be of uniform width and thickness throughout.

3.2.3 The strip shall be electro galvanized to a minimum thickness of 25 microns as specified in IS:3480. The surface of the strip shall be thoroughly cleaned before application of protective coating. Pretreatment, before galvanization, shall conform to IS:6005.

3.2.4 The strip for making flexible conduit shall be wound tightly and so overlapped in subsequent helicals that no openings are seen in normal position.

3.2.5 Flexible conduits shall be lead coated for application in high temperature zones, if specifically mentioned in Data Sheet A.

3.2.6 The conduit shall have uniform diameter throughout its length. The internal surface of all conduits shall be smooth and suitable for pulling insulated cables and wires without damage.

3.3 PVC Conduits

3.3.1 PVC conduits shall generally conform to the requirements of IS:9537(Part I & Part III).

4.0 INSPECTION

4.1 The following stages of manufacture shall be stage inspected by Purchaser or his duly authorized representative.

4.1.1 Inspection of manufacturing processes such as shearing, punching, bending, welding, galvanizing etc.

4.1.2 Inspection of packing material and procedure.

4.1.3 Inspection of finished product.

4.2 The inspection will be carried out as per agreed quality plan.

5.0 TESTING

5.1 Rigid Conduits

a) Acceptance Tests - as per IS:9537 Part 1 & 2 upto 63mm OD
- as per IS:1239 above 63mm OD

i) Dimension checks

ii) Bending test (below 32mm OD)

iii) Compression test

b) Special Tests (as acceptance test) as applicable to galvanizing.

5.2 Flexible Steel Conduits

a) Acceptance Tests - as per IS:3480

i) Dimension checks

ii) Linear breaking test

iii) Test for flexibility

iv) Bend fracture test

v) crushing test

b) Special Tests (as acceptance test) as applicable to galvanizing.

5.3 PVC Conduits

a) Type Tests - as per IS : 9537 (Part 1 & 3)

i) Dimension checks

ii) Bending test

iii) Compression test

iv) Impact test

v) Collapse test

vi) Resistance test

vii) Resistance to burning

viii) Electrical Characteristics

b) Acceptance tests - as per IS:9537 (Part 1 & 3)

i) Dimension checks

ii) Bending test

iii) Compression test

iv) Collapse test

v) Resistance to burning

vi) Electrical characteristics

5.4 Sampling for the tests shall be done as per applicable standards mentioned above.

5.5 The testing shall be carried out as per agreed quality plan.

6.0 PACKING

6.1 The material shall be packed as per manufacturer's standard. Packing procedure shall be to the purchaser's approval.

7.0 DRAWING, DATA AND DOCUMENTS REQUIRED

7.1 The following information shall be furnished within two weeks of award of contract, for purchaser's approval.

a) Manufacturing drawings/details.

b) Recommended Field quality plan covering site handling, storing, laying etc.

c) Final quality plan.

7.3 The following information shall be furnished after testing and inspection

Type Test, routine test and special test certificates in bound volume in requisite number.

DATASHEET A

SPECIFIC TECHNICAL REQUIREMENTS

1.0	APPLICABLE STANDARDS:	IS:9537,IS: 1239, IS:3480
2.0	RIGID STEEL CONDUITS & STEEL PIPES	
a)	Material:	Cold rolled mild steel to IS:226
b)	Applicable standard	
	i) Upto 63mm OD:	IS:9537 Part I & II
	ii) Above 63mm OD:	IS:1239
c)	Surface treatment:	Hot dip galvanizing inside & outside as per IS:2629
d)	Wt. of zinc:	as per IS 4759
e)	Duty:	Medium
f)	Fittings:	Screw type as per IS:2667
3.0	FLEXIBLE CONDUITS:	
a)	Material:	Strip steel cold rolled and annealed
b)	Standard applicable:	IS: 3480
c)	Surface treatment:	Electro galvanized as per IS: 3480
d)	Whether lead coated:	YES
e)	Minimum thickness: of zinc coating	25 microns
4.0	PVC CONDUITS	
a)	Material:	PVC
b)	Applicable standard:	IS: 9537 (Part I & III)

CONSTRUCTIONAL DETAILS OF CABLES SELECTED

(A) LT POWER & CONTROL CABLES

S.NO.	PARTICULARS	DETAILS	
		LT POWER CABLES	LT CONTROL CABLES
1	**REFERENCE STANDARD**	IS: 7098 -PART -1	IS -1554 PART -1
2	**SYSTEM**	415 V AC , 240 V AC & 220V DC	220V DC & 110 V AC
3	**VOLTAGE GRADE**	1.1 KV	1.1 KV
4	**CONDUCTOR**		
4.1	MATERIAL	STRANDED COMPACTED PLAIN ALUMINIUM CONDUCTOR OF H2 GRADE CLASS 2 / STRANDED HIGH CONDUCTIVITY ANNEALED PLAIN COPPER.	STRANDED,NON COMPACTED, HIGH CONDUCTIVITY ANNEALED PLAIN COPPER
4.2	REFERENCE STANDARD	IS 8130	IS 8130
4.3	SHAPE	CIRCULAR/ SHAPED	CIRCULAR
4.4	MINIMUM SIZE	ALUMUNIUM- 16 SQ.MM. COPPER- 2.5 SQ. MM.	2.5 SQ.MM.
4.5	MAXIMUM CONDUCTOR TEMPERATURE WHEN CARRYING CONTINUOSLY CURRENT	90°C	70°C
4.6	MAXIMUM CONDUCTOR TEMPERATURE AT THE TERMINATION OF SHORT CIRCUIT CURRENT	250°C	160°C
5	**NO. OF CORES**	1C,2C,3C,3.5C,4C	AS PER CLAUSE 4.2.1
6	**INSULATION**	EXTRUDED XLPE	EXTRUDED HRPVC, TYPE-C
6.1	REFERENCE STANDARD	IS: 7098 -PART -1	IS -5831 & IS-1554 PART-I
7	**CORE IDENTIFICATION**	BY COLOR CODING AS PER IS: 7098 - PART -1	i) CONTROL CABLES UPTO 5 CORE- COLOR CODING AS PER IS 1554 (Part-1) (ii) CONTROL CABLES ABOVE 5 CORES- BY NUMBERING AS PER IS 1554 (Part-1). INSULATION TO HAVE BLACK COLOR.
8	**INNER SHEATH**	EXTRUDED HRPVC FRLS TYPE -ST2 FOR MULTI CORE CABLES. SINGLE CORE SHALL HAVE NO INNER SHEATH.	EXTRUDED HRPVC TYPE -ST2 FRLS FOR MULTI CORE CABLES. SINGLE CORE SHALL HAVE NO INNER SHEATH.
8.1	REFERENCE STANDARD	IS: 5831 & IS-7098 PART-I	IS: 5831 & IS-1554 PART I
9	**ARMOUR**	NON-MAGNETIC HARD DRAWN ALUMINIUM ROUND WIRE ARMOUR OF H4 GRADE FOR SINGLE CORE CABLES AND GS ROUND STEEL WIRE ARMOUR FOR MUTI- CORE CABLES	GS ROUND STEEL WIRE ARMOUR FOR TWIN & MULTICORE CABLES
9.1	REFERENCE STANDARD	IS:3975 & IS 7098 PART I	IS 3975 & IS-1554 PART I
10	**OUTER SHEATH**	EXTRUDED FRLSH HRPVC TYPE ST2	EXTRUDED FRLSH HRPVC TYPE ST2
10.1	REFERENCE STANDARD	IS: 5831 & IS-7098 PART-I	IS: 5831
11	**MARKING**	(i) CABLE SIZE (CROSS SECTION AREA AND NO. OF CORES, VOLTAGE GRADE, WORD 'FRLS', REF. IS, TYPE OF CABLE, TYPE OF INSULATION/ SHEATH, MANUFACTURER'S NAME AND/OR TRADE NAME, YEAR OF MANUFACTURE-AT EVERY 5M (BY EMBOSSING), 'BHEL-PEM' and 'CUSTOMER' Name @5m (by embossing), (ii) PROGRESSIVE SEQUENTIAL MARKING OF LENGTH OF CABLE IN METERS- AT EVERY 1M (BY EMBOSSING/PRINTING)	
12	**CABLE DRUMS**		
12.1	TYPE OF DRUM	WOODEN (HEAVY CONSTRUCTION) AS PER IS 10418	
12.2	STANDARD DRUM LENGTH	500M FOR LARGER SIZES / 1000M FOR SMALLER SIZES (±) 5% (AS SPECIFIED IN BOQ)	
12.3	PAINTING	ENTIRE SURFACE TO BE PAINTED. ALL FERROUS PARTS USED SHALL BE TREATED WITH SUITABLE RUST PREVENTIVE FINISH OR COATING TO AVOID RUSTING DURING TRANSIT OR STORAGE. WOODEN CABLE DRUMS SHALL BE TREATED BY IMMERSING IN COPPER-NITRATE SOLUTION. DRUM NUMBER SHALL BE INDICATED ON EACH DRUM.	
12.4	OUTERMOST LAYER	TO BE COVERED WITH WATERPROOF POLYETHYLENE	
12.5	CONSTRUCTION	ALL WOODEN PARTS FROM SEASONED WOOD AND FERROUS PARTS SHALL BE TREATED WITH SUITABLE RUST PREVENTIVE FINISH OR COATING. WOODEN DRUM SHALL BE TREATED BY IMMERSING IN COPPER NITRATE SOLUTION.	

12.6	PARTICULAR INFORMATION ON DRUM	BOTH THE END OF CABLES SHALL BE PROPERLY SEALED WITH HEAT SHRINKABLE SEAL. THE CABLE DRUMS SHALL CARRY THE FOLLOWING DETAILS IN PRINTED FORM: A) MSPGCL B) MANUFACTURER'S NAME OR TRADE MAKE C) TYPE OF CABLE & VOLTAGE GRADE D) YEAR OF MANUFACTURE E) TYPE OF INSULATION E.G. XLPE/HRPVC/IE2 F) NO. OF CORE AND SIZES OF CABLES G) CABLE CODE E.G. FRLS/FS H) SINGLE LENGTH OF CABLE ON DRUM I) DIRECTION OF ROTATION, BY ARROW J) APPROX GROSS MASS

(B) SCREENED CONTROL CABLES

S.NO.	PARTICULARS	DETAILS
1	**VOLTAGE GRADE**	1100V
2	**TYPE OF CABLES**	TYPE F (INDIVIDUAL & OVERALL SCREENED) & TYPE G (OVERALL SCREENED)
3	**CODES AND STANDARD**	IS-1554 PART-1, IS-5831, IS-8130, IS-694, SEN-4241475, IEC-60332 (I).
3(i)	**CONDUCTOR**	
(a)	CROSS SECTION AREA	0.5 sq.mm
(b)	CONDUCTOR MATERIAL	STRANDED, TINNED ANNEALED HIGH CONDUCTIVITY COPPER
(c)	CONDUCTOR GRADE	ELECTROLYTIC
(d)	NO. & DIA OF STRANDS	7 X 0.3 mm
(e)	NO. OF PAIRS	0.5 sq.mm. - 2P, 4P, 8P,12P, 24P
(f)	REFERENCE STANDARD	IS-8130
(ii)	**INSULATION**	
(a)	MATERIAL	EXTRUDED HR PVC TYPE-C AS PER IS-5831
(b)	THICKNESS IN mm	0.6 (NOMINAL) AS PER IS-694
(c)	VOLUME RESISTIVITY (MIN) IN ohm-cm	i. 1 x 10^13 Ohm-cm at 27 deg.C / room temp. (Min). ii. 1 x 10^10 Ohm-cm at 85 deg.C (Min.)
(d)	VOLTAGE RATING	1100V
(e)	REFERENCE STANDARD	IS-1554 PART-1 & IS-5831
(f)	OD OF COND. INCLUDING INSULATION	AS PER MANUFACTURER'S CALCULATIONS / STD. PRACTICE
(iii)	**PAIRING & TWISTING**	
(a)	MAX. LAY OF PAIRS (mm)	60
(b)	CONDUCTOR /PAIR IDENTIFICATION	AS PER ATTACHED **ANNEXURE D**
4	**SHIELDING**	
(a)	TYPE OF SHIELDING	AL-MYLAR TAPE
(b)	INDIVIDUAL PAIR SHIELDING	TO BE PROVIDED FOR TYPE-F CABLE ONLY
(c)	OVERALL SHIELDING	TO BE PROVIDED FOR BOTH TYPE-F & TYPE-G CABLES
(d)	MINIMUM THICKNESS OF INDIVIDUAL PAIR SHIELDING	28 MICRONS
(e)	MINIMUM THICKNESS OF OVERALL CABLE ASSEMBLY SHIELDING	60 MICRONS
(f)	SHIELDING COVERAGE	100% WITH AT LEAST 25% OVERLAP
5	**DRAIN WIRE (To be provided separately for individual pair shield and overall shield.)**	
	Material	Multi stranded Annealed tinned copper drain wire.
	Size (No. of strands/ Dia. of each strand)	0.5 sq. mm. (7/0.3 mm.)
6	**FILLERS (if applicable)**	
(a)	TYPE	NON -HYGROSCOPIC WITH FRLS PROPERTY (AS REQUIRED FOR MAINTAINING CABLE CIRCULARITY)
7	**INNER SHEATH**	
(a)	MATERIAL	EXTRUDED HR PVC TYPE ST-2 AS PER IS-5831
(b)	THICKNESS	AS PER IS-1554 PART-1
(c)	Whether FR-LSH Applicable	YES
(d)	COLOUR	**BLACK**
(e)	REFERENCE STANDARD	IS-1554 PART-1 & IS-5831
8	**RIP CORD**	NON-METALLIC RIP CORD UNDER THE INNER SHEATH
9	**ARMOUR**	GALVANISED STEEL ROUND WIRE / STRIP AS PER IS-3975 & IS-1554 PART-1

10	**OUTER SHEATH**		
(a)	MATERIAL	EXTRUDED HR PVC TYPE ST-2 AS PER IS-5831	
(b)	THICKNESS	AS PER IS-1554 PART-1	
(c)	Whether FR-LSH Applicable	YES	
(d)	COLOUR	**GREY**	
(e)	REFERENCE STANDARD	IS-1554 PART-1 & IS-5831	
(f)	MARKING	(i) CABLE SIZE (CROSS SECTION AREA AND NO. OF CORES, VOLTAGE GRADE, WORD 'FRLS', REF. IS, TYPE OF CABLE, TYPE OF INSULATION/ SHEATH, MANUFACTURER'S NAME AND/OR TRADE NAME, YEAR OF MANUFACTURE-AT EVERY 5M (BY EMBOSSING), 'BHEL-PEM' and 'CUSTOMER' Name @5m (by embossing), (ii) PROGRESSIVE SEQUENTIAL MARKING OF LENGTH OF CABLE IN METERS- AT EVERY 1M (BY EMBOSSING/PRINTING)	
11	**TECHNICAL PARAMETERS (C & I) AT 20 DEG C**	0.5 sqmm (IS & OS) Type F	0.5 sqmm (OS) Type G
(a)	MUTUAL CAPACITANCE (MAX.) AT 0.8 KHz, nF / Km	120	100
(b)	CONDUCTOR LOOP RESISTANCE (MAX.), Ohm / Km	78	78
(c)	INSULATION RESISTANCE (MIN.), M Ohm / Km	100	100
(d)	CROSS TALK ATTENUATION (MIN.) AT 0.8KHz, dB / Km	60	60
(e)	CHARACTERISTIC IMPEDANCE (MAX.) AT 1KHz, Ohm	320	340
(f)	ATTENUATION (MAX.) AT 1KHz, dB / Km	1.2	1.2
12	**FR-LSH CHARACTERISTICS**		
(b)	SMOKE DENSITY RATING	Max. 60% (As per ASTM D 2843): Area under coverage.	
(c)	ACID GAS EMMISION	Max. 20% by weight (As per IEC-60754-1)	
(d)	OXYGEN INDEX	Min 29 at room temperature (As per ASTMD 2863)	
(e)	TEMPERATURE INDEX	Min. 250 deg.C at oxygen index value of 21 (As per ASTMD 2863)	
13	**FLAMMABILITY TEST**	(1) AS PER IEC-332-1 (2) Swedish Chimney test SEN-SS-424-1475-F3	
14	**TEST VOLTAGE & DURATION (High Voltage Test)**		
(a)	Core to core	1.5 kV for 1 minute	
(b)	Core to shield	1 kV for 1 minute	
15	**CABLE DRUM DETAILS**		
(a)	Material Type	Wooden, as per IS 10418	
(b)	Standard drum length	1000 metres: upto and including 12 Pairs. 500 metres: above 12 pairs.	
(c)	Tolerance on drum length	±5%	
(d)	Painting	ENTIRE SURFACE TO BE PAINTED. ALL FERROUS PARTS USED SHALL BE TREATED WITH SUITABLE RUST PREVENTIVE FINISH OR COATING TO AVOID RUSTING DURING TRANSIT OR STORAGE. WOODEN CABLE DRUMS SHALL BE TREATED BY IMMERSING IN COPPER-NITRATE SOLUTION. DRUM NUMBER SHALL BE INDICATED ON EACH DRUM.	
(e)	Outermost layer	TO BE COVERED WITH WATERPROOF POLYETHYLENE	
(f)	Construction	ALL WOODEN PARTS FROM SEASONED WOOD AND FERROUS PARTS SHALL BE TREATED WITH SUITABLE RUST PREVENTIVE FINISH OR COATING. WOODEN DRUM SHALL BE TREATED BY IMMERSING IN COPPER NITRATE SOLUTION.	

	TITLE	SPECIFICATION NO.
	LV MOTORS **DATA SHEET-A**	VOLUME II B SECTION D
	1X660 MW BHUSAWAL TPP	REV NO. 00 DATE 28.01.2019 SHEET 1 OF 1

1.0	Design ambient temperature	:	50 ^{o}C
2.0	Maximum acceptable kW rating of LV motor	:	160KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V $\pm$ 10%
	b) Rated frequency (with variation)	:	50 Hz (+5% and -5%)
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal boxes		
	o 90 kW and upto 160kW (Breaker controlled)	:	50 KA for 1 sec.
	o Below 90 kW (SFU + Contactor controlled)	:	50 KA protected by fuse for 0.2 sec
	f) LV System grounding	:	Effectively grounded
5.0	Class of insulation	:	Class ‘F’, with temp rise limited to class B.
6.0	Minimum voltage for starting (As percentage of rated voltage)	:	80% of rated voltage
7.0	Power cables data	:	Shall be given during Detailed engg
8.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg
9.0	Space heater supply	:	240 V, 1¢ , 50 Hz
10.0	Rating up to which Single phase motor	:	Acceptable below 0.20 kW
11.0	Additional tests	:	As per QP and customer motor spec
12.0	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
13.0	Makes	:	As per ANNEXURE-I
14.0	Paint shade	:	RAL 7032
15.0	Degree of Protection of enclosure (motors):		INDOOR IP-55 OUTDOOR IPW-55
16.0	Energy efficiency	:	IE3 as per IS:12615: 2011

- **Also detail Customer spec. for Motors to be referred as enclosed with spec.**

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.

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
    a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
    b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
    f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
    g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
|	|	|	|
Cable Voltage Code (see B below)	No. of cores (e.g. 01,03,3H, 07)	Cable code (See C below)	Cable size (e.g. 035,185,2.5, 0.5)

(A) SYSTEM VOLTAGE CODES:
(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V
(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:
A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
T = TOUGH RUBBER SHEATH
U = OVERALL SCREENED
V = PAIRED OVERALL SCREENED
W = PAIRED INDIVIDUAL SCREENED
Y = COMPENSATING CABLES
I = PRE-FABRICATED CABLES
Z = JELLY FILLED CABLES

SUB-SECTION – IC

SPECIFIC TECHNICAL REQUIREMENTS (C &I)

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 as decided by BHEL shall prevail.

Specific Technical Requirements (C&I):

1) The control of DEBRIS FILTER shall be DCS based. The operation and control philosophy of DEBRIS FILTER shall be as per design memorandum given elsewhere in the specification. Bidder to provide Local Control Panel for DEBRIS FILTER. The motorized valves, geared motor etc. shall be operated from Lamp /Pushbuttons, selector switches etc. located on the Local Control panel.

2) All electrical actuators shall be 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 (TO BE DECIDED BY BHEL) among them are to be complied with.

4) The solenoid valves shall have limit switches for open/close feedback.

5) 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.

6) At least 10% spare channels and window facia shall be provided in each annunciator group in the local control panel.

7) Bidder to comply with codes and standards as mentioned in the specification.

8) All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible.

9) Bidder to delegate /depute their persons/experts as per owner/consultants' requirement.

10) Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system.

11) 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.

SCOPE MATRIX - DEBRIS FILTER (DF)		
S.No.	**PROJECT**	**1X660 MW BHUSAWAL TPS UNIT 6**
1	**SYSTEM APPLICABLE: DEBRIS FILTER (DF)**	Y
2	**SYSTEM CONFIGURATION: UNITISED OR COMMON OR AS APPLICABLE**	UNITISED
3	**CONTROL SYSTEM**	REFER NOTE-1,2
4	**LOCATION OF CONTROL SYSTEM**	
5	**CONTROL SYSTEM SCOPE (BIDDER/BHEL/ CUSTOMER)**	
6	**CONTROL FROM PB's ON STARTER PANEL**	Y; REFER NOTE 3
7	**ANNUNCIATION ON STARTER PANEL (Y/N) -- IF Y, MIN NO. OF HARDWIRED ALARMS / INDICATIONS**	Y; REFER NOTE-4
8	**MIMIC ON LCP (Y/N)**	Y; REFER NOTE-5
9	**ACTUATOR WITH INTEGRAL STARTER (Y/N)**	Y
10	**DPG/ DPT PER DEBRIS FILTER (DF) ***	DIFFERENTIAL PRESSURE TRANSMITTER = 2 nos. (Across each strainer) DIFFERENTIAL PRESSURE GAUGE = 1 no. (Across each strainer)
11	**SEA WATER APPLICATION**	N
	NOTES:	
1	Type of control system shall be DDCMIS (Station C&I) based, located in Central Control Room in BHEL scope. Field instrumentation for the package is in bidder's scope.	
2	Local control cum starter panel for DEBRIS FILTER (DF) is in bidder's scope of supply. Items not specifically mentioned and required for the completeness of the system shall be supplied by bidder.	
3	Push buttons and indication lamps for open/close and Start/stop of drives/equipments for DEBRIS FILTER (DF) shall be provided on the starter panel. Remote and local indication,indicating lamps/LED cluster for instruments/drives/equipments status and critical alarms shall be provided on starter panel for DEBRIS FILTER (DF). Nos. shall be decided during detailed engineering.	
4	No. of facia shall be decided during detailed engineering.	
5	Colored MIMICS on Local control cum starter panel to be provided as per system flow diagram for both streams of Debris Filter.	
6	415 V, 3 phase AC power supply shall be provided by BHEL at a single point for the starter panel. Further any electrical distribution shall be in bidder’s scope. Any other voltage requirement to be arranged/derived by bidder by providing suitable control transformer. Starter panel in bidder's scope shall have provision for redundant feeder with fast automatic changeover.	
7	Bidder to terminate all instrumentation and control elements in the local control cum starter panel for further cabling to DDCMIS. Complete cable schedule (in BHEL excel format provided in electrical portion of the specification) and cable interconnection details from field to Local control cum Starter panel and ,Local control cum Starter panel to DDCMIS shall be provided by bidder.	
8	Following documents shall be provided by bidder during detailed engineering for approval: a. Input/Output list, Drives list, b. Instrument datasheets and check lists/Quality plan, c. Panel external/internal GA drawing and termination details, d. Panel datasheet and QAP e. Recommended control logics / Control philosophy . f. Cable schedule (in BHEL excel format provided in electrical portion of the specification) & cable interconnection details from field to Local control cum Starter panel and, Local control cum starter panel to DDCMIS.	
9	All the instruments along with necessary fittings, accessories and valve manifold etc., instrument rack and junction boxes, erection hardware shall be in bidder's scope of supply.	
10	LIR (Instrument Rack) to be provided for mounting the instruments in the field.	
11	Cable for local wiring, between field instruments to Starter panel shall be screened with 1.5 mm2 minimum and shall be in bidder's scope. Refer 'electrical scope sheet between BHEL and bidder' attached in electrical specification for cable scope.	
12	Mandatory spare list shall be referred in 'List of mandatory spares' attached elsewhere in the specification and shall be supplied by bidder.	
13	*Instruments, root valves, impulse pipe shall be suitable for sea water application having corrossion resistance where media is sea water. All the transmitters and gauges shall have remote seal type having 15m capillary length.	
14	The Vendor list/ sub-vendor list shall be subject to BHEL/Customer approval during contract stage.	
15	The specifications for instruments mentioned in the specification are minimum requirements. The detailed specifications shall be finalized during detail engineering.	
16	No deviations with respect to technical specification shall be acceptable.	

C&I DELIVERABLES LIST

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT						
1X660 MW BHUSAWAL TPP						
Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CUSTOMER	FROM	USER	REMARKS
INSTRUMENTATION						
1	PE-V9-415-XXX-I901	INSTRUMENT DATA SHEETS	-	VENDOR	C&I	
2	PE-V9-415-XXX-I902	INSTRUMENT SCHEDULE	-	VENDOR	C&I	
3	PE-V9-415-XXX-I903	INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS	-	VENDOR	C&I	
5	PE-V9-415-XXX-I905	INSTRUMENT QP/CHECK LIST	-	VENDOR	C&I	
LOCAL CONTROL PANEL						
1	PE-V9-415-XXX-I950	LOCAL CONTROL PANEL DATASHEET	A	VENDOR	C&I	
2	PE-V9-415-XXX-I951	WIRING DIAGRAM	-	VENDOR	C&I	
3	PE-V9-415-XXX-I952	PANEL GA DRAWINGS	-	VENDOR	C&I	
8	PE-V9-415-XXX-I956	BILL OF MATERIAL	-	VENDOR	C&I	
13	PE-V9-415-XXX-I957	LOCAL CONTROL PANEL QUALITY PLAN	`	VENDOR	C&I	
14	PE-V9-415-XXX-I958	LOCAL CONTROL PANEL O&M MANUAL	-	VENDOR	C&I	
19	PE-V9-415-XXX-I925	MANDATORY SPARES BILL OF MATERIAL	A	VENDOR	C&I	
	Notes:	415 - 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

1.0 SCOPE

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

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

2.0 STANDARDS

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

2.2 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:

(a) IS-9334

(b) IS-325

3.0 SERVICE CONDITIONS

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

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

4.0 RATING

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

4.2 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.

5.0 PERFORMANCE

The actuator shall meet the following performance requirements:

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

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

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

5.4 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.

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

6.0 SPECIFIC REQUIREMENT

6.1 CONSTRUCTION

6.1.1 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 integral type. Integral starter shall have facility to hook-up with Plant DCS for positioning of limit and torque switches.

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

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

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

6.2 MOTOR

6.2.1 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.

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

6.2.3 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.

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

6.3 LIMIT SWITCHES

Each actuator shall be provided with following limit switches:

6.3.1 Two (2) torque limit switches, one for each direction of travel, self-locking, adjustable torque type.

6.3.2 Four (4) end-of-travel limit switches, two for each direction of travel.

6.3.3 Two (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.

6.3.4 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.

6.4 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.

6.5 POSITION INDICATOR/TRANSMITTER

The actuator shall have:

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

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

6.6 SPACE HEATER

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

6.7 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.

6.8 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.

7.0 TEST

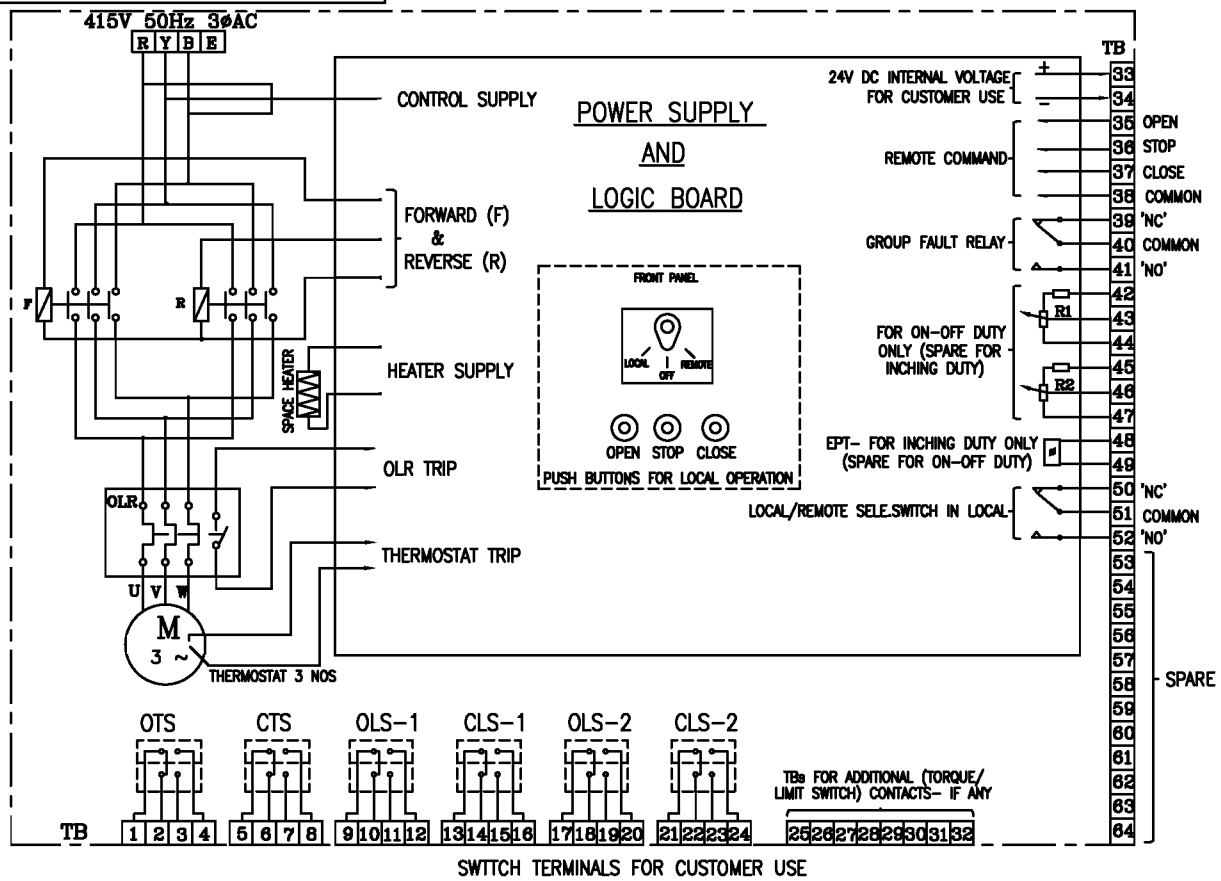
7.1 The actuator and all components thereof shall be subject to tests as per relevant Standards. In addition, if any special test is called for in equipment specification, the same shall be performed.

7.2 TEST WITNESS:

Test shall be performed in presence of Owner/Purchaser's representative so desired by the Owner/Purchaser. The Contractor shall give at lest fifteen (15) days advance notice of the date when the tests are to be carried out.

ALL DIMENSIONS ARE IN MILLIMETRES. FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER RELEVANT QCP / QP.

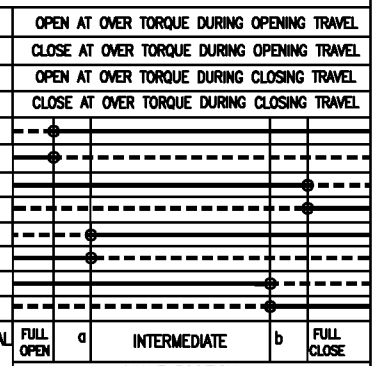
DRAWING NO. 3-V-MISC-24227



SWITCH TERMINALS FOR CUSTOMER USE

CONTACT DEVELOPMENT DIAGRAM

OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL
CTS	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL
OLS-1	9-10	
	11-12	
CLS-1	13-14	
	15-16	
OLS-2	17-18	
	19-20	
CLS-2	21-22	
	23-24	



INDICATES CONTACT CLOSED

INDICATES CONTACT OPEN

CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC

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	#

– CLS NOT TO BE CONNECTED IN TRIP CIRCUIT

* – BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)

NOTE:-

1. ALL TORQUE AND LIMIT SWITCHES (OTS,CTS,OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1-24, REMAINING CONTACTS ARE FOR INTERNAL USE. ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25-32
2. CTS – TORQUE SWITCHES FOR CW ROTATION (CLOSE)
3. OTS – TORQUE SWITCHES FOR CCW ROTATION (OPEN)
4. OLS-1, OLS-2 – LIMITSWITCHES FOR POSITION OPEN
5. CLS-1, CLS-2 – LIMITSWITCHES FOR POSITION CLOSE
6. EPT – ELECTRONIC POSITION TRAMSMITTER (POTENTIOMETRIC TYPE, FOR INCHING DUTY)
7. R1-R2-POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
8. FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
9. M – MOTOR 3ø 415V 50 Hz AC SUPPLY

REV	DATE	ALTERED
		CHD & APPD

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS (DRAWN FOR INTERMEDIATE POSITION OF VALVES)

BHARAT HEAVY ELECTRICALS LTD.,
UNIT: HIGH PRESSURE BOILER PLANT.
TIRUCHIRAPALLI-620014.
365-121

	NAME	SIGN	DATE	NO.OF VAR.
DRN	N.P.ESWAR	N.P	07.10.04	
CHD	D.DINAKARAN	D.D	07.10.04	
APPD	K.ARUNACHALAM	K.A	07.10.04	

DEPT	SCALE	WEIGHT (KG).	REFERENCE INFORMATIONS	NO. OF ITEMS
VL				
CODE				

TITLE: WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER

CARD CODE: U 01

DRAWING NO.: 3-V-MISC-24227

REV: 0

Size A3

SPECIFICATION FOR FIELD INSTRUMENTS

SR. NO.	ITEM	DESCRIPTION
1.0	FIELD INSTRUMENTS	
	This section provides general hardware guidelines for field instruments and equipment to be supplied under this specification.	
1.1	PRESSURE TRANSMITTER	
1.1.1	Working Principle	SMART, HART Protocol.
1.1.2	Type	2 – Wire.
1.1.3	Output Signal	4-20 mA DC.
1.1.4	Signal Processing	Silicon solid state electronic circuitry.
1.1.5	Measuring Element	Capsule/Diaphragm.
1.1.6	Element material	AISI-316 (Stainless Steel) or better.
1.1.7	Static Pressure	150 % of maximum span continuously, without affecting the calibration.
1.1.8	Turn-down ratio	100:1
1.1.9	Span and Zero	Locally adjustable non-interacting. Facility for elevation and suppression by 100% of span.
1.1.10	Enclosure Class	IP-65.
1.1.11	Output Indicator	LCD Type.
1.1.12	Nameplate	Tag number, service engraved in SS tag plate.
1.1.13	Body	Forged Carbon Steel for air and flue gas application and SS for other

SR. NO.	ITEM	DESCRIPTION
		application.
1.1.14	Operating Voltage	16 - 48 Volts D.C.
1.1.15	Load	600 Ohms (min.) at 24 Volts D.C.
1.1.16	Ambient Temperature	0 - 50 °C.
1.1.17	Performance :	
	(a) Accuracy	± 0.1% of Span or better.
	(b) Repeatability	± 0.05% of Span or better.
	(c) Stability	a) +/- 0.1% of calibrated span for 5 year for ranges upto and including 70 Kg/cm2 b) +/- 0.25% of calibrated span for 5 years for ranges more than 70 kg/cm2 (g)
1.1.18	Sealing/Isolation	Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.
1.1.19	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) ½" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock.

SR. NO.	ITEM	DESCRIPTION
		(e) Companion flange with nuts, bolts and gaskets.
		(f) Hand held configuration kit for calibration of SMART Transmitter.
		(g) ½" NPT cable gland.
1.2	DIFFERENTIAL PRESSURE TRANSMITTER/FLOW TRANSMITTER	
1.2.1	Working Principle	SMART, HART Protocol.
1.2.2	Type	2-Wire.
1.2.3	Output signal	4-20 mA DC.
1.2.4	Signal Processing Unit	Silicon solid-state electronic circuitry.
1.2.5	Measuring element	Capsule/Diaphragm.
1.2.6	Element material	AISI-316 (Stainless Steel) or better.
1.2.7	Static Pressure/Overload Pressure	Maximum line (or static) pressure on either side without permanent deformation or loss of accuracy.
1.2.8	Turn-down ratio	100 : 1 minimum.
1.2.9	Span and Zero	Locally adjustable, non-interacting.
1.2.10	Enclosure class	IP-65.
1.2.11	Zero suppression/elevation	At least 100% of Span.
1.2.12	Output Indicator	LCD Type.
1.2.13	Nameplate	Tag number and Service engraved in SS tag plate.

SR. NO.	ITEM	DESCRIPTION
1.2.14	Body	Forged Carbon Steel for air and flue gas application and SS for other application.
1.2.15	Ambient temperature	0 - 50 °C.
1.2.16	Operating Voltage	16 - 48 Volts DC.
1.2.17	Load	600 Ohms (min.) at 24 Volts DC.
1.2.18	Performance:	
	(a) Accuracy	±0.1 % of span or better.
	(b) Repeatability	± 0.05 % of span or better.
	(c) Stability	a) +/- 0.1% of calibrated span for 5 year for ranges upto and including 70 Kg/cm2 b) +/- 0.25% of calibrated span for 5 years for ranges more than 70 kg/cm2 (g)
1.2.19	Sealing / Isolation	Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.
1.2.20	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.

SR. NO.	ITEM	DESCRIPTION
		(e) Hand held configurator kit for calibration of SMART Transmitter
		(f) ½" NPT cable gland.
		(g) ½" NPT generally 5-valve stainless steel manifold, constructed from SS316 bar stock. 3 valve manifold for DP application in flue gas and air.
1.3	DISPLACER TYPE LEVEL TRANSMITTERS	
1.3.1	Type	SMART, HART Protocol.
1.3.2	Stages of operation	Continuous.
1.3.3	Material -	
(a)	Displacer	AISI 316 SS.
(b)	Suspension wire	AISI 316 SS.
(c)	Torque tube housing	Carbon steel or SS as per application.
(d)	Torque tube	Inconel.
(e)	Displacer chamber	CS or SS as per process application.
(f)	Transmitter Housing	Die cast Aluminium or better.
1.3.4	Operating Voltage	16-48 Volts D.C.
1.3.5	Transmission	2-wire.
1.3.6	Output Signal	4-20 mA DC.
1.3.7	Signal processing	Solid-state electronic circuitry.

SR. NO.	ITEM	DESCRIPTION
		engineering units or 0-100%
1.6.10	Output	2 off isolated 4-20mA DC output
1.6.11	Load	< 750 ohms.
1.6.12	Power supply	240V AC, 50 Hz.
1.6.13	Turn Down	100:1.
1.6.14	Accuracy	± 0.2 % of measured value.
1.6.15	Enclosure	NEMA4X (IP67) aluminum, Epoxy coated
1.6.16	Nameplate	Tag number, service engraved in stainless steel tag plate.
	Notes:	
1.	The above on-line flow meter shall not create any obstruction on flow.	
2.	Users' list shall be submitted to support on proven satisfactory performance for similar process applications.	
1.7	PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE	
1.7.1	Type	Bourdon / Bellows / Diaphragm.
1.7.2	Sensing & Socket	AISI-316 SS.
1.7.3	Movement Material	AISI-304 SS.
1.7.4	Case Material	Stainless steel, IP-65.
1.7.5	Dial Size	Generally 150 mm.
1.7.6	Scale	Black lettering on white in 270 ^{o} arc.

SR. NO.	ITEM	DESCRIPTION
1.7.7	Window	Shatterproof glass.
1.7.8	Range Selection	Normal process pressure: 50~70% of range.
1.7.9	Over-range Protection	125% of maximum range by internal stop. External stop at zero.
1.7.10	Adjustment	Micrometer screw for zero. Internal micrometer screw for range.
1.7.11	Element Connection	Argon welding.
1.7.12	Process Connection	1/2" NPT(M) Bottom for local, back for panel mounting.
1.7.13	Performance	Accuracy of ± 1.0 % of span or better.
1.7.14	Operating ambient	0 - 50 ^{o}C.
1.7.15	Safety Feature	Blow out disc /diaphragm at the back.
1.7.16	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.

SR. NO.	ITEM	DESCRIPTION
1.7.17	Applicable standard	IS-3624 / 1996.
1.7.18	Nameplate	Tag number, service engraved in stainless steel tag plate.
1.8	TEMPERATURE GAUGE	
1.8.1	Type	Mercury or gas filled.
1.8.2	Sensing Element Material	Bourdon - AISI-316 SS.
1.8.3	Capillary Armoring	Stainless steel flexible.
1.8.4	Movement Material	AISI 304 SS.
1.8.5	Bulb / Stem Diameter	12 mm.
1.8.6	Bulb / Stem Material	AISI 316.
1.8.7	Capillary	Stainless Steel.
1.8.8	Connection to well	½" NPT.
1.8.9	Case Material	Stainless steel.
1.8.10	Dial Size	150 mm in general.
1.8.11	Scale	Black lettering on white in 270 ^{0} arc.
1.8.12	Mounting	Surface/Panel.
1.8.13	Over range Protection	125 % of range or more.
1.8.14	Instrument connection	Bottom for local and back for panel mounting.
1.8.15	Range	Normal temperature – 50~70% of range.
1.8.16	Zero adjuster	Micrometer screw adjustable from front.

SR. NO.	ITEM	DESCRIPTION
1.8.17	Window	Shatterproof glass.
1.8.18	Accuracy	± 1 % or better.
1.8.19	Enclosure Class	IP-65.
1.8.20	Capillary	5 meters (local surface)/15.0 meters (local panel) - armoured stainless steel.
1.8.21	Compensation	Capillary and Case Compensation.
1.8.22	Accessories	(a) Forged barstock thermowell screwed as per ASME PTC code. Process connection M 33X2 (M). Material of construction of Thermowell: (i) SS 316: In general. (ii) Inconel: For flue gas application. (iii) Tungsten carbide: For coal mill application.
1.8.23	Nameplate	Tag number, service engraved in stainless steel tag plate.
1.9	THERMOCOUPLES	
1.9.1	Type	(a) Type-J (Iron Constantan) / Type-K (Chromel Alumel) / Type-R (Pt.-Rhodium Pt.). [As per application]
		(b) Duplex.
		(c) Ungrounded.

SR. NO.	ITEM	DESCRIPTION
	(q) Accessories	Special cables, electronics, cabinets etc. as required to make the system complete, with bar/chain.
	(r) Range	Application dependent.
	(s) Range increment	0.1% of this selected range.
	(t) Operating temperature	0 -70 ^{0}C
	(u) Accuracy	± 0.5% FS range
2.0	**CONTROL PANELS/DESK MOUNTED INSTRUMENTS AND ELECTRICAL SYSTEM ACCESSORIES**	
2.1	COUPLING RELAY	
2.1.1	Type	Octal base plug-in type/ DIN rail Mounting.
2.1.2	Coil voltage	24 V D.C. in general / other as required.
2.1.3	Contact	2 NO & 2 NC (Minimum).
2.1.4	Contact rating	250 V/5A (A.C)/220V/2A (D.C).
2.1.5	Operating range	70 to 110% of rated voltage.
2.1.6	Insulation	2 kV for 1 minutes between terminal & earth.
2.1.7	Mechanical life	20 million operations.
2.1.8	Coil protection	Diode.
2.1.9	Indication	Coil on LED.

SR. NO.	ITEM	DESCRIPTION
2.1.10	Enclosure	Transparent cover.
2.1.11	Connection	Screw terminals.
2.1.12	Mounting	Projection mounting inside panel / DIN rail mounting.
2.2	DISTRIBUTION BOARDS	
2.2.1	Type	Fixed, Modular.
2.2.2	Power distribution	Through MCCB.
2.2.3	Enclosure	Sheet Steel, IP54.
2.2.4	Mounting	Free standing (Can be attended from both front & back).
2.3	RECEIVER RECORDER	
2.3.1	Type	Microprocessor Based continuous video chart type. (Paper less)
2.3.2	Display type	320 x 240 pixels high resolution coloured LCD graphics.
2.3.3	Number of pen	2/4 as applicable.
2.3.4	Input	4-20mA DC/1-5 Volt/ RTD/ Thermocouple.
2.3.5	Display span rate	1, 5, 10, 20, 30 and 60 min / div. Selectable.
2.3.6	Digital indication	Measured values with engineering unit.
2.3.7	Trends	Coloured display on screen.

SR. NO.	ITEM	DESCRIPTION
2.3.8	Colour of trends	Selectable.
2.3.9	Performance	
(a)	Accuracy	±0.1% of span or better. (Indication & Recording)
(b)	Updation rate	1 Sec or better.
2.3.10	Input open circuit	Up/Down Scale. (selectable)
2.3.11	Reference Junction Compensation	Built-in cold junction compensation for thermocouple inputs.
2.3.12	Power Supply	240 Volt, 1 Ph, 50 Hz A.C.
2.3.13	Operating ambient temperature range	0-50 ^{O} C. (maximum)
2.3.14	Face Dimension	144 mm (W) x 144 mm (H).
2.3.15	Depth	300 mm (typical).
2.3.16	Construction	Case - drawn steel, Bezel-Polycarbonate.
2.3.17	Readable distance	3 meters (minimum)
2.3.18	Mounting	Flush panel.
2.3.19	Accessories	Engraved phenolic nameplate affixed to front flange to identify each recorder by tag number and each pen by color and measured variable. Shunt resistors, Ethernet port, RS232/422a/485 port.
2.3.20	Features	(i) Hi, Hi-Hi, Lo and Lo-Lo contacts each channel.

SR. NO.	ITEM	DESCRIPTION
2.3.21		(ii) 2 MB memory for Data acquisition and 100 MB Zip disk.
		(iii) 3 ½" Floppy disk.
		(iv) Computation functions like linear scaling, square root, differential and engineering unit and all other mathematical functions.
		(v) Memory status display, LCD backlight saver.
		(vi) Event sampling typically 125, 250, 500 msec.
2.4	MULTIPOINT RECORDER	
2.4.1	Type	Microprocessor Based continuous video chart type. (Paper less)
2.4.2	Number of Points	6,12 or 24. (as required)
2.4.3	Input	4-20 mA/1-5V/Thermocouple/RTD.
2.4.4	Recording	Channel number or dot with different color for each channel.
2.4.5	Point Selection	Programmable for any combination of points by selection.
2.4.6	Readable Distance	3 meters. (minimum)
2.4.7	Data Display	Channel number, alarm status, measured data and engineering data (or Programming Display) in green LEDs.

SR. NO.	ITEM	DESCRIPTION
2.4.8	Face Dimension	(i) 144 x 144 mm (approx.) for 6 point.
		(ii) 252 x 206 mm (approx.) for 12 point.
		(iii) 305 x 380 mm (approx.) for 24 point.
2.4.9	Reference Junction Compensation	Built-in.
2.4.10	Mounting	Flush Panel.
2.4.11	Performance	
(a)	Accuracy	± 0.5% of span or better.
(b)	Ambient Temperature effect	± 0.3% of span for 10 ^{O}C variation or better.
(c)	Supply voltage variation effect	± 0.2% of span for 10% variation in supply voltage or better.
(d)	Frequency variation effect	± 0.1% of span for 2 Hz variation in frequency or better.
(e)	Operating Position effect	± 0.1% of span for 0-30 Deg. inclined or better.
2.4.12	Input Open Circuit	Up/Down Scale.
2.4.13	Power Supply	240 Volt, 1 Phase, 50 Hz AC.
2.4.14	Operating Conditions :-	
(a)	Temperature	0-50 ^{O} C.
(b)	Relative Humidity	25%-90%.

SR. NO.	ITEM	DESCRIPTION
(c)	Supply Voltage	-15% to +10%.
2.4.15	Accessories	Engraved phenolic nameplate affixed to front flange to identify each recorder by tag number and each pen by color and measured variable. Shunt resistors, Ethernet port, RS232/422a/ 485 port.
2.4.16	Preferred Features	(i) Hi, Hi-Hi, Lo and Lo-Lo contacts for each channel.
		(ii) 2 MB memory for Data acquisition and 100 MB Zip disk.
		(iii) 3 ½" Floppy disk.
		(iv) Computation functions like linear scaling, square root, differential and engineering unit and all other mathematical functions.
		(v) Memory status display, LCD backlight saver.
		(vi) Event sampling typically 125, 250, 500msec.
2.5	BAR GRAPH INDICATOR	
2.5.1	Type	Bar graph.
2.5.2	Number of channels	One/Two (as required)
2.5.3	Input	4-20 mA/1-5 V/Thermocouple/RTD.
2.5.4	Indication	Green LED / LCD.

SR. NO.	ITEM	DESCRIPTION
2.5.5	Scale	100 mm vertical one for each channel graduated in engineering unit. (linear scale)
2.5.6	Readable Distance	3 meters. (minimum)
2.5.7	Mounting	Flush panel.
2.5.8	Face Dimension	36(W) x 144(H) mm (approx) / 72 x 144 (H) mm.
2.5.9	Resolution	1% of scale or better.
2.5.10	Power Supply	240V, 1 Phase, 50 Hz AC.
2.5.11	Operating Conditions :-	
(a)	Temperature	0-50 ^{O} C.
(b)	Relative Humidity	5%-95%.
(c)	Supply Voltage	-15% to +10%.
2.5.12	Connection between Indicator and Tray	Prefab Cable.
2.5.13	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.
2.5.14	Alarm Facility	1 HI and 1 LO for each channel independently adjustable over span. Voltage free outputs.
2.5.15	Reference Junction Compensation	Built-in cold junction compensation for

SR. NO.	ITEM	DESCRIPTION
		thermocouple inputs.
2.5.16	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.
2.6	VALVE POSITION INDICATOR	
2.6.1	Input	4-20 mA DC/1-5 Volts DC.
2.6.2	Indication	Pointer and Scale. Moving Coil Meter.
2.6.3	Readable Distance	3 meters (minimum)
2.6.4	Pointer Deflection	90 Deg Sector or linear.
2.6.5	Mounting	Flush Panel (Horizontal/vertical)
2.6.6	Accuracy	±1% or better.
2.6.7	Protection Class	IP-42.
2.6.8	Operating Ambient Temp.	0-50 °C.
2.6.9	Scale	0-100%.
2.6.10	Bezel Size	DIN Standard.
2.7	DIGITAL INDICATOR	
2.7.1	Type	Four and half digit LED seven-segment display with sign.
2.7.2	Face Dimension	72 x 144 mm / 48 x 96 mm. (as applicable)
2.7.3	Display Character	13.8 mm, Green. (LED)

SR. NO.	ITEM	DESCRIPTION
2.7.4	Accuracy	0.1% of reading, ±2 digit.
2.7.5	Input	4-20Ma DC/1-5 V DC/ RTD/ Thermocouple.
2.7.6	Mounting	Flush Panel.
2.7.7	Power Supply	240V ±10%, 50 ±2.5 Hz.
2.7.8	Output Contact	2 nos SPDT, contact rating 5A at 240V AC/ 0.25A at 220V DC.
2.7.9	Power/Signal Connection	Screwed.
	Large Display (150x300 mm) indicators shall be provided for MW, MVAR and frequency indications.	
2.8	TOTALIZER / COUNTER	
2.8.1	Type	Electronic.
2.8.2	Number of digits and digit size	Six, 9 mm high.
2.8.3	Input	4-20mA DC.
2.8.4	Reset	Manual.
2.8.5	Readable distance	3 meters. (minimum)
2.8.6	Mounting	Flush.
2.8.7	Performance	
(a)	Accuracy	± 0.5% of span.
2.8.8	Operating ambient temp.	0 - 50 °C.
2.8.9	Accessories	Engraved phenolic nameplate affixed to front flange to identify tag number and measured variable.

SR. NO.	ITEM	DESCRIPTION
2.8.10	Preferred Features	Power supply on/failure LED visible from front.
2.9	PUSH BUTTON	
2.9.1	Type	Shrouded square format.
2.9.2	Face Dimension	32 x 32 mm (maximum)
2.9.3	Contact Configuration	2 NO + 2 NC.
2.9.4	Contact Addition	Add-on block up to 4 each with 2 pairs of contacts.
2.9.5	Contact Material	Hard Silver Alloy.
2.9.6	Contact Rating	500V / 10 A.
2.9.7	Utilization Category	AC11 / DC11.
2.9.8	Insulation Voltage	2 kV for 1 minute between terminals and earth.
2.9.9	Mechanical Life	1 million operation.
2.9.10	Construction	Aluminium shrouding with plastic lens.
2.9.11	Colours	Red, Green, Yellow, Black, etc.
2.9.12	Connection	Screw terminals.
2.9.13	Enclosure Class	IP-52.
2.9.14	Legend	Engraving.
2.10	ILLUMINATED PUSH BUTTON	
2.10.1	Type	Square format.
2.10.2	Face Dimension	32 x 32 mm. (maximum)

SR. NO.	ITEM	DESCRIPTION
2.10.3	Contact Configuration	2 NO + 2 NC. (minimum)
2.10.4	Contact Addition	Add-on-Block up to 4 each with 2 pairs of contacts.
2.10.5	Contact Material	Hard Silver Alloy.
2.10.6	Contact Rating	500 V/ 10A.
2.10.7	Utilization Category	A C11 / DC11.
2.10.8	Insulation Voltage	2 kV for 1 minute between terminals and earth.
2.10.9	Mechanical Life	1 Million Operation.
2.10.10	Lamp	LED with built-in resistors as required.
2.10.11	Lamp Rating :	
(a)	Voltage	240 V AC.
(b)	Watt	2 Watt (approx.)
2.10.12	Lamp and Lens Replacement	From front.
2.10.13	Construction	Transparent Plastic Lens.
2.10.14	Colour	Red, Green, Amber, Yellow etc.
2.10.15	Connection	Screw terminals.
2.10.16	Enclosure Class	IP-52.
2.10.17	Legend	Engraving.
2.11	SELECTOR SWITCH	
2.11.1	Type	2/3/4 position stay put type with rotary lever actuator.

SR. NO.	ITEM	DESCRIPTION
2.11.2	Face Dimension	32 x 32 mm. (maximum)
2.11.3	Contact Configuration	4 pair of contacts.
2.11.4	Contact Addition	Add-on-Block up to 4 each with 2 pairs of contact.
2.11.5	Contact Material	Hard silver Alloy.
2.11.6	Contact Rating	500 V/10 A.
2.11.7	Utilization Category	AC11 / DC11.
2.11.8	Insulation Voltage	2 kV for 1 minute between terminals and earth.
2.11.9	Mechanical Life	1 million operation.
2.11.10	Construction	Aluminium shrouding.
2.11.11	Connection	Screw terminals.
2.11.12	Enclosure Class	IP-52.
2.12	INDICATING LAMP	
2.12.1	Type	LED with built-in resistor.
2.12.2	Face Dimension	32 x 32 mm. (maximum)
2.12.3	Voltage	240 V AC.
2.12.4	Watt	2.5 Watt (approximate).
2.12.5	Lamp and Lens Replacement	From front.
2.12.6	Construction	Transparent Plastic lens.
2.12.7	Colour	Red, Green, Amber, Yellow etc.
2.12.8	Connection	Screw terminals.

SR. NO.	ITEM	DESCRIPTION
2.12.9	Legend	Engraving.
2.13	INDICATING METERS (A.C)	
2.13.1	Type	Rectifier type.
2.13.2	Face Dimension	96 x 96 mm.
2.13.3	Scale	Radial arc of 240 Deg.
2.13.4	Accuracy	1.5% of full scale. ± 0.5 Hz for frequency meter.
2.13.5	Input	0-1/0-5A for current measurement, 0-240V, 50 ± 2.5 Hz for voltage/ frequency measurement.
2.13.6	Zero Adjustment	Screw on meter face.
2.13.7	Enclosure	Shielded Case.
2.13.8	Mounting	Flush Panel.
2.13.9	End Scale Suppression	6 times the measuring range only for motor ammeters.
2.14	INDICATING METERS (D.C)	
2.14.1	Type	Taut band moving coil.
2.14.2	Face Dimension	96 x 96 mm.
2.14.3	Scale	Radial arc of 240 Deg.
2.14.4	Accuracy	1.5% of full scale.
2.14.5	Input	0-75 mA for current measurement. Direct reading for voltage measurement.

SR. NO.	ITEM	DESCRIPTION
2.14.6	Zero Adjustment	Screw on meter face.
2.14.7	Enclosure	Shielded case.
2.14.8	Mounting	Flush Panel.
2.14.9	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.	
2.15	AUXILIARY RELAY	
2.15.1	Type	Electromagnetic.
2.15.2	Coil voltage	240 V A.C / 220V DC. For any other voltage bidder to make his own arrangement.
2.15.3	Contact Configuration	2 NO & 2 NC (Minimum), additional contacts as per requirement with provision for additional contact block expansion.
2.15.4	Contact rating	250V/5A. (A.C/D.C.)
2.15.5	Operating range	80 to 110% of rated voltage.
2.15.6	Insulation	2 kV for 1 minute between terminals & earth.
2.15.7	Mechanical life	20 million operations.
2.15.8	Coil protection	Diode/surge suppressor.
2.15.9	Connection	Screw terminals.
2.15.10	Mounting	Projection mounting inside panel.

SR. NO.	ITEM	DESCRIPTION
2.16	ELECTRICAL TRANSDUCER	
	Transducers shall be provided for conversion of AC electrical quantities such as voltage, frequency, 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.	
2.17	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.	
2.18	ANNUNCIATION	
2.18.1	PLC based system alarm annunciation system shall be solid state/ microprocessor based and shall include all required logic sequence. Display part of the system shall have panel mounted facia LED array assemblies, sets of alarm accept, reset, mute and test push buttons and panel mounted audible devices.	
2.18.2	The system shall be immune to variations in the power supply and shall not generate spurious alarm when the system power is switched on (power-on-reset)	
2.18.3	Controller of the PLC/Microprocessor based control system shall be used for configuring the alarm	
2.18.4	10% wired spare channels & facia shall be provided in all cases	

SR. NO.	ITEM	DESCRIPTION
2.18.5	ANNUNCIATOR LOGIC	
	(a) The circuit components for individual windows shall be mounted on plug -in circuit cards.	
	(b) Input shall be provided with contact bounce filtering. The filter shall delay contact inputs for 15 milliseconds to protect against input device bounce and electrical noise on input lines.	
	(c) Critical alarms shall be hardwired to the input card of annunciator controller.	
2.18.6	OTHER TECHNICAL PARTICULARS	
	(a) Type of contact	NO or NC configurable
	(b) Contact interrogation voltage	24 V DC
	(c) Window drivers.	Electronically short circuit protected, current limiting with automatic recovery
	(d) Facia dimension	75 mm (W) X 50 mm (H)
	(e) LED per facia	8 nos./Window
	(f) Flash rate	Adjustable (slow, fast, intermittent)
	(g) Inscription Type	Etched on photo film (sandwiched)
	(h) Inscription letter height	5 mm (min.)
	(i) No. of row of inscription/ facia	4 (max.)
	(j) No. of letters/row	14 (max.)

SR. NO.	ITEM	DESCRIPTION
	(k) Colour of letters	Black (for white windows)
	(l) Facia front cover	Hi-impact polystyrene
	(m) Facia rear plate	Translucent plastic
	(n) Colour of background	Milk white and red for critical / trip.
	(o) Fascia block plate	Cold rolled sheet steel epoxy painted.
	(p) Audible alarm	Cone type speaker
	(q) Tone generator	Electronic with adjustable tone, amplitude and frequency
	(r) Preferred sequence	(i) Ordinary Channel : ISA-S-18.1-1979-R
		(ii) First-up channel : ISA-S-16.1-1979- F3M3

NOTE:

1. Instruments which are open to atmosphere should be covered with proper canopy.

3.0 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

4.0 CONTROL DESK / PANELS / RACKS

(a) Convenient and logical approach to operational interfaces and aesthetics in the overall view of the panel /desk shall be considered.

(b) For items susceptible to vibration, suitable anti-vibration padding shall be provided to prevent damage or malfunction.

(c) All items inside the panels/cabinets shall be neatly arranged with easy access/maintenance approach.

(d) Incoming power supply feeders shall be duplicated . Alarm shall be provided for failure of a power supply feed.

(e) Desk/panel shall be provided with interior illumination, utility receptacles with plug and cooling fan.

(f) Panel/Desk shall have gland plate at cable entry to panel. Thickness of gland plate shall not be less than 3 mm.

(g) Wire shall be routed/laid through covered trough.

(h) 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.

(i) Nameplate

(i) Nameplate shall be provided for instrument or device mounted on the panel.
(ii) Nameplates for panels shall be provided both in front and rear.

(j) All local control panels shall be housed in air condition environment.

4.1 CONTROL DESK

4.1.1 Devices mounted on the desk shall be flush type. Devices shall be so mounted that their removal and replacement can be accomplished without interruption of services to others.

4.1.2 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.

4.1.3 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. Thickness of sheet shall not be less than 3 mm.

4.1.4 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.

4.1.5 Desk shall be of modular, scalable and industrially ruggedized design and shall have Telephones and Intercom connections.

4.1.6 Desk shall have concealed cable trays for wire dressing.

4.1.7 Design shall include Earthing bolts.

4.1.8 Back installed items shall be suitably concealed from front view.

4.2 BACK UP PANEL

4.2.1 Construction shall be from sheet steel of thickness not less than 3 mm.

4.2.2 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.

4.2.3 Cabinets/Enclosure/Panels

(a)	Material of construction	:	Cold rolled steel sheet.
(b)	Thickness of Sheet	:	(i) 2.0 mm for faces supporting instruments / terminals.
(c)	Construction	:	Welded throughout as per approved National Standards.
(d)	Panel height	:	2300 mm. (approx)
(e)	(i) Corners	:	7 mm inner radius.
	(ii) Dimensional	:	a. In height & length - 3 mm.
	(iii) Tolerances	:	b. In height between adjacent sections - 2 mm.
		:	c. Total for a group - 6 mm.
(f)	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.
(g)	Color of interior	:	Brilliant white.
(h)	Colour external	:	RAL 7032.

(i)	Painting	:	Epoxy powder coated or better.
(j)	Gland plates	:	Removable 3 mm thick. (bottom)
(k)	Cable entry	:	Bottom.
(l)	Hardware	:	(i) Anti vibration pad- 15 mm.
		:	(ii) Predrilled base channel ISMC - 10 or equivalent for all sides.
		:	(iii) Stainless steel buff- finished 2 mm thick kick plate for all sides.
		:	(iv) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws.
		:	(v) Rubber strips to ensure air tightness between kick plate and finished floor.
		:	(vi) Lifting hook / Eye bolt.
		:	(vii) Drawing pocket.
		:	(viii) Door switch, lamps, thermostat, heaters and fans.
(m)	Enclosure Protection	:	As per environment condition of the area of installation. Refer section-1 of this vol.

4.3 LOCAL INSTRUMENT RACKS & ENCLOSURE

4.3.1 General Requirements

(a) Devices located in the field shall be grouped and installed in the enclosure (Closed Rack) in outdoor areas such as Boiler area etc. and in Open Type Rack in covered areas such as 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 which 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 No. PE-189-IN-SK-8004/P0 (Sheets 10) shall be referred for typical arrangement of Local instrument enclosure and rack.

4.3.2 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 color 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.

4.3.3 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.

4.3.4 Junction Box

Junction boxes of metallic construction.

(a) Junction box shall be provided at a dry compartment at one side of the enclosure/rack with front opening type door. Junction box shall be of sheet steel construction with thickness not less than 2 mm. Earth stud shall be furnished at rack for safety grounding.

(b) Terminals shall be screwless cageclamp type of reputed make and 20% spare terminals shall be furnished in the junction box.

10.0 CONTROL & INSTRUMENTATION CABLE

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

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

10.3 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.

10.4 THERMOCOUPLE EXTENSION & COMPENSATING CABLE

(a)	Conductor	:	Solid conductor.
(b)	Conductor size	:	16 AWG (1.31 Sq. mm)
(c)	Type	:	KX (Extension) (Chromel Alumel) RX (Compensating) (Copper-Copper alloy) JX (Extension) (Iron Constantan).
(d)	Conductor Insulation	:	HR PVC Type-C (IS-5831,1984) 0.6 mm thick.
(e)	Operating Voltage	:	300V /500V RMS (Core to earth / core to core).
(f)	Twisting	:	Pair twisted with lay of 60 mm (max)
(g)	Twisting Direction	:	All pairs in the same direction. Lapped to form bunch with mylar tape.

(h)	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.
(i)	Drain wire	:	Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands/size:- 7/0.3mm)
(j)	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.
(k)	Rip Cord	:	Non metallic under sheath.
(l)	Armouring	:	GI wire/strip as per IS 3975.
(m)	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.
(n)	Filler	:	Non hygroscopic with FRLS property.
(o)	Temperature Range	:	Up to 85 °C.
(p)	Insulation at 20^0 C	:	100 MOhms/Km [Min].
(q)	Capacitance at 800 Hz	:	120 nf/km.

(r)	Cross talk	:	60 dB.
(s)	Attenuation	:	1.2 dB/Km
(t)	Codes & Standards	:	IEC 332-1. ANSI MC 96.1. IS-8784-1987.
(u)	Tests		(i) Oxygen Index: Min.29 at room temp. (ASTM-D-2863)
			(ii) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I
			(iii) Temp Index : Min 250 DEG C at 21 Oxy. Ind. (ASTM-D-2863)
			(iv) Smoke Density Rating : Max.60% (ASTM-D-2843).
			(v) Flammability Test : as per IEC 332 Part-I/IEEE-383 Swedish Chimney Test - SS-424-1475 F3.
			(vi) High voltage test Core to core- 1.5 kV for 1 min. Core to screen-1.0 kV for 1 min.
			(vii) Insulation Resistance 100 M Ohm/Km Min.
			(viii) Rodent & Termite repulsion test (Presence of lead shall be confirmed)

(v) 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

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

10.5 INSTRUMENTATION MULTI PAIRED SIGNAL CABLE

(a)	Conductor type	:	Stranded (7) annealed tinned copper.
(b)	Conductor size	:	0.5/1.0/1.5 Sq.mm. (as required)
(c)	Conductor resistance	:	39 Ω/Km/18 Ω/Km/12 Ω/Km.
(d)	Conductor Insulation	:	HR PVC Type-C (IS-5831,1984) 0.6 mm thick.
(e)	Operating Voltage	:	300/500V RMS. (Core to earth/core to core)
(f)	Twisting	:	Twin twisted with lay of 60 mm.

(g)	Twisting Direction	:	All pairs in the same direction. Lapped to form bunch with mylar tape.
(h)	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. (i) Analog signals- Individual pair & overall shield to be considered. (ii) Binary signals- overall shield to be considered.
(i)	Drain wire	:	Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm)
(j)	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
(k)	Rip Cord	:	Non metallic under sheath.
(l)	Armouring	:	GI wire/strip as per IS 3975
(m)	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.

(n)	Filler	:	Non hygroscopic with FRLS property.
(o)	Temperature Range	:	85 °C.
(p)	Insulation at 20 Deg.C	:	100 MOhms/Km [Min]
(q)	Capacitance at 800 Hz	:	120 nf/km
(r)	Cross talk	:	60 dB.
(s)	Attenuation	:	1.2 dB/Km.
(t)	Codes & Standards	:	(i) IPCEA-S-61-402. (ii) BS 5308. (iii) IEC 332-1. (iv) ASTM-B-33. (v) IS-8130-1984. (vi) IS 1554 Part-1. (vii) IS 10810.
(u)	Sheath color	:	Inner- Black and Outer- Gray.
(v)	Tests		(i) Oxygen Index: Min.29 at room temp. (ASTM-D-2863). (ii) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I. (iii) Temp Index: Min 250 ° C at 21Oxy. Ind. (ASTM-D-2863).

(iv) Smoke Density Rating: Max.60% (ASTM-D-2843).

(v) Flammability Test : as per IEC 332 Part-I.

(vi) Swedish Chimney Test-SS-424-1475 F3.

(vii) Insulation Resistance 100 M Ohm / Km Min.

(viii) High voltage test

Core to core- 1.5 kV for 1 min.

Core to screen- 1.0 kV for 1 min.

(ix) Rodent & Termite repulsion test (Presence of lead shall be confirmed).

(w) 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.

10.6 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.

10.7 CONTROL & POWER CABLE

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

11.0 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.

11.1 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.

11.1.1 Electrical Junction Box

(a)	Type of Enclosure	:	Dust tight & weatherproof conforming to IP 65.
(b)	Material	:	3 mm sheet steel
(c)	Type of Cover	:	Solid unhinged with retention chain.
(d)	Paint	:	External - RAL 7032, Internal – Brilliant White.
(e)	Mounting	:	Surface
(f)	Cable Entry	:	3 mm (min) Gland plate
(g)	Gasket	:	Neoprene
(h)	Grounding	:	Brass earth lug with green screw head External-2 nos , Internal-1no.M6.
(i)	Number of Drain Holes	:	Two at bottom capped.
(j)	Identification	:	Label for JB and Tags for cable.
(k)	Accessories	:	(i) Rail mounted cage clamp type screwless terminals with markers.
		:	(ii) Cable gland
		:	(iii) Ferrules
		:	(iv) Canopy at top

11.1.2 Cable Gland

(a)	Type	:	Double compression
(b)	Entry Thread	:	NPT

(c)	Material	:	Brass
(d)	Finish	:	Cadmium Plated
(e)	Protection	:	IP 54 or better
(f)	Accessories	:	Neoprene gasket, locknuts, reducers etc.

11.1.3 Cable Tray

(a)	Material	:	Mild steel, slotted
(b)	Thickness	:	not less than 2.0 mm
(c)	Finish	:	Hot dip galvanized
(d)	Perforation	:	As per MFR standard
(e)	Cover	:	Suitable for tray

11.2 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.

11.2.1 Seamless Stainless Steel Pipe

(a)	Reference	:	ASTM A-312 TP 316
(b)	Material Grade	:	TP 316
(c)	Type	:	Seamless /Plain end
(d)	Size	:	½" NB
(e)	Schedule	:	40
(f)	Standard Length	:	5 meter

11.2.2 Stainless Steel Pipe Fittings

(a)	Reference	:	ASTM A-182 F 316 / ANSI B16.11
(b)	Type	:	Forged
(c)	Rating	:	3000 lbs / 6000 lbs / 9000 lbs
(d)	Size	:	½" NB
(e)	End connection	:	Generally socket weld
(f)	Type of Fittings	:	Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

11.2.3 Seamless Stainless Steel Tube

(a)	Reference	:	ASTM A-213 TP 316
(b)	Material Grade	:	TP 316
(c)	Size	:	½" OD X 2.1 MM Thick
(d)	Type	:	Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
(e)	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.
(f)	Test Pressure	:	400 Kg/Sq. cm (minimum)
(g)	Tolerance	:	± 0.13 mm for outside diameter

± 15 % for wall thickness.

(h) Standard Length : 5 meter

(i) Test : Flare, Hardness, Ball and Bubble Test.

11.2.4 Stainless Steel Tube Fittings

(a) Reference : ASTM-A-182

(b) Type : Double ferrule double compression.

(c) Material : 316 Stainless steel forged.

(d) Ferrule : 316 Stainless Steel.

(e) Type of Fittings : Male/female connector, elbow, cross /equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation.

(f) Size : To suit SS tubing and NPT end connection.

11.2.5 C.S. Pipe

(a) C.S. Pipe : ASTM-A 106 Gr. C

(b) Material : Cold drawn seamless black C.S

(c) Type : Seamless/Plain ends.

(d) Size : ½" NB

(e) Schedule : 80, 160, XXS as required.

(f) Standard Length : 6 meter

11.2.6 C.S. Pipe Fittings

(a)	Reference	:	ASTM-A 105/ANSI B16.11
(b)	Type	:	Forged
(c)	Rating	:	3000 lbs/6000 lbs/9000 lbs
(d)	Size	:	½" NB
(e)	End connection	:	Generally socket weld.
(f)	Type of Fittings	:	Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

11.2.7 A.S. Pipe

(a)	Reference	:	ASTM-A 335 P22 AS PER ANSI B 36.10
(b)	Material	:	Cold drawn seamless A.S
(c)	Type	:	Seamless / Plain ends
(d)	Size	:	½" NB
(e)	Schedule	:	XXS
(f)	Standard Length	:	5 meter

11.2.8 A.S. Pipe Fittings

(a)	Reference	:	ASTM-A 182 F22 AS PER ANSI B 16.11
(b)	Type	:	Forged
(c)	Rating	:	9000 lbs
(d)	Size	:	½" NB

	(e)	End connection	:	Generally socket weld
	(f)	Type of Fittings	:	Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.
11.2.9	Carbon Steel Globe Valve			
	(a)	Reference	:	ASTM A-105
	(b)	Type	:	Globe
	(c)	Construction	:	Forged Body Cadmium Plated.
	(d)	End Connection	:	½" Socket Weld
	(e)	Rating	:	Cl. 800 / CL. 2500
	(f)	Material	:	Body - Carbon steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited
	(g)	Packing	:	Teflon / Grafoil as required
	(h)	Yoke	:	ASTM A105
	(i)	Handwheel	:	Carbon steel
	(j)	Design standard	:	As per ANSI B 16.34
11.2.10	Stainless Steel Globe Valve			
	(a)	Reference	:	ASTM A-182 F316
	(b)	Type	:	Globe
	(c)	Construction	:	Forged Body
	(d)	End Connection	:	Socket Weld
	(e)	Proof Pressure	:	400 Kg/Cm2
	(f)	Material	:	Body - Stainless steel

				Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited
	(g)	Packing	:	Teflon as required
	(h)	Yoke	:	ASTM A182 F316
	(i)	Handwheel	:	Carbon steel
	(j)	Design standard	:	As per ANSI B 16.34
11.2.11	Alloy Steel Globe Valve			
	(a)	Reference	:	ASTM A-182 F22
	(b)	Type	:	Globe
	(c)	Construction	:	Forged Body
	(d)	End Connection	:	½" Socket Weld
	(e)	Rating	:	CL. 2500
	(f)	Material	:	Body - Alloy steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited
	(g)	Packing	:	Grafoil as required
	(h)	Yoke	:	ASTM A182 F22
	(i)	Handwheel	:	Carbon steel
	(j)	Design standard	:	As per ANSI B 16.34
11.2.12	Condensate Pot			
	(a)	Reference	:	ASTM A182 F22 /ASTM A105
	(b)	Material	:	Alloy steel/carbon steel as per applicatio

	(c)	Construction	:	Drilled from bar stock
	(d)	End connection	:	3 nos. ½" socket weld end
	(e)	Accessories	:	Vent valves
11.2.13	Instrument Valve Manifold			
	(f)	Type	:	(i) Two valve manifold
			:	(ii) Five valve manifold
	(g)	Mounting	:	Remote 2" Pipe Mounting
	(h)	Construction	:	Single block (bar stock)
	(i)	Material	:	Forged body and bonnet AISI 316 stainless steel.
	(j)	Ports	:	1/2 " NPT (F)
	(k)	Rating	:	420 Kg/Sq. cm at ambient
	(l)	Operating Temperature	:	(-) 30 to (+) 170 Deg C
	(m)	Packing	:	PTFE Wafer
	(n)	Seat & Stem	:	AISI 316 SS
	(o)	Plug	:	AISI 316 SS free to turn on stem/17-4 PH.
	(p)	Handle Bar	:	AISI 316 SS
	(q)	Connection	:	Straight
	(r)	Accessories	:	(i) Plugs for all ports.
			:	(ii) Mounting Bracket , bolts , nuts.

11.3 PNEUMATIC HOOK UP ACCESSORIES

11.3.1 Air Header :

(a)	Technical Particulars	:	For Panel	For Field
(b)	Material of Construction	:	Stainless steel	Stainless steel
(c)	Inlet Connection	:	2" NPT (M)	1" NPT (M)
(d)	Header Take-off	:	Stainless steel	Stainless steel
(e)	Take off connection	:	1 / 2" NPT (M	1/ 2" NPT (M
(f)	Tube Take-off	:	Tube adapter on valve	Tube adapter on valve
(g)	Drain	:	SS drain valve at lowest point	SS drain valves at lowest poin

11.3.2 Seamless Stainless Steel Tube

(a)	Reference	ASTM A-269 TP 316
(b)	Material Grade	TP 316
(c)	Size	¼" OD X 0.049" wall thickness.
(d)	Type	Cold drawn annealed, pickled, passivated, de-scaled, ,hydraulically cleaned seamless tube.
(e)	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.
(f)	Test Pressure	400 Kg/Sq. cm

(g)	Tolerance	± 0.13 mm for outside diameter ± 15 % for wall thickness
(h)	Standard Length	5 meter
(i)	Test	Flare, Hardness, Ball and Bubble Test

12.0 SPECIAL TOOLS & TACKLE AND TEST EQUIPMENT FOR DCS/PLC AND OTHER SYSTEMS

12.1 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.

12.2 The tools & tackle and Test Equipment shall be shipped in separate container, clearly marked with names of the equipment for which they are intended.

12.3 Bidder shall furnish list of tools & tackle and test equipment proposed to be supplied along with the bid.

9.0 PROCESS CONNECTION & INSTRUMENT HOOK UP

9.1 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. 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.

9.2 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.

9.3 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 425°C 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.

9.4 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.

SR. NO.	INSTRUMENTS	EQUIPMENT/PIPE SIDE	INSTRUMENT SIDE
(a)	**Level Instruments**		
	(i) Internal Displacer	4" – Flanged.	4" – Flanged.
	(ii) External Displacer	2" – Flanged.	2" – Flanged.
	(iii) Level gauge	¾" – Flanged.	¾" – Flanged.

SR. NO.	INSTRUMENTS	EQUIPMENT/PIPE SIDE	INSTRUMENT SIDE
	(iv) DP Type	½" (min.) - welded 1" – welded for vessel like HP heaters, LP heaters, De-aerator etc. application.	½"- NPT.
	(v) External cage Level switch	1"- welded.	1"- welded.
(b)	**Flow Instruments**		
	(i) DP Type	½" - welded in general. 1" – welded for high pressure/ temperature main steam, feed water, PRDS etc. application.	½" – NPT.
(c)	**Pressure Instruments**		
	(i) Conventional	½" (min.)-welded 1"- welded for high pressure/ temperature main steam, feed water, PRDS etc. application.	½" – NPT.
	(ii) Diaphragm type-HFO application	3"- Flanged.	3"- Flanged.

SR. NO.	INSTRUMENTS	EQUIPMENT/PIPE SIDE	INSTRUMENT SIDE
(d)	**Temperature Instruments**		
	(i) Thermowell	Generally - M 33 X2 (M). 1½" Flanged- For air /FG path application.	½" NPT.
(e)	**Analyzer**		
	(i) Liquid analyzer	½"- 1" – welded.	½".

9.5 Size of impulse pipe for pressure measurement in air and flue gas duct path of boiler shall not be less than ¾" NB.

9.6 Separate stubs and take-off points with thermo well/root valves shall be provided for performance guarantee test.

9.7 Impulse pipes shall be clamped at suitable interval not exceeding 1.5 meter. Process pipe shall not be used for supporting the impulse pipe.

9.8 Fittings shall conform to ANSI B 16.11. Threads of piping component shall be of tapered construction.

9.9 Instrument blow down header shall in no case be lower than the material grade ASTM A 106 Gr. C.

9.10 Impulse pipe shall be laid at least with slope of gradient 1:10 to avoid any air pocket or water accumulation.

9.11 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.

9.12 Siphon shall be provided in the impulse pipe or tube to protect the instruments where fluid temperature is 100 ºC or more.

9.13 Orientation of tappings shall be as follows :

(a) For liquid service within 45º at lower half of the pipe horizontal plane.

(b) For gas service within 90º at upper half of the pipe horizontal plane.

(c) For steam service within 45º at upper half of the pipe horizontal plane.

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

9.14 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.

9.15 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.

9.16 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.

9.17 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. 316H 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.

10.0 POWER SUPPLY SYSTEMS

10.1 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.

10.2 Type of power supply systems envisaged are as follows:

(a) 240V AC UPS.

(b) 24V DC battery system.

The battery system shall be dual floating with each stream having its own float cum boost charger. Care shall be taken so that the control system is not damaged during boost charging and also that the cables are properly sized so that the voltage drop does not cause the terminal voltage at the consumer end to fall below the minimum recommended value.

11.0 ENVIRONMENTAL CONSIDERATIONS

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

11.2 TEMPERATURE

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

11.3 HUMIDITY

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.

11.4 ATMOSPHERIC CONTAMINATION

Particulate contamination from fly ash and coal dust and gaseous contaminants such as SO_2 and other flue gas constituents in the coal fired plant are foreseen. This hazard shall be taken into design considerations.

11.5 VIBRATION

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.

11.6 LIGHTNING

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

12.0 SECURITY

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

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

12.3 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.

CONTROL PANELS SPECIFICATION

7.9.1 Elevated Temperature Test

(a) During the first 48 hours the ambient temperature shall be maintained at 50° C and the equipment shall be made to repeatedly perform operations it will be expected to perform in service with loads on various components being equal to those which will be experienced in actual service.

(b) The 48 hours test period shall be continuous but shall be divided into four 12-hour segments. The power supply voltage during each 12 hours segment shall be nominal voltage for 11 hours; followed by 110 percent of nominal voltage for 30 minutes; followed by 90 percent of nominal voltage for 30 minutes.

(c) During the elevated temperature test the cubicle doors shall be kept closed and inside temperature in the zone of highest heat dissipating component/ module shall be monitored. Temperature rise inside the cubicle should not exceed 10 Deg.C above the ambient temperature of 50 Deg.C.

(d) Solid-state logic systems shall be subject to the elevated temperature test and burn-in test as complete assemblies. Testing of individual components or modules shall not be acceptable.

7.9.2 Burn in Test

The 48 hours elevated temperature test shall be followed by 120 hours of burn in test at normal operating temperature. This test shall also be conducted as per above procedure.

7.10 PANELS, CUBICLES AND ENCLOSURES

7.10.1 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.

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.

(b) 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.

(c) Panel/cabinet shall have eyebolt on top for lifting.

7.10.2 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 surface shall be applied to all exterior and interior surfaces, each coat of primer surface shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish colour (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colours 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.

7.10.3 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 colour-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:

(i)	Control wiring (switches, pushbuttons etc.)	:	1.5 Sq.mm
(ii)	Power supply/receptacle /illumination wiring	:	2.5 sq. mm or higher as per load/
(iii)	4-20mA DC current and low voltage signal upto 24V DC	:	0.5 Sq. mm

(p) Identification of conductors shall be done by insulation color-coding identified on drawings or by printed wiring lists.

7.10.4 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 6 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.

7.10.5 Panel/Cabinet/ Desk/Enclosures Environ mental 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:

SR. NO.	LOCATION	ENCLOSURE TYPE
(i)	Indoor type non- ventilated enclosure in non-hazardous area	IP-54.
(ii)	Indoor type ventilated enclosure in non-hazardous area	IP -42.
(iii)	Enclosure in Air conditioned area	IP-22 with suitable canopy at top to prevent ingress of dripping water.
(iv)	Outdoor type in non-hazardous areas	IP-55.
(v)	Outdoor in hazardous areas	As per requirements of the NEC Code for the location.

7.10.6 Terminal Blocks

(a) Terminals shall be chromated galvanized DIN rail mounted screw less cage clamp type. Terminals shall have screwed connection for conductor cross-section above 2.5 mm². Terminal blocks shall conform to IEC 947-7-1.

(b) The characteristics of the terminal blocks shall be as follows:

(i) High contact force, independent of conductor cross-section and large contact surface area.

(ii) Self-loosening protection.

(iii) Resistant to thermal aging and vibration.

(iv) Low and constant voltage drop.

(c) Tension spring shall be made of high quality, non-rusting, acid-resistant steel. The current bar shall be of tin-lead plated copper or brass.

(d) Terminals shall be of non flammable suitable thermoplastic material such as polyamide.

(e) Terminal blocks shall be mounted vertically in panels and cubicles with clearance for at least 100 mm between two sets and between wall and terminal block.

(f) Terminal blocks shall be provided with white marking strips/self-adhesive marker cards. Power terminals shall have protection covers.

(g) At least 20 percent spare unwired terminals shall be provided for all panels/cabinets /desks /junction box etc. This shall be in addition to 20% 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 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 colours depending on voltage levels.

7.10.7 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 colour 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. exemption

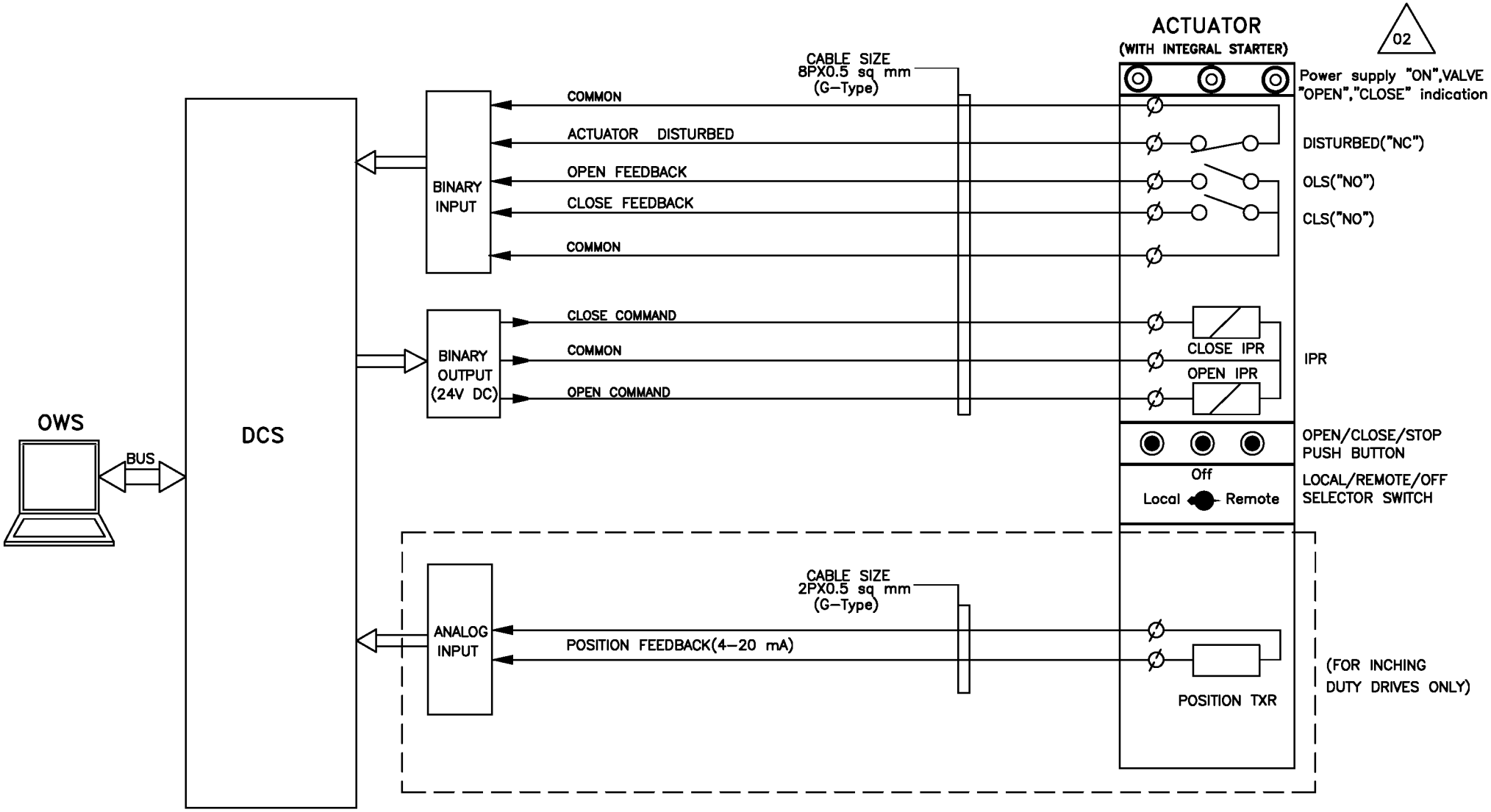
8.0 METERING BASES AND CHART UNITS

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

(a)	Pressure	:	Kg/cm^2.
(b)	Differential Pressure	:	mm of H_2O column/Kg/cm^2.
(c)	Draught	:	mm of H_2O column.
(d)	Vacuum	:	Kg/cm^2 (abs)/mm of Hg column.
(e)	Temperature	:	Degree Celsius (°C).
(f)	Flow (Steam, Water)	:	Tonnes/hr, M^3/Hr.
(g)	Flow (Oil)	:	M^3/Hr, Litter/Hr.
(h)	Flow Air	:	Tonnes/hr/M^3/Hr.
(i)	Density	:	gms/c.c.
(j)	Level	:	mm/%.
(k)	Conductivity	:	Siemens/cm.
(l)	Gas Analyzer	:	Percentage by weight or as specified in respective case.
(m)	Dissolved Oxygen/Silica /Sodium	:	ppm /ppb.

DRIVE CONTROL PHILOSOPHY

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)

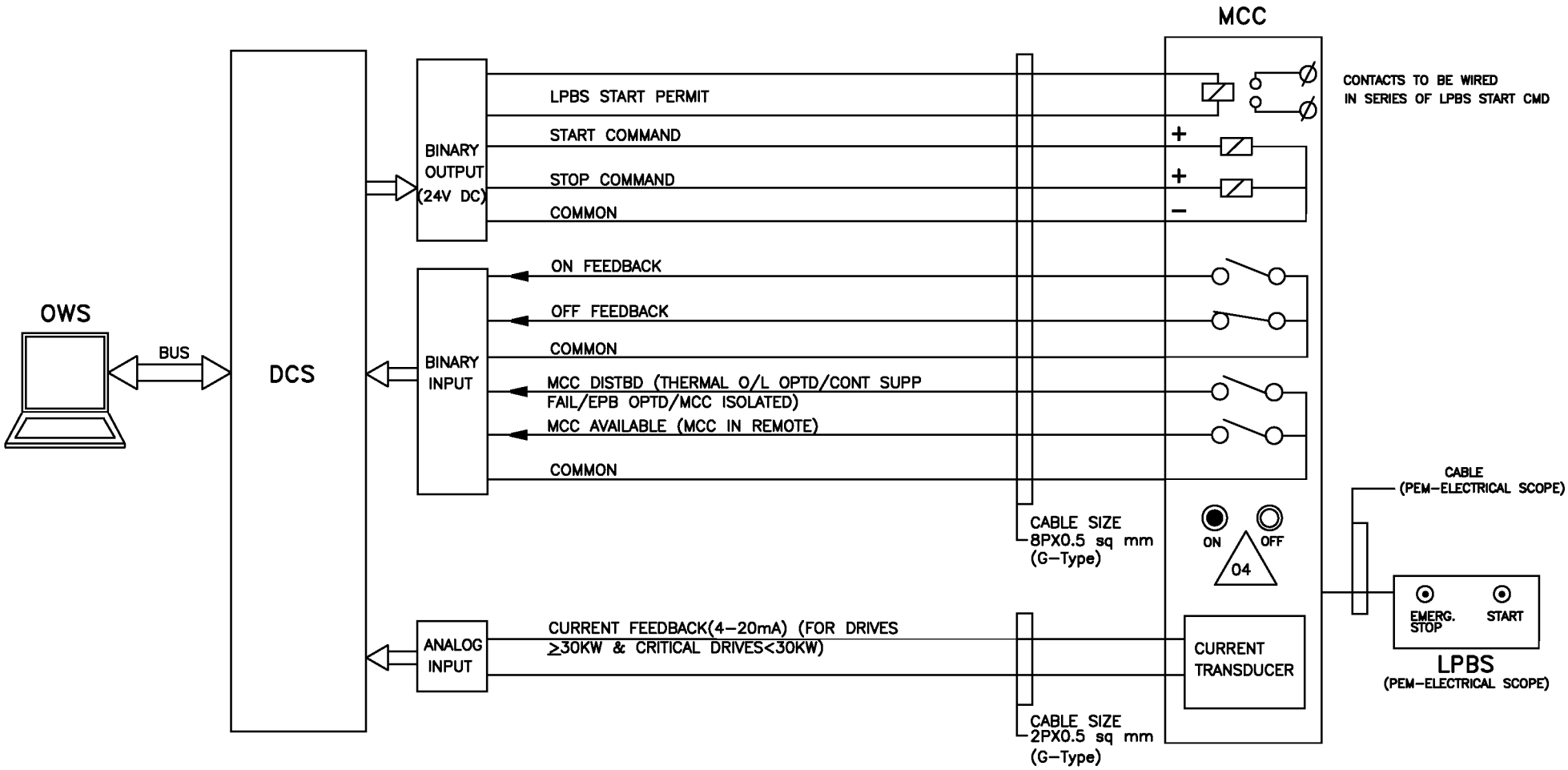


NOTE:

1. DISTURBED= Loss of Power supply (1 Phase/3 Phase),
Loss of control supply, Motor thermostate trip,
Thermal over load relay trip, Valve jammed,
Torque open/close cut off, Local/Off/Remote Sel. switch
in local or off mode etc.

BHEL	PROJECT: 1x660 MW BHUSAWAL STPP	DRG.NO.	PE–DM–415–145–I002
		DATE	01.10.2018
	TITLE: DDCMIS INTERFACE FOR BIDIRECTIONAL DRIVE	REV.NO.	04
		SHT	8 OF 12

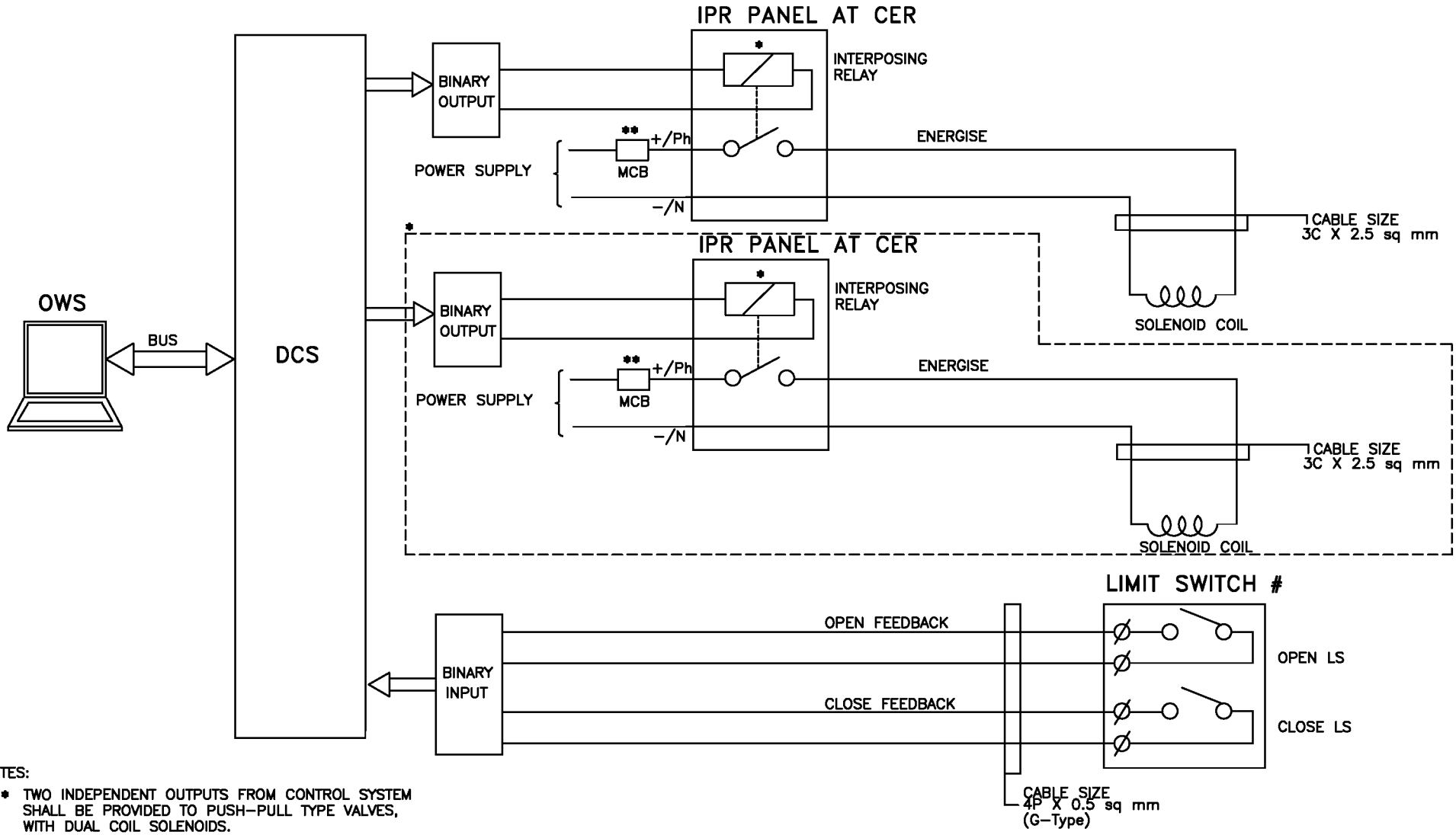
DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE(CONTACTOR OPERATED)



NOTE: INTERPOSING RELAYS(IPRs) TO BE SUPPLIED ALONG WITH MCC.

BHEL	PROJECT: 1x660 MW BHUSAWAL STPP	DRG.NO.	PE-DM-415-145-I002
		DATE	01.10.2018
	TITLE: DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE	REV.NO.	04
		SHT	9 OF 12

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

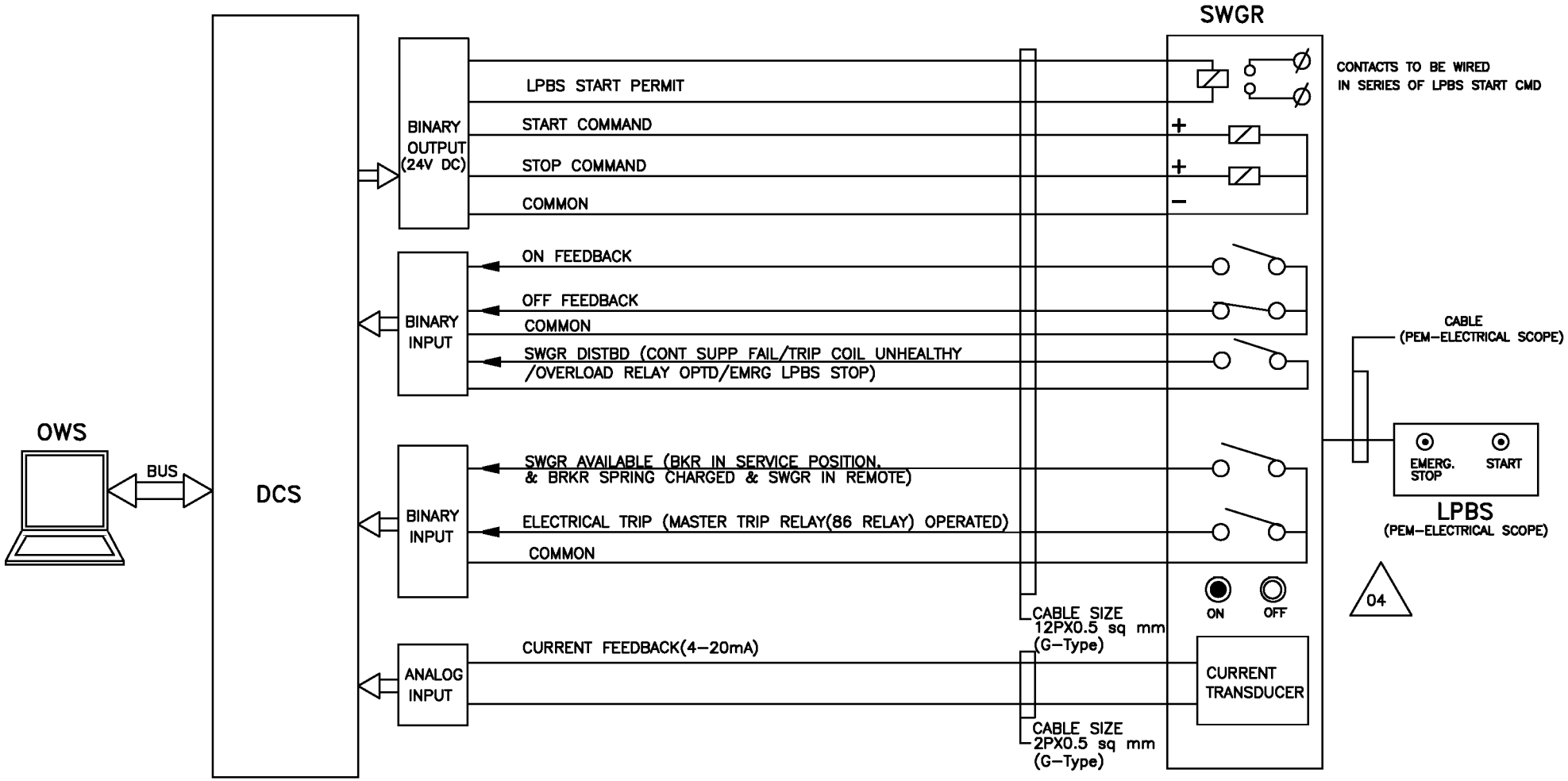


NOTES:

- * TWO INDEPENDENT OUTPUTS FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.
- ** MCB SHALL BE PROVIDED FOR EACH SOLENOID
- # FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.

BHEL	PROJECT: 1x660 MW BHUSAWAL STPP	DRG.NO.	PE-DM-415-145-I002
		DATE	01.10.2018
	TITLE: DDCMIS INTERFACE FOR SOLENOID DRIVE	REV.NO.	04
		SHT	10 OF 12

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



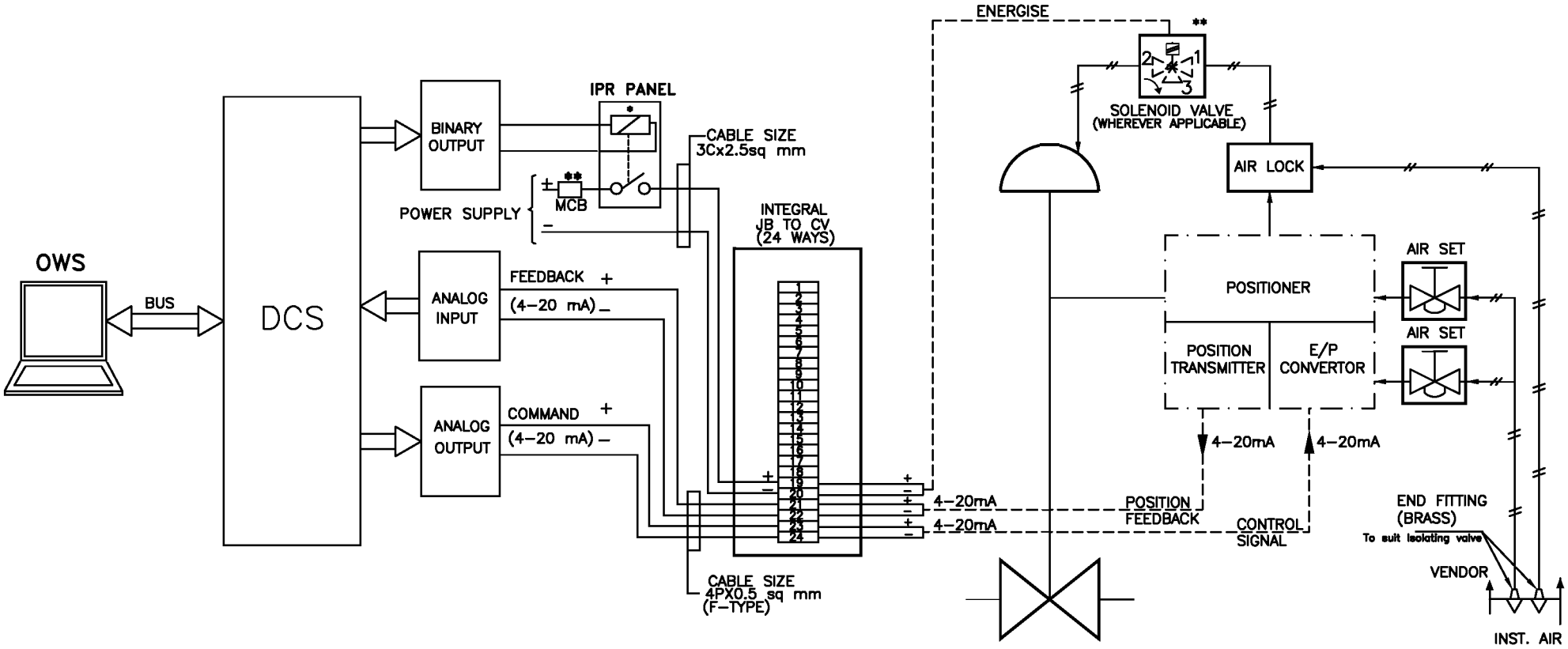
NOTE:- INTERPOSING RELAYS(IPRs) TO BE SUPPLIED ALONG WITH SWITCHGEAR.

BEARING AND WINDING TEMPERATURES FOR HT DRIVES SHALL BE HOOKED TO DCS.

04

BHEL	PROJECT: 1x660 MW BHUSAWAL STPP	DRG.NO.	PE-DM-415-145-I002
		DATE	01.10.2018
	TITLE: DDCMIS INTERFACE FOR UNIDIRECTIONAL HT DRIVE	REV.NO.	04
		SHT	11 OF 12

DCS INTERFACE FOR ANALOG DRIVE



NOTES:

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

BHEL	PROJECT: 1x660 MW BHUSAWAL STPP	DRG.NO.	PE-DM-415-145-I002
		DATE	01.10.2018
	TITLE: TYPICAL HOOK-UP DIAGRAM ANALOG DRIVE	REV.NO.	04
		SHT	12 OF 12

APPLICABLE CODES AND STANDARDS

The required quantities of cable accessories shall be similarly estimated on the basis of number of terminations and proposed routing of the cables and shall be included in the offer allowing a positive allowance of at least 30% for each accessory. The exact quantity of different accessories shall be specified in the offer. Any shortfall in the quantity of accessories observed during actual laying shall be compensated at no extra cost.

5.0 PROVEN PRODUCT

5.1 The offered model of DCS, Microprocessor based control system must have been successfully supplied, erected, tested and commissioned as complete station Control & Instrumentation system for at least two units of capacity not less than 600 MW supercritical Thermal Power Station(s) with reheat type pulverized coal fired boiler. Further, these units should be in successful operation for a minimum period of two (2) years.

5.2 Similarly, all other C&I equipment/PLC/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 500 MW.

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

6.0 CODES AND STANDARDS

6.1 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 Boiler for the design and design calculations, manufacturing and erection procedure as called for under the IBR Act for all items requiring such certification.

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

6.2.1 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.

6.2.2 Pressure Measurement

(a) Instrument and apparatus for pressure measurement - ASME PTC 19.2 (1964).

(b) Bourdon tube pressure and vacuum gauges - IS: 3624/1996.

6.2.3 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.

6.2.4 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.

6.2.5 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.

6.2.6 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).

6.2.7 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.

6.2.8 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.

6.2.9 Annunciator

(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.

6.2.10 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.

6.2.11 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.

(e) Battery: IEEE Std. 1106/IS, 10918, BS 6920-II: 1984, IS 1652, IEC 896-1987.

(f) For Lead acid plante type battery selection & sizing : IEEE Std. 485:1997

6.2.12 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.

6.2.13 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.

6.2.14 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.

6.2.15 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

6.2.16 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.

7.0 DESIGN CRITERIA

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

7.1 GENERAL REQUIREMENTS

7.1.1 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.

(g) Able to withstand high vibration.

MANDATORY SPARES

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
	measurement used.	
3.0	**MEASURING INSTRUMENTS**	
3.1	ELECTRONIC TRANSMITTERS	
3.1.1	Transmitters of all types, ranges and model no. (for the measurement of Pressure, differential pressure flow, level etc.)	10% or 2 no. of each type and model, whichever is more
3.1.2	Electronic cards / PCB's for each type and model and model of transmitters	10% or 5 nos. of each type, whichever is more
3.2	TEMPERATURE ELEMENTS	
3.2.1	RTDs of each type & length	10% or 2 nos. whichever is more
3.2.2	Thermocouples of each type like K-type, R-type, metal etc and length	10% or 2 nos. whichever is more
3.2.3	Thermowell for T/C & RTDs	10% or 1 no. of each type, rating, length used in the system whichever is more
3.2.4	Process actuated switch devices Including all types of pressure, differential pressure, flow, temperature, differential temperature, level switch devices	10% or 1 no. of each type and model whichever is more
3.3	INDICATORS/RECORDERS	
3.3.1	Digital Indicators of each model, type & range (including relevant digital indicators of electrical system)	10% or 2 nos. min. whichever is more

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
3.3.2	Vertical Indicators of each type & model	5% or 1 no. of each model whichever is more
3.3.3	Recorders for each type and model	5% or 1 no. whichever is more.
3.3.4	Consumables for continuous recorders Charts Ink capsules	25 rolls per recorder/ 25 nos per recorder/ 20 nos. per recorder / Ink Pads /Pens.
3.3.5	Consumables for multi point recorders	
(a)	Charts	5 nos. per recorder
(b)	Ink pads	5 nos. per recorder
(c)	Print mechanism/ print head assembly	10% or 5 nos. of each type whichever is more
3.3.6	Level transmitters (displacer type)	
(a)	Electronic cards / PCB's of level transmitters	10% of total quantity used or 1 for each type/rating whichever is more
(b)	Level transmitters	10% of total quantity used or 1 for each type/rating whichever is more
(c)	Electronic water level indicator	10% or 2 nos. min. whichever is more
3.3.7	PD type flow transmitters	10% of total quantity used or 1 for each type/rating whichever is more
3.4	SWITCHES	
3.4.1	Switches (Pressure, DP, Level, Flow, Temperature etc)	10% of each type of total nos. used in the system or minimum 1 no. of each type, model & range whichever is more

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
3.5	Rotameter	10% of each type of total nos. used in the system or minimum 2 no. of each type, model & range whichever is more
3.6	SOLENOID VALVE	10% of each type of total nos. used in the system or minimum 2 no. of each type, model & range whichever is more
3.6.1	Assembly	10% of total quantity used or minimum 2 no. of each type whichever is more
3.6.2	Coil	10% of toatal quantity used or 5 no. whichever is more
3.7	E/P Converter	10% of each type of total nos. used in the system or minimum 2 no. of each type, model & range whichever is more
3.8	SPECIAL INSTRUMENTS	
3.8.1	Nucleonic /non-nucleonic density meter, solid flow meter etc.	1 no. and spare parts as per manufacturer
3.9	Electrical Transducers	10% of total quantity used or minium 1 no. of each type and range whichever is more
4.0	**POWER SUPPLY SYSTEM (24 V DC POWER SUPPLY SYSTEM)**	
4.1	Silicon controlled thyristors, diodes power transistors	100%

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
4.17	Rubber gloves	1 no.
4.18	Voltmeter for measuring cell voltage (centre zero type)	1 no.
4.19	Thermometer	1 no.
4.20	Insulated socket spanner with handle	1 no.
5.0	**PROCESS CONNECTION PIPING** (for impulse piping /tubing, sampling piping/ tubing and air supply piping as applicable)	
5.1	Valves of all types and models	10% or 2 no. of each type, class, size and model whichever is more.
5.2	2 way, 3way, 5way valve manifolds	10% or 2 no. of each type, class size and model whichever is more.
5.3	Fittings	10 nos. of each type
5.4	Purge meters	10 % of each model or 2 Nos. whichever is more
5.5	Filter regulators	10% of each model or 2 Nos. whichever is more
5.6	Impulse pipe & tubing of all type	20 mtrs each type & size
5.7	Impulse line root valve	10% of total quantity used or 4 no. whichever is more for each type and rating of each size
5.8	SS tube	40 mtrs of each type/size
5.9	Fitting for SS tube	40 nos. of each type/size

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
6.0	**INSTRUMENTATION CABLE, INTERNAL WIRING AND ELECTRICAL FIELD**	
6.1	Pre fabricated cable of each type	10% of installed quantity
6.2	Pre fabricated cable connector	10% or1no.of each type and model, whichever is more.
6.3	Other cables	10% of each type, pair and size of actual installed quantity
7.0	**ELECTRICAL ACTUATORS**	
7.1	Actuators	10% or 1 no. of each type, model and rating, whichever is more.
7.2	Power unit for modulating actuator	10% or 2 nos. of each type, whichever is more.
7.3	DC-DC unit/power pack units	10% or 2 nos. of each type, whichever is more.
7.4	Electronic cards	10% or 5 nos. of each type, whichever is more
7.5	Brake assembly	10% or 2 nos. of each type, whichever is more..
7.6	Brake coils	10% or 2 nos. of each type whichever is more.
7.7	Position feed back transmitters	10% or 2 nos. of each type whichever is more.
7.8	Control unit	10% or 2 nos. of each type whichever is more
7.9	Torque and limit switch assembly of each unit	10% or 2 nos. of each type, whichever is more.
7.10	O-ring	1 set of each size

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
7.11	Motor	1 no. of each type & rating
7.12	Auxiliary contact	10% of total quantity used or 2 nos. whichever is more for each type and rating of each size
7.13	Seal kit	1 set of each type & size

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
8.24	Micro PLC system (i.e. integrated CPU & I/O system, where above mentioned components are not applicable)	One Complete Set

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
17.0	CONTROL PANEL AND LOCAL/ REMOTE CONTROL DESK (AS APPLICABLE)	
17.1	Recorder	1(one) No. each type and model
17.2	Bar graph indicator	10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model.
17.3	Digital indicator	10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model.
17.4	Mosaic/Conventional Type Push button Station	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
17.5	Mosaic Type Push button Station with LED Indication	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
17.6	Mosaic Type LED Indication Station	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
17.7	Simaphore Indicator	2(two)Nos. each type
17.8	ANNUNCIATION SYSTEM (For offsite / Auxiliary Plants)	
17.8.1	Each type of PCB (for non-PLC driven system)	1(one) No. each

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
17.8.2	Lamp Box with Facia & Lamps (LED type)	10% with minimum 2 nos.
17.8.3	Hooter	1(one) No.

30.0	**MANDATORY SPARES NOT COVERED ABOVE**	Bidder to supply 10% electronic modules/ cards or any other electronic components required for system such as annunciation system for offsite/auxiliary plant, online condensate tube cleaning system, ambient air monitoring system, plant simulator.

DRAWINGS

G.A. DRAWING – TRANSMITTER RACK

FOR BID PURPOSE ONLY

ISSUE	BY	CH	DATE

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

DO NOT SCALE | DATE : 23-08-2011

G.A. DRAWING-TRANSMITTER RACK

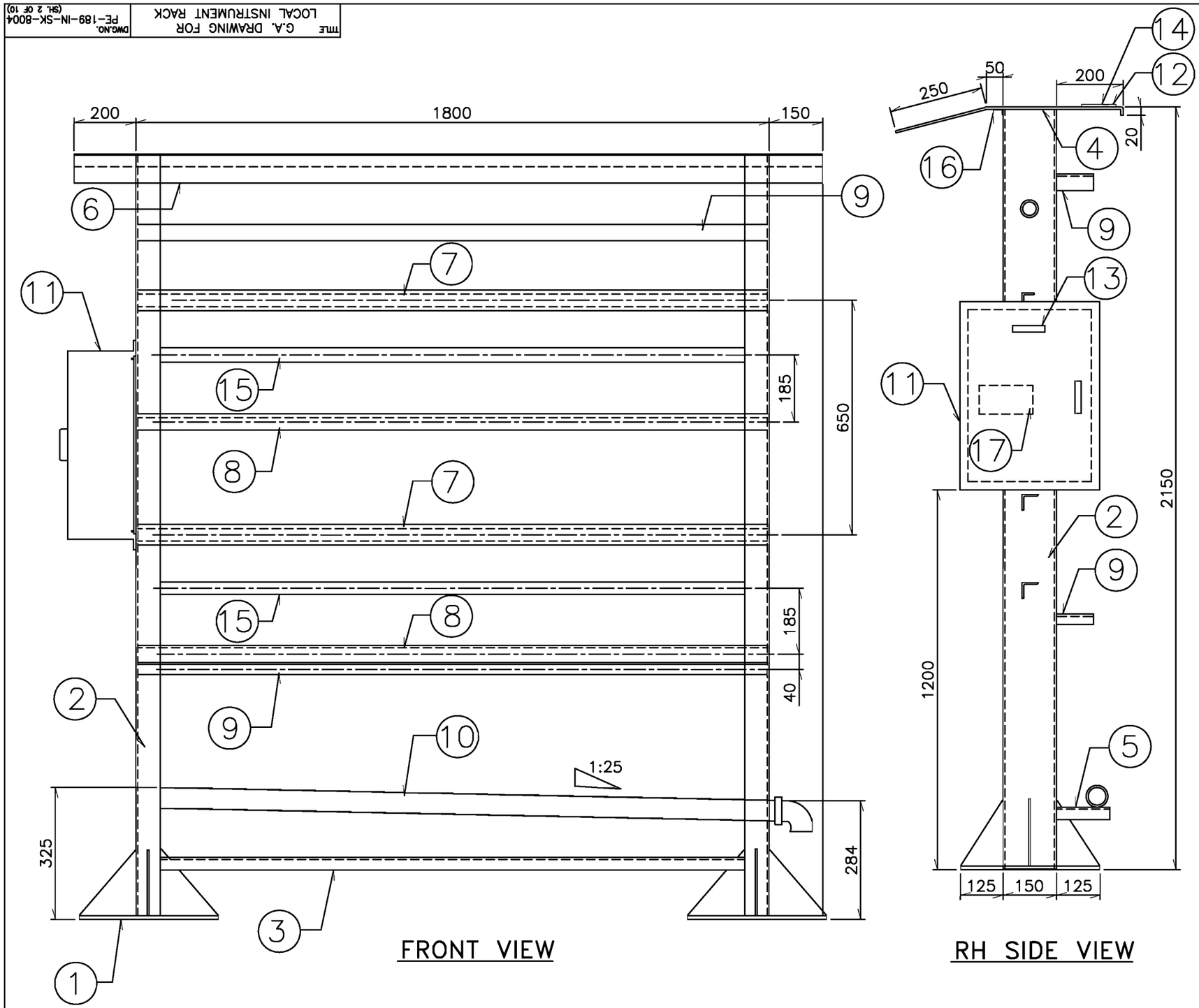
SCALE ~ | APPROVED

DIV INST.
DR P.N.Z.
CH D.J.P.

DWG.NO.PE-189-IN-SK-8004 (SH. 1 OF 10) | P0

TITLE G.A. DRAWING FOR LOCAL INSTRUMENT RACK

DWG.NO. PE-189-IN-SK-8004 (SH. 2 OF 10)



FRONT VIEW

RH SIDE VIEW

LEGEND:

ITEM NO.	DESCRIPTION
1.	M.S. PLATE 400 x 400 x 10
2.	ISMC 150 x 75 x 6
3.	ISMC 75 x 40 x 5
4.	CANOPY MOUNTING PLATE 5mm THICK.
5.	BRACKET FOR DRAIN PIPE.
6.	CANOPY ASSEMBLY 3.0mm THICK CRCA SHEET.
7.	GI PIPE 2" NB CLASS B FOR TRANSMITTER MOUNTING.
8.	M.S. ANGLE 40 x 40 x 5
9.	BRACKET FOR IMPULSE PIPE SUPPORT.
10.	DRAIN PIPE MATERIAL ASTM A106 GR. 'C' SIZE 2" NB SCH 80.
11.	JUNCTION BOX SIZE: 480(H) x 360(W) x 180(D).
12.	BULKHEAD M.S. PLATE 5mm THICK.
13.	COMPACT FLUORESCENT LAMP FOR RACK ILLUMINATION.
14.	XLPE GASKET IN BETWEEN BULKHEAD PLATE & CANOPY MOUNTING PLATE.
15.	PVC CABLE TRAY/ FLEXIBLE CONDUIT FOR CABLE
16.	C' CHANNEL FOR LIGHT FITTING.
17.	TAG PLATE.

NOTES:

1. POWER SOCKET & TB SHALL BE PROVIDED IN JB.
2. COLOR: RAL 7032. OVERALL THICKNESS > 100 MICRONS.
3. TAG PLATE SHALL BE PROVIDED FOR EACH INSTRUMENT.
4. 20% TERMINALS SHALL BE PROVIDED AS SPARE.
5. ANTIVIBRATION PAD & FOUNDATION BOLTS SHALL BE PROVIDED.
6. DIMENSIONS SHOWN ARE TENTATIVE AND SHALL BE FINALIZED AT DETAILING.
7. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED CHEM	CIVIL	ELEC	I&C	MECH	APPD	DATE

FOR RO ISSUE ONLY		
CLEARED		
DEPT	SIGNATURE	DATE
CHEM		
CIVIL		
ELEC		
I&C		
MECH		

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MAHAGENCO

MAHARASHTRA STATE POWER GENERATION CO.LTD.

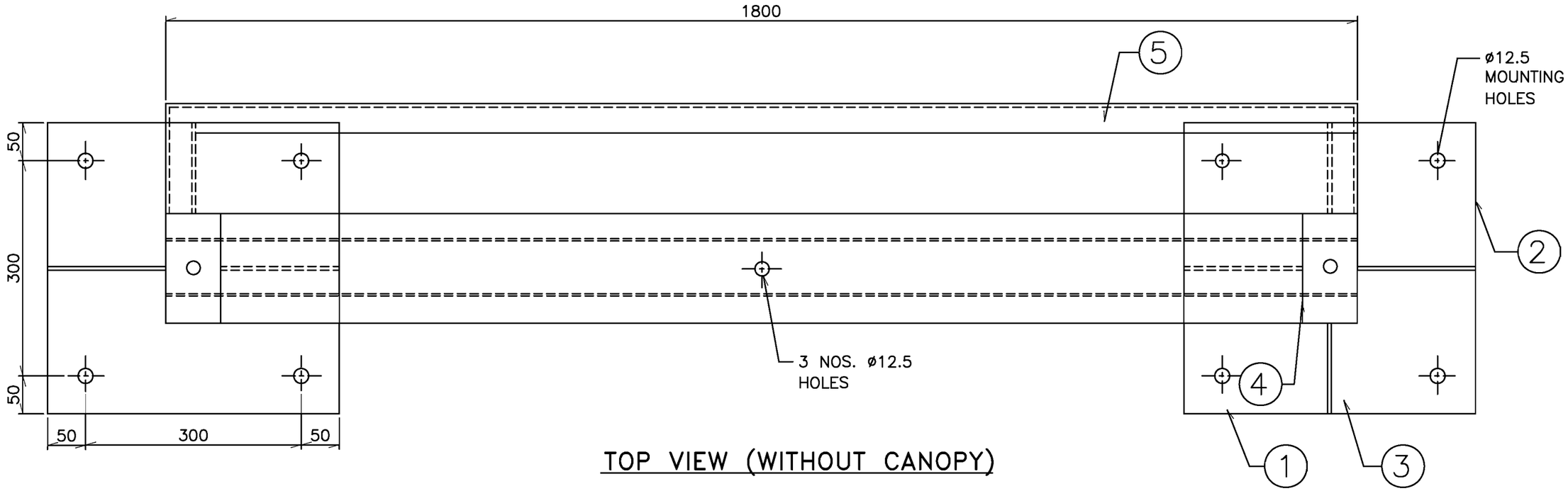
BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

G.A. DRAWING FOR LOCAL INSTRUMENT RACK

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)

SCALE ~	APPROVED	DATE(RO ISSUE)
DIV. INST.		DATE(CURRENT ISSUE) 23-08-2011
DR. P.N.Z.		
CH. D.J.P.	DWG.NO. PE-189-IN-SK-8004(SH. 2 OF 10)	ISSUE P0

TITLE	VIEW OF LOCAL INSTRUMENT RACK W/O CANOPY
DWG.NO.	PE-189-IN-SK-8004 (SH. 3 OF 10)



TOP VIEW (WITHOUT CANOPY)

NOTES:

1. M.S. PLATE 400 x 400 x 10.
2. RIB M.S. PLATE 162.5 x 170 x 5 THICK.
3. RIB M.S. PLATE 125 x 170 x 5 THICK.
4. RIB M.S. PLATE 134 x 165 x 5 THICK. (CANOPY MOUNTING PLATE SUPPORT)
5. BRACKET FOR IMPULSE PIPE SUPPORT.
6. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED CHEM	CIVIL	ELEC	I&C	MECH	APPD	DATE

FOR RO ISSUE ONLY		
CLEARED		
DEPT	SIGNATURE	DATE
CHEM		
CIVIL		
ELEC		
I&C		
MECH		

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BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

VIEW OF
LOCAL INSTRUMENT RACK W/O CANOPY

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)

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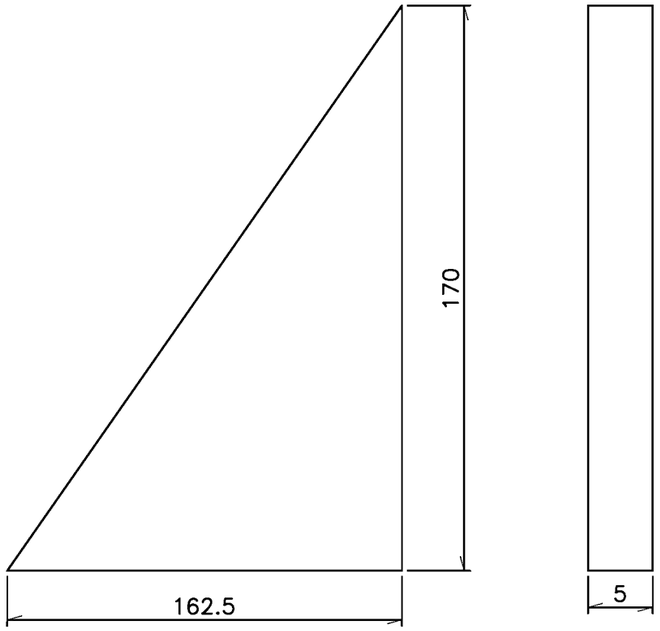
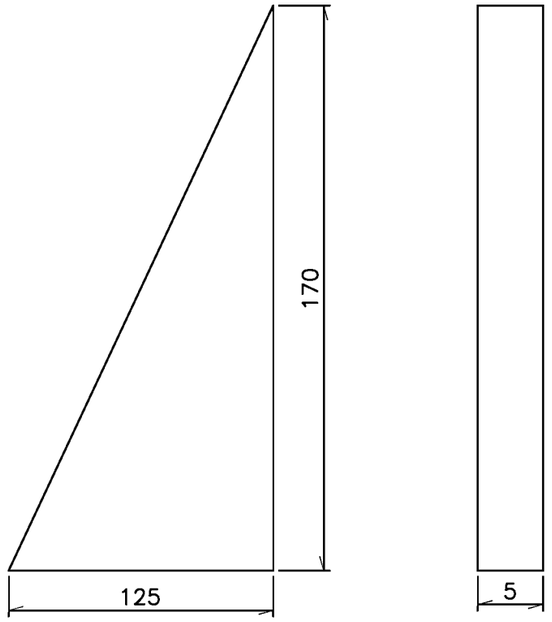
TITLE G.A. DRAWING OF CLEATS FOR LOCAL INSTRUMENT RACK

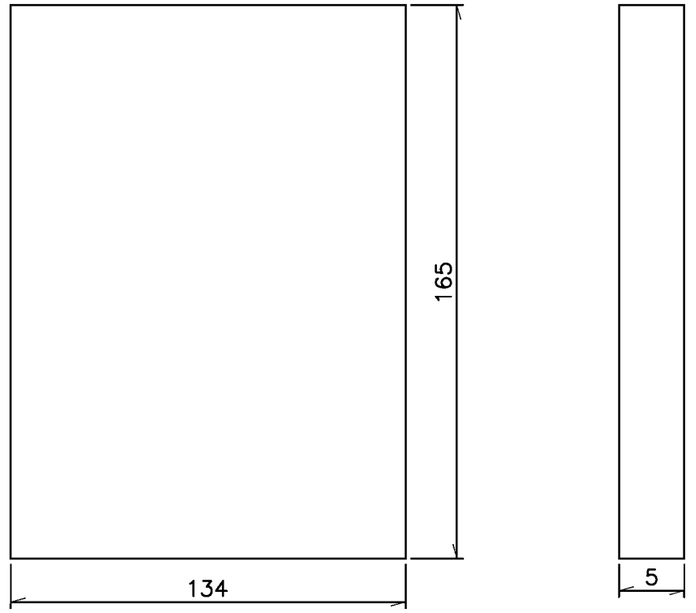
DWG.NO. PE-189-IN-SK-8004 (SH. 4 OF 10)



DETAIL OF-1



DETAIL OF-2



DETAIL OF-3

NOTES:

1. RIB M.S. PLATE 162.5 x 170 x 5 THICK.
2. RIB M.S. PLATE 125 x 170 x 5 HICK.
3. RIB M.S. PLATE 134 x 165 x 5 THICK.
4. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED CHEM	CIVIL	ELEC	I&C	MECH	APPD	DATE

FOR RO ISSUE ONLY

CLEARED		
DEPT	SIGNATURE	DATE
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CIVIL		
ELEC		
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BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

G.A. DRAWING OF CLEATS FOR LOCAL INSTRUMENT RACK

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)

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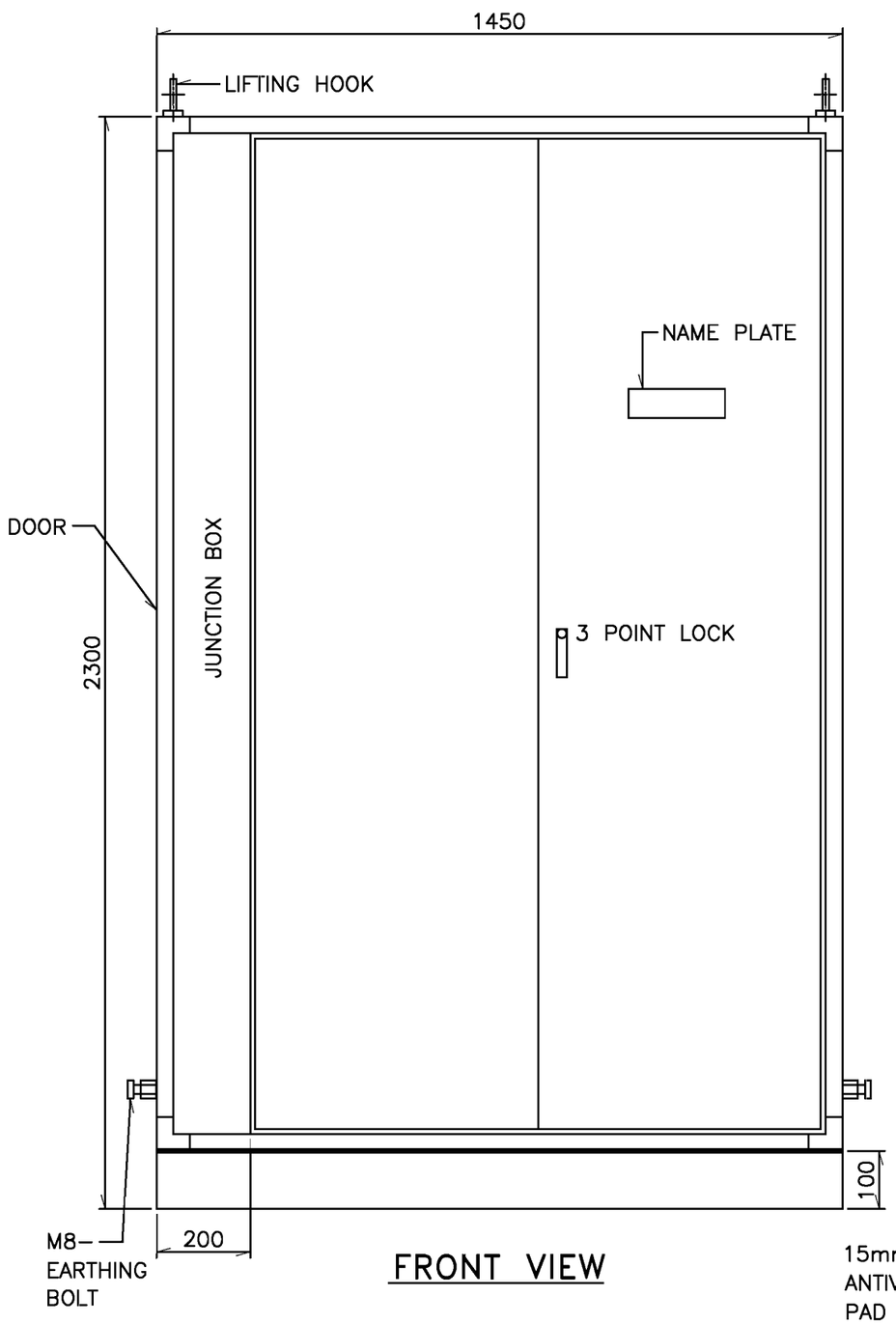
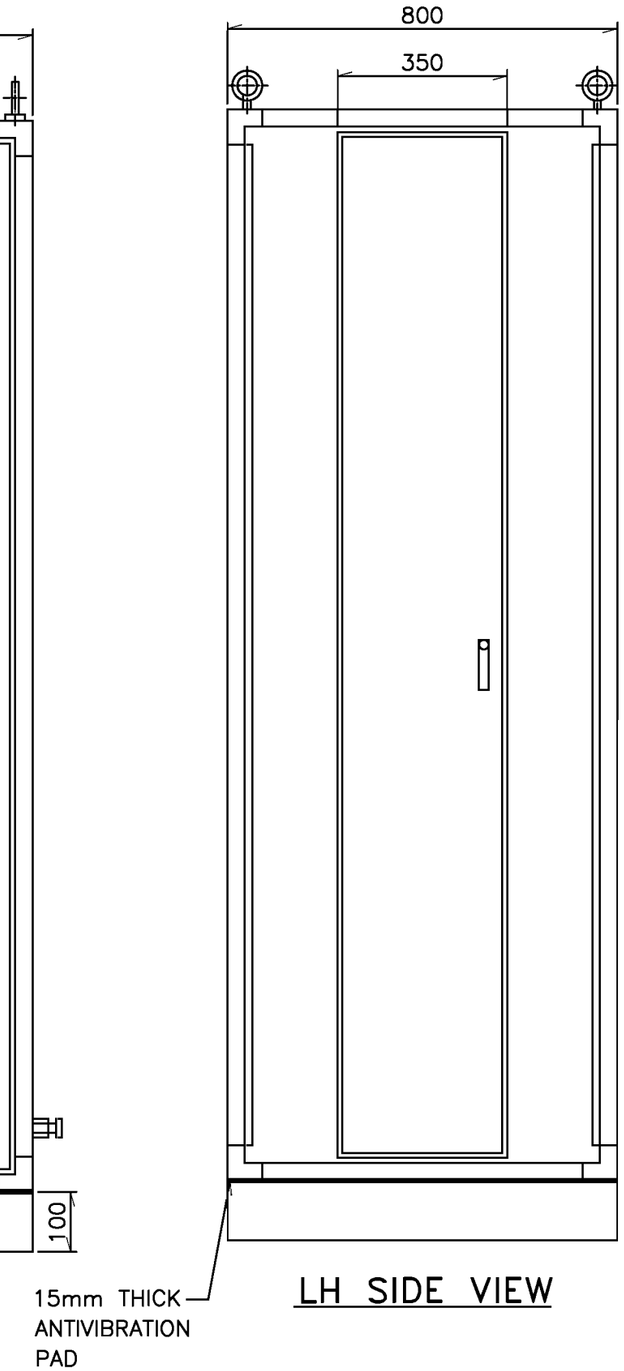
TITLE	DWG.NO.
G.A. DRAWING FOR LOCAL INSTRUMENT ENCLOSURE	PE-189-IN-SK-8004 (SH. 6 OF 10)

LOCAL INSTRUMENT ENCLOSURE



FRONT VIEW



LH SIDE VIEW

NOTES:

1. DIMENSIONS SHOWN ARE TENTATIVE AND SHALL BE FINALIZED AT DETAILING.
2. ALL SHEETS SHALL BE 3mm THICK CRCA SHEET.
3. ALL DOORS SHALL BE FLUSH/CONCEALED TYPE.
4. COLOR:
   EXTERIOR : RAL 7032.
   INTERIOR : BRILLIANT WHITE OVER ALL THICKNESS WILL BE > 100 MICRONS.
5. BASE FRAME WILL BE MADE OUT OF ISMC 100 AND COLOR WILL BE BLACK PAINT FINISH.
6. BULKHEAD PLATE FOR TOP AND BOTTOM SHALL BE 1150 x 650 x 6.
7. CABLE GLAND PLATE OF THICKNESS 3mm CRCA SHEET SHALL BE PROVIDED BOTTOM OF JUCTION BOX.
8. ENCLOSURE PROTECTION CLASS SHALL IP–65.
9. TERMINALS INSIDE JUCTION BOX SHALL BE SCREWLESS CAGE CLAMP TYPE.
10. DOORS SHALL BE PROVIDED WITH CONCEALED HINGES, THREE POINT LOCKING FOR FRONT, REAR AND SIDE DOOR HINGES SHALL BE OF STAINLESS STEEL.
11. XLPE GASKET SHALL BE PROVIDED BETWEEN BULKHEAD PLATE & ENCLOSURE.
12. EARTH BUSBAR 25 x 6 TINNED COPPER.
13. DRAIN PIPE SLOPE SHALL BE 1:25 APPROX.
14. COMMOMN LOCK/KEY SHALL BE PROVIDED FOR ALL LIE'S & JB'S.
15. FOUNDATION BOLTS SHALL BE PROVIDED.
16. TAG PLATES SHALL BE PROVIDED FOR EACH INSTRUMENTS.
17. INSTRUMENT TAG VIS–A–VIS SERVICE AND TERMINAL DETAILS SHALL BE PRINTED ON PHENOLIC BOARD MOUNTED ON BACK SIDE OF JUNCTION BOX DOOR.
18. 20% TERMINALS SHALL BE PROVIDED AS SPARE.
19. NAME PLATE OF PANEL SHALL BE FIXED ON FRONT DOOR.
20. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

FOR BID PURPOSE ONLY

DO NOT SCALE

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DEPT	SIGNATURE	DATE
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MAHARASHTRA STATE POWER GENERATION CO.LTD.
BHUSAWAL T.P.S. UNIT–6 : 1 X 660 MW PROJECT

G.A. DRAWING FOR
LOCAL INSTRUMENT ENCLOSURE

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)

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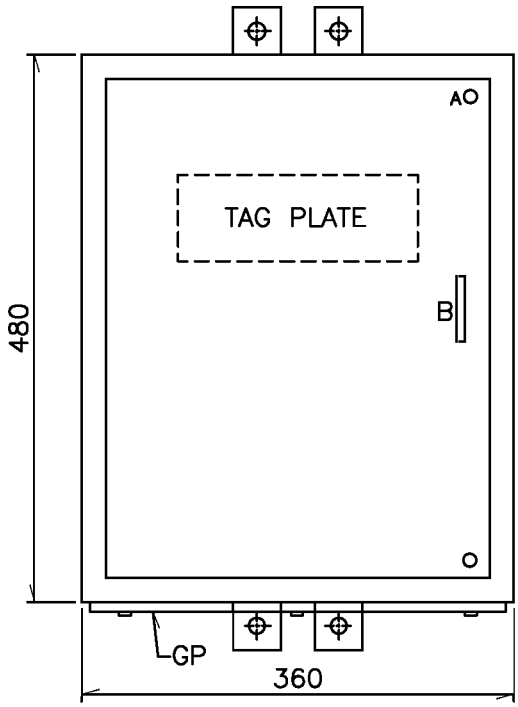
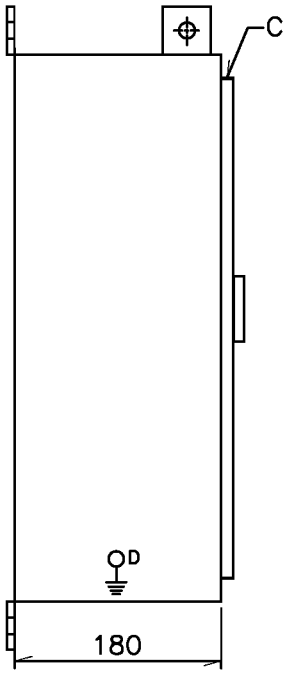
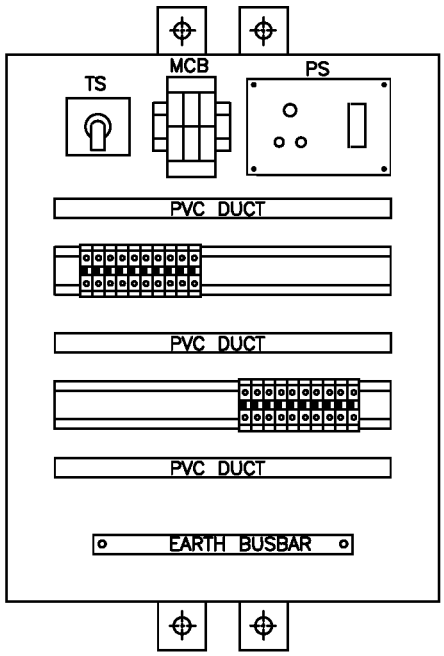


FRONT VIEW



SIDE VIEW



INTERNAL FRONT VIEW

LEGEND:

A – DOOR LOCK
B – DOOR HANDLE
C – HINGES
D – EARTH STUD
GP – GLAND PLATE
PS – POWER SOCKET
TS – TOGGLE SWITCH
TBS – TERMINAL BLOCKS

NOTES:

1. JB WILL BE MADE OUT OF 2.0 mm CRCA SHEET.
2. PROTECTION CLASS IP–65.
3. COLOR: EXT.–RAL 7032, INT.–BRILLIANT WHITE.
4. NUTS FOR MOUNTING THE JUNCTION BOX SHALL BE PROVIDED.
5. 3 mm THICK CRCA GLAND PLATE (GP) AT BOTTOM SHALL BE PROVIDED.
6. SCREWLESS CAGE CLAMP TERMINALS SHALL BE USED.
7. EARTH BUS BAR SHALL BE OF 25x6 TINNED COPPER.
8. INSTRUMENT TAG VIS–A–VIS SERVICE AND TERMINAL DETAILS SHALL BE PRINTED ON PHENOLIC BOARD MOUNTED ON BACK SIDE OF DOOR.
9. COLOR CODE FOR POWER SUPPLY: PHASE–RED, NEUTRAL–BLACK & EARTH – GREEN.
10. CABLE FOR PANEL LIGHTING SHALL BE 1.5 SQ.mm, 1100V GRADE.
11. SIGNAL WIRING SHALL BE 4Px0.5 SQ.mm TINNED COPPER, TWISTED PAIR, OVERALL SHIELDED 500V GRADE, FRLS PVC.
12. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

FOR BID PURPOSE ONLY

ISSUE	BY	CH	DATE

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

PROJECT : BHUSAWAL T.P.S. UNIT–6 : 1 X 660 MW PROJECT

DO NOT SCALE | DATE : 23–08–2011

G.A. OF JB LOCAL INSTRUMENT RACK

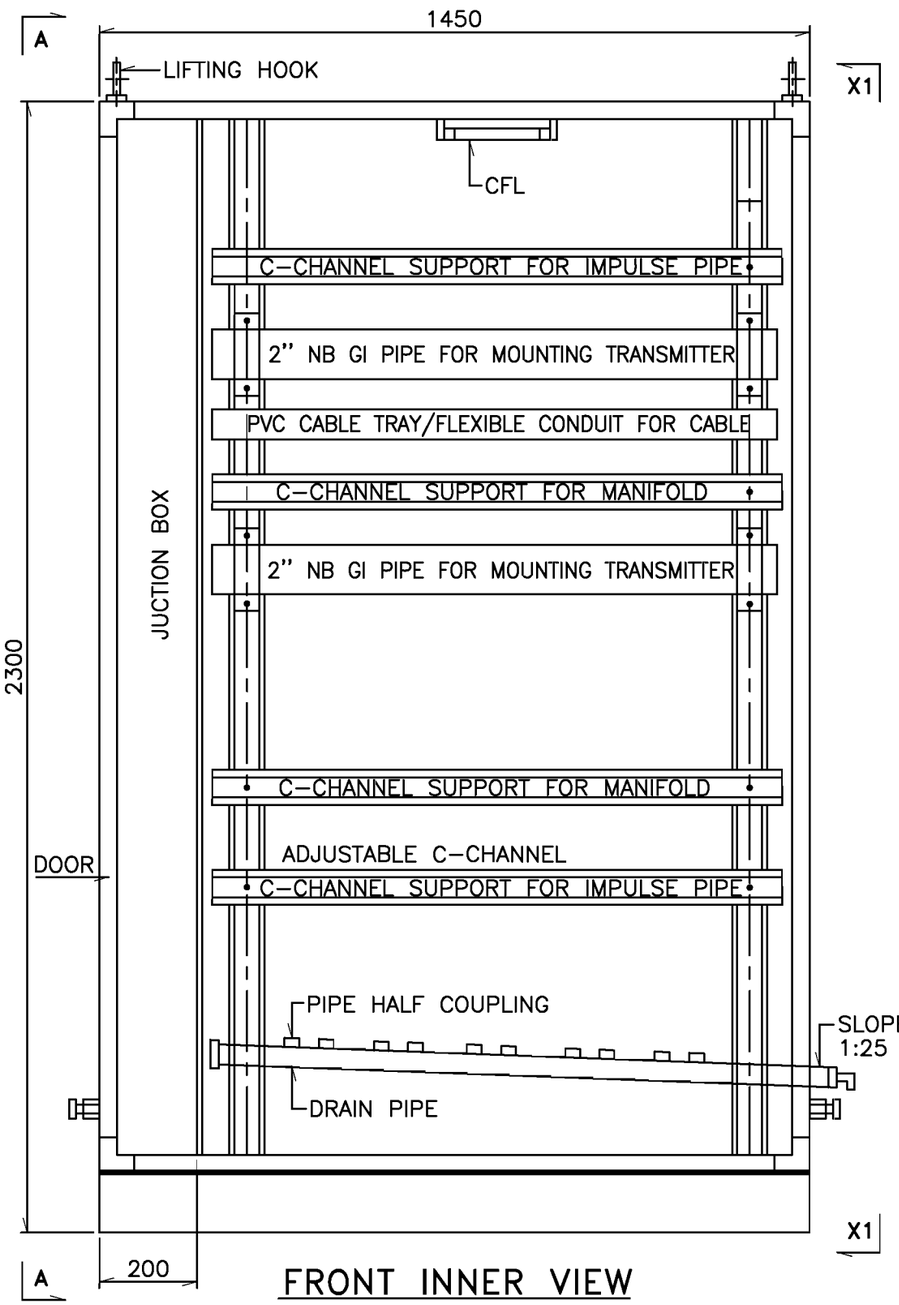
SCALE ~ | APPROVED

DIV INST.
DR P.N.Z.
CH D.J.P.

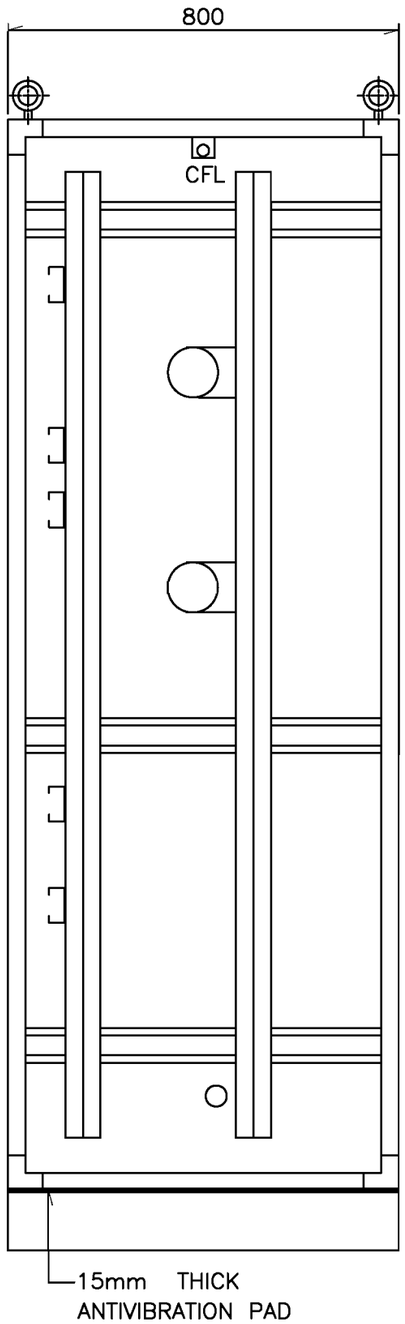
DWG.NO.PE–189–IN–SK–8004 (SH. 5 OF 10) | P0

TITLE INNER G.A. DRAWING FOR LOCAL INSTRUMENT ENCLOSURE

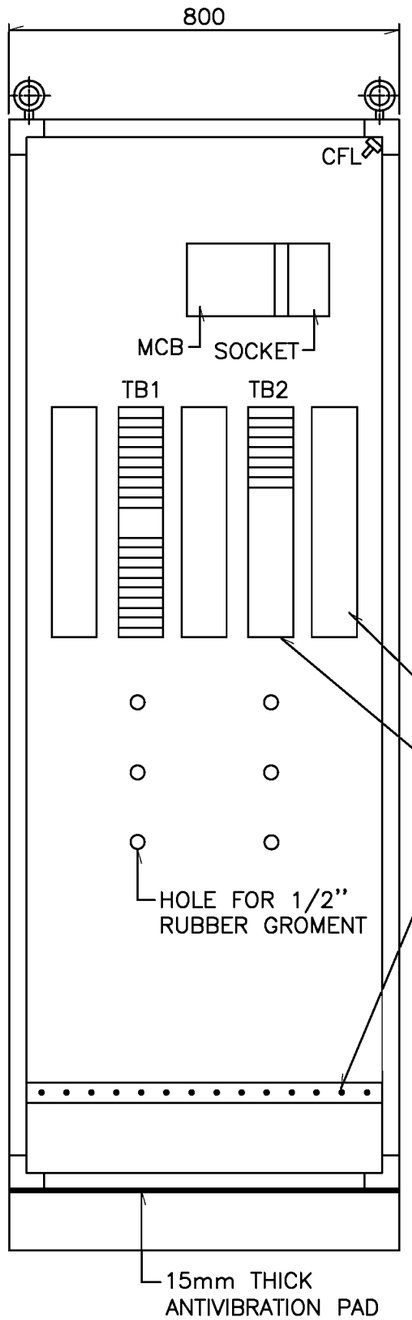
DWG.NO. PE-189-IN-SK-8004 (SH. 7 OF 10)



FRONT INNER VIEW



SIDE VIEW FROM X1-X1



SIDE VIEW FROM A-A

NOTES:

1. PVC WIRE DUCT WITH COVER SHALL BE PROVIDED.
2. FOR ILLUMINATION COMPACT FLUORESCENT LAMP IN LIE AND IN JB SHALL BE PROVIDED.
3. DRAIN HEADER IS APPLICABLE FOR STEAM/WATER PROCESS IMPULSE LINES ONLY.
4. DRAIN PIPE SHALL BE 2" NB ASTM A106 GR.C SCH.80.
5. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

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BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

INNER G.A. DRAWING FOR LOCAL INSTRUMENT ENCLOSURE

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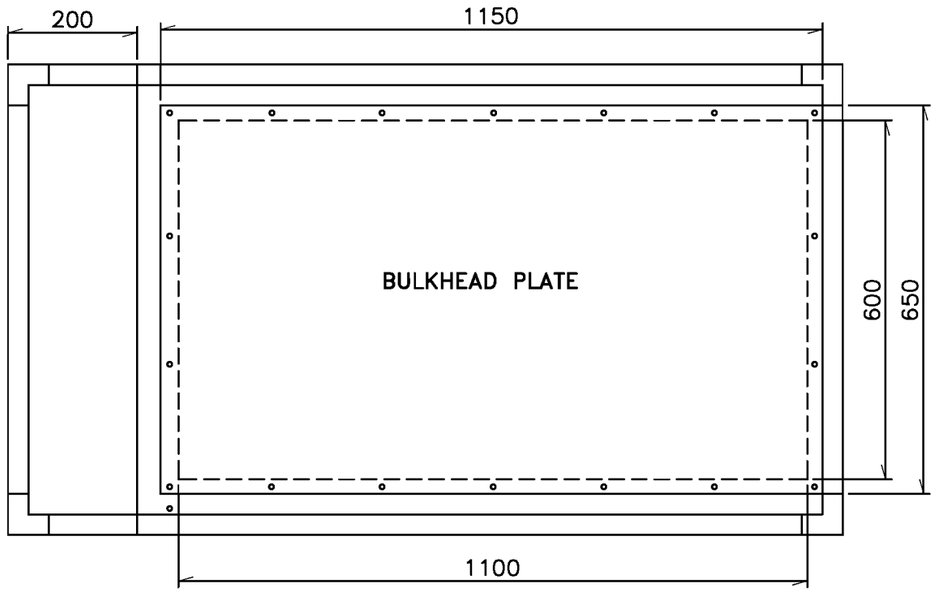
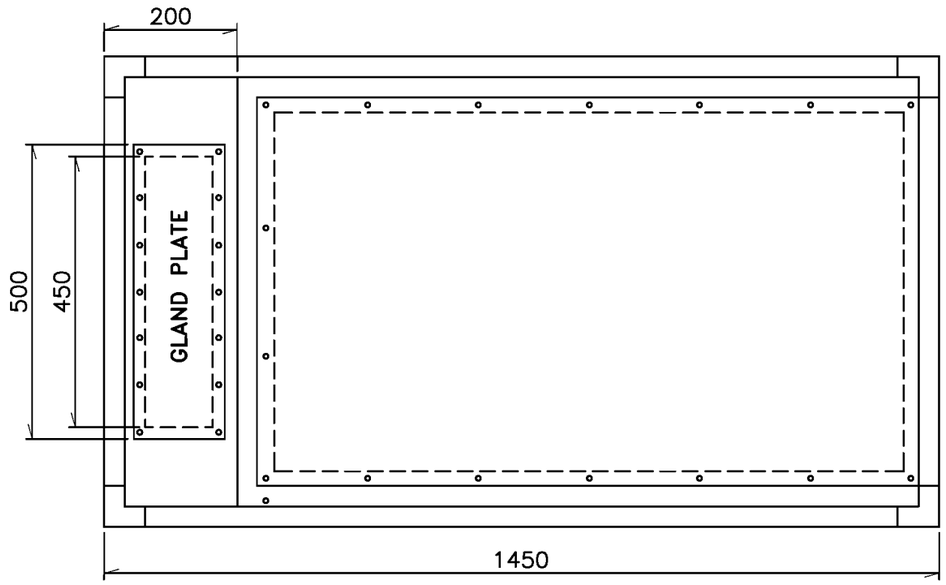
TITLE BULKHEAD DETAILS FOR LOCAL INSTRUMENTS ENCLOSURE

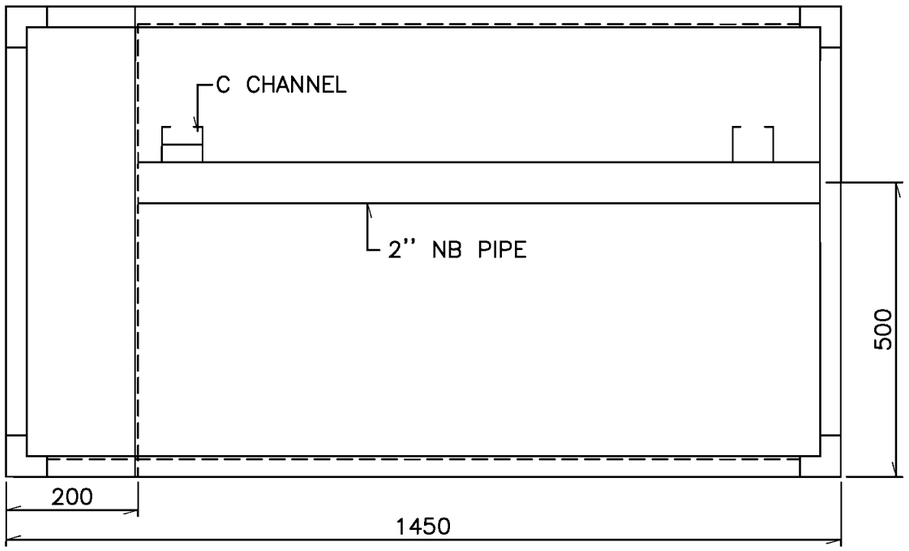
DWG.NO. PE-189-IN-SK-8004 (SH. 8 OF 10)



TOP VIEW



BOTTOM VIEW



TOP VIEW WITHOUT BULKHEAD PLATE

NOTES:

1. BULK HEAD PLATE DIMENSION ARE 1150 x 650 x 6.
2. IMPULSE PIPE ENTRY: BOTTOM ENTRY FOR AIR/FLUE GAS APPLICATIONS.
3. IMPULSE ENTRY: TOP ENTRY FOR STEAM/WATER APPLICATIONS.
4. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

FOR BID PURPOSE ONLY

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BULKHEAD DETAILS FOR LOCAL INSTRUMENT ENCLOSURE

PROCON ENGINEERS

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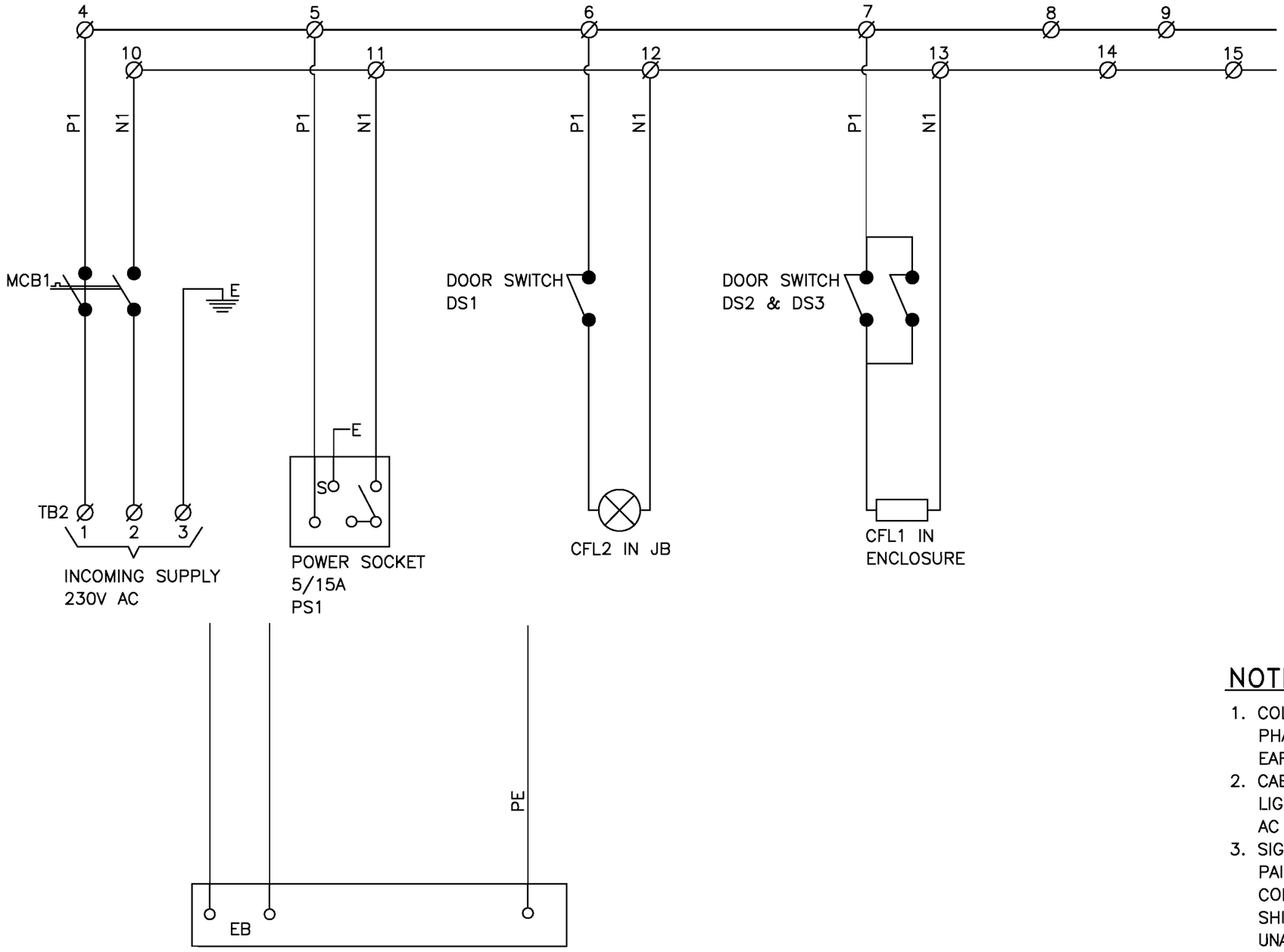
TITLE ELECTRICAL WIRING AND TERMINATION DRAWING FOR LOCAL INSTRUMENT ENCLOSURE

DWG.NO. PE-189-IN-SK-8004 (SH. 9 OF 10)

POWER WIRING CIRCUIT



NOTES:

1. COLOR CODING FOR POWER SUPPLY: PHASE–RED, NEUTRAL–BLACK AND EARTH–GREEN.
2. CABLE ROUTING FROM TB TO PANEL LIGHT WILL BE 1.5 sq.mm 1100V AC GRADE.
3. SIGNAL WIRING WILL BE DONE BY 4 PAIR x 0.5 sq.mm ANNEALED TINNED COPPER, PAIR TWISTED OVERALL & SHIELDED, VOLTAGE GRADE 1100V, UNARMOURED FRLS PVC SHIELDED CABLE.

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ELECTRICAL WIRING AND TERMINATION DRAWING FOR LOCAL INSTRUMENT ENCLOSURE

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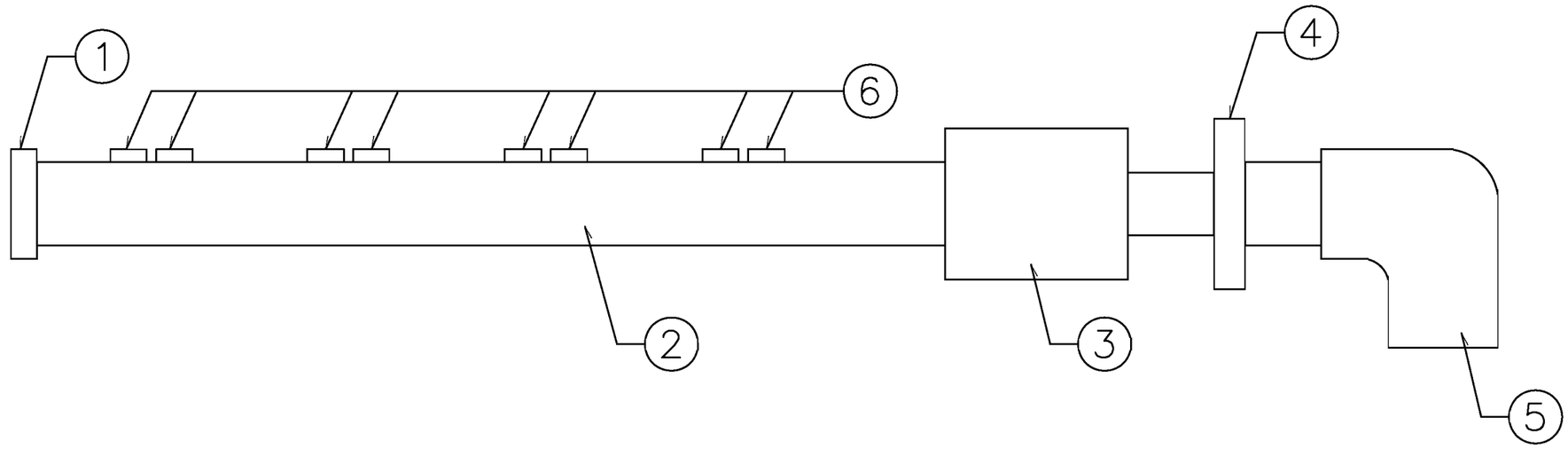
CH. D.J.P.	DWG.NO. PE–189–IN–SK–8004 (SH. 9 OF 10)	ISSUE P0

TITLE DRAIN HEADER DETAIL FOR LOCAL INSTRUMENT ENCLOSURE

DWG.NO. PE-189-IN-SK-8004 (SH. 10 OF 10)



BILL OF MATERIAL

SL. NO.	DESCRIPTION	QTY.
1	2'' S.W. CAP, CS	1
2	2'' NB, ASTM A-106, SCH 80/GR. C	1
3	2'' SW x 1'' NPT(F) COUPLING, CS	1
4	1'' NPT(M) x 1'' BSP(M) HEX. NIPPLE WITH FITTING, CS	1
5	1'' BSP(F) ELBOW, CS (BOTH ENDS THREADED)	1
6	HALF COUPLING; SIZE; 1/2'' NB SW	AS REQD.

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DRAIN HEADER DETAIL FOR LOCAL INSTRUMENT ENCLOSURE

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SCALE ~

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DATE(CURRENT ISSUE) 23-08-2011

CH. D.J.P.

DWG.NO. PE-189-IN-SK-8004 (SH. 10 OF 10)

ISSUE P0

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

FOR BID PURPOSE ONLY

DO NOT SCALE | DATE : 23-08-2011

ISSUE	BY	CH	DATE

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

SCALE ~ | APPROVED

DIV INST.
DR P.N.Z.
CH D.J.P.

DWG.NO.PE-189-IN-SK-8003 (SH. 1 OF 20) | P0

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 AND SPECIFICATION OF CONTROL & INSTRUMENTATION.

3. DRAIN PIPE IN RACK AND ENCLOSURE SHALL BE 2'' NB SCH 80.

FOR BID PURPOSE ONLY

ISSUE	BY	CH	DATE

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

DO NOT SCALE | DATE : 23-08-2011

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

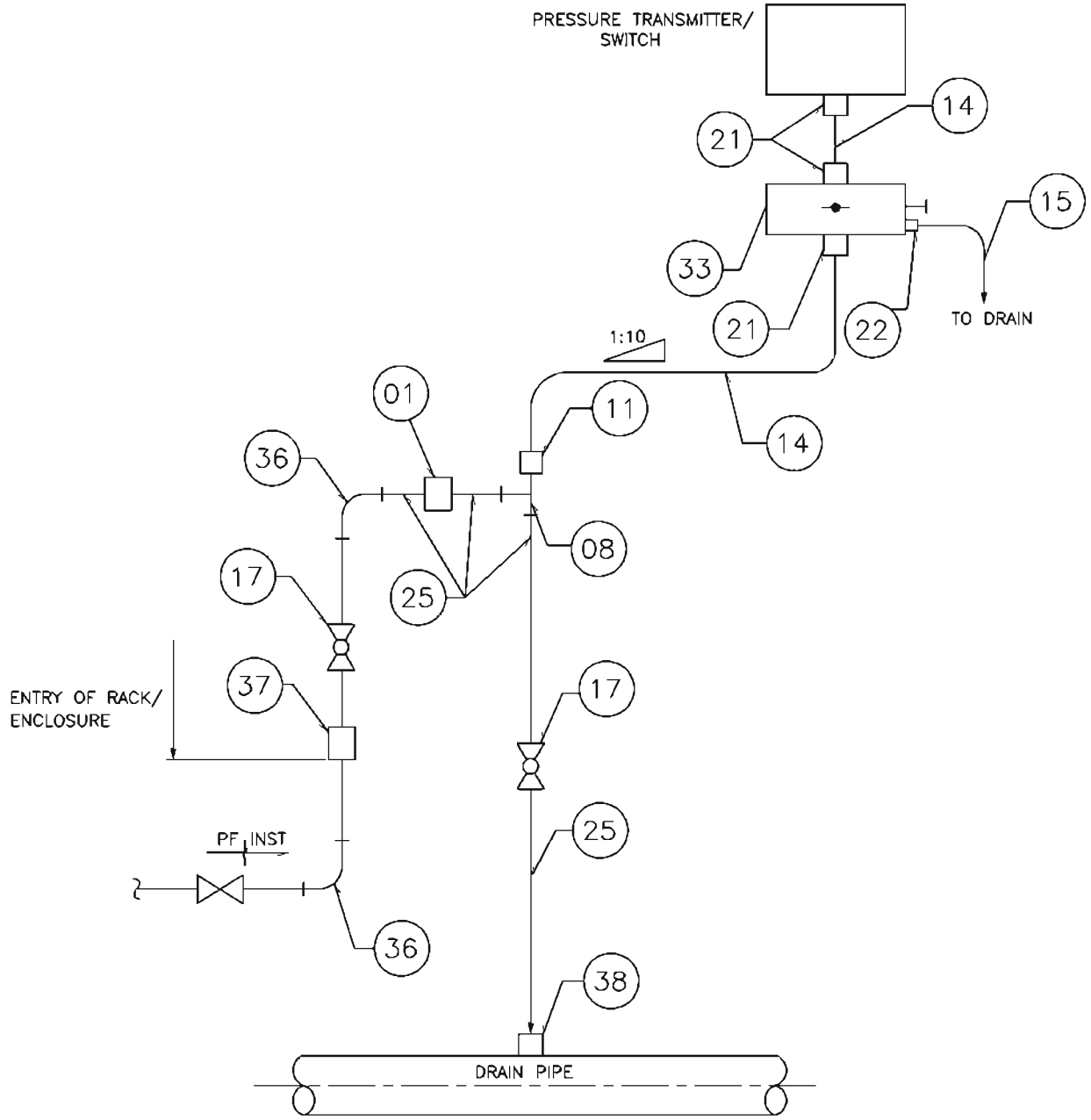
SCALE ~ | APPROVED

DIV INST.
DR P.N.Z.
CH D.J.P.

DWG.NO. PE-189-IN-SK-8003 (SH. 2 OF 20) | P0

TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM

DWG.NO. PE-189-IN-SK-8003 (SH. 3 OF 20)



PRESSURE TRANSMITTER/PRESSURE SWITCH MOUNTED ABOVE SOURCE POINT

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
08	1	EQUAL TEE (FEMALE) 1/2" SW 3000lbs, CS/AS
11	1	MALE CONNECTOR 1/2" PE x 1/2" OD 3000l lbs OF CS/AS
17	2	GLOBE VALVE 1/2" SW 800lbs OF CS/AS
14	3 MTRS.	TUBE 1/2" OD, 2.1mm THICK, SS 316
21	3	MALE CONNECTOR 1/2" NPT(M) x 1/2" OD 3000 lbs, SS 316
25	15 MTRS.	IMPULSE PIPE 15 NB SCH 80, CS/AS
33	1	2 VALVES MANIFOLD 1/2" NPT(F), SS 316
01	1	FULL COUPLING 1/2" SW 3000lbs, CS/AS
15	0.15 MTRS.	TUBE 8mm OD, 1.0mm THK. SS 316
22	1	MALE CONNECTOR 1/4" NPT(M) x 8mm OD 3000 lbs
36	2	90° ELBOW 1/2" SW 3000lbs, CS/AS
37	1	BULKHEAD UNION/COUPLING CL:3000 lbs, 1/2" NB-SW, AS PER ANSI B16.11, CS/AS
38	1	HALF COUPLING CL:3000 lbs/ 1/2" NB-SW, AS PER ANSI B16.11, CS/AS

SERVICE : CONDENSER PRESSURE, INSTRUMENT AIR ETC.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED CHEM	CIVIL	ELEC	I&C	MECH	APPD	DATE

FOR RO ISSUE ONLY		
CLEARED		
DEPT	SIGNATURE	DATE
CHEM		
CIVIL		
ELEC		
I&C		
MECH		

"A" (PRELIMINARY) ISSUED ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION / FABRICATION SHOP IS PERMITTED ONLY 'B' (INCLUSIVE) ISSUED ONLY.

INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION / FABRICATION FIELD MUST GO DESIGN OFFICE TO CLEAR 'HOLDS' IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION / FABRICATION WORK RELATED TO 'HOLDS'.

DRAWINGS SIGNED BY PROCON ENGINEERS' AUTHORISED REPRESENTATIVE ONLY ARE CONSIDERED VALID DRAWINGS.

MAHAGENCO

MAHARASHTRA STATE POWER GENERATION CO.LTD.
BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

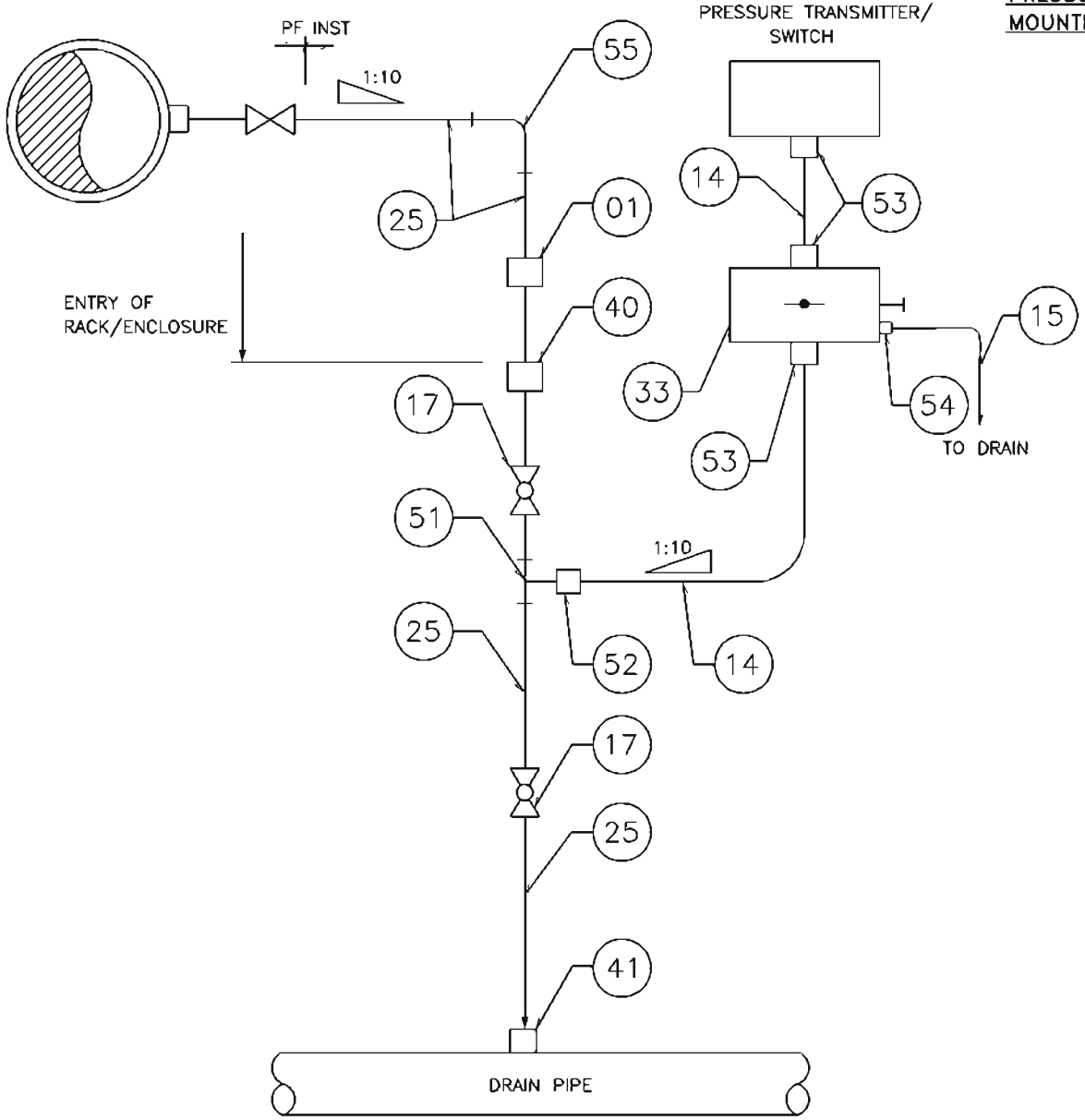
TYPICAL INSTRUMENT INSTALLATION DIAGRAM

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)

SCALE ~	APPROVED	DATE(RO ISSUE)
DSN. INST.		DATE(CURRENT ISSUE) 23-08-2011
DR. P.N.Z.		
CH. D.J.P.	DWG.NO. PE-189-IN-SK-8003(SH. 3 OF 20)	ISSUE PO

TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM

DWG.NO. PE-189-IN-SK-8003 (SH. 4 OF 20)



PRESSURE TRANSMITTER/PRESSURE SWITCH MOUNTED BELOW SOURCE POINT

BILL OF MATERIAL

ITEM NO.	QTY./ INST	DESCRIPTION
51	1	EQUAL TEE (FEMALE) 1/2" SW 6000lbs, CS/AS
52	1	MALE CONNECTOR 1/2" PE x 1/2" OD 6000l lbs, CS/AS
17	2	GLOBE VALVES 1/2" SW 800lbs, CS/AS
14	3 MTRS.	TUBE 1/2" OD, 2.1mm THK, SS 316
53	3	MALE CONNECTOR 1/2" NPT(M) x 1/2" OD 6000 lbs, SS 316
25	15 MTRS.	IMPULSE PIPE 15 NB GR.B SCH 80, CS/AS
33	1	2 VALVES MANIFOLD 1/2" NPT(F), SS 316
01	1	FULL COUPLING 1/2" SW 6000lbs, CS/AS
15	0.15 MTRS.	TUBE 8mm OD, 1.0mm THK, SS 316
54	1	MALE CONNECTOR 1/4" NPT(M) x 8mm OD 6000 lbs, SS 316
55	2	90° ELBOW 1/2" SW 6000lbs, CS/AS
40	1	BULKHEAD UNION/COUPLING CL:6000 lbs, 1/2"NB-SW, AS PER ANSI B16.11, CS/AS
41	1	HALF COUPLING CL:6000 lbs, 1/2" NB-SW, AS PER ANSI B16.11, CS/AS

SERVICE : CONDENSATE, FEED WATER ETC.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED CHEM	CIVIL	ELEC	I&C	MECH	APPD	DATE

FOR RO ISSUE ONLY

CLEARED		
DEPT	SIGNATURE	DATE
CHEM		
CIVIL		
ELEC		
I&C		
MECH		

"A" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

CONSTRUCTION / FABRICATION WORK is PERMITTED ON "B" (RELEASED) ISSUES ONLY.

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DRAWINGS SIGNED BY PROCON ENGINEERS' AUTHORISED REPRESENTATIVE ONLY ARE CONSIDERED VALID DRAWINGS.

MAHAGENCO

MAHARASHTRA STATE POWER GENERATION CO.LTD.
BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

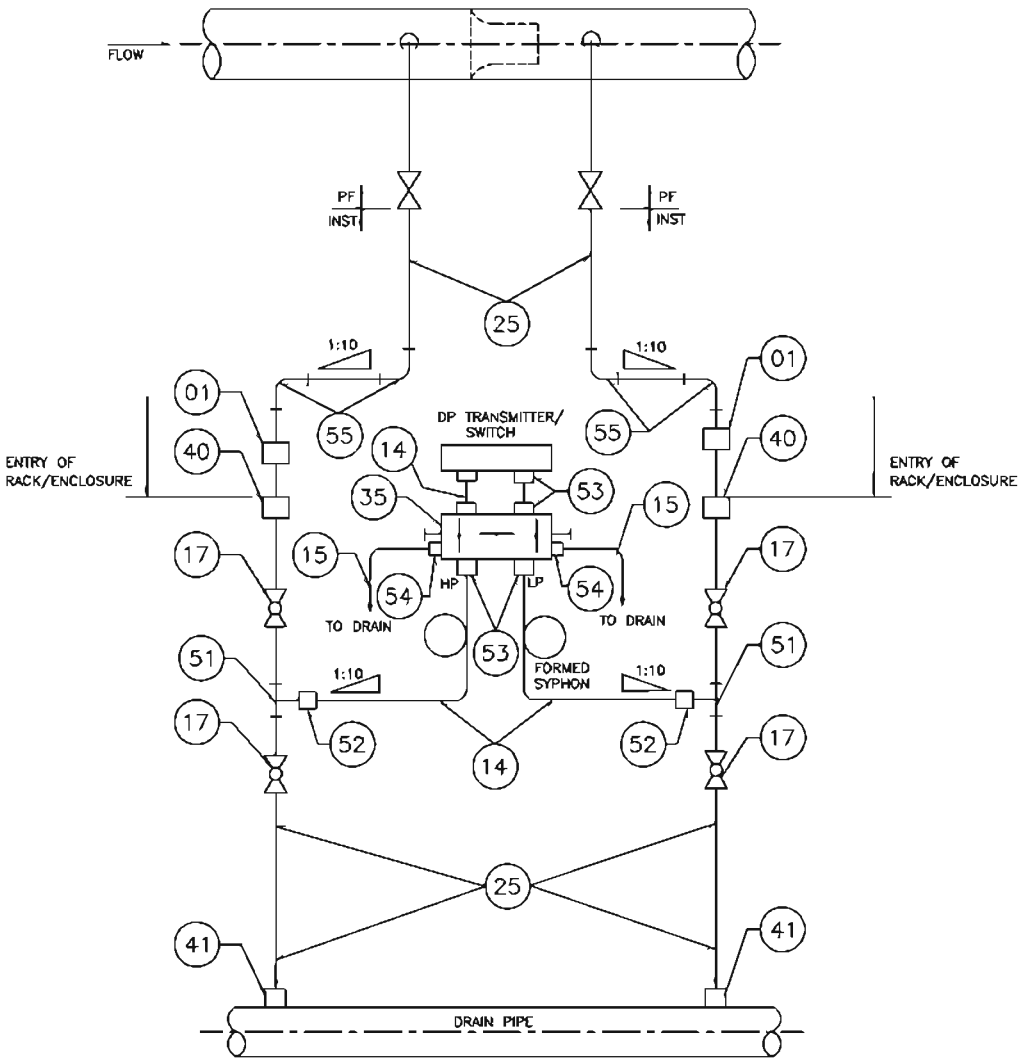
PROCON ENGINEERS
(DIVISION OF NIMGTO CONSULTING ENGINEERS PVT.LTD.)

SCALE ~	APPROVED	DATE(RO ISSUE)
DN. INST.		DATE(CURRENT ISSUE) 23-08-2011
DR. P.N.Z.		
CH. D.J.P.	DWG.NO. PE-189-IN-SK-8003 (SH. 4 OF 20)	ISSUE P0

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

DWG.NO. PE-189-IN-SK-8003 (SH. 1 OF 2)

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



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
51	2	EQUAL TEE (FEMALE)1/2" SW 6000lbs CS/AS
52	2	MALE CONNECTOR 1/2" PE x 1/2" OD 6000 lbs, CS/AS
17	4	GLOBE VALVES 1/2" SW 800lbs, CS/AS
14	6 MTRS.	TUBE 1/2" OD, 2.1mm THK, SS 316
53	6	MALE CONNECTOR 1/2" NPT(M) x 1/2" OD 6000 lbs, SS 316
25	30 MTRS.	IMPULSE PIPE 15 NB GR.B SCH 80, CS/AS
35	1	5 VALVES MANIFOLD 1/2" SE 6000 lbs, SS 316
01	2	FULL COUPLING 1/2" SW 6000lbs, CS/AS
15	0.3 MTRS.	TUBE 8mm OD, 1.0mm THK, SS 316
54	2	MALE CONNECTOR 1/4" NPT(M) x 8mm OD 6000 lbs, SS 316
55	4	90° ELBOW 1/2" SW 6000lbs, CS/AS
40	2	BULKHEAD UNION/COUPLING CL:6000 lbs, 1/2" NB-SW, AS PER ANSI B16.11, CS/AS
41	2	HALF COUPLING CL:6000 lbs, 1/2" NB-SW, AS PER ANSI B16.11, CS/AS

SERVICE : CONDENSATE, FEED WATER ETC.
PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE.

FOR BID PURPOSE ONLY

DO NOT SCALE

MAHAGENCO MAHARASHTRA STATE POWER GENERATION CO.LTD.
BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)

ISSUE	REVISIONS	BY	CLEARED CHEM	CIVIL	ELEC	I&C	MECH	APPD	DATE

FOR RO ISSUE ONLY — CLEARED

DEPT	SIGNATURE	DATE
CHEM		
CIVIL		
ELEC		
I&C		
MECH		

"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK. CONSTRUCTION / FABRICATION WORK IS PERMITTED ON "R" (RELEASED) ISSUES ONLY.

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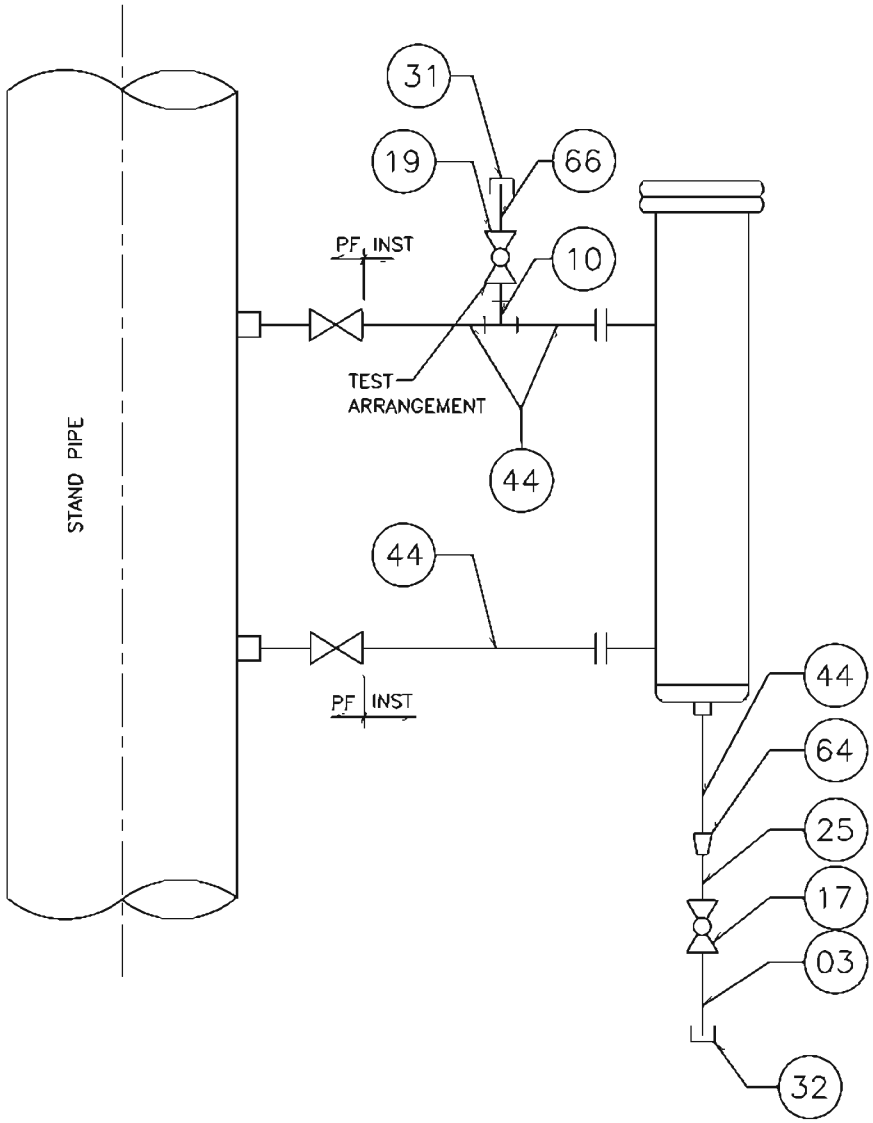
DRAWINGS SIGNED BY PROCON ENGINEERS' AUTHORISED REPRESENTATIVE ONLY ARE CONSIDERED VALID DRAWINGS.

SCALE	~		DATE (RO ISSUE)
DIV.	INST.	APPROVED	DATE (CURRENT ISSUE) 23-08-2011
DR.	P.N.Z.		
CH.	D.J.P.	DWG.NO. PE-189-IN-SK-8003 (SH. 1 OF 2)	ISSUE P0

TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM
DWG.NO. PE-189-IN-SK-8003 (SH. 10 OF 20)

FLOAT OPERATED LEVEL SWITCH



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
17	1	GLOBE VALVES 1/2" SW 800lbs, CS/AS
25	0.5 MTRS.	IMPULSE PIPE 15 NB SCH 80, CS/AS
32	1	PLUG 1/2" NPT(M) 3000lbs, CS/AS
10	2	EQUAL TEE (FEMALE) 1" SW 3000lbs, CS/AS
44	2 MTRS.	IMPULSE PIPE 25 NB SCH 80, CS/AS
64	1	REDUCER 1" SW x 1/2" SW 3000lbs, CS/AS
19	1	GLOBE VALVES 1" SW 800lbs, CS/AS
31	1	PLUG 1" NPT(F) 3000lbs, CS/AS
66	1	1" NB SCH 80 SW x 1" NPT(M) SEAMLESS NIPPLE 3000 lbs, CS/AS
03	1	15 NB SCH 80 SW x 1/2" NPT(M) SEAMLESS NIPPLE 3000lbs, CS/AS

SERVICE : CONDENSATE.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED CHEM	CIVIL	ELEC	I&C	MECH	APPD	DATE

FOR RO ISSUE ONLY		
CLEARED		
DEPT	SIGNATURE	DATE
CHEM		
CIVIL		
ELEC		
I&C		
MECH		

"A" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSE ONLY AS INDICATED IN THE SHELL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.
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MAHAGENCO — MAHARASHTRA STATE POWER GENERATION CO.LTD.
BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)

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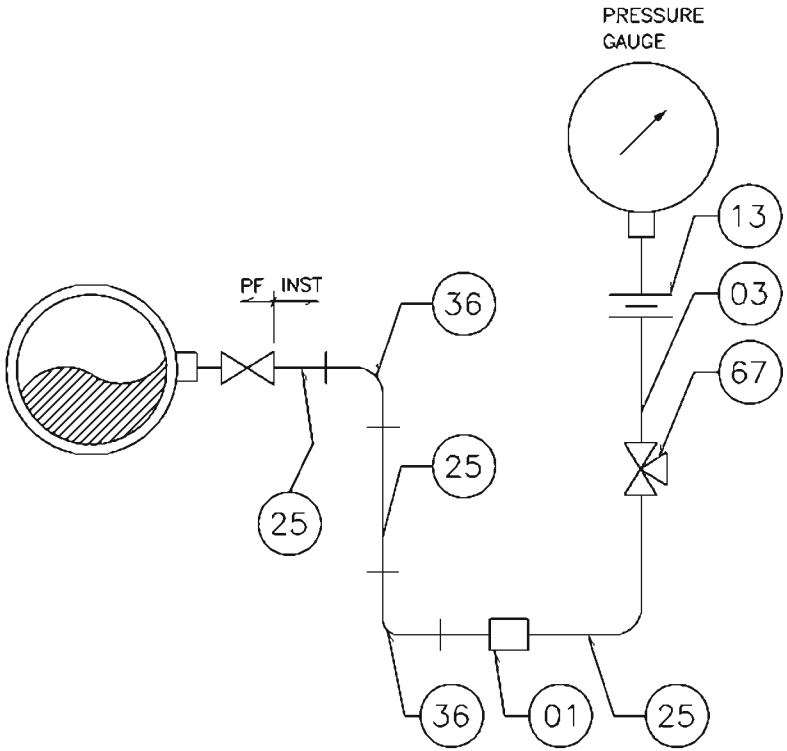
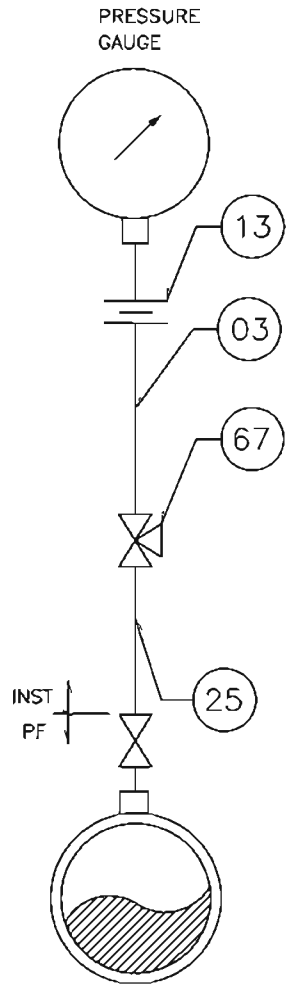
DN.	INST.		
DR.	P.N.Z.		DATE(CURRENT ISSUE) 23-08-2011
CH.	D.J.P.	DWG.NO. PE-189-IN-SK-8003 (SH. 10 OF 20)	ISSUE P0



HORIZONTAL TAPPING



VERTICAL TAPPING

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
25	15 MTRS.	IMPULSE PIPE 15 NB SCH 80, CS/AS
01	1	FULL COUPLING 1/2" SW 3000lbs, CS/AS
36	2	90° ELBOW 1/2" SW 3000lbs, CS/AS
03	1	1/2" NPT(M) x 1/2" PE, 4" LONG NIPPLE, CS/AS
13	1	NUT & TAIL FITTING WITH CU WASHER 1/2" NPT(F) x 1/2" PE
67	1	3 WAY GAUGE COCK 1/2" SW 3000lbs, CS/AS

SERVICE : WATER, CONDENSATE ETC.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED CHEM	CIVIL	ELEC	I&C	MECH	APPD	DATE

FOR RO ISSUE ONLY		
CLEARED		
DEPT	SIGNATURE	DATE
CHEM		
CIVIL		
ELEC		
I&C		
MECH		

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MAHAGENCO
MAHARASHTRA STATE POWER GENERATION CO.LTD.
BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

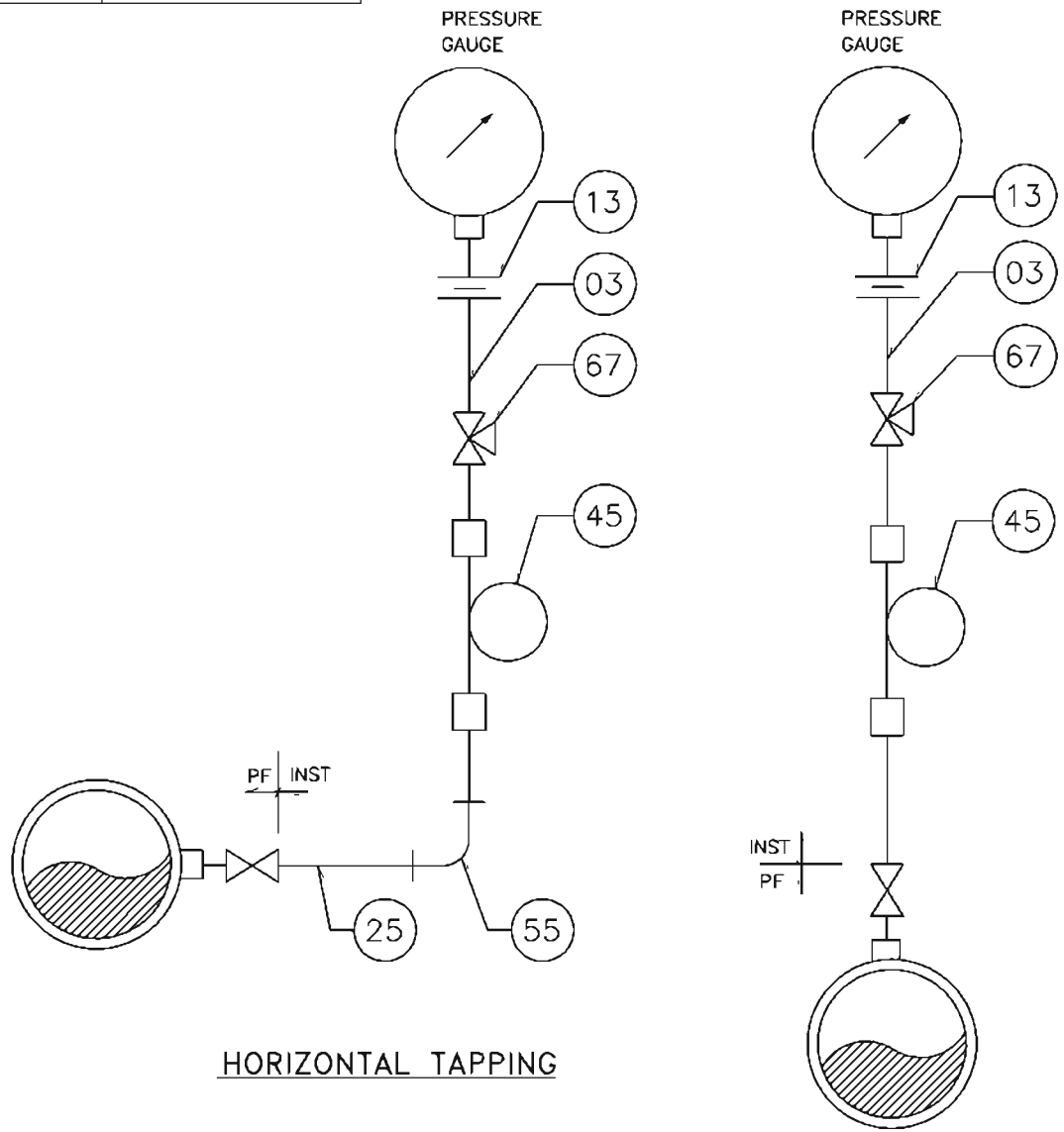
TYPICAL INSTRUMENT INSTALLATION DIAGRAM

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)

SCALE	~	APPROVED	DATE(RO ISSUE)
DN.	INST.		
DR.	P.N.Z.		DATE(CURRENT ISSUE) 23-08-2011
CH.	D.J.P.	DWG.NO. PE-189-IN-SK-8003 (SH. 11 OF 20)	ISSUE P0

TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM

DWG.NO. PE-189-IN-SK-8003 (SH. 12 OF 20)



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
25	15 MTRS.	IMPULSE PIPE 15 NB SCH 80, CS/AS
55	1	90° ELBOW 1/2" SW 6000lbs, CS/AS
03	1	1/2" NPT(M) x 1/2" PE 4" LONG NIPPLE, CS/AS
13	1	NUT & TAIL FITTING WITH SS WASHER 1/2" NPT(F) x 1/2" PE
45	1	SYPHON 1/2" OD SCH. 80, CS/AS
67	1	3 WAY GAUGE COCK 1/2" SW 3000lbs, CS/AS

SERVICE : STEAM, FEED WATER.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED CHEM	CIVIL	ELEC	I&C	MECH	APPD	DATE

FOR RO ISSUE ONLY CLEARED		
DEPT	SIGNATURE	DATE
CHEM		
CIVIL		
ELEC		
I&C		
MECH		

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MAHAGENCO

MAHARASHTRA STATE POWER GENERATION CO.LTD.
BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)

SCALE	~	APPROVED	DATE(RO ISSUE)
DIV.	INST.		
DR.	P.N.Z.		DATE(CURRENT ISSUE) 23-08-2011
CH.	D.J.P.	DWG.NO. PE-189-IN-SK-8003(SH. 12 OF 20)	ISSUE P0

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
27	15MTRS.	IMPULSE PIPE 3/4'' NB, CS/AS.
26	A/R	GI PIPE, 1/2'' NB.
09	2	FORGED UNEQUAL TEE AS PER ANSI B16:11 SIZE: 2 x3/4'' NB SW x 1/2'' NPTF,CL 3000.
46	3	GALVANISED ELBOW CL 3000 SIZE: 1/2'' NPTF.
20	1	QUICK DISCONNECTING FITTING MALE/END CONN. TO SUIT 1/2'' OD CONN.
02	A/R	NYLON NOSE TO SUIT 1/2'' END CONN. PR. TESTING 10 Kg/cm^2g.
14	A/R	SEAMLESS TUBE 1/2'' OD, 2.1mm THICK, SS 316.
47	3	BULK HEAD COUPLING TO SUIT 1/2'' OD TUBE & 1/2'' NB PIPE, SS 316.
65	5	BALL VALVE 1/2'' NPT(F), SS 316.
21	18	MALE CONNECTOR 1/2'' NPT(M) x 1/2'' OD 3000lbs, SS 316.
48	1	INSTRUMENT AIR HEADER 1'' NB PIPE, SS 316.
64	1	EQUAL TEE, SS 316, TO SUIT 1/2'' OD TUBE.
05	1	PR. GAUGE, 4'' DIAL SIZE, RANGE 0–10 Kg/cm^2g CONNECTION 1/2'' NPTM
06	1	3 WAY GAUGE COCK 1/2''NPTF x 1/2'' OD.

FOR BID PURPOSE ONLY

DO NOT SCALE | DATE : 23–08–2011

ISSUE	BY	CH	DATE

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

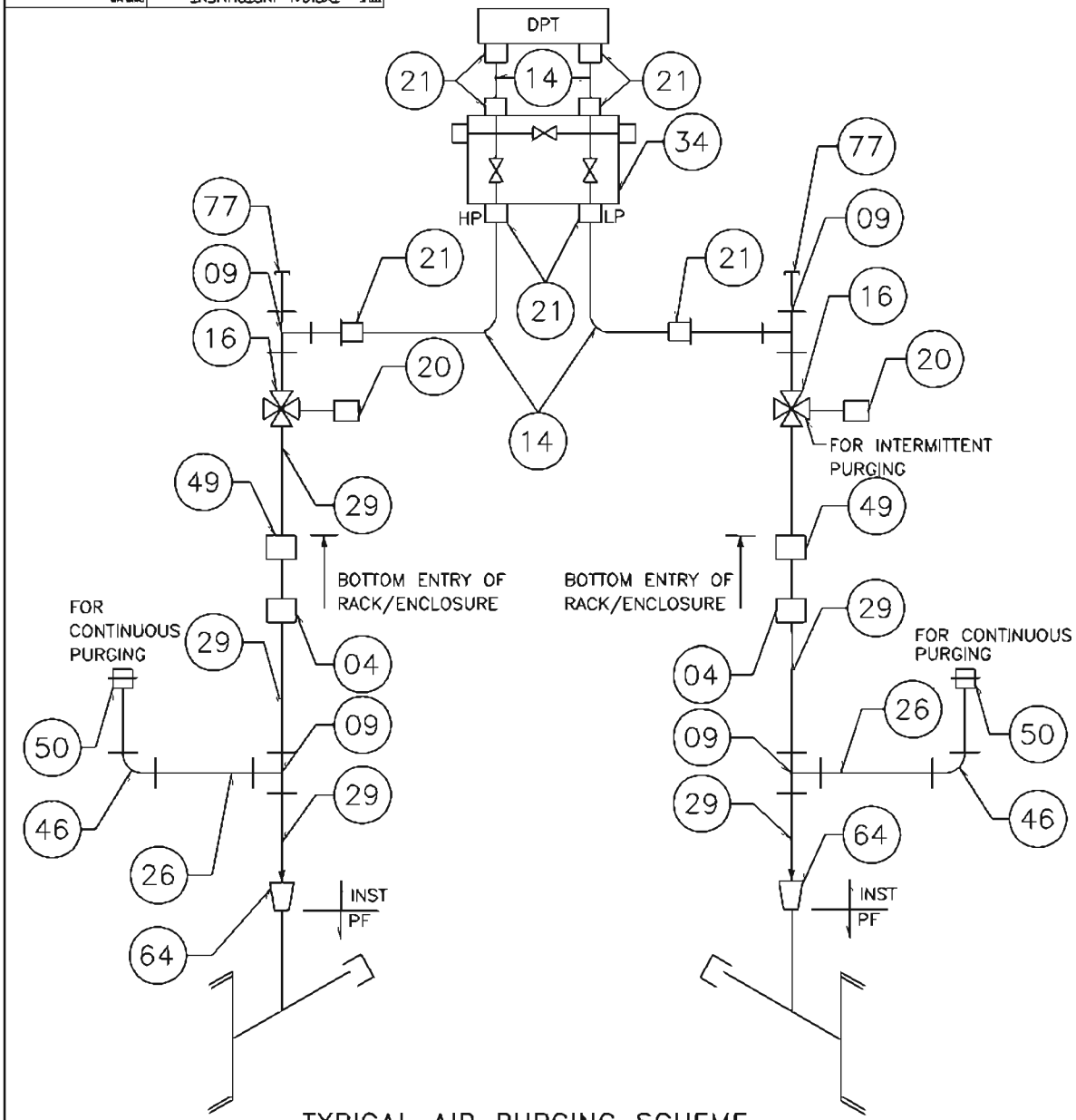
PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

SCALE ~ | APPROVED

DIV INST.
DR P.N.Z.
CH D.J.P.

DWG.NO.PE-189-IN-SK-8003 (SH. 18 OF 20) | PO



TYPICAL AIR PURGING SCHEME

BILL OF MATERIAL

ITEM NO.	QTY./ INST	DESCRIPTION
64	2	REDUCER 1" BSPF x 3/4" NB-SW CL 3000, CS/AS
04	2	FORGED COUPLING 3/4" SW CL 3000 AS PER ANSI B16:11
09	4	FORGED UNEQUAL TEE AS PER ANSI B16.11 SIZE : 2 x 3/4" NB-SW x1/2" NPTF, CL 3000
77	2	NIPPLE & CAP 3/4" NB-SCH 80,CAP-3/4" NPTF
14	6 MTRS.	SEAMLESS TUBE 1/2" OD, x 2.1mm THK., SS 316
16	2	FOUR WAY VALVE SIZE: (2 x 3/4" NB-SW)x(2 x 1/2"NPTF) CL:800
20	2	QUICK DISCONNECTING FITTING SIZE: 1/2"NPTM
21	8	MALE CONNECTOR 1/2" NPT(M) x TO SUIT 1/2" OD TUBE, SS 316
29	30 MTRS.	SEAMLESS PIPE/3/4" NB SCH 80
26	A/R	PIPE AS PER IS-1239 SIZE: 1/2" NB-HEAVY GRADE
34	1	3 VALVE MANIFOLD 1/2" NPT(F), SS 316
46	2	GALVANISED ELBOW CL 3000 SIZE : 1/2" NPTF
49	2	BULK HEAD COUPLING CL 3000 SIZE : 3/4" NB SW, CL 3000, AS PER ANSI B16.11
50	2	BULK HEAD COUPLING CL 3000 SIZE : 1/2" NPTF, AS PER ANSI B16.11

SERVICE : FLUE GAS, FURNACE ETC.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED CHEM	CIVIL	ELEC	I&C	MECH	APPD	DATE

FOR RO ISSUE ONLY — CLEARED

DEPT	SIGNATURE	DATE
CHEM		
CIVIL		
ELEC		
I&C		
MECH		

"A" (PRELIMINARY) ISSUED ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK.

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DRAWINGS SIGNED BY PROCON ENGINEERS' AUTHORISED REPRESENTATIVE ONLY ARE CONSIDERED VALID DRAWINGS.

MAHAGENCO

MAHARASHTRA STATE POWER GENERATION CO.LTD.
BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

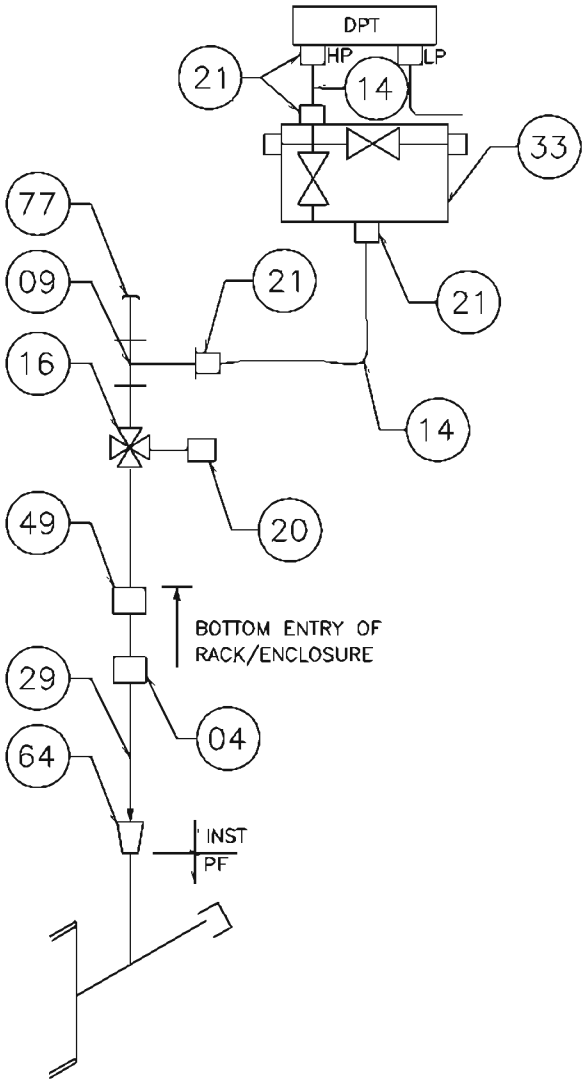
TYPICAL INSTRUMENT INSTALLATION DIAGRAM

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)

SCALE ~	APPROVED	DATE(RO ISSUE)
DW. INST.		DATE(CURRENT ISSUE) 23-08-2011
DR. P.N.Z.		
CH. D.J.P.	DWG.NO. PE-189-IN-SK-8003(SH. 17 OF 20)	ISSUE P0

TITLE	TYPICAL INSTRUMENT INSTALLATION DIAGRAM
DWG.NO.	PE-189-IN-SK-8003 (SH. 18 OF 20)

DIFF. PRESSURE TRANSMITTER MOUNTED ABOVE SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
64	1	REDUCER 1" BSPF x 3/4" NB–SW CL 3000
04	1	FORGED COUPLING 3/4" SW CL 3000, AS PER ANSI B16.11
09	1	FORGED UNEQUAL TEE AS PER ANSI B16.11 SIZE : 2 x 3/4" NB–SW x 1/2" NPTF, CL 3000
77	1	NIPPLE & CAP 3/4" NB–SCH 80,CAP–3/4" NPTF, CS/AS
14	6 MTRS.	SEAMPLESS TUBE 1/2" OD, x 2.1mm THK., SS 316
16	1	FOUR WAY VALVE SIZE : (2 x 3/4" NB–SW)x(2 x 1/2"NPTF) CL 800.
20	1	QUICK DISCONNECTING FITTING SIZE : 1/2"NPTM
21	5	MALE CONNECTOR, SS 316 1/2" NPT(M) x TO SUIT 1/2" OD TUBE
29	30 MTRS.	SEAMLESS PIPE/3/4" NB SCH 80
33	1	2 VALVE MANIFOLD 1/2" NPT(F), SS 316
49	1	BULK HEAD COUPLING SIZE : 3/4" SW, CL 3000 lbs AS PER ANSI B16.11

SERVICE : FLUE GAS, PRIMARY AIR, SECONDARY AIR ETC.

NOTE:

1. AIR PURGING ARRANGEMENT SHALL BE INCLUDED.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED CHEM	CIVIL	ELEC	I&C	MECH	APPD	DATE

FOR RO ISSUE ONLY CLEARED		
DEPT	SIGNATURE	DATE
CHEM		
CIVIL		
ELEC		
I&C		
MECH		

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DRAWINGS SIGNED BY PROCON ENGINEERS' AUTHORISED REPRESENTATIVE ONLY ARE CONSIDERED VALID DRAWINGS.

MAHAGENCO

MAHARASHTRA STATE POWER GENERATION CO.LTD.
BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)

SCALE	~	APPROVED
DIV.	INST.	
DR.	P.N.Z.	
CH.	D.J.P.	

DATE(RO ISSUE)
DATE(CURRENT ISSUE) 23-08-2011
DWG.NO. PE-189-IN-SK-8003 (SH. 18 OF 20) ISSUE P0

SUB-SECTION – ID

DATASHEET-A

	DATA SHEET - A		SPECIFICATION NO.: PE-TS-415-165-N003 ,Rev01
	DEBRIS FILTER (DF)		REV. NO.: 00; DATE : 29.04.20
			SECTION : I SUB-SECTION : ID
SL NO	**DESCRIPTION**	**UNITS**	**PROJECT: 1X660 MW BHUSAWAL TPS**
1.00	**GENERAL**		
1.1	No. of Strainers/ Filters required for station	Nos.	Total 2 Sets
1.2	Liquid Handled		Clarified water (Refer enclosed water analysis at Annexure III of Datasheet A)
1.3	Size of Debris Filter Shell	NB	2300
1.4	Length of Debris Filter Shell	mm	Maximum 5000 including counter flanges (Flap of butterfly valve shall be extended to approx 500 mm inside the Debris Filter from starting edge of C/F)
1.5	Scope of Counter Flange of Debris Filter Shell		Counterflange in Bidder's scope
1.6	BOQ for Debris Discharge Piping .		1. Dia of pipe: To be decided by bidder 2. Length of pipe: (In Bidder's Scope) – 50 m pipe length 3. No. of bends: (In Bidder's Scope) – 5 nos
1.7	Filter type/ duty		On line / continuous
1.8	Location		Condenser Inlet (Outside TG Hall)
2	**DESIGN DATA**		
2.1	Operating pressure at Debis Filter Inlet Flange	kg/cm2 (g)	2.0 to 2.5
2.2	Design pressure for Debis Filter Shell	kg/cm2 (g)	5.0 Kg/cm2 (g) & Vacuum 0.1Kg/cm2 (abs)
2.3	Design Mechanical temperature	Deg. C	60
2.4	Flow rate through filter		
	a) Normal	Cub m/Hr	34390
	b) Maximum	Cub m/Hr	41268
2.5	Design differential pressure for filter section/ screen	kg/cm2 (g)	1.5 (Min.)
2.6	Type of suspended matter likely to enter the filter		Typical debris encountered in closed circuit CW system with Cooling Tower
2.7	Differential pressure measuring system set pressure		
	• For initiating flushing/ backwashing	mbar	60
	• For alarm/ annunciation	mbar	90
2.8	Filter section/ screen perforation size	mm	10 mm (Max)
2.9	Free flow area in the screen basket		Atleast 110 % of pipe inlet area
2.1	Debris discharge flow during flushing period	Cub m/ Hr.	Not to exceed 2.5% of total flow rate
3	**GUARANTEED PERFORMANCE REQUIREMENT**		
3.1	Pressure drop across the filter (i.e. between inlet and outlet connection) at normal flow		
	a) Clean condition	mbar	30
	b) Partially (50%) chocked condition	mbar	60

	DATA SHEET - A		SPECIFICATION NO.: PE-TS-415-165-N003 ,Rev01
	DEBRIS FILTER (DF)		REV. NO.: 00; DATE : 29.04.20
			SECTION : I SUB-SECTION : ID
SL NO	**DESCRIPTION**	**UNITS**	**PROJECT: 1X660 MW BHUSAWAL TPS**
4	**MATERIALS OF CONSTRUCTION**		
4.1	Filter body/ housing along with Body Flange		Filter Body - Carbon Steel to IS –2062 Body Flange - Carbon Steel to IS –2062 (Housing thickness to be decided by bidder and detailed thickness calculation shall be submitted by bidder to BHEL during detailed engineering. However, in any case, housing thickness shall not be less than 18 mm)
4.2	Connecting pipe (Inlet/ Outlet)		Carbon Steel to IS 2062
4.3	Filter screen/ section		SS 316
4.4	Shaft		SS 316
4.5	Supporting cage		Carbon Steel to IS 2062
4.6	Differential measuring system		SS
4.7	Flushing/ backwashing unit		SS
4.8	Backwash rotor shoes		Neoprene
4.9	Any other internal hardware /pipes etc.		SS
4.10	Flushing Pump (If applicable)		
	a) Casing		CI
	b) Impeller		SA351 CF8M
	c) Shaft		SS316
4.11	Valves		
4.11.1	Check Valves (65 NB & Above)		For sizes 65 NB and above:- Swing check or dual plate type.
	a) Body & Bonnet		ASTM A216 Gr. WCB for Cast body
	b) Disc for Check Valve		ASTM A216 Gr. WCB for Cast body
	c) Stem		ASTM A 182 Gr F6 for cast body
4.11.2	Check Valves (50 NB & Below)		For size 50 NB and below-Piston type
	a) Body & Bonnet		ASTM A 105 for Forged body
	b) Disc for Check Valve		ASTM A 105 for Forged body
	c) Stem		ASTM A-105 Hard faced with stellite for forged body.
4.11.3	Gate/ Globe Valves 50 Nb & Below		
	Body & Bonnet		ASTM A 105 for Forged body
4.11.4	Gate/Globe Valves (65NB & above)		
	➢ Body & Bonnet		ASTM A216 Gr. WCB for Cast body
	➢ Disc		ASTM A216 Gr. WCB for Cast body
	➢ Stem		ASTM A 182 Gr F6 for cast body
	➢ Companinon Flange		SS316
4.11.5	BFV Valves (65NB & above)		
	➢ Body & Disc		CI as per IS 210, FG 260
	➢ Sealing		EPDM
	➢ Shaft Bearing		Leaded Bronze
	➢ Shaft		SS304
	➢ Seat ring		SS316
	➢ companion Flange		Carbon steel as per IS 2062
4.11.6	Ball valves		
	i) Body		SA 351 CF8M

	DATA SHEET - A		SPECIFICATION NO.: PE-TS-415-165-N003 ,Rev01
	DEBRIS FILTER (DF)		REV. NO.: 00; DATE 29.04.20
			SECTION : I SUB-SECTION : ID
SL NO	**DESCRIPTION**	**UNITS**	**PROJECT: 1X660 MW BHUSAWAL TPS**
	ii) Ball		SA 351 CF8M
	iii) Stem		SS316
4.12	Debris discharge/ Interconnecting Piping material		In Bidder's Scope
	MATERIAL		Carbon steel
4.13	Inspection hole/ Man hole		2 nos of 600 NB size (1 for DF purpose and 1 for BFV access purpose)
5	**COUNTER FLANGES FOR DEBRIS FILTER SHELL**		In Bidder's Scope
5.1	MATERIAL		
	a) Flanges		Carbon Steel to IS 2062 Gr. B or eq for thickness, drilling etc refer Annexure iv in section C1(In Bidder's Scope)
	b) Fasteners		A 193 & A 194 (In Bidder's scope).
	c) Gaskets		Min 4 mm thick rubber (In Bidder's scope).
5.2	Drilling Standard		BS 4504 or equivalent
6	**OTHER COUNTER FLANGES**		
6.1	MATERIAL		
	a) Flanges		Carbon Steel to IS 2062 Gr. B or eq for thickness, drilling etc refer Annexure iv in section C1(In Bidder's Scope)
	b) Fasteners		A 193 & A 194 (In Bidder's scope).
	c) Gaskets		Min 4 mm thick rubber (In Bidder's scope).
7	**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	**Connecting pipe size (OD x Thk)**	mm x mm	2336 x 18
9	**PAINTING**		
9.1	External Surface		
	a) Surface preparation		SA - 2.5 of Swedish Specn. SIS-05-59-00-1967
	b) Primer		One coat of Red Lead primer
	c) Intermediate Paint		-
	d) Final paint		Adequate no (2 to 3) of finish coat of synthetic enamel paint to achieve total DFT of 150 to 200 micron.

	DATA SHEET - A		SPECIFICATION NO.: PE-TS-415-165-N003 ,Rev01
	DEBRIS FILTER (DF)		REV. NO.: 00; DATE : 29.04.20
			SECTION : I SUB-SECTION : ID
SL NO	**DESCRIPTION**	**UNITS**	**PROJECT: 1X660 MW BHUSAWAL TPS**
9.2	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 (min. Two) of Synthetic Enamel paint to achieve total DFT of min. 200 microns. Colour- code shall be as per IS 9404
10	**SHOP TEST**		
10.1	Hydrostatic test		
	a) Test Pressure	bar (g)	1.5 times design pressure
	b) Test duration	min.	30
10.2	Leakage test		
	a) Test Pressure	bar (g)	Design Pressure
	b) Test duration	min.	30
11	Adequate provision for future installation of cathodic protection required		YES (Along with Sacrificial type anodic protection by Bidder)
12	Whether automatic flushing/ back- washing operation effected by the following :		
	i. Differential pressure		YES
	ii. Adjustable timer		YES
	iii. Push button		YES
13	Whether provision for manual flushing / backwashing operation is made in the event of control system failure.		YES (if required)
14	Whether built in flushing arrangement complete with flushing pump, valves, and associated piping, is provided.		YES (if required)
15	**MANDATORY SPARES**		
15.1	Filter element seating component	1	set
15.2	Actuators along with motors	1	set
15.3	Debris discharge and other valves	1	set
15.4	Gaskets etc.	2	sets
15.5	Wetted nuts and bolts etc	1	set
15.6	Other nuts and bolts etc	1	Lot (20%)
15.7	C&I Spares		Attached as annexure-1

Notes for Mandatory Spares:

1	Spares not applicable for the Package to be specifically quoted as “NOT APPLICABLE”.
2	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.
3	Wherever % is indicated for the mandatory spares, the quantity shall be calculated for % of supply for total quantity for station, 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.
4	In respect of quantity mentioned as 'Set' means the total quantity of all the components/items used in particular equipment unless otherwise specified.
5	Whenever the quantity is indicated as a percentage, it shall mean percentage of total population of that item in the station (project) unless specified otherwise, and the fraction will be rounded off to the next higher whole number. Wherever the requirement has been specified a ‘set’, it will include the total requirement of the item for a unit, module or the station or as specified. Where it is not specified, a ‘set’ would mean the requirement for the single equipment/system as the case may be. Also, the ‘set’ would include all components required to replace the item
6	Wherever quantity is specified both as a percentage and a value, the bidder has to supply the higher quantity until and unless specified otherwise

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
	measurement used.	
3.0	**MEASURING INSTRUMENTS**	
3.1	ELECTRONIC TRANSMITTERS	
3.1.1	Transmitters of all types, ranges and model no. (for the measurement of Pressure, differential pressure flow, level etc.)	10% or 2 no. of each type and model, whichever is more
3.1.2	Electronic cards / PCB's for each type and model and model of transmitters	10% or 5 nos. of each type, whichever is more
3.2	TEMPERATURE ELEMENTS	
3.2.1	RTDs of each type & length	10% or 2 nos. whichever is more
3.2.2	Thermocouples of each type like K-type, R-type, metal etc and length	10% or 2 nos. whichever is more
3.2.3	Thermowell for T/C & RTDs	10% or 1 no. of each type, rating, length used in the system whichever is more
3.2.4	Process actuated switch devices Including all types of pressure, differential pressure, flow, temperature, differential temperature, level switch devices	10% or 1 no. of each type and model whichever is more
3.3	INDICATORS/RECORDERS	
3.3.1	Digital Indicators of each model, type & range (including relevant digital indicators of electrical system)	10% or 2 nos. min. whichever is more

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
3.3.2	Vertical Indicators of each type & model	5% or 1 no. of each model whichever is more
3.3.3	Recorders for each type and model	5% or 1 no. whichever is more.
3.3.4	Consumables for continuous recorders Charts Ink capsules	25 rolls per recorder/ 25 nos per recorder/ 20 nos. per recorder / Ink Pads /Pens.
3.3.5	Consumables for multi point recorders	
(a)	Charts	5 nos. per recorder
(b)	Ink pads	5 nos. per recorder
(c)	Print mechanism/ print head assembly	10% or 5 nos. of each type whichever is more
3.3.6	Level transmitters (displacer type)	
(a)	Electronic cards / PCB's of level transmitters	10% of total quantity used or 1 for each type/rating whichever is more
(b)	Level transmitters	10% of total quantity used or 1 for each type/rating whichever is more
(c)	Electronic water level indicator	10% or 2 nos. min. whichever is more
3.3.7	PD type flow transmitters	10% of total quantity used or 1 for each type/rating whichever is more
3.4	SWITCHES	
3.4.1	Switches (Pressure, DP, Level, Flow, Temperature etc)	10% of each type of total nos. used in the system or minimum 1 no. of each type, model & range whichever is more

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
3.5	Rotameter	10% of each type of total nos. used in the system or minimum 2 no. of each type, model & range whichever is more
3.6	SOLENOID VALVE	10% of each type of total nos. used in the system or minimum 2 no. of each type, model & range whichever is more
3.6.1	Assembly	10% of total quantity used or minimum 2 no. of each type whichever is more
3.6.2	Coil	10% of toatal quantity used or 5 no. whichever is more
3.7	E/P Converter	10% of each type of total nos. used in the system or minimum 2 no. of each type, model & range whichever is more
3.8	SPECIAL INSTRUMENTS	
3.8.1	Nucleonic /non-nucleonic density meter, solid flow meter etc.	1 no. and spare parts as per manufacturer
3.9	Electrical Transducers	10% of total quantity used or minium 1 no. of each type and range whichever is more
4.0	**POWER SUPPLY SYSTEM (24 V DC POWER SUPPLY SYSTEM)**	
4.1	Silicon controlled thyristors, diodes power transistors	100%

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
4.17	Rubber gloves	1 no.
4.18	Voltmeter for measuring cell voltage (centre zero type)	1 no.
4.19	Thermometer	1 no.
4.20	Insulated socket spanner with handle	1 no.
5.0	**PROCESS CONNECTION PIPING** (for impulse piping /tubing, sampling piping/ tubing and air supply piping as applicable)	
5.1	Valves of all types and models	10% or 2 no. of each type, class, size and model whichever is more.
5.2	2 way, 3way, 5way valve manifolds	10% or 2 no. of each type, class size and model whichever is more.
5.3	Fittings	10 nos. of each type
5.4	Purge meters	10 % of each model or 2 Nos. whichever is more
5.5	Filter regulators	10% of each model or 2 Nos. whichever is more
5.6	Impulse pipe & tubing of all type	20 mtrs each type & size
5.7	Impulse line root valve	10% of total quantity used or 4 no. whichever is more for each type and rating of each size
5.8	SS tube	40 mtrs of each type/size
5.9	Fitting for SS tube	40 nos. of each type/size

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
6.0	**INSTRUMENTATION CABLE, INTERNAL WIRING AND ELECTRICAL FIELD**	
6.1	Pre fabricated cable of each type	10% of installed quantity
6.2	Pre fabricated cable connector	10% or1no.of each type and model, whichever is more.
6.3	Other cables	10% of each type, pair and size of actual installed quantity
7.0	**ELECTRICAL ACTUATORS**	
7.1	Actuators	10% or 1 no. of each type, model and rating, whichever is more.
7.2	Power unit for modulating actuator	10% or 2 nos. of each type, whichever is more.
7.3	DC-DC unit/power pack units	10% or 2 nos. of each type, whichever is more.
7.4	Electronic cards	10% or 5 nos. of each type, whichever is more
7.5	Brake assembly	10% or 2 nos. of each type, whichever is more..
7.6	Brake coils	10% or 2 nos. of each type whichever is more.
7.7	Position feed back transmitters	10% or 2 nos. of each type whichever is more.
7.8	Control unit	10% or 2 nos. of each type whichever is more
7.9	Torque and limit switch assembly of each unit	10% or 2 nos. of each type, whichever is more.
7.10	O-ring	1 set of each size

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
7.11	Motor	1 no. of each type & rating
7.12	Auxiliary contact	10% of total quantity used or 2 nos. whichever is more for each type and rating of each size
7.13	Seal kit	1 set of each type & size

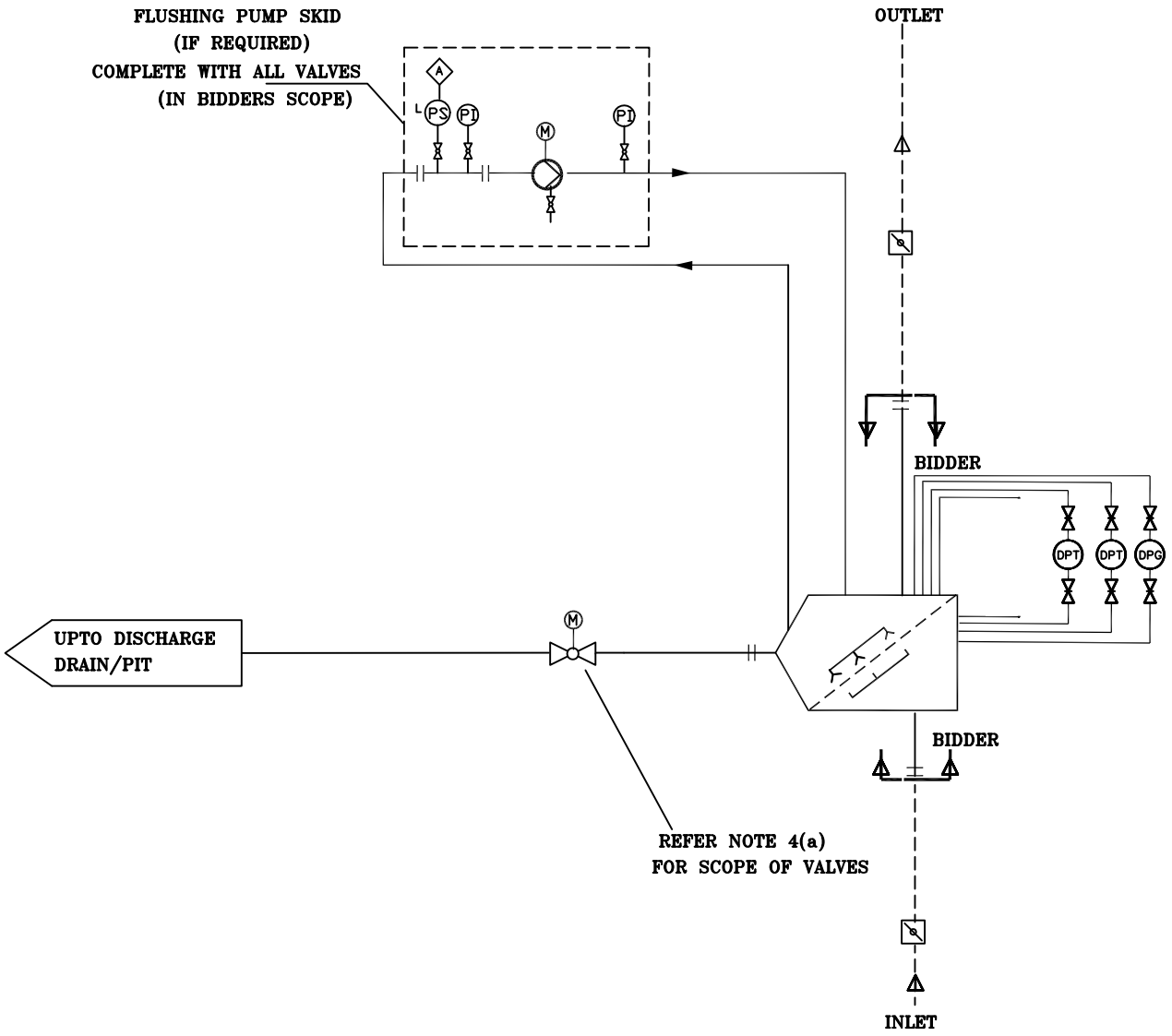
SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
8.24	Micro PLC system (i.e. integrated CPU & I/O system, where above mentioned components are not applicable)	One Complete Set

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
17.0	CONTROL PANEL AND LOCAL/ REMOTE CONTROL DESK (AS APPLICABLE)	
17.1	Recorder	1(one) No. each type and model
17.2	Bar graph indicator	10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model.
17.3	Digital indicator	10% of total quantity used in the system or minimum 1(one) no. whichever is more for each type and model.
17.4	Mosaic/Conventional Type Push button Station	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
17.5	Mosaic Type Push button Station with LED Indication	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
17.6	Mosaic Type LED Indication Station	10% of total quantity used in the system or minimum 2(two) nos. whichever is more for each type and model.
17.7	Simaphore Indicator	2(two)Nos. each type
17.8	ANNUNCIATION SYSTEM (For offsite / Auxiliary Plants)	
17.8.1	Each type of PCB (for non-PLC driven system)	1(one) No. each

SR. NO.	EQUIPMENT/PACKAGE NAME	QUANTITY
17.8.2	Lamp Box with Facia & Lamps (LED type)	10% with minimum 2 nos.
17.8.3	Hooter	1(one) No.

30.0	**MANDATORY SPARES NOT COVERED ABOVE**	Bidder to supply 10% electronic modules/ cards or any other electronic components required for system such as annunciation system for offsite/auxiliary plant, online condensate tube cleaning system, ambient air monitoring system, plant simulator.

ANNEXURE-II



NOTE :-

1. SCHEMATIC SHOWN IS TYPICAL FOR ONE DF, SHALL BE IDENTICAL FOR THE SECOND DF.

2. INSTRUMENTS/ANNUNCIATIONS/ INTERLOCKS INDICATED IN THE SCHEME ARE TENTATIVE, SHALL BE PROVIDED AS PER APPROVED DRGS./ DOCUMENTS/ CONTROL PHILOSOPHY IN THE EVENT OF ORDER.

3. COUNTERFLANGES FOR DF ARE INCLUDED IN BIDDERS SCOPE. ALL INTERCONNECTING / DEBRIS DISPOSAL PIPING IS INCLUDED IN BIDDER SCOPE.

4. BIDDER's SCOPE OF SUPPLY ALSO INCLUDES :
   a) ALL VALVES ON BIDDER'S INTERCONNECTING /DEBRIS DISPOSAL PIPING ALONGWITH THEIR COUNTER FLANGES.
   b) FLUSHING PUMP SKID, IF REQUIRED COMPLETE WITH FLUSHING PUMP, VALVES, INSTRUMENTS ETC.

5. PURCHASER — BIDDER'S SCOPE OF SUPPLY

FLOW DIAGRAM FOR
DEBRIS FILTER
1 x 800 MW BHUSAWAL

ANNEXURE- III

ANALYSIS OF RAW WATER

SR. NO.	PARAMETERS	UNITS	VALUES
1.0	pH		8.0 – 8.5
2.0	Temperature	^0C	22 - 30
3.0	Conductivity	µS/cm	1300
4.0	Colour	Hazen Units	Not Available
5.0	Odour		Not Available
6.0	Taste		Not Available
7.0	TDS	ppm	870
8.0	P-Alkalinity as $CaCO_3$	ppm	Nil
9.0	M-Alkalinity as $CaCO_3$	ppm	400
10.0	T – Alkalinity as $CaCO_3$	ppm	400
11.0	Organic Matter as $KMnO_4$	ppm	50
12.0	Iron (as Fe)	ppm	1
13.0	Turbidity (NTU)	ppm	100 during Non – Monsoon Up to 10,000 during Monsoon
14.0	**CATIONS**		
	(a) Ca as $CaCO_3$	ppm	295
	(b) Mg as $CaCO_3$	ppm	77
	(c) Na as $CaCO_3$	ppm	203

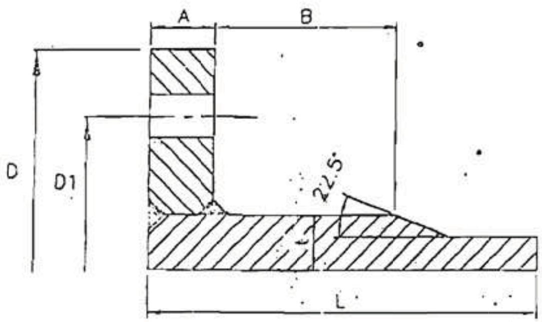
SR. NO.	PARAMETERS	UNITS	VALUES
	(d) K as $CaCO_3$	ppm	10
	Total Cation	ppm	**585**
15.0	**ANIONS**		
	(a) HCO_3 as $CaCO_3$	ppm	400
	(b) Chlorides	ppm	149
	(c) SO_4 as $CaCO_3$	ppm	33
	(d) Fluoride as $CaCO_3$	ppm	1
	(e) Nitrate as NO_3	ppm	2
	Total Anion	ppm	**585**
16.0	Ammonia	ppm	Absent - Traces
17.0	Silica Colloidal (as SiO_2)	ppm	< 1 (can be present in summer)
18.0	Silica Non - Colloidal (as SiO_2)	ppm	36
19.0	Free Chlorine	ppm	Nil
20.0	Total Suspended Solids	ppm	Not Available
21.0	Carbonates as $CaCO_3$	ppm	Not Available
22.0	Boron	ppm	Not Available
23.0	Oil & Grease	ppm	Not Available

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

DRAWING NO. PE-DG-999-141-M017

ANNEXURE IV



NOTES:-

Flange thicknesses listed are for Design pressure=5Kg/cm²(g) and Flange dimensions as given in the table. Final thickness of the flange 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 'D'	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	1820	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 **(CS)**	20			90	38	110	325	150
2700 (Dup. SS)	20			50 (Min.)				125 (Min.)

— TENTATIVE

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	PH		25.06.07
	DSGN	PH		25.06.07
	CHD	SPV		25.06.07
	APPD	SH		25.06.07

TITLE

COUNTER FLANGE/ BODY FLANGE DETAILS

DRAWING NO. PE-DG-999-141-M017

SHEET 01 OF 01 REV 00

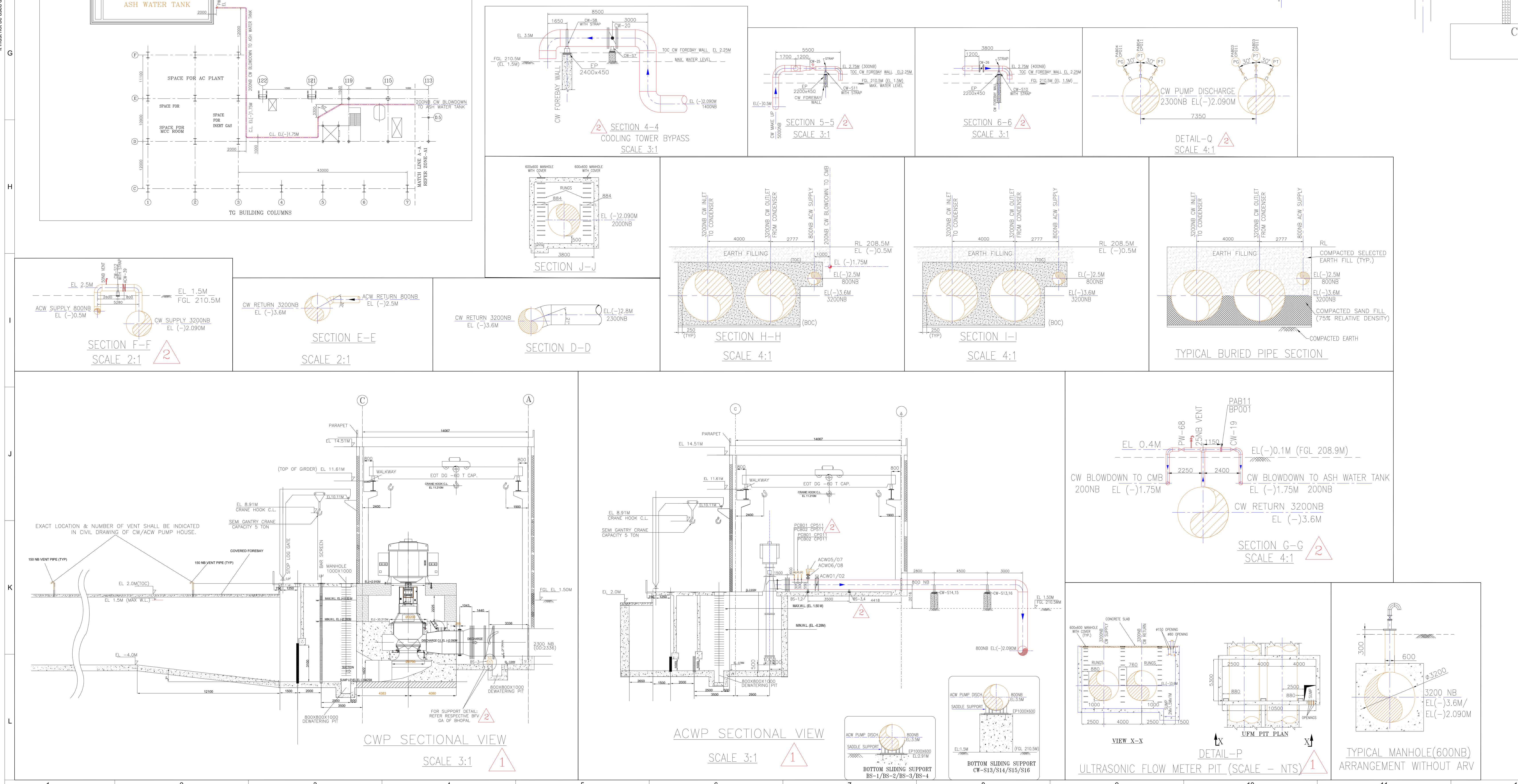
17

R26

REFERENCE DRG FOR DEBRIS FILTER LOCATION DETAILS AS PER BHEL LAYOUT DRG

FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM



PIPE SIZES			
SL NO	NB	OD(MM)	THICK (MM)
1	100	115.0	5.4
2	150	166.5	5.4
3	200	219.1	6.0
4	250	273.0	6.0
5	300	323.9	6.0
6	350	355.6	6.0
7	400	406.4	6.0
8	450	457.0	6.0
9	500	508.0	6.0
10	600	610.0	6.0
11	700	711.0	7.0
12	800	813.0	8.0
13	900	914.0	10.0
14	1400	1422.0	12.0
15	2000	2032.0	17.5
16	2300	2336.0	18.0
17	3200	3240	20.0

LOAD DETAILS:- (2)

SL. No.	HANGER / SUPPORTS No.	Fx	Fy	Fz	Mx	My	Mz
		LOAD (TONNE)			MOMENTS (T-m)		
1	Anchor 1	(-)177	0	(-)49	1	(-)28	(-)3
2	Anchor 2	221	0	0	0	0	0
3	Anchor 3	(-)34	0	(-)41	0	209	0
4	Anchor 4	93	0	0	0	0	0
5	Anchor 5	231	0	1	0	(-)2	0
6	Anchor 6	(-)92	0	(-)178	0	198	0
7	Anchor 7	663	0	0	4	0	0
8	Anchor 8- DELETED	-	-	-	-	-	-
9	Anchor 9	(-)2	0	(-)20	0	0	0
10	Anchor 10	220	(-)10	0	0	0	0
11	Anchor 11	220	(-)10	0	0	0	0
12	CW-S1	2	(-)7	0	0	0	0
13	CW-S2	0	(-)106	3	0	0	0
14	CW-S3	1	(-)5	0	0	0	0
15	CW-S4	0	(-)106	4	0	0	0
16	CW-S5	0	(-)12	1	0	0	0
17	CW-S6	0	(-)22	(-)3	0	0	0
18	CW-S7	0	6	2	0	0	0
19	CW-S8	0	(-)14	(-)4	0	0	0
20	CW-S9,10 &11	0	(-)1	0	0	0	0
21	CW-S12,13,14, 15&16	0	(-)6	0	0	0	0
22	CW-A1	3.4	(-)11.8	22.1	3.2	27.3	0
23	CW-A3	0.8	(-)10.4	(-)22.2	4.3	6.3	0
24	BS-1,2	1.0	(-)5	0	0	0	0
25	BS-3,4	1.0	(-)4	0	0	0	0
26	BS-5,6	10	(-)40	0	0	0	0

Axis: (+)X: Turbine to Generator
(+)Y: Vertically Upwards
(+)Z: Plant North

VALVE DATA (HOLD)						
SL NO	VALVE No.	SIZE (NB)	TYPE	LENGTH (mm)	WEIGHT (Kg)	SCOPE
1	CW-01,02	2300	BFV (MO)	–	–	BPL
2	CW-03,04	2300	BFV (MO)	–	–	BPL
3	CW-27	2000	BFV	–	–	BPL
4	CW-28	500	BFV	–	–	BPL
5	CW-29	200	GLV	–	–	TRY
6	CW-20	1400	BFV	–	–	BPL
7	CW-25	300	GV	–	–	TRY
8	CW-26	400	GV	–	–	TRY
9	ACW-01,02	800	BFV (MO)	–	–	BPL
10	ACW-38	450	BFV	–	–	BPL
11	OP-1	2000	ORIFICE PLATE IN CW RC LINE			PC
12	OP-2	450	ORIFICE PLATE IN ACW RC LINE			PC

HOLD:-

1. DEBRIS FILTER
2. BFV, ARV & GV DRAWINGS
3. ULTRASONIC FLOW METER
4. CW/ACW PUMPS

NOTES:

1. ALL DIMENSIONS ARE IN MM'S AND LEVELS ARE IN METRES.
2. ALL ELEVATIONS INDICATED IN THE DRG. ARE W.R.T. POWER HOUSE GROUND FLOOR ELEVATION AS 0.00M. EL 0.00M CORRESPONDS TO RL (+)209.0M
3. DESIGN PARAMETERS :
   PRESSURE : 5 kg /sq.cm (g) FOR CW SYSTEM AND 7.5 kg /sq.cm (g) FOR ACW SYSTEM
   DESIGN MECHANICAL TEMPERATURE : 60°C
4. PIPE SPECIFICATION & SIZE:
   PIPING UPTO AND INCLUDING 150NB SHALL BE CARBON STEEL ERW, IS:1239(HEAVY GRADE).
   PIPING 200NB AND ABOVE SHALL BE CARBON STEEL (IS:2062) R&W CONFORMING TO IS:3589.
   3200NB – 3240 OD x 20 THK, 2500NB – 2540 OD x 20 THK, 800NB – 813 OD x 8.0 THK,
   150NB – 166.5 OD x 5.4 THK.
5. CW BURIED PIPING COMING UNDER RAIL OR ROAD SHALL BE CONCRETE ENCASED.
6. INSTRUMENTS MARKED WITH * ARE FOR PERFORMANCE GUARANTEE TEST.
7. COMPANION FLANGES FOR BUTTERFLY VALVES SUPPLIED BY BHEL/BPL ARE SUPPLIED ALONG WITH VALVES & FOR VALVES PROCURED BY BHEL/PEM, COMPANION FLANGES TO BE SUPPLIED BY BHEL-PC.
8. FOR PAINTING AND SURFACE PROTECTION REQUIREMENT, KINDLY REFER CW P&ID.
9. INSTRUMENTS MARKED ▲ THUS SHALL BE SUPPLIED ALONGWITH THE EQUIPMENTS.
10. ORIENTATION OF BFV SHALL BE (BFV – EQIPMENT – BFV; SEAL OF BFV)
11. MANHOLE ASSEMBLY INCLUDING 600NB THROUGH FLANGE,BLANK FLANGE WITH LIFTING LUGS, GASKET ETC. TO BE SUPPLIED BY PC.
12. CW SYSTEM : 150NB DRAIN & VENT VALVES SHALL BE PROVIDED AS REQD. AS PER LAYOUT.
    ACW SYSTEM : 50 NB SIZE DRAIN & VENT VALVES SHALL BE PROVIDED FOR PIPE SIZES 400 NB & ABOVE
    25 NB DRAIN & VENT VALVES SHALL BE PROVIDED FOR PIPE SIZES UPTO 350NB AS PER LAYOUT REQUIREMENT.
13. HOLE FOR ANUBAR IS TO BE DRILLLED PRECISELY TO THE REQUIRED SIZE AND IT MUST NOT BE GAS CUT.
14. ALL PRESSURE TAPPINGS & ROOT VALVES TO BE OF 15 NB.
15. ALL BENDS 800 NB AND ABOVE ARE OF MITRE TYPE WITH RADIUS = 0.75D. ALL OTHER BENDS ARE LR ELBOWS. MITRES FORMS SHOWN IN THE DRG ARE INDICATIVE.
16. DETAILS OF CW PUMP HOUSE & CW CHANNELS ARE SHOWN FOR REFERENCE ONLY. RESPECTIVE GA DRAWING TO BE REFERRED.
17. FOR CONCRETE DETAILS OF ENCASING, CONCRETE BLOCK & CW CHANNEL REFER CIVIL DRAWINGS.
18. NUMBER & LOCATION OF ARVs SHALL BE PROVIDE AS PER SURGE ANALYSIS REPORT.
19. PORTABLE SUMP PUMP MAY BE USED FOR EMPTYING CW PIPE. (2)

(1) REFERENCE DRAWINGS:

1.	PLOT PLAN	PE-DG-415-100-M001
2.	EQUIPMENT PLAN AT 0.0M	PE-DG-415-100-M003
3.	MAIN PLANT CROSS SECTION	PE-DG-415-100-M007
4.	P&ID – COOLING WATER AND AUX COOLING WATER SYSTEM	PE-DG-415-165-N001
5.	PG TEST INSTRUMENTATION SCHEME	PE-DG-415-100-N298
6.	MECH GA OF CW & ACW PUMP HOUSE	PE-DG-415-165-N004
7.	CW PIPING INSIDE TG HALL	PE-DG-415-165-M001
8.	GA & RC DETAIL OF PLAN, SEC. CHANNEL FROM CT TO FOREBAY	PE-DG-415-165-N004

REV	DATE	ALTD	CHD	APPD
02	12.03.20	BS	AB	PM
01	07.11.19	AK/BS	AMT	PM

REV 02:
1. 200NB PIPE CW BLOWDOWN/RETURN TO ASH WATER TANK & ETP SHOWN AS PER MSE REQUIREMENT.
2. DRAWING REVISED AS PER CUSTOMER COMMENTS.
3. OTHERS REVISED AS MARKED (2).

REV 01:
1. DRAWING IS REVISED AS CUSTOMER COMMENTS DTD. 09.01.2019
2. DRAWING IS UPDATED IN GENERAL.
3. REVISION MARKED AS (1).

JOB No. 415
STATUS CONTRACT
DISTRIBUTION
TO
No.OFF

OWNER: MAHAGENCO — MAHARASHTRA STATE POWER GENERATION CO. LTD.

CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
VASHI, NAVI MUMBAI

PROJECT: 1x660 MW BHUSAWAL TPS UNIT-6

CONTRACTOR: BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE: –

	NAME	SIGN	DATE
DRN	AK	---sd---	14.12.2018
DESN	AMT	---sd---	14.12.2018
CHD	PM	---sd---	14.12.2018
APPD	SPV	---sd---	14.12.2018

TITLE: LAYOUT OF CW/ACW PIPING (BETWEEN A-ROW & PUMP HOUSE/COOLING TOWER)

CUSTOMER PACKAGE CODE: –
SCALE 1:1
DISCIPLINE: M C E I L
DRAWING No. PE-DG-415-165-M002
SHEET 01 OF 01
REV 02

SIZE-A0

SUB-SECTION - IIA

STANDARD TECHNICAL SPECIFICATION (MECHANICAL)

STANDARD TECHNICAL SPECIFICATION FOR DEBRIS FILTER

STANDARD QUALITY PLANS

1.00.00 **GENERAL**

This specification covers the Design, Performance and Operational Requirements, Constructional Features, Manufacture, Assembly. Inspection and Testing at the Manufacturer's and/or his Sub-contractor's works and Painting for delivery of Debris Filter (Backwash Type) complete with all accessories as specified hereinafter.

2.00.00 **CODES AND STANDARDS**

2.01.00 The design, materials manufacture, inspection and testing of the Debris Filter complete with all accessories, shall comply with the requirements of the latest revisions of the following appropriate codes and standards :

2.01.01 IS/ BS/ DIN/ US Standards regarding pressure vessels, pipes, 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 their 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 Debris Filter shall be supplied.

3.01.02 The Debris Filter shall be capable of safe, proper and continuous operation. 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 wherever necessary. Adequate provision for future installation of cathodic protection shall be provided.

3.01.04 The Debris Filter shall be designed to suit installation in on-line or off-line arrangement as specified in Data Sheet-A.

In the on-line arrangement, the inlet and outlet pipes of the debris filter shall be in line with each other on the same axis without any off-set between the centre lines of inlet and outlet pipes.
In the off-line arrangement, the debris filter inlet and outlet pipes shall be at right angle (90^{o}) to each other.

3.02.00 **Performance Requirements**

The Debris Filter with all accessories shall be designed and guaranteed to meet the following requirements:-

3.02.01 The Debris Filter shall perform satisfactorily under the flow and pressure conditions specified in Data Sheet -A and shall be capable of housing the various forms of debris / sludge i.e., suspended particles / matter, mussels, grass, leaves, wood pieces etc. The performance of the Debris Filter shall be continuous with minimum number of flushing/ backwashing operations.

3.02.02 The Debris Filter shall be designed such that the pressure drop across the Debris Filter (i.e., between inlet and outlet connections) under clean conditions and partially (50%) chocked conditions shall not be more than those specified in Data Sheet -A.

3.02.03 Unless otherwise specified in Data Sheet -A, debris discharge / wash water flow rate during flushing/back washing operation shall be limited to 10% of the total flow rate and flushing / backwashing operation shall be completed within a period of maximum three (3) minutes. The pressure drop across the debris filter during flushing/ backwashing operation shall not be more than the pressure drop under partially (50%) chocked condition.

3.02.04 The coarse particles and floating matter accumulating at the filter section/screen are flushed out of the system by the system by the debris flushing / backwash unit such that the pressure drop across the filter after flushing / backwashing, shall not be more than 1.1 times the pressure drop under clean conditions.

3.03.00 **Operational Requirement**

The Debris Filter and other accessories shall be designed for the following flushing/backwashing operation modes:

3.03.01 Complete automatic flushing/backwashing operation effected by the following:-

- differential pressure measuring system at a pre-determined differential pressure across the filter screen.
- adjustable timer (0-24 hours)
- push button (for manual initiation of sequential flushing / backwashing)

3.03.02 Manual operation in the event of failure of control system.

3.04.00 **Filter Housing/ Body**

3.04.01 The Debris Filter housing/body shall be designed and manufactured as per the applicable codes for pressure vessels. It shall house the filter section / screen assembly and shall have flanged inlet, outlet, flushing/ debris discharge openings and pressure measuring tappings etc.

3.04.02 In design of Debris Filter housing/ body due attention shall be given for easy removal and replacement of filter section / screen assembly.

3.04.03 The Debris Filter shall be provided with inspection hole with bolted cover.

3.04.04 The Debris Filter body / housing shall be provided with vent and drain connections with isolating valves. It shall be possible to drain unfiltered and filtered water.

3.04.05 If specified in Data Sheet-A, filter body/housing shall be epoxy painted.

3.05.00 **Filter Section / Screen assembly.**

3.05.01 The Debris Filter section/screen shall be designed for the maximum differential pressure across the filter and shall be securely positioned by a supporting cage and shall be securely mounted in the housing or body.

3.05.02 The perforation/mesh size of the Debris Filter section shall not be more than that specified in Data Sheet-A.

3.05.03 The arrangement of the Debris Filter section shall be such that the forced accumulation of debris on the filter screen / section shall be minimum.

3.06.00 **Differential Pressure Measuring System**

3.06.01 The Debris Filter shall be provided with a measuring system for differential pressure across the filter section/screen, to check debris accumulation and to initiate flushing/ backwashing operation. This shall consist of a differential pressure transmitter for automatic flushing operation, a differential pressure gauge for manual observation with adequate number of taping with isolating valves and equalising valves.

3.06.02 The contacts for differential pressure transmitter and for differential pressure gauge shall be independent so that in the event of failure of one, the other is available.

3.06.03 The differential pressure measuring system shall be provided with D.P. transmitter & DPG of remote seal arrangement..

3.07.00 **Flushing / Backwash Unit. :**

3.07.01 The Debris Filter shall be provided with suitable flushing/backwash unit (to be installed at ground floor) and debris discharge/ backwash outlet valve with associated actuator to flush out the accumulated debris/ sludge.

3.07.02 The flushing pump shall be provided with mechanical seals to the extent possible. If gland packing is provided it should be of good quality to prevent leakage of water bran pump glands.

3.07.03 The flushing arrangement shall be either fixed type with flushing valves or a rotating debris extractor.

3.07.04 If any water is to be injected for backwashing the filter section/screen, water shall be taken from down-stream side of the filter section/ screen. Necessary pump, valves and piping for water injection shall be supplied.

3.07.05 View glass to be provided in debris outlet pipe to monitor the flushing of debris.

3.08.00 **Valves**

The flushing valves (if any,) the debris discharge/backwash outlet valve, isolation, vent and drain valves shall conform to appropriate codes / standards.

3.09.00 **Instrumentation and Control System**

3.09.01 Complete instrumentation and control system for automatic flushing/ backwashing operation, protection, interlocking, indication/ annunciation of high differential pressure and other malfunctions etc. shall be provided. This shall consist of adequate operational hardware, local control panel and interconnecting control and power cabling between the control panel and the debris filter and its associated electrical devices.

3.09.02 The control panel shall house all necessary instruments, indicating/ annunciation lamps, alarms, differential pressure indicator, timer, function selector switches, relays, protection and interlocking systems, start/stop push buttons, counter to register number of flushing operations etc., and shall be complete with internal wiring. In addition to the above, the control panel shall meet the requirements of the enclosed specification.

3.09.03 All instrumentation shall be of reputed make and shall meet the requirement of the enclosed specification.

3.10.00 **Actuators :**

The actuators for flushing arrangement and debris discharge valve shall be electric motor operated and shall meet the requirements of the enclosed specification. The actuators shall be provided with auxiliary hand-wheel for manual operation in the event of power failure.

3.11.00 **Electric Motors :**

The drive motors for differential pressure measuring system flushing pump and water injected pump (if applicable) shall confirm to the requirements of the enclosed specification.

3..12.00 **Other Accessories.**

3.12.01 Counter flanges, complete with gaskets, bolts and nuts etc., shall be supplied for the filter 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.

3.12.02 Debris Filter shall be provided with suitable lifting arrangement for handling during erection and maintenance.

4.00.00 **SHOP INSPECTION AND TESTS**

4.01.00 **General:**

4.01.01 Manufacturer shall conduct all tests and stage inspections as per the approved quality plan to ensure that the Debris Filter and other accessories shall conform to the requirements of this specification and of the applicable codes/ standards.

4.01.02 All materials used for manufacture/fabrication of the Debris Filter 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 approved quality plan and applicable codes at his cost, for which samples shall be identified by BHEL's representative.

4.01.03 All shop tests shall be conducted in the presence of BHEL's representative and test certificates / reports for the same shall be furnished to BHEL for approval.

4.01.04 Qualification of welding procedures and welders shall be as per ASME B&PV Code, Section-IX / applicable codes.

4.02.00 **Filter Housing / Body**

4.02.01 Chemical analysis, mechanical tests shall be carried out on housing/body, strainer/ screen, strainer/ screen shaft and other appurtenances as per the applicable material specification standards.

4.02.02 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.

4.03.00 **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.

4.04.00 **Filter Section/Screen assembly**

Supporting cage and filter section/screen materials shall be tested for chemical properties. Checks shall be carried out for perforation/mesh size, defects etc.

4.05.00 **Flushing / Backwash Unit**

4.05.01 Material of various components of the flushing/Backwash Unit shall be tested for chemical and mechanical properties.

4.05.02 Hollow shaft of backwash rotor shall be ultrasonically tested as per ASTM-A 388 for internal flaws. Penetrant test shall be carried out for surface flaws.

4.06.00 **Valves**

Inspection and testing of valves including leakage test shall be carried out as per the requirements of the applicable standards. Correlating test certificates for materials of the valve components shall be furnished.

4.07.00 **Flanges**

4.07.01 In case of fabricated flanges, all the welds shall be subjected to 100% radiography as per ASME B&PV code, section VIII, Division-1.

4.07.02 In case of forged flanges, ultrasonic testing shall be carried out as per ASTM-A 388.

4.07.03 If the thickness of the plate used for flanged 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.

4.07.04 Chemical and mechanical test certificates shall be furnished for flange materials.

4.07.05 Flanges shall be checked for edge preparation, fit up and satisfactory working with matching parts.

4.08.00 All materials for various nozzles, seals, pipes, gaskets, nuts bolts etc., shall be of tested quality and correlating test certificates for chemical and mechanical properties shall be furnished.

4.09.00 **Dimensional Checks**

Dimensional checks of various components of the Debris Filter shall be carried out as per the drawings approved by BHEL. Alignment and fit up of movable parts shall be checked.

4.10.00 **Hydrostatic Test**

Hydrostatic test shall be conducted on the Debris Filter housing/body at a pressure of 1.5 times the design pressure. The duration of the test shall be minimum 30 minutes.

4.11.00 **Leakage Test**

Leakage test shall be conducted at the design pressure to demonstrate that the filter assembly is leak tight and no water seepage shall take place at various nozzle and valve connections.

4.12.00 **Functional Tests**

The Debris Filter assembly complete with valves, actuators and other accessories shall be subjected to functional tests and the following shall be checked:-

4.12.01 Smooth and free operation of all movable parts.

4.12.02 Interlocks and sequential operation.

4.12.03 Satisfactory operation of actuator torque switches, limit switches etc.

4.13.0 Performance Test:

Performance Test shall be conducted to ensure that the Debris Filter meets the specified performance requirements.

5.00.00 **TESTING AT SITE**

After completion of installation at site, the Debris Filter with complete accessories, will be tested to check that the filter performance meets the requirements of its 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 equipment/ parts not meeting the requirement if the deficiency still persists.

6.00.00 **QUALITY ASSURANCE & QUALITY PLAN**

6.01.00 The Debris Filter and other accessories to be supplied shall have assured quality and workmanship.

6.02.00 Typical quality plans are enclosed herewith this specification for bidder's guidance. The bidder shall comply with these minimum requirements and shall furnishing own quality plan based on materials and components of the filter being offered.

7.00.00 **NAME PLATE AND TAG NUMBERS**

7.01.00 The Debris Filter 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
c) Design temperature
d) Filter section/screen mesh size
e) Empty and operating weights
f) Revolving speed of backwash rotor

7.02.00 Each valve 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 drawing submitted for approval during contract stage.

7.03.00 Each motor / actuator shall be provided with a name plate indicating the following details:

a) Supply conditions.
b) KW Rating
c) Make

8.00.00 **DRAWINGS, DATA & INFORMATION TO BE SUBMITTED AFTER THE AWARD OF CONTRACT**:

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

1.00.00 **DRAWINGS, DATA AND 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 -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 the Debris Filter with all accessories, indicating the principal dimensions and weights of equipment offered, size and location of various nozzle connections, withdrawal space and scope of supply etc.

b) Foundation arrangement drawings (wherever applicable) showing load data on supports, size and location of anchor bolts etc.

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 drawings of filter housing/body, filter screen/section assembly, flushing / backwash unit, differential pressure measuring system, actuators, motors, control panel etc. indicating bill of quantities and materials of construction.

10.02.02 Flow and control logic diagrams for complete filter during normal and flushing operation and system write-up covering all modes of operation.

1.02.03 Final version of performance evaluation procedures at site.

1.02.04 Detailed schedule of valves indicating tag numbers, type, make, size, pressure & temperature ratings, materials etc.

1.02.05 Detailed schedule of power & control cable.

1.02.06 Detailed schedule of piping and fittings indicating sizes, materials, maximum working pressure & temperatures etc.

1.02.07 Control panel layout and list of instruments provided on control panel and internal wiring diagrams.

1.02.08 List of annunciations, protections and interlocks provided.

1.02.09 Detailed drawings of flanges.

1.02.10 Quality Plan

1.02.11 Material test certificates.

1.02.12 Shop tests reports and certificates.

1.02.13 Write-up and instruction manuals for erection, operation and maintenance.

1.02.14 Storage instructions.

1.02.15 Vendor to send 3 sets of final documents (O&M Manual, GA drg, P&ID) direct to site under intimation to PEM.

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN			SPEC. NO	PE-TS-417/435-165-N003 (REV.0)	DATE:
		CUSTOMER			QP NO.:	PE-QP-417-165-N003	DATE: 28.02.2020
		PROJECT:			PO NO.:		DATE:
		ITEM: DEBRIS FILTER	SYSTEM:	CW SYSTEM	SECTION:		SHEET 01 OF 07

Sl. No.	Component / Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks
					M	C/N					M	C	N	
1	2	3	4	5	6		7	8	9	D*	** 10			11
1.0.0	DEBRIS FILTER													
1.1.0	Raw Material													
[a]	Housing Shell, Nozzle flanges & Main flanges/Counter Flange	Chemical properties	MA	Chemical Analysis	One sample/cast / heat / batch	One sample/cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Test Certificate/lab test report	√	P	V	V	All raw material identification as per manufacturer TC/Lab report by BHEL
		Physical properties	MA	Physical test	One sample/cast / heat / batch	One sample/cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Test Certificate/ lab test report	√	P	V	V	
		Surface Defects	MI	Visual	100%	100%	Approved drg/Data sheet	Approved drg/Data sheet	Test Certificate	√	P	V	V	
		Sub Surface Defects	MA	Ultrasonic Test	100%	100%	ASME A 435/A609	ASME A 435/A609	Inspection report	√	P	V	V	Plates > 20mm Thk only
[b]	Nozzle Pipes	Chemical properties	MA	Chemical Analysis	One sample/cast / heat / batch	One sample/cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Test Certificate / lab test report	√	P	V	V	
		Physical properties	MA	Physical test	One sample/cast / heat / batch	One sample/cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Test Certificate / lab test report	√	P	V	V	
		Surface defects	MA	Visual	100%	100%	Approved drg/Data sheet	Approved drg/Data sheet	Test Certificate /Inspection Report	√	P	V	V	
		Leak tightness	MA	Hydrostatic test	100%	100%	Approved drg/Data sheet	Approved drg/Data sheet	Test Certificate/Inspection Report	√	P	V	V	
[c]	Screen basket	Chemical properties	MA	Chemical Analysis	One sample/cast / heat / batch	One sample/cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Test Certificate / lab test report	√	P	V	V	
		Physical properties	MA	Physical test	One sample/cast / heat / batch	One sample/cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Test Certificate / lab test report	√	P	V	V	
		Surface Defects	MA	Visual	100%	100%	Approved drg/Data sheet	Approved drg/Data sheet	Test Certificate /Inspection Report	√	P	V	V	
		Sub-surface defects	MA	Ultrasonic test	100%	100%	ASME A 745	ASME A 745	Inspection report	√	P	V	V	Plates > 20mm Thk only (UT full volume)
		Corrosion Resistance	MA	IGCI	One/Heat	One/Heat	ASTM A 923	ASTM A 923	Test Report	√	P	V	V	

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	Amardeep Kumar	Nishant Sekhar	Checked by	28.02.2020	Ashish Panigrahi			Prepared by:			
Reviewed by:	28/2/20 CHANDAN MAITI	Vishal kumar yadav	Reviewed by:	28/2/2020	R K Jaiswal			Reviewed by:			

बीएचईएल BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC. NO	PE-TS-417/435-165-N003 (REV.0)	DATE:
		CUSTOMER		QP NO.:	PE-QP-417-165-N003	DATE: 28.02.2020
		PROJECT:		PO NO.:		DATE:
		ITEM: DEBRIS FILTER	SYSTEM: CW SYSTEM	SECTION:		SHEET 02 OF 07

Sl. No.	Component / Operation	Characteristics	Class	Type of Check	Quantum of Check 6 M	Quantum of Check 6 C/N	Reference Documents	Acceptance Norms	Format of Record	D*	Agency ** 10 M	Agency C	Agency N	Remarks
1	2	3	4	5	M	C/N	7	8	9	D*	M	C	N	11
1.2.0	**Inprocess Quality Control**													
1.2.1	Welding procedure specificatio	Correctness	CR	Scrutiny	100%	100%	ASME Sec. IX	ASME Sec. IX	QW 482 of ASME Sec.IX	√	P	V	V	
1.2.2	Welding procedure qualification	Weld soundness	CR	Physical test	100%	100%	ASME Sec. IX	ASME Sec. IX	QW 483 of ASME Sec.IX	√	P	V	V	Welding procedure already approved by BHEL/ LRQA / NTPC shall be followed.
1.2.3	Welder performance qualification	Weld soundness	CR	Physical test	100%	100%	ASME Sec. IX	ASME Sec. IX	QW 484 of ASME Sec.IX	√	P	V	V	Welders already qualified by BHEL/ LRQA / NTPC shall be employed for this job.
1.2.4	Fit-up of butt weld	Alignment.and dimensions	MA	Template, visual	100%	100%	Manufacturing Drawng	ASME Sec.VIII Div. I	Log book	√	P	V	–	
1.2.5	Fit-up of shell flange and nozzle assembly to shell	Orientation,alignment and dimensions	MA	Template, visual	100%	100%	Manufacturing Drawng	ASME Sec.VIII Div. I	Log book		P	–	–	
1.2.6	**Weld quality for Pressure Parts**													
	[a] Root run	Surface defects	MA	Penetrant test / Visual	100%	100%	ASME Sec.VIII Div. I / sec V	ASME Sec.VIII Div. I Appendix 8	Operation Process Sheet		P	–	–	
1.2.7	[a] Completed butt welds	1.Surface defects	MA	Penetrant test	100%	100%	ASME Sec.VIII Div. I / sec V	ASME Sec.VIII Div. I Appendix 8	Inspection report	√	P	V	V	
		2.Sub-surface defects	CR	Radiography test	10% of total weld length+ 100% T Joints.	10% of total weld length+ 100% T Joints.	ASME Sec.VIII Div. I / sec V	ASME Sec.VIII Div. I Appendix 4 / UW 52	Radiographs and inspection report	√	P	V	V	RT films will be reviewed by BHEL
	[b] Completed fillet welds	Surface defects	MA	Penetrant test	100%	100%	ASME Sec.VIII Div. I / sec V	ASME Sec.VIII Div. I Appendix 8	Inspection report	√	P	V	V	
1.2.8	Pickling and Passivation	Protection Layer	MA	Visual	100%	100%	IS : 10117	IS : 10117	Log Book	√	P	–	–	
1.2.9	Fabricated Shell (Prior to sand blasting)	1.Dimensions, Orientation	MA	Measurement by visual	100%	100%	Manufacturing Drawing	Manufacturing Drawing	Inspection report	√	P	V	V	
		2. Hydro test	CR	Hydrostatic Pr. @ 1.5 times of design pr.(positive) [Duration 30 minutes]	100%	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1	Inspection report	√	P	V	V	

BHEL				BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING		QUALITY		Sign & Date		Doc No:			
	Sign & Date	Name	Sign & Date	Name	Seal		Sign & Date	Name	Seal
Prepared by:	(signature)	Nishant Sekhar	Checked by	(signature) 25.02.2020 Ashish Panigrahi		Prepared by:			
Reviewed by:	(signature)	Vishal kumar yadav	Reviewed by:	(signature) 28/2/2020 R K Jaiswal		Reviewed by:			

बी एच ई एल BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN			SPEC. NO	PE-TS-417/435-165-N003 (REV.0)	DATE:
		CUSTOMER :			QP NO.:	PE-QP-417-165-N003	DATE: 28.02.2020
		PROJECT:			PO NO.:		DATE:
		ITEM: DEBRIS FILTER	SYSTEM:	CW SYSTEM	SECTION:		SHEET 03 OF 07

Sl. No.	Component / Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks
					M	C/N					M	C	N	
1	2	3	4	5	6		7	8	9	D *	** 10			11
1.3.0	Final tests (completed equipments) - After assembly	1.Dimensions, orientation, workmanship & finish	MA	Measurement by visual	100%	100%	G.A.drawing	G.A.drawing	Inspection report	√	P	V	V	
		2. Leak tightness for aasembly	CR	Leak test @ design pr.(positive) [Duration 30 minutes]	100%	100%	ASME Sec.VIII Div.1	No leakage	Inspection report	√	P	W	V	
		3.Dry function test for Debris filter	CR	Operational test	100%	100%	Approved PROC	Approved Procedure	Inspection report	√	P	W	V	
1.4.0	**Rubber Lining -Shell (Applicable for sea water application)**													
1.4.1	Rubber Formulation	Tensile, elongation & hardness	MA	Physical test	One per lot	One per lot	Manufacturer's procedure	BS 6374/Equivalent	Test certificate	√	P	V	V	
		Polymer Identification	MA	Flame test	One per lot	One per lot	For Semi Ebonite /Ebonite Polymer catches fire and on removal from fire continues to burn	For Semi Ebonite /Ebonite Polymer catches fire and on removal from fire continues to burn	Inspection report	√	P	V	V	
		% Change in weight after 24 hours of immersion in sea water at 70°	MA	Immersion test (bleeding test)	One per lot	One per lot	ASTM D 471	+ / - 1%	Inspection report	√	P	V	V	
1.4.2	Surface preparation of items to be lined	Free from rust, scale,dust & grease	MA	Visual	100%	100%	SA 2.5	SA 2.5	Internal Inspection report		P	–	–	
1.4.3	Vulcanising	Temperature, Pressure & Time	MA	Process monitoring	100%	100%	Manufacturer's procedure	Manufacturer Procedure	Process Procedure		P	–	–	
1.4.4	Vulcanised Rubber Lined items	[a] Chip test	MA	Chip test	One per lot	One per lot	Approved Drawing & BS 6374/Equivalent	BS 6374/Equivalent	Inspection report	√	P	V	V	
		[b] Adhesion, Visual defects, Thickness & Hardness	MA	Measurement, Visual Inspection	100% visual. Thickness/ hardness at random	100% visual. Thickness/ hardness at random	Approved Drawing & BS 6374/Equivalent	BS 6374/Equivalent	Inspection report	√	P	V	V	
		[c] Spark test for Pin Holes at 5 kv/mm	MA	Spark test for Pin Holes	100%	100%	Approved Drawing & BS 6374/Equivalent	BS 6374/Equivalent	Inspection report	√	P	V	V	

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	Balwinder Kumar	Nishant Sekhar	Checked by		Ashish Panigrahi 28.02.2020			Prepared by:			
Reviewed by:		Vishal kumar yadav	Reviewed by:		R K Jaiswal 28/2/2020			Reviewed by:			

		MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS			QUALITY PLAN					SPEC. NO	PE-TS-417/435-165-N003 (REV.0)			DATE:
					CUSTOMER					QP NO.:	PE-QP-417-165-N003			DATE: 28.02.2020
					PROJECT:					PO NO.:				DATE:
					ITEM: DEBRIS FILTER			SYSTEM:	CW SYSTEM	SECTION:				SHEET 04 OF 07
Sl. No.	Component / Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks
					6						M	C	N	
1	2	3	4	5	M	C/N	7	8	9	D *	** 10			11
2.4.0	**Ball valves**													
2.4.1	**Materials**													
	Body and Tail end pieces	Chemical,Physical properties	MA	Chemical & Physical analysis	One Sample/Cast / heat	One Sample/Cast / heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Test certificate	√	P	V	V	
2.4.2	Ball	Chemical,Physical properties	MA	Chemical & Physical analysis	One Sample/Cast / heat	One Sample/Cast / heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Test certificate	√	P	V	V	
2.4.3	Stem	Chemical,Physical properties	MA	Chemical & Physical analysis	One Sample/Cast / heat	One Sample/Cast / heat	Approved drg/ Data sheet	Approved drg/ Data sheet	Test certificate	√	P	V	V	
2.4.4	**In-process Inspection**													
2.4.5	Machining of body, end, pieces, ball	Dimension	MA	Measurement	100%	100%	Approved drg/Data sheet	Approved drg/Data sheet	Log book	√	P	V	V	
2.4.6	Ball	a) Surface defects	MA	Penetrant test	100%	100%	ASME Sec.VIII Div.1	ASME Sec.VIII Div.1 Appendix 8	Inspection report	√	P	V	V	
		b) Hardness	MA	Hardness testing	Random	Random	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report	√	P	V	V	
2.4.7	**Assembly**	a) Dimensions	MA	Measurement	100%	100%	EN ISO 17292	EN ISO 17292	Test certificate	√	P	V	V	
		b) Opening / Closing	MA	Operation	100%	100%	As per approved data sheet	As per approved data sheet	Inspection report	√	P	V	V	
2.4.8	**Testing**													
	[a] Body	Leakage	CR	Hydreulic test	100%	100%	EN 12266-1&2/API 598/Appd data sheet	EN 12266-1&2/API 598 & Appd. Data sheet	Test certificate	√	P	V	V	
	[b] Seat test	Leakage	CR	Hydraulic test	100%	100%	EN 12266-1&2/API 598/Appd data sheet	EN 12266-1&2/API 598 & Appd. Data sheet	Test certificate	√	P	V	V	
	[c] Seat	Leakage	CR	Air test	100%	100%	EN 12266-1&2/API 598/Appd data sheet	EN 12266-1&2/API 598 & Appd. Data sheet	Test certificate	√	P	V	V	

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:		Nishant Sekhar	Checked by	28.02.2020	Ashish Panigrahi			Prepared by:			
Reviewed by:		Vishal kumar yadav	Reviewed by:	28/2/2020	R K Jaiswal			Reviewed by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN			SPEC. NO	PE-TS-417/435-165-N003 (REV.0)	DATE:
		CUSTOMER			QP NO.:	PE-QP-417-165-N003	DATE: 28.02.2020
		PROJECT:			PO NO.:		DATE:
		ITEM: DEBRIS FILTER	SYSTEM:	CW SYSTEM	SECTION:		SHEET 05 OF 07

Sl. No.	Component / Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks
											M	C	N	
1	2	3	4	5	6 M	6 C/N	7	8	9	D *	** 10			11
3.0.0	**Butterfly valves**													
3.1.0	**Materials**													
	Body and Disc	Chemical properties	MA	Chemical properties	One Sample/Cast / heat	One Sample/Cast / heat	Approved drg/Data sheet	Approved drg/Data sheet	Test certificate	√	P	V	V	
		Physical properties	MA	Physical properties	One Sample/Cast / heat / batch	One Sample/Cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Test certificate	√	P	V	V	
3.1.1	Shaft	Chemical properties	MA	Chemical properties	One Sample/Cast / heat	One Sample/Cast / heat	Approved drg/Data sheet	Approved drg/Data sheet	Test certificate	√	P	V	V	
		Physical properties	MA	Physical properties	One Sample/Cast / heat / batch	One Sample/Cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Test certificate	√	P	V	V	
3.1.2	Seat	–	MA	–	One Sample/Cast / heat	One Sample/Cast / heat	Approved drg/Data sheet	Approved drg/Data sheet	Test certificate	√	P	V	V	
3.1.3	Stem	Chemical properties	MA	Chemical properties	One Sample/Cast / heat	One Sample/Cast / heat	Approved drg/Data sheet	Approved drg/Data sheet	Test certificate	√	P	V	V	
		Physical properties	MA	Physical properties	One Sample/Cast / heat / batch	One Sample/Cast / heat / batch	Approved drg/Data sheet	Approved drg/Data sheet	Test certificate	√	P	V	V	
3.2.0	**Assembly**	a) Dimensions	MA	Measurement	100%	100%	EN ISO 17292/Appd data sheet	EN ISO 17292/Appd data sheet	Test certificate	√	P	V	V	
		b) Opening / Closing	MA	Operation	100%	100%	As per approved data sheet	As per approved data sheet	Inspection report	√	P	–	–	
3.3.0	**Testing**													
	[a] Body	Leakage	CR	Hydraulic test	100%	100%	EN 12266-1&2/API598	EN 12266-1&2/API 598 & Appd. Data sheet	Test certificate	√	P	V	V	
	[b] Seat test	Leakage	CR	Hydraulic test	100%	100%	EN 12266-1&2/API598	EN 12266-1&2/API 598 & Appd. Data sheet	Test certificate	√	P	V	V	
	[c] Seat	Leakage	CR	Air test	100%	100%	EN 12266-1&2/API598	EN 12266-1&2/API 598 & Appd. Data sheet	Test certificate	√	P	V	V	

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:		Nishant Sekhar	Checked by	28.02.2020	Ashish Panigrahi			Prepared by:			
Reviewed by:		Vishal kumar yadav	Reviewed by:	29/2/2020	R K Jaiswal			Reviewed by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN			SPEC. NO	PE-TS-417/435-165-N003 (REV.0)	DATE:
		CUSTOMER			QP NO.:	PE-QP-417-165-N003	DATE: 28.02.2020
		PROJECT:			PO NO.:		DATE:
		ITEM: DEBRIS FILTER	SYSTEM:	CW SYSTEM	SECTION:		SHEET 06 OF 07

Sl. No.	Component / Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks
					M	C/N					M	C	N	
1	2	3	4	5	6		7	8	9	D*	** 10			11
4.0.0	GEARED MOTOR DRIVE	Running Test	CR	Functional Test	100%	100%	Approved Data Sheet	Approved Data Sheet	Test certificate					
		No load	CR	Functional test	100%	100%	Approved Data Sheet	Approved Data Sheet	Inspection Report	√	P	V	V	
		Noise test	CR	Functional test	100%	100%	Approved Data Sheet	Approved Data Sheet	Inspection Report	√	P	V	V	
		Oil leakage test	CR	Functional test	100%	100%	Approved Data Sheet	Approved Data Sheet	Inspection Report	√	P	V	V	
		Visual	CR	–	100%	100%	Approved Data Sheet	Approved Data Sheet	Inspection Report	√	P	V	V	
		Name plate verification	CR	–	100%	100%	Approved Data Sheet	Approved Data Sheet	Inspection Report	√	P	V	V	
4.1.0	Complete Unit of planetary gear	No Leak Test	CR	Functional test	One Sample/lot	One Sample/lot	Approved Data Sheet	Supplier Catalogue	Manufacturer's compliance certificate	√	P	V	V	
		Noise Level	MI	Functional test	One Sample/lot	One Sample/lot	Approved Data Sheet	Approved Data Sheet	Inspection Report	√	P	V	V	
		Visual Name plate Verification	MI	–	100%	100%	Approved Data Sheet	Approved Data Sheet	Inspection Report	√	P	V	V	
4.2.0	Actuators	Functional test	MA	Electrical test	100%	100%	Supplier catalogue/Appd data sheet	Supplier catalogue/Appd data sheet	Test certificate	√	P	V	V	
		Make, Range, Model	MA	Visual	100%	100%	Supplier catalogue/Appd data sheet	Supplier catalogue/Appd data sheet	Inspection Report	√	P	V	–	
		Assembly check alongwith valves	MA	Visual	100%	100%	Supplier catalogue/Appd data sheet	Supplier catalogue/Appd data sheet	Inspection Report		P	–	–	
5	Fasteners													
5.1	Internal Fasteners (Duplex SS)	Chemical & Physical properties	MA	Chemical & Mechanical analysis	1 Per heat/HT Batch	2 Per heat/HT Batch	Approved drg/Data sheet	Approved drg/Data sheet	Test Certificate/ lab test report	√	P	V	V	
		Visual & workmanship finish	MA	Visual	Sample	Sample	Approved drg/Data sheet	Approved drg/Data sheet	Inspection Report	√	P	V	V	
		Dimensions	MA	Measurement	Sample	Sample	Approved drg/Data sheet	Approved drg/Data sheet	Inspection Report	√	P	V	V	

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:		Nishant Sekhar	Checked by	28-02-2020	Ashish Panigrahi			Prepared by:			
Reviewed by:		Vishal kumar yadav	Reviewed by:	28/2/2020	R K Jaiswal			Reviewed by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN			SPEC. NO	PE-TS-417/435-165-N003 (REV.0)	DATE:
		CUSTOMER			QP NO.:	PE-QP-417-165-N003	DATE: 28.02.2020
		PROJECT:	S		PO NO.:		DATE:
		ITEM: DEBRIS FILTER	SYSTEM:	CW SYSTEM	SECTION:		SHEET 07 OF 07

Sl. No.	Component / Operation	Characteristics	Class	Type of Check	Quantum of Check		Reference Documents	Acceptance Norms	Format of Record		Agency			Remarks
					6						M	C	N	
1	2	3	4	5	M	C/N	7	8	9	D *	** 10			11
5.2	**Main Fasterners**	Visual	MA	Visual	Sample	Sample	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report / Mfr TC	√	P	V	V	
		Dimensions	MA	Measurement	Sample	Sample	Approved drg/Data sheet	Approved drg/Data sheet	Inspection report / Mfr TC	√	P	V	V	
		Chemical & Physical properties	MA	Chemical & Physical test a) Tensile b) Yield c) Elongation d) Proof load	1 sample per heat	1 sample per heat	Approved drg/Data sheet	Approved drg/Data sheet	Test Certificate/ lab test report	√	P	V	V	
5.3	**All Components / Equipments**	Painting Dry film thickness and visual	MA	Measurement	Random	Random	Painting schedule	Painting schedule	Inspection report	√	P	V	V	
		Packing	MA	Measurement	100%	100%	Packing Procedure	Packing Procedure	Inspection report	√	P	W	_	Note 1 & 2

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTAT

** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: CUSTOMER,

P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE

MA: MAJOR, **MI**: MINOR, **CR:** CRITICAL

NOTE:

1 Photographs of the wooden box (with LR No.) in which items are finally packed as per approved packing procedure is to submitted to BHEL (wherever applicable) before dispatch.

2. Clearance for dispatch of items will be given only after receipt of above photos

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:		Nishant Sekhar	Checked by	28-02-2020	Ashish Panigrahi			Prepared by:			
Reviewed by:		Vishal kumar yadav	Reviewed by:	28/2/2020	R K Jaiswal			Reviewed by:			

	QUALITY PLAN	CUSTOMER:	PROJECT:		SPEC. NO :PE-TS-415-100-M008
		BIDDER/VENDOR:	QAP NO.PE-QP-415-100-M020	REV.00 DTD. 22.12.2018	SPEC. TITLE TWO WAY BUTTERFLY VALVE
	SHEET 1 OF **5**	SYSTEM **WATER SYSTEM LP VALVES**	ITEM: **BUTTERFLY VALVES**		SECTION II

S.NO.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1.	**MATERIALS**											
1.1	BODY, DISC, SHAFT	1 MECH./CHEM PROPERTIES	MA	CHEM & PHYS. TESTS	ONE/ HEAT/ BATCH	APPD DRG/ TECH SPEC	APPD DRG/ TECH SPEC	TEST CERT.	3/2	2	1	- CORRELATION REQUIRED FOR BODY DISC - FOR CI ONLY MECH. PROPERTIES
		2.DIMENSIONS	MA	MEASURE-MENT	100%	TECH. SPEC	TECH SPEC	LOG BOOK	2	2	1	
		3. SUB-SURFACE DEFECTS OF SHAFT	CR	UT**(**)**	100%	ASTM A388	ASTM A388	TEST CERT.	3/2	2	1	DIA 40 MM & GREATER
		4. CASTINGS SURFACE DEFECTS	CR	1) VISUAL	100%	MSS SP55	MSS SP55	--DO—	3/2	2	1	
				2) MPI	100%	ASTM E-709/165	NO DEFECTS	--DO—	3/2	2	1	
				3) DPT	100%	ASTM E165	-DO-	-DO-	3/2	2	1	
				4) RT	100%	ASM E B16.34	ASM E B16.34	-DO-	3/2	2	1	- RT ON SS VALVES (FILM REVIEW BY BHEL)
		5. HEAT TREATMENT	MA	REVIEW OF HT RECORD	100%	TECH. SPEC	REL. MATL. STD	MATL. T.C	3/2	2	1	- SOLUTION ANNEALING FOR OTHER MATL. AS PER REL. SPEC
1.2	SOFT SEAT CLAMPING RING & SOFT SEAT S.S. MATING SEAT	1)CHEM., PHYS PROPS	MA	CHEM. PHYS TESTS	1/HEAT	TEST SPEC/ APPD DATA SHEET	TECH SPEC/ APPD DATA SHEET	LAB REPORT	3/2	2	1	
		2) INTERNAL DEFECTS	MA	UT TEST(**)	100%	ASTM A388	ASTM B16.34 APPENDIX-IV	TEST CERT	3/3	2	1	FOR S.S MATING SEAT THICKNESS 25MM & ABOVE
		3) VISUAL INSPN	MA	VISUAL	100%	TECH. SPEC	NO DEFECTS	TEST CERT.	3/2	2	1	
		4)CHEMICAL TESTING OF BODY SEAT RING, MATING SEAT (SS)	CR	IGC TEST	1/HEAT/BATCH	ASTM A262	ASTM A262 PRACTICE 'E'	TEST REPORT	3/2	2	1	
1.3	SOFT SEAT	1. VISUAL INSPN	MA	VISUAL	100%	TECH. SPEC/	TECH. SPEC/	LOG BOOK	3/2	2	1	

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

	QUALITY PLAN	CUSTOMER:	PROJECT:		SPEC. NO :PE-TS-415-100-M008
		BIDDER/VENDOR:	QAP NO.PE-QP-415-100-M020	REV.00 DTD. 22.12.2018	SPEC. TITLE TWO WAY BUTTERFLY VALVE
	SHEET 2 OF **5**	SYSTEM **WATER SYSTEM LP VALVES**	ITEM: **BUTTERFLY VALVES**		SECTION II

S.NO.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
		2.DIMENSIONS	MA	MEASURE-MENT	100%	APPD DRG TECH. SPEC	APPD DRG TECH SPEC	LOG BOOK	2	2	1	
		3. TENSILE STRENGTH	MA	TESTING	1. SAMPLE / BATCH	IS:3400(PART-1)	120Kg/CM^2 (MIN)	I.R	3/2	3/2	1	
		4.ELONGATION	MA	TESTING	-DO-	IS:3400(PART-1)	250%(min)	I.R	3/2	3/2	1	
		5. HARDNESS	MA	TESTING	-DO-	MFG. STD.	$70^0 \pm 5^0$ (Shore-A)	I.R	3/2	3/2	1	
		6. BLEED RESISTANCE	MA	TESTING	-DO-	SAMPLE TO BE KEPT IN 33% HCL, DM WATER, 48% NaOH FOR 72 HRS	NO DISCOLOU-RATION, WEIGHT GAIN ± 0% TO +2%	T.C	3/2	3/2	1	
		7. OZONE RESISTANCE	MA	TESTING	1/ BATCH	ASTM-D-1149	NO CRACKS AT 50 pphm Ozone	TEST CERT	3/2	3/2	1	
		8. AGEING TEST	MA	TESTING	1/ BATCH	ASTMD-573	No deterioration	TEST CERT	3/2	3/2	1	
		9. HYDRAILIC STABILITY TEST AFTER AGING	MA	TESTING	1/BATCH	TECH SPEC./ AWWA C504	TECH SPEC./ AWWA C504	TEST CERT.	3/2	2	1	
1.4	FASTENERS	1. VERIFICATION OF MAKE, GRADE	MI	VISUAL	100%	TECH. SPEC/ DATA SHEET	TECH. SPEC/ DATA SHEET	INSPN REPORT	3	3/2	1	
		2. DIMENSIONS	MA	MEASURE-MENT	SAMPL-ING PLAN	RELV STD.	RELV STD.	INSP REPORT	3	3/2	1	
1.5	GEAR BOX		MA									
	GEAR, WORM , BUSH & SHAFT	1. CHEM. COMP. & PHYS PROPERTIES	MA	CHEM & PHYS TEST	1/ BATCH	RELV STD/ DATA SHT/ MFG DRG	RELV STD/ DATA SHT/ MFG DRG	TEST CERT	3/2	2	1	
		2. DIMENSIONS	MA	MEASURE-MENT	100%	RELV STD/ DATA SHT/ MFG DRG	RELV STD/ DATA SHT/ MFG DRG	INSP REPORT	2	2	1	
		3. HARDNESS(GEAR & WORM)	MA	MEASURE-MENT	100%	RELV STD/ DATA SHT/ MFG DRG	RELV STD/ DATA SHT/ MFG DRG	TEST CERT	3/2	2	1	
		4. DESIGN VERIFICATION										
		a) TORQUE CAPABILITY	MA	TESTING (TORQUE AT TWICE OF RATED TORQUE OF GEAR BOX)	ONE/ TYPE/SIZE/ RATED TORQUE	AWWA C504 CL 4.2.8	AWWA C504 CL 4.2.8	TEST CERT.	3/2	1	-	REFER NOTE

BHEL	PARTICULARS	BIDDER/VENDOR	
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	DATE		BIDDER'S/ VENDOR'S COMPANY SEAL

	QUALITY PLAN	CUSTOMER:	PROJECT:		SPEC. NO :PE-TS-415-100-M008
		BIDDER/VENDOR:	QAP NO.PE-QP-415-100-M020	REV.00 DTD. 22.12.2018	SPEC. TITLE TWO WAY BUTTERFLY VALVE
	SHEET 3 OF 5	SYSTEM **WATER SYSTEM LP VALVES**	ITEM: **BUTTERFLY VALVES**		SECTION II

S.NO.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
		b) GEAR BOX P.O.D. (LIFE CYCLE TEST)	MA	(CYCLE TESTING)	ONE/ TYPE/SIZE/ RATED TORQUE	APPROVED PROCEDURE/ AWWA C504 CL 4.5.8.5.9	APPROVED PROCEDURE/ AWWA C504 CL 4.5.8.5.9	TEST CERT.	2	1*		REFER NOTE
1.6	**ELECTRICAL ACTUATORS**	1. TORQUE TESTING & SETTING OF TORQUE SWITCH	MA	}MECH., ELEC. }TESTS	100%	TECH. SPEC./ APPD. DRG./ DATA SHEET/ IS:9334	APPD. DRG./ DATA SHEET./ IS:9334	INSPN. REPORT	3	2	1	
		2. TRAVEL/STROKE	MA	}								
		3. TRAVEL TIME	MA	}								
		4. OPERATION OF LIMIT SWITCH	MA	}								
		5. MANUAL OPERATION THROUGH HAND WHEEL	MA	}								
		6. OPERATION TEST WITH POWER SUPPLY VARIATION ENERGISES TO OPEN/CLOSE	MA	}								
		7. IR,HV,IR	MA	}								
		8.DEGREE OF PROTECTION	MA	WATER, DUST TEST	1/ TYPE	TECH. SPEC./ APPD. DRG./ DATA SHEET/ IS:9334	APPD. DRG./ DATA SHEET/ IS:9334	3RD PARTY TEST CERT.	3	-	2,1	
		9. DESIGN VERIFICATION	MA	TYPE TEST	ONE/MODEL / TYPE/ SIZE /RATING	AWWA C540/	AWWA C540	TEST CERT	3/2	2	1`	
2.0	**INPROCESS CONTROL**											
2.1	BODY, DISC, SHAFT, SOFT SEAT MATING SEAT	1 DIMENSIONS	MA	MEASURE-MENT	100%-	MFG DRG	MFG DRG	LOG BOOK	2	2	1	
		2. SURFACE DEFECTS	CR	VISUAL	100%	FINISH	NO VISUAL DEFECTS	INSP REPORT	2	2	1	
		3. SURFACE DEFECTS	CR	DP/ MPI	100%	ASTM E165	NO SURFACE DEFECTS	INSP REPORT	3/2	2	1	MACHINED AREAS
3.0	**TESTING**											
3.1	PROOF OF	1. DISC STRENGTH	MA	HYDRO TEST	ONE/ TYPE/	AWWA C504	AWWA C504	TEST CERT.	3/2	1*	--	Refer note

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PRABHJYOT SINGH	NAME		
	SIGNATURE		
	DATE		BIDDER'S/ VENDOR'S COMPANY SEAL

	QUALITY PLAN	CUSTOMER:	PROJECT:		SPEC. NO :PE-TS-415-100-M008
		BIDDER/VENDOR:	QAP NO.PE-QP-415-100-M020	REV.00 DTD. 22.12.2018	SPEC. TITLE TWO WAY BUTTERFLY VALVE
	SHEET 4 OF 5	SYSTEM **WATER SYSTEM LP VALVES**	ITEM: **BUTTERFLY VALVES**		SECTION II

S.NO.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
	DESIGN TESTS	TEST			SIZE/ CLASS	CL 5.1.4	CL 5.1.4					
		2. LIFE CYCLE TESTING	MA	HYDRO TEST	ONE/TYPE/ CLASS / SIZE GROUP	APPROVED PROCEDURE/ AWWA C504 CL 5.1.4	APPROVED PROCEDURE AWWA C504 CL 5.1.4	TEST CERT.	3/2	1*	--	Refer note
3.2	VALVE LEAK TIGHTNESS TEST	1. SHELL TEST	MA	HYDRO TEST	100%	APPD. DRGS/ RELV STD	NO LEAKAGE	TEST CERT	2	1	--	Refer note
		2. SEAT LEAKAGE	MA	HYDRO TEST/ AIR TEST (IF AIR TEST SPECIFIED IN APPD DRG)	100%	APPD. DRGS/ RELV STD	NO LEAKAGE	TEST CERT	2	1	--	
3.3	FUNCTIONAL TEST OF ACTUATOR WITH VALVE	1. SETTING OF LIMIT, ,TORQUE SWITCHES & OPERATION	MA	TESTING	100%	TECH SPEC/ APPD.DRG/ APPD DATA SHEET/IS:9334	TECH SPEC/ APPD.DRG/ APPD DATA SHEET/IS:9334	TEST CERT.	3/2	1		
		2. OPERATION TEST WITH POWER SUPPLY ENERGISED,OPEN/ CLOSE & CURRENT DRAWN	MA	TESTING	100%	TECH SPEC/ APPD.DRG/ APPD DATA SHEET/IS:9334	TECH SPEC/ APPD.DRG/ APPD DATA SHEET/IS:9334	TEST CERT.	3/2	1		
3.4	PERFORMANCE TEST	1.VALVE & ACTUATOR PERFORMANCE	MA	**	100%	TECH SPEC/ RELV STD	SMOOTH OPERATION	TEST CERT	2	1		**OPERATING THREE TIMES FROM THE FULLY CLOSED TO THE FULLY OPENED AND THE REVERSE UNDER DESIGN CONDITION, MANUALLY AS WELL AS THROUGH OPERATOR.
4.0	**COMPLETE ASSEMBLY**											
4.1	**FINAL INSPECTION**	1. OVERALL L DIMENSION	MA	MEAS.	100%	APPD DRG		INSPN REPORT	2	1		
		2. CLEANLINESS	MA	VISUAL	100%	APPD DRG/ TECH SPEC		INSPN REPORT	2	2	1	
		3. NAMEPLATE WITH VALVE TAG NOS.	MA	VISUAL	100%	APPD DRG/ TECH SPEC		INSPN REPORT	3/2	2	1	

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	DATE		BIDDER'S/ VENDOR'S COMPANY SEAL

	QUALITY PLAN	CUSTOMER:	PROJECT:		SPEC. NO :PE-TS-415-100-M008
		BIDDER/VENDOR:	QAP NO.PE-QP-415-100-M020	REV.00 DTD. 22.12.2018	SPEC. TITLE TWO WAY BUTTERFLY VALVE
	SHEET 5 OF **5**	SYSTEM **WATER SYSTEM LP VALVES**	ITEM: **BUTTERFLY VALVES**		SECTION II

S.NO.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
5.0	**PAINTING**	AS PER BHEL TECH. SPEC	MA	VISUAL	100%	AS PER TECH. SPEC.		COMPLAINCE REPORTS & PHOTOGRAPH	3/2	2	1	FOR CI VALVES ONLY
6.0	**PACKING**	SOUNDNESS	MI	VISUAL	100%	AS PER TECH SPECIFICATION		INSP REPORT	2	2	1	PHOTOGRAPHS OF WOODEN CASES HAVING DULY PACKED VALVES TO BE FURNISHED TO BHEL-PEM FOR VERIFICATION TO OBTAIN MDCC

NOTE: REVIEW/ VERIFICATION OF INSPECTION REPORTS / TEST CERTIFICATES, IN CASE THESE TESTS CARRIED OUT EARLIER ON THE IDENTICAL MODEL/TYPE SIZE/CLASS RATING/ SIZE GROUP OF TESTED VALVES, GEAR BOX, ACTUATOR AND WITNESS BY REPUTED CUSTOMER LIKE NTPC OR THIRD PARTY INSPECTION AGENCY LIKE LLOYDS, TUV , DNV ETC. If the same above TCs are not available then the required type tests to be carried out by the bidder on identical valves, electric actuators, gear box without any commercial implications/ at their own cost AND the POD tests shall be witnessed by BHEL/ customer.

ABBREVIATIONS: CHP=CUSTOMER HOLD POINT CR= CRITICAL ACTIVITY MA= MAJOR ACTIVITY PT= DYE PENETRATION TEST P=PERFORMED BY V=VERIFIED BY W= WITNESSED BY (customer at random)
1= BHEL/TPI 2= VENDOR 3= SUB VENDOR I R= INSPECTION REPORT TC= TEST CERTIFICATE,UT=Ultrasonic test, LPI=liquid penetrant inspection, MPI=magnetic particle inspection.

(**) NORMAL BEAM PROBE OF 20/10MM DIA & 2/2.5 MHz SHALL BE USED. USING THIS PROBE THE BACK WALL ECHO SHALL BE SET AT 100% FULL SCREEN HEIGHT (FSH) IN SOUND AREA. AT THIS SENSITIVITY LEVEL THE ITEM SHALL BE SCANNED & ANY DEFECT ECHO MORE THAN 20% FSH IS NOT ACCEPTABLE. ALSO ANYWHERE COMPLETE LOSS OF BACK WALL ECHO IS NOT ACCEPTABLE

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

	MANUFACTURER/BIDDER/VENDOR NAME & ADDRESS	QUALITY PLAN		SPEC. NO.: PE-TS-020-100-M004	DATE: 24.01.2020
		CUSTOMER :		QP NO.: PE-QP-020-100-M006	DATE: 27.01.2020
		PROJECT:		PO NO.: LATER	DATE:
		ITEM: GM BALL VALVES (SIZE 15 TO 50NB/ PN16), FSS/FCS BALL VALVES (SIZE 15 TO 50NB / CLASS 800) & CSS/CCS (SIZE 65 TO 200 NB/ CLASS 150)	SYSTEM: L.P. VALVES	SECTION: II	SHEET 1 OF 4

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
									D	**			
					M	C/N				M	C	N	
1	2	3	4	5	6		7	8	9				
1.0	MATERIALS												
1.1	BODY, END PIECES BALL, SPINDLE, GLAND, LEVER, FASTENERS	1. PHYSICAL, CHEMICAL PROPS.	MA	PHYSICAL, CHEM.TESTING	ONE PER BATCH/ LOT/ HEAT	APPD. DRG. / REL. STD.	APPD. DRG./ REL. STD.	MILL T.C.	√	P/W	V	-	CORRELATION REQD. FOR BODY & END PIECES W.R.T. HEAT Nos.
		2. HEAT TREATMENT	CR	REVIEW OF H.T. RECORDS	100%	-DO-	-DO-	H.T. INTERNAL INSPN. RECORDS	√	P/W	V	-	
		3. SURFACE DEFECTS	MA	VISUAL	100%	MSS-SP-55	FREE FROM DEFECTS	INSPN. REPORT	√	P/W	V	-	
1.2	BODY, END PIECES	1. SURFACE DEFECTS	CR	PENETRANT TEST	100%	ASTM E 165	ANSI B 16.34	TEST REPORT	√	P/W	V	-	APPLICABLE ONLY FOR SS CASTINGS.
1.3	GEAR BOX												
1.3.1	GEAR, WORM GEAR & SHAFT	1. PHYSICAL, CHEMICAL PROPS.	MA	PHYSICAL, CHEM. TESTING	ONE PER BATCH	REL. STD./ DATA SHEET/ MFG. DRG.	REL. STD./ DATA SHEET/ MFG. DRG.	T.C.	√	P/W	V	V	
		2. HARDNESS	MA	MEASUREMENT	100%	REL. STD./ DATA SHEET/ MFG. DRG.	REL. STD./ DATA SHEET/ MFG. DRG.	T.C.	√	P/W	V	V	
1.3.2	GEAR BOX ASSEMBLY	1. APPEARANCE	MA	VISUAL	100%	DRG./DATA SHEET	DRG./DATA SHEET	INSPN. REPORT	√	P/W	V	V	
		2. PERFORMANCE	MA	OPERATION TEST	100%	DRG./DATA SHEET	DRG./DATA SHEET	SUPPLIER T.C.	√	P/W	V	V	
		3. DIMENSIONS	MA	MEASUREMENT	100%	REL STD./ DATA SHEET/ MFG. DRG.	REL STD./ DATA SHEET/ MFG. DRG.	INSPN. REPORT	√	P/W	V	V	
1.3.3	DESIGN VERIFICATION OF GEAR BOX	1. TORQUE CAPABILITY	MA	TESTING (TORQUE AT TWICE OF RATED TORQUE OF GEAR BOX)	ONE/ TYPE/MODEL/ RATED TORQUE	APPROVED PROCEDURE	APPROVED PROCEDURE	T.C.	√	P/W	V	V	REFER NOTE No. 1

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Rahul Kadam	Checked by:		Krishna Kumar Yadav
Reviewed by:		Sweta Singhal	Reviewed by:		Ritesh Kumar Jaiswal

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/BIDDER/VENDOR NAME & ADDRESS	QUALITY PLAN		SPEC. NO.: PE-TS-020-100-M004	DATE: 24.01.2020
		CUSTOMER :		QP NO.: PE-QP-020-100-M006	DATE: 27.01.2020
		PROJECT:		PO NO.: LATER	DATE:
		ITEM: GM BALL VALVES (SIZE 15 TO 50NB/ PN16), FSS/FCS BALL VALVES (SIZE 15 TO 50NB / CLASS 800) & CSS/CCS (SIZE 65 TO 200 NB/ CLASS 150)	SYSTEM: L.P. VALVES	SECTION: II	SHEET 2 OF 4

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
		2. GEAR BOX P.O.D. (LIFE CYCLE TEST)	MA	CYCLE TESTING	ONE/ TYPE/MODEL/ RATED TORQUE		APPROVED PROCEDURE	APPROVED PROCEDURE	T.C.	√	P/W	V	V	REFER NOTE No. 1
2.0	**IN PROCESS INSPECTION**													
2.1	MACHINING OF ALL COMPOMENTS	1. DIMENSIONS	MA	MEASUREMENT	100%		MFG. DRG.	MFG. DRG.	LOG BOOK	-	P/W	-	-	
		2. SURFACE FINISH	MA	VISUAL	100%		MFG. DRG.	MFG. DRG.	LOG BOOK	-	P/W	-	-	
		3. HARDNESS (FOR BALL AND SPINDLE)	MA	HARDNESS TESTING	100%		APPD. DRG. / REL. STD.	APPD. DRG. / REL. STD.	T.C.	√	P/W	V	V	
		4. SURFACE DEFECTS	CR	PENETRANT TEST	100%		ASTM E 165	ANSI B16.34	T.C.	√	P/W	V	-	FOR BALL, SPINDLE SEATS & MACHINED SURFACES.
3.0	**BEFORE GALVANISING - SHELL TEST FOR PRESSURE PARTS (FOR CS VALVES ONLY)**													
3.1	BODY, END PIECES (PRESSURE PARTS)	LEAK TIGHTNESS	CR	HYDRAULIC TEST	100%		APPD. DRG.	NO LEAKAGE	T.C.	√	P/W	V	-	
4.0	HOT DIP GALVANIZING OF CARBON STEEL BODY, END PIECES AND ALL OTHER CARBON STEEL VALVE PARTS	1. FREEDOM FROM SURFACE DEFECTS	MA	VISUAL	100%		IS:2629	IS:2629	INSPN REPORT	√	P/W	V	-	
		2. UNIFORMITY IN THICKNESS	MA	THICKNESS	VALVE BODY AT RANDOM		IS:2629	IS:2629	INSPN REPORT	√	P/W	V	V	THICKNESS 50 MICRONS (MIN.) TO BE CHECKED WITH ELCOMETER ##
		3. ADHESION	MA	KNIFE TEST	-DO-		IS:2629	IS:2629	INSPN REPORT	√	P/W	V	V	
5.0	**ASSEMBLY OF ALL VALVE**													
5.1	BALL AND SEAT	MIRROR FINISH (BALL)	CR	BUFFING/ GRINDING/ MACHINING	100%		THE SURFACE SHALL BE SMOOTH AND SHALL HAVE UNIFORM CONTACT WITH SOFT SEAT		LOG BOOK	√	P/W	V	V	
6.0	**FINAL TESTING**													
6.1	ASSEMBLY	1. DIMENSIONS	MA	MEASUREMENT	100%	10% #	APPD. DRG.	APPD. DRG.	INSPN. REPORT	√	P/W	W	W	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Rahul Kadam	Checked by:		Krishna Kumar Yadav
Reviewed by:		Sweta Singhal	Reviewed by:		Ritesh Kumar Jaiswal

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/BIDDER/VENDOR NAME & ADDRESS	QUALITY PLAN	SPEC. NO.: PE-TS-020-100-M004	DATE: 24.01.2020
		CUSTOMER :	QP NO.: PE-QP-020-100-M006	DATE: 27.01.2020
		PROJECT:	PO NO.: LATER	DATE:
		ITEM: GM BALL VALVES (SIZE 15 TO 50NB/ PN16), FSS/FCS BALL VALVES (SIZE 15 TO 50NB / CLASS 800) & CSS/CCS (SIZE 65 TO 200 NB/ CLASS 150) — SYSTEM: L.P. VALVES	SECTION: II	SHEET 3 OF 4

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N			D	M	C	N	
1	2	3	4	5	6		7	8	9	*	**		
		2. OPENING/ CLOSING	MA	OPERATION	100%	10% #	SMOOTH OPERATION OF VALVE	SMOOTH OPERATION OF VALVE	-DO-	√	P/W	W	W	
			MA	TORQUE TESTING	100%	10% #	TORQUE CALCULATIONS	TORQUE WITHIN CALCULATED VALUE	-DO-	√	P/W	W	W	For 200NB size valve
		3. **APPEARANCE:** WORKMANSHIP, ORIENTATION, MARKING, TAG No.	MA	VISUAL	100%	10% #	APPD. DRG.	APPD. DRG.	INSPN. REPORT	√	P/W	W	W	
6.2	BODY	1. LEAK TIGHTNESS	CR	HYDRAULIC TEST	100%	10% #	APPD. DRG.	NO LEAKAGE	T.C.	√	P/W	W	W	
6.3	SEAT	1. LEAK TIGHTNESS	CR	-DO-	100%	10% #	-DO-	-DO-	-DO-	√	P/W	W	W	
		2. LEAK TIGHTNESS	CR	PNEUMATIC TEST	100%	10% #	-DO-	REL. STD.	-DO-	√	P/W	W	W	
6.4	COMMISSIONING SPARES	WORKMANSHIP & SUITABILITY	MA	VISUAL	100%	100%	-DO-	APPD. DRG.	INSPN. REPORT	√	P/W	W	-	
7.0	PACKING IN WOODEN CASES AND MARKING	SOUNDNESS OF PACKING	MA	VISUAL	100%		APPD. DRG.	APPD. DRG.	SOFT COPY OF PHOTOGR-APHS	-	P	V	-	Vendor to provide the following to BHEL-PEM for verification: a) Photographs of valves duly placed inside the wooden box just before final packing. b) Photographs of the wooden box in which valves have been finally packed just before dispatch. Clearance for dispatch

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Rahul Kadam	Checked by:		Krishna Kumar Yadav
Reviewed by:		Sweta Singhal	Reviewed by:		Ritesh Kumar Jaiswal

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/BIDDER/VENDOR NAME & ADDRESS	QUALITY PLAN		SPEC. NO.: PE-TS-020-100-M004	DATE: 24.01.2020
		CUSTOMER :		QP NO.: PE-QP-020-100-M006	DATE: 27.01.2020
		PROJECT:		PO NO.: LATER	DATE:
		ITEM: GM BALL VALVES (SIZE 15 TO 50NB/ PN16), FSS/FCS BALL VALVES (SIZE 15 TO 50NB / CLASS 800) & CSS/CCS (SIZE 65 TO 200 NB/ CLASS 150)	SYSTEM: L.P. VALVES	SECTION: II	SHEET 4 OF 4

SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N			* D	** M	C	N	
1	2	3	4	5	6		7	8	9				
													of valves will be given only after receipt of the photos of valves in satisfactory condition as mentioned above.

NOTE:

1. **REVIEW/ VERIFICATION OF TEST REPORT/CERTIFICATE, IN CASE THESE TESTS HAVE BEEN CARRIED OUT EARLIER (WITHIN THE LAST 5 YEARS FROM PLACEMENT OF PROJECT SPECIFIC PO, BASED ON FRAMEWORK AGREEMENT) ON THE IDENTICAL MODEL/TYPE/RATING OF GEAR BOX, AT AN INDEPENDENT LABORATORY OR WITNESSED BY REPUTED CUSTOMER LIKE NTPC ETC. OR THIRD PARTY INSPECTION AGENCY LIKE LLOYDS, TUV, DNV ETC. IF THE ABOVE TEST REPORTS/CERTIFICATES ARE NOT AVAILABLE OR NOT FOUND SATISFACTORY BY BHEL/CUSTOMER, THEN THE REQUIRED TYPE TESTS TO BE CARRIED OUT BY THE VENDOR ON GEAR BOX WITHOUT ANY COMMERCIAL IMPLICATIONS AT HIS OWN COST & WITNESSED BY BHEL/CUSTOMER.**

2. **BHEL RESERVES THE RIGHT FOR CONDUCTING REPEAT TEST, IF REQUIRED.**

 # The extent of check to be witnessed is 10% or min. 2nos. at random by BHEL/CUSTOMER & 100% by vendor for each size, type & rating of valve for project specific PO quantity.

Minimum thickness of galvanizing may vary based on project specific requirement, which shall be informed project wise.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C**: MAIN SUPPLIER (BHEL)/ THIRD PARTY INSPECTION AGENCY, **N**: CUSTOMER,

P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE

MA: MAJOR, **MI**: MINOR**, CR:** CRITICAL

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		Rahul Kadam	Checked by:		Krishna Kumar Yadav
Reviewed by:		Sweta Singhal	Reviewed by:		Ritesh Kumar Jaiswal

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

SUB-SECTION - IIB

STANDARD TECHNICAL SPECIFICATION (ELECTRICAL)

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
		PROJECT:		PO NO.:	DATE:
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 of 2

S. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY **			REMARKS
1	2	3	4	5	6		7	8	9					
					M	C/ N				D	M	C	N	
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC.	MFG. SPEC.	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	VISUAL	100%	-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	LOG BOOK		P	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MFG.SPEC./	MFG.SPEC.	LOG BOOK		P	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	-	MFG. SPEC/ APPROVED DATASHEET	MFG. SPEC/ APPROVED DATASHEET	LOG BOOK	✓	P	V	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST	MA	VISUAL	100%	-	IS-325 / IS-12615/ APPROVED DATA SHEET	IS-325 / IS-12615/ APPROVED DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	-	APPROVED DRG/ DATA SHEET	APPROVED DRG/ DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1 & NOTE-2

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:		PRAVEEN DUTTA	Reviewed by:		RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

		3.NAMEPLATE DETAILS	MA	VISUAL	100%	-	IS-325 / IS-12615 / APPROVED DATA SHEET	SAME AS COL. 7	TEST/ INSPN. REPORT	✓	P	V	-	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MFG. STANDARD / (#)	AS PER MFG. STANDARD / (#).	INSPC. REPORT	✓	P	W	-	(#) REFER NOTE-8

NOTES:
1. Routine tests on 100% motors shall be done by the vendor. However, BHEL/ Customer shall witness routine tests on random samples. The sampling plan shall be mutually agreed upon.
2. For exhaust/ventilation fan motors of rating up to 1.5 KW, only routine test certificates shall be furnished for scrutiny.
3. In case test certificates for these tests on similar type, size and design of motor from independent laboratory are available, the same is valid for 5 years.
4. BHEL reserves the right to perform repeat test, if required.
5. After packing and prior to issue MDCC, photographs of items to be despatched shall be sent to BHEL for review.
6. In case of any changes in QP commented by customer at contract stage, same shall be carried out by bidder without any implication to BHEL/ Customer.
7. Project specific QP to be developed based on customer requirement.
8. For export job, BHEL technical specification for seaworthy packing to be followed.
9. Packing shall be suitable for storage at site in tropical climate conditions.
10. Latest revision/ year of issue of all the standards (IS/ ASME/ IEC etc.) indicated in QP shall be referred.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR**, CR:** CRITICAL
D: DOCUMENTATION

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:		PRAVEEN DUTTA	Reviewed by:		RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

SUB-SECTION - IIC

STANDARD TECHNICAL SPECIFICATION (C &I)

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
Panel Height: Not less than 2365 mm (Refer data sheet-A (No. PES-145A-DS1-0)
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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 1 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY **			REMARKS
1	2	3	4	5	6		7	8	9	D	M	C	N	
					M	C/N								
	RAW MATERIAL													
1.0	Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	√	P/W	V		
		2. Bend Test	CR	Mech. test	Sample	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	√	P/W	V		
		3. Surface finish	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	---		
		4. Waviness	MA	Visual	100%	10%	Manufacturing Standard	No Waviness	Inspection Report	√	P/W	---		
		5. Thickness	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	V		
		6. Mill marking	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	Sample	IS:2062	IS:2062	Test Certificate	√	P/W	---		
		2. Surface Defects	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	---		
		3. Straightness	MA	Measurement	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	---		
		4. Mill marking	MA	Visual	100%	10%	IS:2062	IS:2062	Inspection Report	√	P/W	V		

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 2 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
		2. IR and HV	MA	Electrical	100%	10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	10% 10% 10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
		4. Type / Routine Test Certificates	MA	Verification	100%	10%	IS:1554 or IS:694	IS:1554 or IS:694	Inspection Report	√	P/W			
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays	1. Verification at make and Type	CR	Visual	Sample	Sample	Approved Drg/Datasheet	Approved Drg/Datasheet	Test Certificate	√	P/W			
		2. Verification of Test Certificates	CR	Scrutiny of Type / Routine T.Cs.	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			
		3. Operation / Functional check	CR	Electrical	Sample+ 100% @	Sample+ 10% @	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			+ for relay & contactors only

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 3 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
	Timers, Space Heaters, Thermostat, Indicating meters etc.	4. I.R.	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			@ for all components except relays & contactors.
		5. H.V.	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			
		6. Calibration	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W	V		
		7. Pick up / Drop off Voltage	MA	Electrical	100%	10%	Relevant Indian Std & Catalogue	Relevant Indian Std & Catalogue	Inspection Report	√	P/W			
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	Sample	Manufacturing Standard	Manufacturing Standard	Test Certificate	√	P/W			
		2. Surface defects	MA	Visual	Sample	Sample	Manufacturing Standard	Manufacturing Standard	Test Certificate	√	P/W			
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	Sample	Manufacturing Standard	Manufacturing Standard	Test Certificate	√	P/W			
	IN PROCESS INSPECTION													

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 4 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
6.0	Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Surface defects after bending	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W			
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Deburring	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
	ASSEMBLY													
8.0	Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Alignment	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		3. Welding Quality	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		4. Surface defects	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 5 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Periodic	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		3. Dipping / Removal Time	MA	Measurement	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		4. Surface quality after every dip	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		5. Primer after phosphating	MA	Visual, Thickness	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		6. Putty Application & Rubbing after primer	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		7. Paint first coat	MA	Visual, Thickness	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/4/2020	CHETAN MALIK	Checked by:	14/04/2020	KUNDAN PRASAD		
Reviewed by:	14/4/2020	RK RAINA	Reviewed by:	14/4/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 6 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	V		
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		3. Ferrule numbers	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		4. Colour of wiring	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	V		
		5. Size of Conductor	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	V		
11.	Component Mounting	1. Correct components	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			
		2. Fixing	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W			

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD		
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 7 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
	FINAL TESTING													
12.	Final Inspection	1. Workmanship	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	W		
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		At Random by BHEL, based on 100 % internal test reports by Mfr.
		3. Components identification Marking / Name plates	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		5. Dimensions	MA	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		6. Door functioning	MA	Functional	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		At Random by BHEL, based on 100 % internal test reports by Mfr.
		7. Paint Shade	CR	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/2/2020	KUNDAN PRASAD			Reviewed by:			
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 8 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/N					M	C	N	
		8. Paint Thickness	CR	Measurement	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		9. Workmanship of Gaskets	MA	Visual	100%	10%	Manufacturing Standard	Manufacturing Standard	Inspection Report	√	P/W	W		
		10. Wiring Layout	MA	Visual	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		11. Wire Termination	MA	Pulling manually	Sample	Sample	-----	Firm termination	Inspection Report	√	P/W	W		
		12. Continuity	MA	Electrical	100%	10%	-----	Continuity OK	Inspection Report	√	P/W	W		
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	Sample	Approved Drg/Datasheet Relevant IS-13947 Part-1, IS-2148.	Approved Drg/Datasheet Relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	√	P/W	V		
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	10%	Approved Drg/Datasheet Relevant IS.	Approved Drg/Datasheet Relevant IS.	Inspection Report	√	P/W	W		

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	14/2/2020	CHETAN MALIK	Checked by:	14/02/2020	KUNDAN PRASAD
Reviewed by:	14/2/2020	RK RAINA	Reviewed by:	14/2/2020	RK JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-145-I056	DATE: 07.02.2020
	PROJECT:		PO NO.: --	DATE: --
	ITEM: LOCAL CONTROL PANEL	SYSTEM: C&I	SECTION: C	SHEET 9 OF 9

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
15	FUCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		2. Instrument Calibration	CR	Electrical	10%	10%	Approved Drg/Datasheet	Approved Drg/Datasheet	Inspection Report	√	P/W	W		
		3. Temperature rise	CR	Electrical	100%	10%	Approved Drg/Datasheet Relevant IS.	Approved Drg/Datasheet Relevant IS.	Inspection Report	√	P/W	W		

NOTES:

1. Customer's specification for painting shall be included in the technical specification. In the absence of Customer's spec. for painting, vendor to obtain BHEL's approval on their painting specification / procedure.
2. Copies of all TC's (Test Certificates) for components shall be submitted to BHEL for verification and acceptance.
3. BHEL reserves the right to conduct repeat tests, if required.

LEGENDS:
*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION, **D**: DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR, **CR:** CRITICAL

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	14/12/2020	CHETAN MALIK	Checked by:	14/12/2020	KUNDAN PRASAD
Reviewed by:	14/12/2020	RK RAINA	Reviewed by:	14/12/2020	RK JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

STANDARD CHECK LIST FOR C&I INSTRUMENTS(for MSE& Max pckgs)

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 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 correlation are not available manufacturer's compliance to be provided.
4. Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same along with test certificates to be verified by BHEL.

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		VIPUL KUMAR VERMA	Checked by:		KUNAL GANDHI
Reviewed by:		SURESH CHAND SHARMA	Reviewed by:		RITESH KUMAR JAISWAL

STANDARD CHECK LIST FOR C&I INSTRUMENTS(for MSE& Max pckgs)
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 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 correlation is not available, MFR's compliance to be provided
5. Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same along with test certificates to be verified by BHEL.

BHEL					
ENGINEERING			**QUALITY**		
	Sign & Date	Name		Sign & Date	Name
Prepared by:		VIPUL KUMAR VERMA	Checked by:		KUNAL GANDHI
Reviewed by:		SURESH CHAND SHARMA	Reviewed by:		RITESH KUMAR JAISWAL

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL PANELS	SPECIFICATION NO.: PES-145-054A
		VOLUME
		SECTION
		REV. NO. 01 DATE: 24.01.2019
		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: 24.01.2019
		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:

SECTION III

DOCUMENTS TO BE SUBMITTED BY BIDDER

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 shall be supplied on 'As Required Basis' and to be supplied at the time of commissioning of Debris Filter & 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 equipment, Trial run and Performance Testing at site shall be included by bidder in the base price itself.

h) The main flanges for DF shall be suitable for the forces and moments as per the specification.

i) The hydrostatic test pressure shall be 1.5 times the design pressure.

j) All sub - vendors shall be subject to BHEL/ Customer/Customer's Consultant approval in the event of order.

k) The Performance guarantees of equipments shall stand valid till the satisfactory completion of performance testing & its acceptance by BHEL/ Customer/Customer's Consultant.

l) The orientation of piping around DF shall be finalised during detailed Engg.

m) 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 bidder's scope. The instrumentation cable and cabling from instruments/ actuators to junction boxes is also included in bidder's scope.

- Valve actuators and controls shall be provided as specified in Data Sheet-A and Project specific requirements as specified in Section IB & Section IC

- 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.

- Switch gear panel should have suitable arrangement like bus coupler for providing redundancy to incoming supply feeder.

	TITLE : SCHEDULE OF PERFORMANCE GUARANTEES FOR DEBRIS FILTER (DF)	SPEC. NO. PE-TS- 415-165-N003 ,Rev01
		SECTION : III
		SUB SECTION : IIIA
		Sheet 1 of 1 Date- 29.04.2020

S.NO.	DESCRIPTION	UNITS	1 X 660 MW BHUSAWAL
1.	Pressure drop across the Debris Filter (i.e. between inlet & outlet nozzle) under clean condition and Normal flow condition	MWC	

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

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

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

भेल BHEL	LOAD DATA (ELECTRICAL)	JOB NO.	415	ORIGINATING AGENCY		PEM (ELECTRICAL)
		PROJECT TITLE	1X660MW BHUSAWAL TPS	NAME		DATA FILLED UP ON
		SYSTEM / S	VENTILATION SYSTEM	SIGN.		DATA ENTERED ON
		DEPTT. / SECTION	ELECTRICAL	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE

ANNEXURE - B

CABLE SCHEDULE FORMAT

ANNEXURE III

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

	Title	SPECIFICATION NO.
	DATA SHEET - B **DEBRIS FILTER** **(BACKWASH TYPE)**	PE-TS-XXX-165-N003
		SECTION: **C** SUB-SECTION: **IIIC**
		SHEET 1 OF 9

INSTRUCTION TO BIDDER
1. This data sheet shall be read in conjunction with Specification No. PE-TS-XXX-165-N003
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO.	ITEM	UNIT	PARTICULARS
1.0	**General :**		
1.1	Number of Debris Filter being supplied.	Nos.	
1.2	Type & Model (on-line/off-line)		
1.3	Manufacturer		
1.4	Country of origin		
1.5	Capacity, each	M^3/hr	
1.6	Size		
	a) Inlet connection	mm	
	b) Outlet connection	mm	
1.7	Liquid to be filtered		
2.0	**Design :**		
2.1	Design Pressure	Bar (g)	
2.2	DesignTemperature	^oC	
2.3	Flow rate through the Filter : a) Normal b) Maximum allowable c) Minimum	M^3/hr	
2.4	Design differential pressure for filter section/ screen	bar (g)	
3.0	**Guaranteed Performance**		
3.1	Pressure drop across the Filter (i.e., between inlet and outlet connections) at normal flow rate a) Clean condition b) 50% chocked condition c) During flushing operation d) After flushing operation	Bar	
3.2	Debris discharge flow during flushing operation.	M^3/hr	
3.3	Flushing period	Minutes	

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

INSTRUCTION TO BIDDER
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SL.NO.	ITEM	UNIT	PARTICULARS
3.4	Minimum pressure differential to cause flushing/ backwashing		
3.5	Maximum size of Particle/ debris which can be safely handled by the filter.		
3.6	Power consumption during flushing	KW	
	a) Flushing Valves(s) b) Debris Discharge Valve c) Debris Extractor d) Water Injector Pump (if any) e) Any other f) Total		
4.0	Operation :		
4.1	Whether automatic flushing/ back-washing operation effected by the following		
	a) Differential pressure		YES/NO
	b) Adjustable timer		YES/NO
	c) Push button		YES/ NO
	d) Any other		YES/NO
4.2	Whether provision for manual flushing / backwashing operation is made in the event of control system failure.		YES/ NO
5.0	**Filter Housing Body :**		
5.1	Code/ Standard		
5.2	Outer diameter	mm	
5.3	Thickness	mm	
5.4	Materials		
	Housing/ Body		
	Internal Hardware		

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

	Title	SPECIFICATION NO.
	DATA SHEET - B **DEBRIS FILTER** **(BACKWASH TYPE)**	PE-TS-XXX-165-N003
		SECTION: **C** SUB-SECTION: **IIIC**
		SHEET 3 OF 9

INSTRUCTION TO BIDDER
1. This data sheet shall be read in conjunction with Specification No. PE-TS-XXX-165-N003
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO.	ITEM	UNIT	PARTICULARS
	External hardware		
5.5	Lining materail (if applicable) and thickness		
5.6	Inspection Hole :		
	a) Type		
	b) Size	mm	
5.7	Whether sight glass is provided		YES/ NO
6.0	**Filter Section/ Screen Assembly :**		
6.1	Perforation/ mesh size	mm	
6.2	Free filter surface area	m^2	
6.2	Total surface area	M^2	
6.4	Thickness	mm	
6.5	Materails :		
	a) Filter section/ scree		
	b) Supporting cage		
	c) Hardware for fixing the filter section/ screen		
7.0	**Flushing/ Backwashing Unit :**		
7.1	Type		
7.2	Flushing Valves (if applicable)		
	a) Nos. provided	Nos.	
	b) Type		
	c) Materials • Body • Disc/ Flap • Shaft		
	d) Tag Number		

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

INSTRUCTION TO BIDDER
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SL.NO.	ITEM	UNIT	PARTICULARS
7.3	Debris Extractor (if applicable)		
	a) Type		
	b) Materials		
7.4	Debris discharge/ backwash outlet valves :		
	a) Type		
	b) Size	mm	
	c) Materials		
	♦ Body		
	♦ Disc/ Trim		
	♦ Shaft		
	d) Tag Number		
7.5	Size of Debris discharge/ backwash outlet valves is greater than pipe line size		YES/NO
7.6	Any water injection is required		YES/ NO
7.7	Whether Pump, valves and piping for water injection is included in the offer.		YES/ NO.
7.8	Debris discharge/ backwash outlet pipe		
	a) Material		
	b) O.D. and thickness	mm	
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		

SL.NO.	ITEM	UNIT	PARTICULARS
	f) No. of contacts	Nos.	
	g) Contact rating		
	h) Enclosure		
	i) Type of Mounting		
8.2	Whether differential Pressure gauge is provided for manual observation.		YES/ NO
8.3	Diffrential Pressure Gauge :		
	a) Type		
	b) Make and Model		
	c) Range		
	d) Accuracy		
	e) Material of sensing element		
	f) No. of contacts	Nos.	
	g) Dial size	mm	
	h) Enclosure		
	i) Mounting		
8.4	Whether built in flushing arrangement complete with flushing pump, valves, and associated piping, is provided.		YES/ NO
8.5	Whether remote seal type D.P. Transmitter		YES/ NO
9.0	**Timer for Flushing Operation**		
9.1	Timer make		
9.2	Range of duration setting		
10.0	**Actuators :**		
10.1	Actuators for flushing valves :		
	a) Type and make		

INSTRUCTION TO BIDDER
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SL.NO.	ITEM	UNIT	PARTICULARS
	b) Nos. provided		
	c) Motor rating	KW	
10.2	Actuators for debris discharge/ backwash outlet valves		
	a) Type and make		
	b) Motor rating	KW	
1.03	Actuator for Debris Extractor	KW	
	Type & make Nos. provided Motor rating		
10.4	Any other		
11.0	**Electric Drive Motors**		
11.1	Drive motor for water injection pump (if applicable)		
	a) Type and make		
	b) Rating	KW	
11.2	Drive motor for debris extractor		
	a) Type and make		
	b) Rating	KW	
11.3	Drive motor for differential pressure measure, measuring system flushing pump (if applicable).		
	a) Type and make		
	b) Motor rating	KW	
11.4	Any other		

Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					

	Title	SPECIFICATION NO.
	DATA SHEET - B **DEBRIS FILTER** **(BACKWASH TYPE)**	PE-TS-XXX-165-N003
		SECTION: **C** SUB-SECTION: **IIIC**
		SHEET 7 OF 9

INSTRUCTION TO BIDDER
1. This data sheet shall be read in conjunction with Specification No. PE-TS-XXX-165-N003
2. Items which deviate from Specification shall be marked with an asterisk (*)

SL.NO.	ITEM	UNIT	PARTICULARS
12.0	**Counter Flanges for inlet & outlet** :		
12.1	Nos. provided	Nos.	YES/ NO
12.2	Type		
12.3	Size		
12.4	Rating		
12.5	Materials		
	a) Flanges b) Bolts and Nuts c) Gaskets		
12.6.	Code/ Standard		
12.7	Counter flanges for all other terminal points are provided.		YES/ NO
13.0	**Control Panel**		
13.1	Type		
18.2	Model & Manufacturer		
13.3	Operating Voltage/ frequency	V/ Hz	
13.4	Control Voltage/ frequency	V/ Hz	
13.5	Materials of housing and door		
13.6	Protections/ interlocks provided for :		
13.7	Alarms/ Annunciations provided for :		
13.8	Indicators provided for :		

Name of Bidder/ Vendor

Revision Number	0	1	2	3	4
Signature of Bidder/ Vendor Authorised Representative					
Date :					

INSTRUCTION TO BIDDER
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SL.NO.	ITEM	UNIT	PARTICULARS
13.9	Whether counterto register number of flushing operations, is provided.		YES/ NO
13.10	Whether interconnecting control and power cabling between the control panel and filter is included in the offer.		YES/ NO
14.0	Whether lifting lugs are provided.		YES/ NO.
15.0	Whether supports complete with foundation plates, bolts, nuts, etc. are included in the offer (wherever required).		YES/ NO
16.0	**Shop Inspection and Tests**		
16.1	Whether all the tests and inspections as detailed in the specification/ quality plan are carried out.		YES/ NO
16.2	Hydorstatic Test :		
	a) Test Pressure	Bar (g)	
	b) Test duration	Minutes	
17.0	**Painting :**		
17.1	External Surfaces :		
	a) Surface Preparation b) Primer c) Finish		
17.2	Internal Surfaces :		
	a) Surface Preparation b) Primer c) Finish		
18.0	**Weights :**		
18.1	Empty Weight	Kg.	
18.2	Operating	kg	

Name of Bidder/ Vendor					
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Date :					

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SL.NO.	ITEM	UNIT	PARTICULARS
19.0	Overall Dimensions		
	a) Debris Filter		
	b) Flushing skid		
	c) D.P. measuring system skid		
20.0	Weight of heaviest unit/ component to be handled.		
21.0	Space required for removal.		
22.0	Headroom required during installation at site.		
23.0	Other information (if any)		

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Name of Bidder/ Vendor					
Revision Number	**0**	**1**	**2**	**3**	**4**
Signature of Bidder/ Vendor Authorised Representative					
Date :					