



MAHARASHTRA STATE POWER GENERATION COMPANY LIMITED

1X660 MW BHUSAWAL TPS

TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM

SPECIFICATION NO.: PE-TS-415-154-A101-R00



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA**



TITLE:
1x660 MW BHUSAWAL TPS

SPECIFICATION NO. PE-TS-415-154-A101

**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

SUB-SECTION:

REV. NO. 00

DATE :01.06.2019

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PROJECT INFORMATION

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1.0 <u>INTRODUCTION</u> The proposed 1x 660 MW Bhusawal Thermal Power Project will be set up by Maharashtra State Power Generation Co. Ltd. (MAHAGENCO) in Dipnagar near Bhusawal, Maharashtra, India. The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given herein under is for general guidance and shall not be contractually binding on the Owner. All relevant site data/information as may be necessary shall have to be obtained /collected by the Bidder. 2.0 <u>APPROACH TO SITE</u> Deepnagar is well connected by rail and road. By road, it is about 8 Km from Bhusawal city. Nearest railway station is at Bhusawal. The nearest Airport is at Aurangabad. The nearest sea port is at Mumbai. The site is located on the Mumbai-Nagpur Highway. 3.0 <u>LAND</u> Bhusawal Thermal Power Plant is already having 1x62.5 MW + 2x210 MW Units and Two (2) Units of 500 MW each are under execution stage. About 108.94 Hectares of land is acquired by MAHAGENCO near existing TPS. It is proposed to install 1x 660 MW unit on this land. 4.0 <u>SOURCE OF COAL</u> Indian coal would be sourced from Machaakata coal blocks in Orissa state. The Coal will be received at Plant site directly by rail. The coal from the railway wagons would be unloaded by means of wagon tipplers and will be either bunkered or stacked in the stock pile at site. 5.0 <u>SOURCE OF WATER</u> The main source of water is considered Ozerkheda Reservoir which is located at around 18 km from plant site.		

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6.0 <u>ASH DISPOSAL AREA</u> The ash generated from 1 x 660 MW unit shall be disposed off in slurry form to the existing Ash Pond located at Velhala, approx. 12 Km from the site.		
7.0 <u>PROJECT INFORMATION</u>		
7.1	Client / Owner	: Maharashtra State Power Generation Co. Ltd.
7.2	Consultant	: Procon Engineers, Navi Mumbai (Division of Nimoto Consulting Engineers Pvt. Ltd.)
7.3	Project Title	: BHUSAWAL T.P.S. UNIT – 6 : 1X660 MW
7.4	Location	: Dipnagar, Near Bhusawal, Maharashtra, India
7.5	Nearest railway station	: Bhusawal
7.6	Nearest Airport	: Aurangabad
7.7	Nearest Harbour	: Mumbai
7.8	Access Roads	: NH 6 (Mumbai-Nagpur Highway)
7.9	Elevation above MSL	: 210 M
7.10	Longitude/latitude	: 75° 51' 10" East / 21° 02' 30" North
7.11	Seismic Zone	: Zone III as per IS:1893
7.12	<u>AMBIENT TEMPERATURE</u>	
7.12.1	Mean of daily maximum temperature	: 48.25 °C (during May)
7.12.2	Mean of daily minimum temperature	: 18 °C (during January)
7.12.3	Highest temperature recorded	: 48.7°C

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7.12.4	Lowest temperature recorded : 13°C		
7.13	Wet bulb temperature : 27°C (Maximum)		
7.14	Rainfall : 112 mm average annually		
7.15	Wind Speed : 0 to 39 Km/hr		
7.16	Wind direction : East North East to West South West		
	<u>ELECTRICAL</u>		
7.17	<u>MAIN POWER SOURCE FROM GRID</u>		
7.17.1	Rated Voltage : 400kV		
7.17.2	Voltage variation : ± 10 %		
7.17.3	Frequency Variation : ± 5 %		
7.17.4	Rated Short Circuit : 50 kA, Three Phase Symmetrical Level		
7.18	<u>AUXILIARY POWER SUPPLY</u>		
	Auxiliary electrical equipment shall be suitable for operation on the following supply system:		
7.18.1	Motors above 1000 kW & other Power devices : 11kV,3Ph,3wire,50Hz system		
7.18.2	Motors below 1000 kW & above 160kW & other power devices : 3.3kV, 3 ph, 3 wire 50 Hz, Non Effectively earthed		
7.18.3	Motors upto 160 kW & other power devices : 415V, 3 ph, 4 wire 50 Hz		
7.18.4	Motor Starting Methods : Direct on Line		
7.18.5	(a) Lighting fixtures, Space heaters, and single Phase motors : 240V, 1 phase, 50 Hz Supply through suitably rated transformers to limit the short circuit level to 9kA – 1 sec.		

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(b) Control & : 240V, 1 Phase, 50 Hz from UPS Instrumentation 7.18.6 Short circuit levels of 11kV, 3.3 kV and 415V system equipments The equipment shall be suitable for the following short circuit levels (a) 11kV Switchgears : 44 kA/3 sec (b) 3.3kV Switchgears : 40 kA/3sec (c) 415V PCC/ : 50 kA/1sec PMCC/ MCC (d) Lighting : 9 kA/1sec Distribution Boards & 240V A.C. supply 7.18.7 Auxiliary DC supply The auxiliary DC supply will be used for control, indication & protection, Turbine lube oil system, AVR, Emergency DC lighting of power plant and Control & Instrumentation etc. (a) Voltage : (i) 220V DC for utility purpose (ii) 24V DC for Control and Instrumentation (b) Voltage variation : + 10 %, - 15 % 7.18.8 Emergency power supply (a) Purpose : (i) Standby power to normal incomer of emergency MCC (ii) Alternate power source to Fire water Pumps (b) Rated voltage and frequency : 415 V, 3 phase, 3 wire, 50 Hz.		

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7.18.9	UPS power supply (a) Purpose : (i) Vital process loads (ii) Critical lighting (iii) Control and Instrumentation (iv) Office for LAN power supply/Server etc. (b) Rated Voltage : 415V, 3 ph, neutral/240V single phase, 50Hz	
7.19	The variation in voltage and frequency may be $\pm 10\%$ and $\pm 5\%$ respectively. The combined voltage and frequency variation may be $\pm 10\%$. All devices shall be suitable for continuous operation over the entire range of voltage variation without any change in their performance	
7.20	Power socket shall be 415V AC, 50 Hz, 4 pin 32/63 Amps. Power socket outlets for portable tools, hand lamps etc shall be 240 volts, single phase, 3 pin, metal clad industrial type	
7.21	All electrical equipment shall be designed for the following ambient conditions (a) Maximum ambient temperature : 50°C (b) Minimum Ambient temperature : 13°C	



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SECTION – IA

SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)



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1.0 SCOPE

This specification is intended to cover design, engineering, manufacture, fabrication, assembly, supply, inspection/ testing at vendor's & sub-vendor's works, painting, mandatory spares, startup and commissioning spares, special tools and tackles (as applicable), forwarding, proper packing, shipment and delivery at site, preparation and submission of drawing/ documents & equipment/ system guarantee etc. as specified hereinafter for **1X660 MW BHUSAWAL TPS, OXYGEN DOSING SYSTEM**.

Broad scope of work of this package includes all equipment and accessories. Please also refer C&I section for C&I scope.

The Oxygen dosing system as specified in Technical Specification shall consist of the followings:

- Entire Oxygen dosing system mounted on skid as per P&IDs and Data Sheet-A.
- Instrumentation (minimum) as per the enclosed P&ID.
- Start-up & commissioning spares as required, mandatory spares as specified.
- Racks (1 Nos.) hold 26 cylinders, cylinders (26 Nos.), injector assemblies (4 nos.), loose tees (10 nos.), loose elbows (10 nos.), loose tubing (200 meter), compression fittings (40 nos.) for loose tubing.
- Foundation nuts & bolts to fix each skid on the floor, as required.

1.1 SCOPE OF SERVICES

The bidder's scope also includes following services for scope under this specification: -

- Design and engineering.
- Fabrication of the skid mounted oxygen dosing system.
- Painting as per the enclosed painting schedule. However, any variation in the painting schedule as finally approved by customer shall be taken care by the bidder without any commercial and delivery implication. Color-coding scheme shall be intimated to vendor during detailed engineering.
- Inspection and testing of the skid as per the approved quality assurance plan.
- Supply of the skid mounted oxygen dosing system up to the power plant site along with all accessories as defined in the technical specification.

1.2 CIVIL SCOPE

Nil.

2.0 OXYGEN DOSING SYSTEM: (2 SKIDS FOR UNIT)

(Refer Drawing. No. PE-DG-415-154-A101, R02)

One skid of Oxygen Dosing System consists of the following: -

- One number of bank of two oxygen cylinders, dosing at downstream of Deaerator/ CPU outlet.
- Two number of Pressure Regulator as per Section D1 and Data Sheet – A.
- Associated Piping, valves, fitting as indicated in the P&ID of oxygen dosing system and Data Sheet-A enclosed and as required to make the system complete.
- Control & instrumentation as per P&ID of Oxygen Dosing System, Data sheet-A, Section IB.

3.0 TERMINAL POINTS

- i. All wiring for field instruments (pressure and flow transmitters), solenoid valves and MFC shall be terminated at JB by the oxygen dosing vendor for further connection to DCS by BHEL.
- ii. All vent connections shall be connected via vent header and terminated at one point of the skid for further connection to atmosphere, if required, by BHEL.
- iii. Dosing termination point shall be after MFC and terminated at one point by the oxygen dosing



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- supplier for further interconnection till dosing locations by BHEL.
- iv. 24 V-DC connection to SV-3, SV-4 and SV-5 shall be directly connected by BHEL.

4.0 QP AND SUB VENDOR APPROVAL

- 4.1** The quality assurance plan is enclosed elsewhere in technical specification, however requirement of detailed QP, inspection checklist, certificate of conformance etc. for each equipment and sub-vendor shall be finalized during detailed engineering stage; decision of BHEL/ customer shall be binding on vendor in this regard. Any changes/ additional tests insisted upon by Owner during approval of QAP's shall be accepted by bidder without any commercial and delivery implication to BHEL/ Customer. Bidder shall submit the quality plans in BHEL format during detailed engineering stage. Bidder to note further that during detailed engineering all the QAP's/ check lists etc. shall be submitted to Customer/ BHEL for approval. All inspection & testing etc. shall be carried out accordingly.
- 4.2** The sub vendor list (Annexure- II) enclosed is indicative only and is subject to approval/ acceptance by customer. Bidder to propose his sub vendor list with back up documents (experience list, end user performance certificate as applicable) etc. The same shall subject to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL/ Customer.

5.0 DOCUMENTS TO BE SUBMITTED BY BIDDER ALONG WITH THE BID

BIDDER SHOULD SUBMIT THE SIGNED AND STAMPED COPY OF THE FOLLOWING DOCUMENTS:

- Deviation, if any in the enclosed Schedule of deviation with cost of withdrawal only with mention of specification clause for which deviation is being asked. (Stamped & Signed).
- Compliance certificate (stamped & signed).
- Price Schedule duly filled in (stamped & signed).
- List of Recommended spares, if any (stamped & signed).

Note: Any other documents submitted by bidder except as asked in the bid's specification shall not be evaluated & considered as null & void.

6.0 DRAWING/ DOCUMENTS REQUIREMENT

For the drawings/ documents submission schedule, please refer ANNEXURE-III.

For the drawings/ documents submission procedure, please refer ANNEXURE-VI. The bidder has to submit the revised drawing/ document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. Bidder to comply with the observations of the BHEL and CUSTOMER without price & delivery implication.

7.0 SPARES

- 7.1** All the spares for the equipment under the contract provided by the vendor will strictly conform to the specifications and documents and will be identical to the corresponding main equipment/ components supplied under the contract.
- 7.2** The quality plan and the inspection requirement finalized for the main equipment will also be applicable to the corresponding spares.

8.0 MANDATORY SPARES

- 8.1** The list of mandatory spares considered essential by the BHEL & Customer is indicated in Annexure- V.
- 8.2** All mandatory spares shall be delivered at site at least two months before scheduled date



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of initial operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipment.

- 8.3 Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the total population of the item in the station (project), unless specified otherwise and the fraction will be rounded off to the next higher whole number.
- 8.4 "One (1) Set" and "One (1) set of each type & rating" is defined as total numbers as required for one complete replacement for one equipment of similar size & capacity.
- 8.5 Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until & unless specified otherwise.
- 8.6 Mandatory spares listed in Price Schedule is bare minimum requirement. In case any additional mandatory spares requirement is covered elsewhere in the tender specification apart from specified above, same shall be deemed to have been covered in bidder's scope of supply.
- 8.7 All mandatory spares shall be supplied as per the requirement of the specifications. In case any spare indicated in the specification is "not applicable" for particular equipment, then suitable applicable alternate spare has been offered / shall be supplied by the bidder without any financial implication."
- 8.8 Bidder to write "Quoted / Not Applicable" against all items. Any item which is quoted as "not applicable" by the bidder in the above list and is found to be "applicable" at a later date shall be supplied by the bidder without any commercial and delivery implication.
- 8.9 Any cell left blank in the unpriced schedule shall be treated as "Quoted" and is included in total price.
- 8.10 The spares shall be treated and packed for a long storage under the climatic condition prevailing at site.
- 8.11 Each spare part shall be clearly marked and labelled on the outside of the packing with its description. When more than one spare part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers, and other packages must be suitably marked and numbered for the purpose of identification.
- 8.12 The Bidder shall note that if there in any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.

9.0 VOID

10.0 RECOMMENDED SPARES

- 10.1 Bidders shall furnish a recommended spare parts schedule which the Bidder considers necessary and which has not been specified in the list of mandatory spares for the normal and trouble free plant operation for 3 year operation along with their offer for all equipment under the scope. The list of spares shall include such spares which are to be stored to achieve the plant availability level indicated by the bidder. The unit price of each recommended spares shall be indicated separately and shall not be quoted along with the lumpsum price. The price indicated for the recommended spares shall not be considered for the purpose of evaluation.
- 10.2 All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended to be replacements. The spares shall be treated and packed for long storage under climatic conditions prevailing at the site, e.g. small items shall be packed in sealed transparent plastic bags with desiccator packs as necessary.

11.0 SPECIAL TOOLS AND TACKLES



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- One set of all special tools shall be furnished and shipped with each piece of equipment for dismantling, maintenance, adjustment, and calibration of the equipment. The tools shall be shipped in separate heavily constructed wooden boxes provided with hinged covers and padlock hasps.
- The Contractor shall supply under this contract all maintenance tools for each piece of equipment/ system and it shall be boxed separately and the boxes shall be appropriately marked for shipment and identification of contents.
- A weather-proof itemized list of the contents shall also be attached to the outside of each container.
- The maintenance tools shall include all special handling rigs, bars, slings, cable and all specialized equipment for control system maintenance such as extender boards, scopes, and all software and hardware. Further, Bidder shall also include a full set of regular maintenance tools and tackles required. Bidder shall also include all maintenance tools and tackles in their scope. Total price of all the maintenance tools and tackles shall be included in the quoted lump sum price.

12.0 PACKING

To prevent damage to any equipment/ item of the skid during transit, wooden/ angle iron/ steel frame supports to be provided wherever required. Special attention shall be provided while packing and loading for overhead equipment.

Bidder shall submit the packing details during detailed engineering for approval. Any changes required in packing details shall be complied by the bidder without any price and delivery implication.

13.0 PAINTING

Bidder to note that painting shall be as per approved painting schedule to be finalized during detailed engineering, however the same shall be prepared in line with the schedule enclosed in Section IA/ Annexure-IV.

14.0 OTHER DESIGN REQUIREMENTS

Bidder to note that other design requirement of the Oxygen dosing skids shall be as below: -

- All the terminal points shall be easily accessible and towards one side of skid.
- All valves shall be easily accessible for the operator.
- All equipment shall have SS name plate clearly indicating the equipment name.
- Tube fittings of the system shall be done using elbows and tees. Tube bending is not acceptable.
- All JB's shall be mounted in their respective dosing skids only.
- MFC shall also be mounted in an enclosure. DOP of enclosure shall be IP-65 minimum. Other technical requirements of this enclosure shall be in line with JB details indicated elsewhere in the specification.
- All cylinders supplied should conform to "Gas Cylinder Rules, 2004" and CCE license for the same shall be arranged by the bidder.
- All items supplied for the oxygen dosing systems shall be suitable for oxygen service. Bidder shall provide the certificates indicating items are oxygen cleaned or suitable for oxygen service.
- MOC of individual item/ equipment mentioned in the technical specification is only indicative. However, Bidder shall follow/ comply and design the oxygen dosing system in line with the following below mentioned ASTM standards.
 - o **ASTM G63:** Guide for evaluating non-metallic materials for oxygen service.
 - o **ASTM G93:** Standard Practice for Cleaning Methods and Cleanliness Levels for Material and Equipment Used in Oxygen-Enriched Environments.
 - o **ASTM G 94:** std. guide for evaluating Metals for oxygen service.
 - o **ASTM F1792-97 (2010):** Standard Specification for Special Requirements for Valves Used in Gaseous Oxygen Service.
 - o **ASTM G88:** Standard Guide for Designing Systems for Oxygen Service.



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- Any change envisaged to meet the above standards and system/ service requirements during detailed engineering shall be agreed/ complied by the bidder without any price/ delivery implication to BHEL/ Customer.
- All the instruments/ equipment/ electrical items shall be provided & designed with maximum star rating as available in line with energy conservation policies notified by BEE, GOI at the time of supply.

15.0 MISCELLANEOUS REQUIREMENTS

- Finish paints for touch-up painting of equipment after erection at site in sealed container.
- Document approval by Customer/ BHEL under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval.
- Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to Customer and BHEL for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at Customer/BHEL end, delay in review/ approval of drawing beyond one month will be to Customer/BHEL account.
- Relevant requirements as per GTR, GCC, ECC & SCC. Any statutory requirement / clearance required for the packages from government / local body shall be in bidder's scope.
- In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
- Vendor to attend regular engineering meeting with BHEL and Customer fortnightly in BHEL or Customer office as decided during detail engineering. Vendor will depute his entire concerned Engineering representatives along with the project manager for discussion and approval. Meeting can be held at site also.
- Latest version of all codes and standards to be followed.
- For detailed dispatch instructions, Bidder to refer special condition of contract (SCC) of the project.

16.0 CODES & STANDARDS

- Design Standard of empty oxygen cylinder - IS-7285
- Ball Valves Design standard - MSS-99-2010/ Equivalent
- Ball Valves Test standard - MSS-99-2010/ Equivalent
- Check Valves/ NRV Design standard - MSS-99-2010/ Equivalent
- Check Valves/ NRV Test standard - MSS-99-2010/ Equivalent
- Pressure Regulator Cleaning standard - ASTM G 93
- 3-way Valve Manifold Design standard - MSS-99-2010
- 3-way Valve Manifold Cleaning standard - ASTM G 93
- Structural steel - IS 2062

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2.4 <u>ELECTRICAL WORK</u> Bidder need to note that Two (2) (1W +1S) supply feeders of 415V, 3 phase, 4 wire AC system shall be provided for each skid from suitable LT switchgear. Complete skid including changeover between feeders\ starters\LCP\interlocks\protection devices\any other supply etc. shall be in Bidder's scope only. Skid complete with internal cabling and earthing need to be supplied by Bidder. Supply and erection of electrical items (power/control cables, cabling materials, local push button station & earthing) external to skid shall also be included. Any other equipment/ materials required for completeness of all electrical work (though not mentioned specifically) is in Bidder's scope. (a) Necessary electric motors for all motor driven equipment along with couplings, reduction gears and all other accessories as required for the complete Chemical Feed Systems. (b) Local Emergency Stop Push Button Stations with for unidirectional & bi-directional motors as specified for the complete Chemical Feed Systems. (c) Control Panels each with all accessories as follows: (i) START – STOP Push Buttons, ON-OFF Indicating Lamps along with other devices/accessories specified elsewhere in this document. selector switches (as determined by operational requirement) for all drives/equipment of		

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Chemical Feed Systems shall be provided in the control panel. (ii) For all motors of rating 30 KW and above, ammeter shall be provided in the Control Panel. (iii) Trip alarm annunciation for all motors shall be provided in the Control Panel. (d) Special cables if any. (e) Grounding of skid mounting equipment and skid grounding. (f) All structures, steel attachments embedded components etc. as required for complete electrical work. 2.5 Chipping and dressing of foundation and grouting work as would be required for erection of equipment and accessories, pipes, nozzles, instrumentations, valves, fittings, all embedment and all other accessories are included in Bidder's scope under this specification. 2.6 All necessary structural works required for satisfactory operation and maintenance of complete Chemical Feed Systems. The items of work shall include but not be limited to the following: (a) All stairs, platforms, railings, ladders, etc. (b) All inserts, bolts, necessary structural supports along with anchor bolts. 2.7 Supply and application of shop painting and final painting at manufacturer's works and at site for the entire Water Treatment Plant as specified elsewhere in this specification. 2.8 For Mandatory Spares, Spares required for erection and commissioning, Recommended Spares, Special Tools And Tackles, fixtures etc., as required for regular operation and maintenance of the equipment offered for the entire Chemical Feed Systems and supply of first charge of lubricating oil,		

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DATA SHEET – A

Sl. No	Description	Parameter
Mechanical Items		
1.0	No. of skid(s) for project	Two (One for CPU and One for Deaerator)
2.0	Cylinders:	
2.1	Quantity mounted on skid	Two per skid (Total Four)
2.2	Loose supply of filled Oxygen cylinders	Total 26 loose cylinders on a rack for two skids near oxygen dosing skids in TG Hall BC Bay
2.3	Design Standard of empty oxygen cylinder	IS-7285
2.4	Water Capacity	50 liters
2.5	Gas Capacity	10 m ³
2.6	Max Working pressure at 15°C	204 Kg/cm ²
2.7	Accessories	One Cylinder storing rack (MS), with capacity to hold 26 cylinders.
3.0	All Tubing:	
3.1	Material	SS 316
3.2	Diameter	15 NB (1/2" OD), 18 BWG
4.0	Ball Valves	
4.1	Body, Bonnet, stem	SS 316
4.2	Trim Material	SS 316
4.3	Design standard	MSS-99-2010/ Equivalent
4.4	Test standard	MSS-99-2010/ Equivalent
4.5	Size	15 NB
4.6	End Connections	Ferruled
4.7	Rating	2000 PSI
4.8	Valve operation	Manual or pneumatic as per P&ID
5.0	Check Valves/ NRV	
5.1	Body, cover, disc/piston & seat	SS 316
5.2	Design standard	MSS-99-2010/ Equivalent
5.3	Test standard	MSS-99-2010/ Equivalent
5.4	Size	15 NB
5.5	End Connections	Ferruled
5.6	Rating	2000 PSI
5.7	Valve operation	Manual
6.0	Pressure Relief Valve	
6.1	Type	Spring loaded, angle type
6.2	Body, bonnet, disc & nozzle	SS 316
6.3	Valve discharges to	Atmosphere (vent)
6.4	Back pressure	Constant
6.5	Set pressure	42 Kg/cm ² (g) for skid 1 and 22 Kg/cm ² (g) for skid 2
6.6	Inlet Connections	Ferruled
6.7	Outlet Connections	Ferruled
7.0	Fittings	SS-316
8.0	Pressure Regulator	
8.1	Quantity	Two per skid (total 4), each mounted to an oxygen cylinder
8.2	Body & trim	Brass & Monel
8.3	O-Ring	Viton
8.4	Seat	PCTFE
8.5	Filter	Bronze (40 micron)
8.6	Inlet connection	1/2 "
8.7	Cleaning standard	ASTM G 93
8.8	Outlet connection	1/2 "
8.9	Operating pressure	204 Kg/cm ² (g)
8.10	Set outlet Pressure	40 Kg/cm ² (g) for skid dosing at CPU outlet and 20 Kg/cm ² (g) for skid dosing at deaerator outlet.
9.0	Mass Flow Controller	



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9.1	Expected Flow of O ₂ in process	50-400 gm/ hr. (for skid dosing at deaerator outlet); 40-300 gm/ hr. (for skid dosing at CPU outlet)
9.2	MOC-wetted parts	SS 316
9.3	Operating pressure	Pressure reducing valve set pressure (refer P&IDs)
10.0	3-way Valve Manifold	
10.1	Process End Connection	1/2 Inch NPT(F)
10.2	MOC	SS 316 & Viton O-Ring
10.3	Design standard	MSS-99-2010
10.4	Cleaning standard	As per ASTM G 93
10.5	MAWP	250 bar
10.0	Structural steel	IS 2062
11.0	Nuts, bolts & Lock Nuts	SS 304



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ANNEXURE I

QUALITY PLAN FOR OXYGEN DOSING SYSTEM

		MANUFACTURER'S NAME & ADDRESS :		MANUFACTURING QUALITY PLAN				PROJECT PACKAGE		: 1x660 MW BHUSAWAL TPS : OXYGEN DOSING SYSTEM			
				ITEM: OXYGEN DOSING SYSTEM SUB - SYSTEM : DEAERATOR & CEP DISCHARGE DOSING		PSI QP. NO : REV. : DATE : PAGE :				CONTRACT NO. MAIN SUPPLIER BHEL QP. NO NTPC QP. NO		: BHEL/PEM/NOIDA	
S.NO.	COMPONENTS/ OPERATION	CHARACTERISTICS CHECKED	CATEGORY	TYPE/ METHOD CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY**			REMARKS	
1	2	3	4	5	6	7	8	9	D*	M	C	N	11
1.0	<u>WELDER'S QUALIFICATION</u>												
1.1	WELDING PROCEDURE SPECIFICATION (WPS)	CORRECTNESS	MA	SCRUTINY	100%	ASME IX	ASME IX	QW 482		P	V	V	
1.2	WELDER PERFORMANCE & PROCEDURE QUALIFICATION RECORD	WELD SOUNDNESS & WELDING PERFORMANCE	MA	PHYSICAL TEST	100%	ASME IX	ASME IX	QW 483 & QW 484		P	V	V	
2	EMPTY OXYGEN CYLINDER	MTC, HYDRO TEST & RELEVANT TESTS AS PER IS 7285	MA	IS 7285	100%	APPROVED DATASHEET	AS PER APPROVED DATASHEET	MFRS CERTIFICATE		P	V	V	
3	VALVES (BODY & BONNET)	MATERIAL	MA	--	100%	APPROVED DATASHEET	AS PER MODEL DECODIFICATION MENTIONED IN MFRS CATALOGUE	MANUFACTURERS COC		P	V	V	
4	INSTRUMENTS												
4.A	PRESSURE GAUGE	MOC FOR WETTED PARTS, CALIBRATION & BOURDON OVER PRESSURE PROTECTION & TYPE	MA	MEASUREMENT	1/TYPE	APPROVED DATASHEET	AS PER APPROVED DATASHEET	MFRS CERTIFICATE		P	V	V	
4.B	PRESSURE TRANSMITTER	CALIBRATION, OVERLOAD PROTECTION & TYPE TEST CERTIFICATE	MA	MEASUREMENT	100%	APPROVED DATASHEET	AS PER APPROVED DATASHEET	MANUFACTURERS COC		P	V	V	
5	SOLENOID VALVES	MATERIAL	MA	VISUAL	100%	APPROVED DATASHEET	AS PER MODEL DECODIFICATION MENTIONED IN MFRS CATALOGUE	MANUFACTURERS COC		P	V	V	
6	CYLINDER PRESSURE REGULATOR	MATERIAL	MA	VISUAL	100%	APPROVED DATASHEET	AS PER MANUFACTURERS CATALOGUE	MANUFACTURERS COC		P	V	V	
7	TERMINATION BOX	COUNTUNITY,IR-HV-IR & DEGREE OF PROTECTION	MA	ELECTRICAL	100%	APPROVED DATASHEET	AS PER APPROVED DATASHEET	MFRS COC & INSPECTION REPORT		P	V	V	
8	TUBING	CHEMICAL & PHYSICAL	MA	CHEMICAL & PHYSICAL TEST	100%	APPROVED DRAWING DATASHEET	APPROVED DRAWING DATASHEET	LAB REPORT		P	V	V	
9	MASS FLOW CONTROLLER	CALIBRATION REPORT	MA	ELECTRICAL	100%	APPROVED DRAWING & DATASHEET	APPROVED DRAWING & DATASHEET	CALIBRATION REPORT		P	V	V	
10	FITTING	MATERIAL	MA	VISUAL	100%	APPROVED DRAWING	AS PER MODEL DECODIFICATION MENTIONED IN MFRS CATALOGUE	MANUFACTURERS COC		P	V	V	
11	FINAL ASSAMBLY	DIMENSION, ORIENTATION & COMPLETENESS.	MA	MEASUREMENT	100%	APPROVED DRAWING	APPROVED DRAWING	INSPECTION		P	W	W	
	FAT	LEAKAGE		N2 FILL FOR 2HR	100%	APPROVED DRAWING / FACTORY ACCEPTANCE TEST	NO LEAKAGE	INSPECTION REPORT		P	W	W	
12	POWDER COATING STAMPING	DFT MEASUREMENT	MI	VISUAL	100%	NTPC APPROVED PAINTING SCHEME				P	W	V	
13	PMI Test for SS	GRADE CONFIRMATION	MA	CHEM.TEST	100%	BHEL APPD.DATA SHEET/DWG	BHEL APPD.DATA SHEET/ DWG	INSPECTION REPORT		P	W	W	

NOTES: ALL INSTRUMENTS SHALL BE OXYGEN CLEANED AND SUITABLE FOR OXYGEN SERVICE. MANUFACTURERS COC CERTIFYING THE SAME REGARDING OXYGEN CLEANED SHALL BE SUBMITTED FOR REVIEW DURING FINAL INSPECTION.

		LEGEND : * RECORDS IDENTIFIED WITH "TICKS" SHALL BE ESSENTIALLY INCLUDED BY CONTACTION IN QA DOCUMENTATION. ** M : MANUFACTURER/SUB-CONTRACTOR C : BHEL, N:NTPC INDICATE "P" PERFORM, "W" WITNESS, AND "V" VERIFICATION AS APPROPRIATE, "CHP" SHALL BE IDENTIFIED IN COLUMN"N".		DOC NO. REV : CAT :		
MANUFACTURER/ SUB SUPPLIER	MAIN SUPPLIER		FOR CUSTOMER USE			
SIGNATURE				REVIEWED BY	APPROVED BY	APPROVAL SEAL



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TEST PROCEDURE FOR OXYGEN DOSING SYSTEM

- A Factory Acceptance Testing will be conducted at vendor's Factory. This will be for verification of the functional performance of critical equipment/instruments and hardware design when run at design pressure, temperature and flow.
- FAT will be carried out using only the inert gas such as Nitrogen. Following will be the FAT protocol.
- Checking the completeness of the system. This will include visual inspection of equipment and instruments as per the P & ID s & GA along with skid after assembling on skid.
- Soap joint leak test of tubing/fittings/valves using nitrogen at 1.25 times of maximum operating pressure.
- (ANSI B31.8), for 2 hours. The allowable pressure drop would be up to 0.5 bar over 2 hours.
- Functional testing of calibrated components (equipment/ instruments) using nitrogen. The test controller will be connected to Mass flow controller. The set point will be given from test controller & this will be monitored.
- Testing of Assembly of skid, instruments, termination box will be done by BHEL as per approved Quality Assurance Plan.
- Inert test run using nitrogen to demonstrate flow.
- Final Assembly & Factory Acceptance Test will be witnessed by BHEL & CUSTOMER.



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ANNEXURE – II

SUB VENDOR LIST (INDICATIVE)



TITLE :
1x660 MW BHUSAWAL TPS

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SUB VENDOR LIST - MECHANICAL

SR. NO.	ITEM		SUPPLIER	PLACE	REMARK
1.0	BOILER, TURBINE, GENERATOR (BTG)				
1.1	CONDENSOR ON LINE TUBE CLEANING SYSTEM	(a)	GEA-BGR		
		(b)	TAPROGGE GMBH		
1.2	CARBON STEEL PIPE FITTING	(a)	ALLIED INTERNATIONAL S.P.A. ITALY		
		(a)	ASIAN PAINTS		
1.3	PAINTINGS	(b)	BURGER PAINTS		
		(c)	SHALIMAR PAINTS		
		(d)	NEROLAC PAINTS		
		(e)	JOHNSON & NICHOLSON		
1.4	SPRING SUPPORT AND	(a)	SARATHI		
		(a)	WEIR PUMPS		
1.5	BOILER FEED PUMP	(b)	KSB AKTIENGESELLSCHAFT		
		(c)	SULZER PUMPS		
		(d)	TORISHIMA PUMPS		
1.6	CONCRETE VOLUTE PUMPS	(a)	KBL		
		(b)	FLOWERVE INDIA CONTROL PVT LTD, INDIA		
		(a)	SPIRAX MARSHALL PVT LTD		
1.7	STEAM TRAPS	(b)	GREAVES LTD		
		(c)	PENNANT ENGINEERING PVT LTD		
		(d)	LEADER VALVES LTD		
		(e)	CRESCENT VALVES MFG CO PVT LTD		
1.8	VACCUUM PUMPS	(a)	SIEMENS		
		(b)	UNIQUE SYSTEM, NEW JERSY, USA		
1.9	RAPH	(a)	L & T HOWDEN PVT LTD		
1.10	ID/FD/PA FANS	(a)	L & T HOWDEN PVT LTD		
1.11	SEAL AIR FANS	(a)	TLT ENGINEERING INDIA PVT LTD, GUJARAT		
1.12	SCANNER COOLING AIR FAN	(a)	C. DOCTOR		
1.13	MILLS	(a)	L & T-MHI		
		(b)	BHEL		
1.14	GEAR BOX (COAL MILL)	(a)	FLENDER		
1.15	SOOT BLOWERS	(a)	CLYDE BERGEMANN INDIA, NOIDA		
1.16	BOILER CIRCULATION PUMP	(a)	M/S HAYWARD TYLER LIMITED, UK		
1.17	METALLIC EXPANSION	(a)	MILLAR FITTINGS, UK		
1.18	NON- METALLIC EXPANSION	(a)	KE - BURGMANN FLEXIBLE INDIA PVT. LTD.		
1.19	SCREW PUMPS	(a)	TUSHACO PUMPS PVT. LTD.		
		(a)	LLYODS INSULATION (INDIA) LTD.		
1.20	INSULATION	(b)	ROCKWOOL INDIA LTD.		
		(c)	HYDERABAD INDUSTRIES LTD.		
		(d)	MINWOOL ROCK FABRICS LTD.		
1.21	PLATES (BOILER)	(a)	SAIL		
		(b)	TATA STEEL		
		(c)	JINDAL STEEL		
1.22	SECONDARY STRUCTURE & BUCKSTAY FOR BOILER	(a)	METALFAB HIGHTECH PVT. LTD., NAGPUR		
1.23	BOILER DUCTS & SECONDARY STRUCTURE	(a)	SEAM INDUSTRIES NAGPUR		
		(b)	ENESTEE ENGINEERING LTD, NAGPUR		
1.24	HANDRAILS & GRATING	(a)	INDIANA GRATING PVT. LTD., MUMBAI		
1.25	COAL MILL COMPONENT	(a)	M/S AIA ENGINEERING LTD., AHMEDABAD		
1.26	COAL PIPES	(a)	M/S PRATIBHA INDUSTRIES LTD., MUMBAI		
		(a)	SEAM INDUSTRIES NAGPUR		
1.27	MISC. TANK FABRICATION	(b)	ENESTEE ENGINEERING LTD, NAGPUR		
		(c)	ERA BUILDING SYSTEM		
		(d)	RATNAMANI TUBES & METAL		
1.28	GASKETS (METALLIC &	(a)	IGP (MADRAS)		
1.29	BOLTS & NUTS (FASTENERS)	(a)	DEEPAK FASTENERS LTD. LUDHIYANA		
		(b)	POINEER NUT & BOLTS PVT. LTD.		
1.30	SAFETY VALVE	(a)	DRESSER		
		(b)	FISCHER CONTROLS		
1.31	SAFETY RELIEF VALVE	(a)	SPIRAX MARSHALL		
		(b)	LEADER VALVES		
1.32	CERAMIC LINED BENDS	(a)	CARBORUNDUM UNIVERSAL LTD.		
		(a)	SPIRAX MARSHALL		
1.33	FAB/CAST/FORGED STRAINERS/ Y TYPE STRAINERS	(b)	GUJARAT OTOFILT		
		(c)	MULTITEX FILTRATION		
		(d)	GRAND PRIX FAB		
		(e)	MICON VALVES (I) PVT. LTD		
		(f)	FLOWTECH ENGINEERS		
1.34	STEEL CASTINGS FOR COAL MILL	(a)	SYNERGY STEELS LTD, NEW DELHI		
		(b)	SRINATHJI ISPAT LTD., GAZIABAD		
		(c)	G.S. ALLOY CASTINGS LTD., ANDHRA		
		(d)	N.S. ENGINEERING COMPANY PVT. LTD.,		
1.35	FUEL OIL HEATING & PRESSURISING SYSTEM	(a)	TECHNOFAB ENGINEERING LTD., NEW DELHI		
1.36	BFP DRIVE TURBINE	(b)	THERMOSYSTEM PVT. LTD., HYDERABAD		
		(a)	HTC, CHINA		
1.37	FORGED STEEL VALVE (UP TO 50 NB SIZE)	(a)	FOURESS LIMITED		
		(b)	KSB LIMITED		
		(c)	L & T		
		(d)	BANKIM		
		(e)	BDK VALVES		
		(f)	LEADER		
		(a)	FOURESS LIMITED		
		(b)	CRESCENT		
	FORGED CARBON STEEL	(c)	TECHNO VALVES		

1.38	VALVE	(d)	R & D MULTIPLES		
		(e)	BHEL		
		(f)	LEADER		
		(g)	A.V. ENGG.		
1.39	RUBBER EXPANSION JOINT	(a)	D'WAREN & CO.		
		(b)	S.L. MANEKLAL		
		(c)	CORI ENGG. PVT. LTD		
1.40	CONDENSATE EXTRACTION PUMPS	(a)	WEIR PUMPS		
		(b)	KIRLOSKAR BROS. LTD., PUNE		
1.41	GEAR BOX FOR BFP	(a)	TRIVENI ENGG. & IND. PVT. LTD., MYSORE		
1.42	CONDENSER TUBES	(a)	PLYMOUTH, USA		
		(b)	SHIN HAN METAL CO. LTD., KOREA		
		(c)	REMI EDELSTAL TUBULARS LTD.		
1.43	FABRICATION & SUPPLY OF STEEL STRUCTURE	(a)	DIAMOND ENGG., TAMILNADU		
		(b)	VASAN INDUSTRIES, TAMILNADU		
		(c)	ERA BUILDING SYSTEM LTD., RUDRAPUR		
1.44	WINDBOX	(a)	GK SONS ENGG. ENTERPRISES PVT. LTD.,		
1.45	STRUCTURAL STEEL FABRICATED COMPONENTS FOR ESP	(a)	VRINDA ENGG. PVT. LTD., KOLKATA		
		(b)	S.S. FABRICATORS & MANUFACTURERS,		
		(c)	DYNAMECH DESIGNER COMPANY,		
		(d)	JAS EQUIPMENT & ENGINEERS PVT. LTD.,		
		(e)	THE UNITED ENGINEERS, KOLKATA		
		(f)	UNI PROFILES PVT. LTD., ORISSA		
		(g)	FRIENDS ENGG. CORPORATION. BHILAI		
		(h)	ENCORE PROJECTS PVT. LTD., BHILAI		
		(i)	QUALITY ENGG. WORKS, KOLKATA		
		(j)	EASTERN ENGINEER & ASSOCIATES,		
		(k)	DEHU ENGINEERS (I) PVT. LTD., PUNE		
		(l)	NAAISON ENGINEERS PVT. LTD.,		
		(m)	SRINIVASA ENGINEERS PVT. LTD,		
		(a)	BHARAT ALUMINUM CO. LTD.		
1.46	ALUMINUM SHEET	(b)	HINDALCO INDUSTRIES LTD.		
		(c)	NATIONAL ALUMINUM COMPANY LTD.		
		(a)	VALCOVNY TRUB CHIUMUTOV		
1.47	C.S. PIPING & ALLOY STEEL PIPING	(b)	ARCELOR MITTAL TUBULAR ROMAN S.A.,		
1.48	SLIDING BEARING FOR ESP	(a)	METAL ENGG. & TREATMENT CO. PVT.LTD.,		
		(b)	ROLLON BEARING PVT. LTD., BANGALORE		
1.49	PLATE TYPE HEAT EXCHANGER	(a)	GEA ECOFLEX INDIA, NAVI MUMBAI		
		(b)	FUNKE WARMETAUSCHER, Gmbh GERMANY		
		(c)	TRANter INDIA PVT. PUNE		
1.50	HYDRAULIC UNIT FOR LOADING DEVICE & ROLLER	(a)	HYDAC (INDIA) PVT. LTD., MUMBAI		
1.51	DUCTING SUPPORT &	(a)	PIPE HANGER & SUPPORT VT. LTD.,		
1.52	ESP FOUNDATION BOLTS	(a)	VRINDA ENGINEERING PVT. LTD., KOLKATA		
		(b)	COMMERCIAL ENGINEERING BODY BUILDERS		

6.0	VERTICAL TURBINE PUMPS	(a)	KIRLOSKAR BROTHERS LTD. (KBL)		
		(b)	MATHER & PLATT		
		(c)	WPIL		
		(d)	JYOTI PUMPS		
		(e)	FLOWMORE		
		(f)	SAM		
		(a)	KBL		
		(b)	KSB PUMPS		
		(c)	MATHER & PLATT		

7.0	HORIZONTAL CENTRIFUGAL PUMPS	(d)	SAM TURBO		
		(e)	WPIL		
		(f)	JYOTI PUMPS		
		(g)	FLOWMORE		
		(h)	SULZER		
8.0	METERING/DOSING PUMPS	(i)	KISHOR PUMPS		
		(a)	MILTON ROY INDIA (P) LTD.		
		(b)	V.K. PUMPS		
9.0	SUMP PUMP	(c)	SHAPO TOOLS		
		(a)	KIRLOSKAR BROTHERS LTD. (KBL)		
		(b)	SAM		
		(c)	KISHOR PUMPS		
		(d)	FLOW MORE		
		(e)	KSB		
		(f)	VARTAK PUMPS		
10.0	FUEL OIL PUMPS	(g)	MAXFLOW		
		(a)	TUSHACO		
		(b)	ALKETON, MADRAS		
		(c)	PSI ENGINEERING		
		(d)	ROTO PUMPS		
		(e)	BOURNMEN, GERMANY		
		(f)	DELTA CORPORATION		
		(g)	ALL WEILER, GERMANY		
11.0	AIR BLOWER (LOBE TYPE)	(h)	TMO, SWEDEN		
		(a)	EVEREST TRANSMISSION		
		(b)	KAY ENGG. WORKS		
		(c)	SWAM PNEUMATICS		
		(d)	ROOTS		
12.0	BUTTERFLY VALVES (MANUAL/PNEUMATIC)	(a)	KIRLOSKAR BROTHERS LTD.		
		(b)	FOURESS		
		(c)	L & T		
		(d)	INTERVALVE (INDIA) LTD		
		(e)	R&D MULTIPLES		
		(f)	AUDCO		
		(g)	INSTRUMENTATION LTD		
		(h)	HAWA VALVES		
		(i)	VENUS PUMPS & ENGINEERING WORKS		
		(j)	BHEL		
		(k)	FLOW VEL		
		(l)	LEADER VALVES		
13.0	RUBBER EXPANSION JOINT	(a)	D'WAREN & CO		
		(b)	S.L. MANEKLAL		
		(c)	SRM EXOFLEX PVT LTD		
		(d)	CORI ENGINEERS		
14.0	STRAINERS	(a)	SPIRAX MARSHALL		
		(b)	MICON VALVES (I) PVT. LTD.		
		(c)	FLOWTECH ENGINEERS		
		(d)	FOURESS LTD.		
		(e)	KSB LTD.		
		(f)	L & T		
		(g)	LEADER		
		(h)	PROCEDYNE ENGINEERS		
15.0	CAST IRON VALVE (GATE /GLOBE/CHECK/AIR RELEASE VALVE)	(a)	LEADER VALVE		
		(b)	VENUS PUMP		
		(c)	FOURESS		
		(d)	LEVCON		
		(e)	DURGA ENGG CO.		
		(f)	L & T		
		(g)	R & D MULTIPLES		
		(h)	FLUIDLINE VALVES CO PVT LTD		
		(i)	INTER VALVE (INDIA) LTD		
		(j)	NSSL LIMITED		
16.0	CAST STEEL VALVES (GATE/GLOBE/CHECK/ BALL VALVE)	(a)	L & T		
		(b)	KIRLOSKAR BROS. LTD		
		(c)	CRESENT VALVES		
		(d)	AUDCO		
		(e)	KSB		
		(f)	LEVCON		
		(g)	FOURESS		
		(h)	R & D MULTIPLES		
		(i)	FLUIDLINE VALVES		
		(j)	NSSL LIMITED		
		(k)	VENUS PUMP		
		(l)	DURGA ENGG CO.		
		(m)	HAWA VALVES		
		(n)	A.V.VALVES		
17.0	STAINLESS STEEL (GATE/GLOBE/CHECK VALVE)	(a)	CRESCENT		
		(b)	FOURESS		
		(c)	R & D MULTIPLES		
18.0	GUN METAL/BRASS/ BRONZE VALVES	(a)	LEADER VALVES		
		(b)	SARKAR		
		(c)	LEVCON		
		(d)	BOMBAY METAL & ALLOYS		
		(e)	SANT ENGG		
		(f)	BANKIM & COMP.		
		(g)	BDK		
19.0	FORGED STEEL VALVE	(a)	FOURESS LIMITED		
		(b)	KSB LIMITED		
		(c)	L & T		
		(d)	BANKIM		
		(e)	BDK VALVES		

		(f)	LEADER		
		(g)	A.V.ENGG		
		(h)	CRESCENT		
		(i)	BHEL		
20.0	L.D. PIPING	(a)	SETH & SURA ENGG. CO. LTD.		
		(b)	IVCRL		
		(c)	RAUNAQ		
		(d)	ZUBERI		
		(e)	INDIAN HUME PIPES LTD		
		(f)	DYNAMIC SS ENGG PVT LTD		
21.0	L.P.PIPING	(a)	UNITECH MACHINES, NEW DELHI		
		(b)	AARTI INFRASTRUCTURE, NAGPUR		
		(c)	ZUBERI, JAIPUR		
		(d)	SETH & SURA ENGG CO. LTD		
22.0	DIESEL ENGINES	(a)	KIRLOSKAR CUMMINS		
		(b)	GREAVES COTTON		
		(c)	ASHOK LEYLAND		
23.0	FLANGES & FITTINGS	(a)	ALLIANCE		
		(b)	JYOTI		
		(c)	EBY		
24.0	AIR DRYING UNIT	(a)	DONALDSON		
	(Refrigerant Type)	(b)	SABRO		



TITLE :
1x660 MW BHUSAWAL TPS

SPECIFICATION NO.: PE-TS-415-154-A101

**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

SUB-SECTION: IA

REV. NO. 00

DATE : 01.06.2019

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
1.	FILLING OF OXYGEN CYLINDER	FILLING OF EMPTY CYLINDERS MAY BE DONE FROM ANY CCE LICENSED OXYGEN GAS FILLER	AS APPLICABLE	
2.	EMPTY OXYGEN CYLINDERS	BPCL	ALLAHABAD	
		EVEREST KANTO	BOMBAY	
		MARUTI KOATSU CYLINDER LTD	HALOL, GUJARAT	
3.	CHECK VALVE/BALL VALVE/	HAMLET	USA	
		SWAGELOK	USA	
		PARKER	USA	
4.	VALVE MANIFOLD	HAMLET	USA	
		EXCEL HYDRO	MUMBAI	
		AURA INC., NEW DELHI	GERMANY	
		PRECISION ENGG. INDUSTRIES, MUMBAI	KOREA	
		DK TECH	KOREA	
		ANDERSON GREENWOOD	USA	
		ASLACH	MUMBAI	
		HP VALVE AND FITTING	CHENNAI	
		HYD AIR	LONAVLA	
		FLUID CONTROL	MUMBAI	
		MICRO PRECISION	FARIDABAD	
		PARKER	USA	
		SWAGELOK	USA	
		BALDOTA	MUMBAI	
		METPRESS ENGINEERING WORKS, KOLKATA		
5.	PRESSURE REDUCING VALVE	TESCOM	USA	
		SWAGELOK	USA	
6.	TUBING	SWAGELOK	USA	
		HAMLET	USA	
		PARKER	USA	
		SANDVIK	USA	
		APEX TUBES PVT.LTD		
		REMI EDELSTAHL TUBULARS PVT.LTD		
		PRAKASH STEELAGE PVT. LTD		
		VIKAS INDUSTRIAL PRODUCTS	NOIDA	
7.	NEEDLE VALVE & PRESSURE SAFETY VALVE	SWAGELOK	USA	
		HAMLET	USA	
		PARKER	USA	
8.	SOLENOID VALVE	ROTEX	BARODA	
		AVCON	MUMBAI	
		ASCO	CHENNAI	
		SMC	NOIDA	
		NUCON	HYDERABAD	
9.	3 WAY VALVE	HI TECH	AHMEDABAD	
		ADVANCE VALVES PVT.LTD	NOIDA	
		BDK	HUBLI	
		FOURESS ENGG.INDIA LTD.	MUMBAI	
		FLUIDLINEVALVES COMPANY PRIVATE LTD.,	MUMBAI	
		INSTRUMENTATION LTD.	PALAKAD	
		KIRLOSKAR BROTHERS LTD.	PUNE	
		VENUS PUMP & ENGG. WORKS	KOLKATA	



TITLE : 1x660 MW BHUSAWAL TPS	SPECIFICATION NO.: PE-TS-415-154-A101	
	TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM	
	SUB-SECTION: IA	REV. NO. 00
		DATE :01.06.2019

		SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY	CHENNAI	
		STAFFORD CONTROLS LIMITED	PUNE	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
10.	PAINT	ASIAN PAINTS (I) LTD.		
		BERGER PAINTS INDIA LTD		
		GOODLASS NEROLAC		
		JENSON & NICHOLSON (I) LTD		
		CDC CARBOLINE (I) LTD.		
		SHALIMAR PAINTS LTD.		
		ADDISON PAINTS LTD		
		GRAND POLYCOAT		
		BOMBAY PAINTS		
		HEMPLE PAINTS (SINGAPORE)		
		JHONSON & NICHOLSON		
		SEVEN SEAS PAINTS PVT. LTD		
11.	STRUCTURE STEEL	SAIL		
		TISCO		
		JINDAL		
		BHUSAWAL		
12	MASS FLOW CONTROLLER	BROOK'S (EMERSON)		

NOTE:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.

BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.

2. DEALERS ARE NOT ACCEPTABLE FOR ANY ITEM OF THE PACKAGE. BIDDER SHALL PROCURE ALL ITEMS INCLUDING PLATES, STRUCTURAL, FLANGES; COUNTER FLANGES ETC. FROM APPROVED SUB VENDOR ONLY.
3. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.



TITLE :
1x660 MW BHUSAWAL TPS

SPECIFICATION NO.: PE-TS-415-154-A101

**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

SUB-SECTION: IA

REV. NO. 00

DATE :01.06.2019

SUB VENDOR LIST C&I

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4.0 <u>LIST OF APPROVED VENDORS – CONTROL & INSTRUMENTATION</u>			
<u>SR. NO.</u>	<u>NAME OF EQUIPMENT / ITEM</u>		<u>APPROVED VENDORS</u>
1.0	<u>FIELD / PRIMARY INSTRUMENTS:</u>		
1.1	RTD & THERMOCOUPLES	(a)	PYRO ELECTRIC INSTRUMENTS GOA PVT. LTD.
		(b)	GENERAL INSTRUMENTS CONSORTIUM, MUMBAI
		(c)	DETRIVE, MUMBAI
		(d)	TEMSSENS INSTRUMENTS(I) PVT. LTD, UDAIPU
1.2	SMART ELECTRONIC TRANSMITTERS (PRESSURE, DIFF. PRESSURE)	(a)	EMERSON PROCESS MANAGEMENT (I) LTD
		(b)	FUJI, JAPAN
		(c)	YOKOGAWA, JAPAN/ YOKOGAWA INDIA
		(d)	ABB, GERMANY / FARIDABAD
		(e)	HONEYWELL, USA / PUNE
1.3	DISPLACER TYPE LEVEL TRANSMITTER	(a)	CHEMTROL MIL
		(b)	DRESSER, COIMBTORE
		(c)	V-AUTOMAT, DELHI
		(d)	ECKARDT, GERMANY
1.4	LEVEL TRANSMITTERS (DISPLACEMENT TYPE)	(a)	DRESSER MASONIELAN, FRANCE (DRESSER VALVES INDIA LTD. COIMBATORE)
		(b)	CHEMTROLS, MUMBAI (ECKARDT, GERMANY)
		(c)	ECKARDT, GERMANY

CONSULTANT : PROCON ENGINEERS

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1.5	LEVEL TRANSMITTERS (ULTRASONIC TYPE)	(d) ENDRESS+HAUSER, GERMANY/INDIA
		(e) KROHNE, FRANCE
		(f) PEPPERL+FUCHS, GERMANY/INDIA
		(g) VEGA, GERMANY
		(h) KAB INSTRUMENTS LTD.
1.6	RADAR TYPE LEVEL TRANSMITTERS	(a) SIEMENS MILLTRONICS
		(b) ENDRESS & HAUSER
		(c) SBEM
		(d) EMERSON
		(e) AMETEKEDREXELBRROK (CHEMTROLS)
1.7	TEMPERATURE TRANSMITTERS	(a) EMERSON PROCESS (FORMERLY FISHER ROSEMOUNT), USA/DAMAN
		(b) ABB, GERMANY / FARIDABAD
		(c) FUJI, JAPAN
		(d) HONEYWELL, USA / PUNE
		(e) YOKOGAWA, JAPAN/ YOKOGAWA INDIA
		(f) MOORE, USA
1.8	MAGNETIC LEVEL SWITCHES	(a) LEVCON INSTRUMENTS PVT. LTD., KOLKATA
		(b) V.AUTOMAT, NEW DELHI
		(c) ASIAN INDUSTRIAL VALVES, CHENNAI
1.9	LEVEL SWITCHES CONDUCTIVITY TYPE	(a) BHARAT HEAVY ELECTRICALS LTD.
		(b) YARWAY, USA

CONSULTANT : PROCON ENGINEERS

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		(c)	LEVELSTATE, UK
		(d)	SOLARTON, UK (PRESENTLY CALLED AS MOBREY)
		(e)	CHEMTROL
		(f)	LEVEL STATE (HITECH SYSTEMS)
		(g)	MOBREY
1.10	FLOW SWITCHES	(a)	SWITZER, CHENNAI
		(b)	KRONHE MARSHALL
		(c)	GENERAL INSTRUMENTS MUMBAI
		(d)	CHEMTROL
1.11	BYPASS ROTAMETER	(a)	IEPL, HYDERABAD
		(b)	PLACKA INSTRUMENTS INDIA PVT. LTD., CHENNAI
		(c)	TRAC, HYDERABAD
		(d)	EUREKA, PUNE
1.12	ROTAMETER	(a)	INSTRUMENTATION ENGINEERS PVT. LTD.
		(b)	SIGMA INSTRUMENTS CO.
		(c)	EUREKA INDUSTRIAL EQPT. PVT. LTD.
		(d)	TELACE EQUIPMENT PVT. LTD.
1.13	FLOW INTEGRATOR (ELECTRONIC TYPE)	(a)	ABB, GERMANY / FARIDABAD
		(b)	MASIBUS, GANDHINAGAR
		(c)	YOKOGAWA, JAPAN/ YOKOGAWA INDIA
		(d)	LEKKTROTEK, PUNE
		(e)	EMERSON

CONSULTANT : PROCON ENGINEERS

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		(f)	ENDRESS & HAUSER
		(g)	FORBES MARSHALL
1.14	GAUGES (PRESSURE, DIFF. PRESSURE)	(a)	A N INSTRUMENTS PVT. LTD., KOLKATA
		(b)	GENERAL INSTRUMENTS CONSORTIUM, GOA/ MUMBAI
		(c)	GOA THERMOSTATIC INSTRUMENTS, GOA
		(d)	FORBES MARSHALL LTD., HYDERABAD
		(e)	WAAREE INDUSTRIES, MUMBAI
		(f)	H.GURU INSTRUMENTS (SOUTH INDIA), BANGALORE
		(g)	WIKA INSTRUMENTS INDIA PVT. LTD., PUNE
		(h)	GOA INSTRUMENTS PVT. LTD.,
		(i)	MONOMETER, MUMBAI
		(j)	BELLS CONTROLS LTD., KOLKATA
		(k)	SWITZER INSTRUMENTS LTD., CHENNAI
		(l)	WIKA ALEXANDER WIEGAND GMBH&CO., GERMANY
		(m)	BUDENBURG GUAGE CO. LTD
		(n)	INSTRUMENTATION PVT. LTD., BANGALORE
		(o)	INDOSONIC INSTRUMENT, MUMBAI
		(p)	PRECISION
		(q)	ASHCROFT

CONSULTANT : PROCON ENGINEERS

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1.15	TEMPERATURE GAUGE	(a)	GOA THERMOSTATIC INSTRUMENTS, GOA
		(b)	GENERAL INSTRUMENTS CONSORTIUM,
		(c)	A.N. INSTRUMENTS PVT. LTD., KOLKATA
		(d)	H. GURU INSTRUMENTS (SOUTH INDIA), BANGALORE
		(e)	FORBES MARSHALL, HYDERABAD
		(f)	WIKI INSTRUMENTS INDIA PVT. LTD., PUNE
		(g)	WAREE, DADRA GOA INSTRUMENTS PVT. LTD.,
		(h)	BELLS CONTROLS LTD., KOLKATA
		(i)	SWITZER INSTRUMENTS LTD., CHENNAI
		(j)	WIKI ALEXANDER WIEGAND GMBH&CO., GERMANY
		(k)	BUDENBURG GUAGE CO. LTD.
		(l)	INDOSONIC INSTRUMENT, MUMBAI
1.16	SWITCHES (PRESSURE, DIFF. PRESSURE)	(a)	INDFOSS INDUSTRIES LTD., GHAZIABAD
		(b)	SWITZER INSTRUMENTS COMPANY, CHENNAI
		(c)	SOR INC., USA
		(d)	PYROELECTRIC, GOA
		(e)	DRESSER INDUSTRIES INC, USA
		(f)	REGULATEURS GEORGIN, FRANCE

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		(g)	DELTA CONTROLS LTD., U.K.
		(h)	KDG INSTRUMENTS LTD. U.K.
		(i)	ASHCROFT
		(j)	DWAYER, USA
		(k)	GENERAL INSTRUMENTS CONSORTIUM
1.17	TEMPERATURE SWITCH	(a)	INDFOSS INDUSTRIES LTD., GHAZIABAD
		(b)	SWITZER INSTRUMENTS COMPANY, CHENNAI
		(c)	GENERAL INSTRUMENTS CONSORTIUM, MUMBAI
		(d)	SOR INC., USA
		(e)	PYROELECTRIC, GOA DRESSER INDUSTRIES INC, USA
		(f)	REGULATEURS GEORGIN, FRANCE
		(g)	DELTA CONTROLS LTD., U.K.
		(h)	KDG INSTRUMENTS LTD. U.K.
1.18	AIR FILTER REGULATOR	(a)	PLACKA, CHENNAI
		(b)	SHAVO NORGREN, INDIA
1.19	MASS FLOW METER (CORROLIOUS PRINCIPLE)	(a)	EMERSON PROCESS MANAGEMENT (I) LTD
		(b)	ABB
		(c)	YOKOGAWA
		(d)	ENDRESS+ HAUESER
		(e)	GE SENSING & INSPECTION TECHNOLOGIES
		(f)	FORBES MARSHALL

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1.20	I/P CONVERTER	(a)	ECKHARDT, GERMANY
		(b)	MTL, CHENNAI
		(c)	ABB
		(d)	WATSON SMITH (PRESENTLY NORGREN)
		(e)	EMERSON PROCESS MGMT ASIA PACIFIC LTD.
		(f)	MOORE CONTROLS
1.21	FLOW ELEMENTS	(a)	INSTRUMENTATION LTD.
		(b)	MICRO PRECISION PRODUCTS
		(c)	ENGINEERING SPECIALITIES PVT. LTD.
		(d)	GENERAL INSTRUMENTS
1.22	LEVEL GAUGES (FLOAT TYPE)	(a)	SB ELECTRO
		(b)	SIGMA
		(c)	V AUTOMAT
		(d)	LEVCON
		(e)	CHEMTROLS
		(f)	ASIAN INDUSTRIAL VALVES
1.23	ORP TRANSMITTERS	(a)	FORBES MARSHALL
1.24	DENSITY METER (NUCLEONIC TYPE)	(a)	ENDRESS + HAUSER
		(b)	THERMO MEASURE TECH.
		(c)	CHEMTROL (THERMO FISHER)
1.25	DENSITY METER (NON-NUCLEONIC TYPE)	(a)	ENDRESS + HAUSER
		(b)	THERMO MEASURE TECH.
		(c)	CHEMTROL (THERMO FISHER)

CONSULTANT : PROCON ENGINEERS

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1.26	SOLID MASS FLOW METER	(a)	SIEMENS MILLTRONICS
		(b)	CHEMTROL (THERMO FISHER)
		(c)	SIEMENS INSTRUMENTS, CANADA
1.27	PULL CORD SWITCH	(a)	JAYASHREE ELECTRODEVICES PVT. LTD.
		(b)	A.G. SYSTEM CONTROLS, MUMBAI
1.28	BELT SWAY SWITCH	(a)	JAYASHREE ELECTRODEVICES PVT. LTD.
		(b)	A.G. SYSTEM CONTROLS, MUMBAI
1.29	ZERO SPEED SWITCH	(a)	A.G. ELECTRONICS
		(b)	JAYASHREE ELECTRODEVICES PVT. LTD.
1.30	PROXIMITY SWITCH	(a)	AW
		(b)	JAYASHREE ELECTRODEVICES PVT. LTD.
1.31	LEVEL SWITCH (RF TYPE)	(a)	EIP ENVIRO LEVEL CONTROLS
2.0	<u>DCS, HMI, MONITORING AND PLC SYSTEMS:</u>		
2.1	DDCMIS	(a)	ABB.
		(b)	YOKOGAWA
		(c)	SIEMENS.
		(d)	BHEL
		(e)	EMERSON PROCESS MANAGEMENT
		(f)	MHI
2.2	PLC	(a)	ALLEN BRADLEY.
		(b)	SCHNEIDER
		(c)	ROCKWELL

CONSULTANT : PROCON ENGINEERS

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		(d)	GE FANUC
2.3	MASTER SLAVE CLOCK	(a)	SYMMETRICOM INC., USA
		(b)	HOPF, GERMANY
		(c)	HATHWAY, USA
		(d)	SERTEL ELECTRONICS, CHENNAI
		(e)	ADVANCE MICRONIC
2.4	DOT MATRIX PRINTER	(a)	HP / EPSON / WIPRO / TVS / SAMSUNG
2.5	LASER & COLOUR INKJET PRINTERS	(b)	HP / EPSON / CANON / IBM / XEROX / SAMSUNG
2.6	COMPUTERS FOR OPERATOR / ENGINEER / HISTORY STATION, SHIFT SUPERVISOR, STORIAN, SOFT LINK STATION FOR INTERFACING WITH OTHER SYSTEMS, PERFORMANCE CALCULATION AND SER STATION	(a)	IBM
		(b)	DELL
		(c)	HP/COMPAQ
2.7	TFT MONITOR	(a)	LG / SAMSUNG / HP / COMPAQ / IBM / DELL
2.8	VIBRATION MONITORING SYSTEM & TURBO-SUPERVISORY INSTRUMENTS	(a)	ROCKWELL AUTOMATION, USA
		(b)	BENTLEY NEVADA, USA / INDIA
		(c)	SHINKAWA, JAPAN / FORBES MARSHALL,
		(d)	VIBROMETER, SWITZERLAND
2.9	LARGE VIDEO SCREENS	(a)	BARCO BELGIUM / BARCO, INDIA
		(b)	PLANAR, USA / PYROTECH, INDIA
		(c)	CHRISTIE, USA / CHRISTIE, INDIA

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		(d)	SYNELEC
		(e)	DELTA, THAILAND / DELTA POWER SYSTEMS, INDIA
2.10	HART COMMUNICATOR	(a)	HONEYWELL, USA/PUNE
		(b)	EMERSON PROCESS (FORMERLY FISHER ROSEMOUNT), USA / DAMAN
		(c)	YOKOGAWA, JAPAN / YOKOGAWA, INDIA
		(d)	MERIAM, USA / CHEMTROLS, MUMBAI
		(e)	ABB, GERMANY / INDIA
		(f)	FUJI, JAPAN
2.11	HART MANAGEMENT SYSTEM	(a)	PEPPERL+FUCKS, GERMANY / INDIA
		(b)	MTL, UK / INDIA
		(c)	EMERSON PROCESS, USA / DAMAN
2.12	ALARM ANNUNCIATION SYSTEM	(a)	PROCON, CHENNAI
		(b)	I I C, HYDERABAD
		(c)	MINILEC, PUNE
		(d)	IIC, MUMBAI
		(e)	PIRIE, MUMBAI
		(f)	PECON, VADODARA
		(g)	POSITRONICS
2.13	RCMS (ROTATING MACHINE CONDITION MONITORING SYSTEM)	(a)	VIBROTECH (M/S MEGITT INDIA PVT. LTD.)
		(b)	M/S SKF INDIA LTD.
2.14	ACOUSTIC PYROMETER	(a)	BONNENBERG + DRESCHER GMBH, GERMANY

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2.15	ACOUSTIC STEAM LEAK DETECTION SYSTEM (ASLD)	(a)	HI-TECH SYSTEM & SERVICES LTD, NEW DELHI (AMI MAKE)
		(b)	SARTECH INTL, CHENNAI (INSTROTECH MAKE INSPECTA FFT
2.16	EPABX SYSTEM	(a)	SIEMENS
		(b)	BPL
2.17	FURNACE TV CAMERA SYSTEM	(c)	HITECH SYSTEM & SERVICES LTD. (M/S LENOX INSTRUMENT COMPANY INC., USA
3.0	<u>ELECTRICAL & SECONDARY INSTRUMENTS:</u>		
3.1	DIGITAL INDICATOR	(a)	ABB, GERMANY / FARIDABAD
		(b)	MASSIBUS, GANDHINAGAR PYROTECH, UDAIPUR
		(c)	LEKTROTEK, PUNE
		(d)	GOSSSEN / CAMILLE BAUER / METRAWATT YOKOGAWA, JAPAN / INDIA
		(e)	SIEMENS
3.2	BARGRAPH INDICATORS	(a)	ABB, GERMANY / FARIDABAD
		(b)	MASSIBUS, GANDHINAGAR
		(c)	PYROTECH, UDAIPUR
		(d)	LEKTROTEK, PUNE
		(e)	GOSSSEN / CAMILLE BAUER / METRAWATT
		(f)	M-SYSTEM, JAPAN (CHINO LAXSONS DAMAN)
		(g)	SIEMENS

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3.3	PEN, POINT AND CHARTLESS RECORDERS	(a)	EUROTHERM, UK
		(b)	TATA HONEYWELL
		(c)	YOKOGAWA, JAPAN (YOKOGAWA, INDIA)
		(d)	CHINO (LAXSON), JAPAN
		(e)	ABB, UK / GERMANY
		(f)	FUJI ELECTRIC, JAPAN
3.4	TRANSDUCERS	(a)	SEIMENS
		(b)	AUTOMATIC ELECTRIC LTD., MUMBAI
		(c)	PYROTECH, UDAIPUR
		(d)	SOUTHERN TRANSDUCERS, CHENNAI
		(e)	ACCORD, PUNE MECO, MUMBAI
		(f)	ABB
		(g)	SITU, MUMBAI
		(h)	RISHABH
		(i)	ADEPT, PUNE
3.5	ELECTRICAL ANALOG (PANEL) METERS	(a)	AUTOMATIC ELECTRIC LTD., MUMBAI
		(b)	MECO, MUMBAI
		(c)	RISHAB, NASIK
3.6	SELECTOR SWITCHES AND CONTROL SWITCHES	(a)	KAYCEE
		(b)	ALSTOM
		(c)	L & T
		(d)	SIEMENS

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3.7	MOSAIC ANALOG (MOVING COIL) INDICATORS	(a)	GOSSEN, GERMANY
		(b)	WEIGEL, GERMANY
3.8	MOSAIC DIGITAL INDICATORS	(a)	GOSSEN, GERMANY
		(b)	WEIGEL, GERMANY
3.9	INTERPOSING RELAYS FOR COMMAND OUTPUT TO MCC	(a)	JYOTI
		(b)	H&B
		(c)	ALSTOM
		(d)	ELASTA
		(e)	OEN SIEMENS
		(f)	ABB
3.10	RELAYS / AUX. CONTACTORS	(a)	TELEMECANIQUE & CTRLS
		(b)	ABB
		(c)	SIEMENS
		(d)	GEC – ALSTOM
		(e)	L & T
3.11	LIMIT SWITCHES	(a)	BHARTIYA CUTLER & HAMMER, FARIDABAD
3.12	MINIATURIZED PUSH BUTTONS / ILPB (24X48MM) MOSAIC GRID COMPATIBLE	(a)	SIEMENS
		(b)	TEW, GERMANY (OLD NAME SUBKLEW)
4.0	<u>CONTROL DESKS & PANELS:</u>		
4.1	UNIT CONTROL PANELS (UCP)/ ELECTRICAL CONTROL PANEL (ECP)/ CONTROL DESK (MOSAIC GRID BASED)	(a)	BHEL EDN
		(b)	PYRO TECH, UDAIPUR
		(c)	INSTRUMENTATION LTD. KOTA
		(d)	KHODAY CONTROL SYSTEMS, BANGALORE

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		(e)	CHEMIN CONTROLS, PONDICHERRY
4.2	CRT DESK / OPERATOR DESK	(a)	PYRO TECH, UDAIPUR
		(b)	INSTRUMENTATION LTD. KOTA
		(c)	KHODAY CONTROL SYSTEMS, BANGALORE
		(d)	CHEMIN CONTROLS, PONDICHERRY
4.3	MOSAIC GRID/ MOSAIC TILES & OTHER MOSAIC ITEMS	(a)	SYMO, SWITZERLAND
		(b)	TEW, GERMANY (OLD NAME SUBKLEW)
		(c)	PYROTECH
4.4	LOCAL PANELS / DISTRIBUTION BOARDS	(a)	CONTROL & SCHEMATICS
		(b)	PYROTECH
		(c)	RITTAL
		(d)	L&T
4.5	TERMINAL BLOCKS	(e)	ELMEX
		(f)	PHOENIX
		(g)	WAGO
5.0	<u>ANALYSERS:</u>		
5.1	SWAS ANALYSERS	(a)	POLYMETRON / ZELLWEGGER – ANALYTICALS
		(b)	ABB
		(c)	ORION, USA
		(d)	ROSEMOUNT ANALYTICAL-CHEMPURE,
		(e)	HACH ULTRA FRANCE,
		(f)	HACH USA

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		(g)	YOKOGAWA
		(h)	AMETECH
		(i)	FORBES MARSHALL
		(j)	EMERSON
5.2	SWAS (STEAM AND WATER ANALYSIS SYSTEM) PANELS	(a)	ABB KENT, U.K.
		(b)	ABB LTD. FARIDABAD
		(c)	FORBES MARSHAL
		(d)	EMERSON PROCESS MANAGEMENT INSTRUMENTATION LTD., KOTA
		(e)	YOKOGAWA
5.3	CO ANALYSER (IN SITU TYPE)	(a)	AMETEK, USA / SINGAPORE
		(b)	CODEL INTERNATIONAL LTD. UK
		(c)	LAND COMBUSTION UK
5.4	OXYGEN IN FLUE GAS ANALYSER (ZIRCONIA PROBE TYPE)	(a)	AMETEK, USA / SINGAPORE
		(b)	LAND INSTRUMENTS, UK
		(c)	EMERSON PROCESS MANAGEMENT (I) LTD
		(d)	YOKOGAWA, JAPAN
		(e)	ENOTECH, GERMANY
		(f)	ABB, UK
		(g)	TELEDYNE, USA
		(h)	FUJI (AIC)
5.5	SMOKE DENSITY ANALYSER / PARTICULATE EMISSION ANALYSER / OPACITY ANALYSER	(a)	DURAG, GERMANY
		(b)	CODEL, UK
		(c)	LAND COMBUSTION UK

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		(d)	EMERSON
		(e)	ABB
		(f)	FUJI (AIC)
5.6	NOX / SO ₂ ANALYSER (IN SITU)	(a)	CODEL, UK
		(b)	FORBES MARSHALL
		(c)	LAND COMBUSTION, UK
5.7	OZONE ANALYSER	(a)	BMT MESSTECHNIK, GMBH
5.8	RESIDUAL OZONE ANALYSER	(a)	ECO SENSORS / KAUFFMANN UMWITTECHNIK .EK
5.9	OZONE LEAK DETECTOR	(a)	OTTPL
6.0	<u>CONTROL VALVES / ACTUATORS / SOLENOID VALVES:</u>		
6.1	ELECTRICAL ACTUATORS FOR REGULATING & OPEN / CLOSE VALVES	(a)	ROTORK CONTROL (INDIA) LTD.,
		(b)	AUMA (INDIA) LTD.,
		(c)	LIMITORQUE INDIA LTD.
6.2	PNEUMATIC ACTUATORS-REGULATING & OPEN / CLOSE	(d)	INSTRUMENTATION LTD., PALGHAT
		(e)	KELTRON CONTROLS, KERALA
6.3	SH/RH SPRAY CONTROL VALVES SH/RH SPRAY BLOCK VALVES FEED CONTROL VALVES	(a)	MIL CONTROLS LTD.
		(b)	INSTRUMENTATION LTD. PALGHAT
		(c)	FISHER SANMAR LTD.
		(d)	CONTROL COMPONENT INC., USA
		(e)	HORA (HOLTER REGELARMATUREN GMBH & CO.)
6.4	LFO/HFO CONTROL, AND TRIP VALVES, FLOW CONTROL, PRESSURE	(a)	MIL CONTROLS LTD.
		(b)	INSTRUMENTATION LTD. PALGHAT

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	CONTROL, TEMP. CONTROL, AND BURNER TRIP VALVES, BALL VALVES	(c)	FOURESS ENGG (I) LTD, BANGALORE
		(d)	SAMSON CONTROLS , PUNE
6.5	SOOT BLOWER PRESSURE REDUCING VALVE	(a)	MIL CONTROLS LTD.
		(b)	INSTRUMENTATION LTD., PALGHAT
		(c)	FISHER SANMAR LTD.
		(d)	CONTROL COMPONENT INC., USA
		(e)	HORA (HOLTER REGELARMATUREN GMBH & CO.)
6.6	APRDS CONTROL VALVES	(a)	INSTRUMENTATION LTD.
		(b)	CONTROL COMPONENT INC., USA
		(c)	HORA (HOLTER REGELARMATUREN GMBH & CO.)
6.7	CONTROL VALVES- NON CRITICAL	(a)	DEZURIK COPES VULCAN LTD., U.K.
		(b)	CONTROL COMPONENT INC., USA
		(c)	FISHER SANMAR LIMITED
		(d)	INSTRUMENTATION LTD
		(e)	MIL CONTROL LTD.
		(f)	FISHER XOMOS SANMAR LTD.
		(g)	HORA (HOLTER REGELARMATUREN GMBH & CO.)
6.8	SOLENOID VALVE	(a)	ASCO, CHENNAI
		(b)	ROTEX AUTOMATION LTD., GUJRAT
		(c)	AVCON CONTROLS, MUMBAI
6.9	HP/LP BYPASS VALVES	(a)	BOPP & REUTHER SR GMBH CONTROL COMPONENTS INC (CCI)

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6.10	ELECTRO-HYDRAULIC ACTUATOR	(a)	LEONARDO AUTOMATION (INDIA) PVT. LTD.
7.0	<u>ERECTION HARDWARES:</u>		
7.1	LOCAL INSTRUMENT RACK (LIR) AND LOCAL INSTRUMENT ENCLOSURES (LIE)	(a)	PYROTECH, UDAIPUR
		(b)	INSTRUMENTATION LTD., KOTA
		(c)	ELECTRONICS CORPORATION OF INDIA LTD., HYDERABAD
		(d)	CHEMIN CONTROLS, PONDICHERRY
		(e)	PRAMMEN INDUSTRIES
7.2	INSTRUMENT VALVES	(a)	EXCEL HYDRO PNEUMATICS PVT. LTD., MUMBAI
		(b)	BHEL
		(c)	METPRESS ENGINEERING WORKS, KOLKATA
		(d)	BALDOTA VALVE & FITTING CO. PVT. LTD., MUMBAI
		(e)	AURA INC., NEW DELHI
		(f)	INSTRUMENTATION LTD. PALGHAT
		(g)	PRECISION ENGG. INDUSTRIES, MUMBAI
		(h)	VIKAS INDUSTRIAL PRODUCTS, NEW DELHI
7.3	VALVE MANIFOLDS	(a)	EXCEL HYDRO PNEUMATICS PVT. LTD., MUMBAI
		(b)	METPRESS ENGINEERING WORKS, KOLKATA

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		(c)	BALDOTA VALVE & FITTING CO. PVT. LTD., MUMBAI
		(d)	AURA INC., NEW DELHI
		(e)	PRECISSION ENGG. INDUSTRIES, MUMBAI
		(f)	HP VALVES AND FITTINGS, CHENNAI
7.4	COMPRESSION FITTINGS / SOCKET WELD FITTINGS	(a)	SWAGELOCK, USA
		(b)	ASTEC VALVES & FITTINGS PVT. LTD.
		(c)	MET-LOK HYDRO PNEUMATICS PVT. LTD.
7.5	CONDENSATE POTS	(a)	EXCEL HYDRO-PNEUMATICS PVT. LTD., MUMBAI
		(b)	MICROPRECISION, FARIDABAD
		(c)	INSTRUMENTATION LTD. PALGHAT
		(d)	METPRESS ENGINEERING WORKS, KOLKATA
		(e)	BALDOTA VALVES & FITTINGS CO. PVT. LTD., MUMBAI
		(f)	PRECISSION ENGG. INDUSTRIES, MUMBAI
7.6	IMPULSE & SAMPLE PIPINGS	(a)	TPS TECHNITUBE ROHREN WERKE GMBH, GERMANY
		(b)	MAHARASHTRA SEAMLESS LTD.
		(c)	BHEL
		(d)	CHOKSI TUBE COMPANY LTD., INDIA
		(e)	INDIAN SEAMLESS METAL TUBES LTD., INDIA
		(f)	MANNESMANN AG, GERMANY

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		(g)	TOUVAY AND CAUVIN GULF EC, DUBAI
		(h)	JINDAL SAW PIPES LTD., INDIA
		(i)	SUMITOMO CORPORATION, JAPAN / KAWASAKI
		(j)	RATNAMANI METALS & TUBES LTD., AHMEDABAD
7.7	JUNCTION BOX (FRP)	(a)	DEVI POLYMERS, CHENNAI
		(b)	SUCHITRA INDUSTRIES, BANGALORE
		(c)	RITTAL
		(d)	PYROTECH
		(e)	L&T
		(f)	HENSEL ELECTRIC INDIA PVT. LTD., SRIPERUMBUDUR
7.8	AIR CYLINDER	(a)	VELJAN HYDRAIR, HYDERABAD
		(b)	NUCON INDUSTRIES, HYDERABAD
		(c)	PRECISION ENGG. (PREAC), BANAGALORE
		(d)	ASCO, CHENNAI
8.0	<u>CABLES:</u>		
8.1	CONTROL CABLES	(a)	DELTON CABLES, FARIDABAD
		(b)	UNIVERSAL CABLES, SATNA
		(c)	NICCO CABLE, KOLKATA
		(d)	POLYCAB, DAMAN
		(e)	GAYOLENE, MUMBAI
		(f)	RELIANCE ENGRS, BANGALORE
		(g)	CORDS CABLES, RAJASTHAN

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		(h)	PARAMOUNT CABLES, ALWAR
		(i)	THERMOCABLES, BANGALORE,
		(j)	KEI INDUSTRIES LTD., CHENNAI
8.2	INSTRUMENTATION CABLE	(a)	DELTON CABLES, FARIDABAD
		(b)	UNIVERSAL CABLES, SATNA
		(c)	NICCO CABLE, KOLKATA
		(d)	POLYCAB, DAMAN
		(e)	GAYOLENE, MUMBAI
		(f)	RELIANCE ENGRS, BANGALORE
		(g)	CORDS CABLES, RAJASTHAN
		(h)	PARAMOUNT CABLES, ALWAR
		(i)	THERMOCABLES, BANGALORE / HYDERABAD
		(j)	KEI INDUSTRIES LTD., CHENNAI
		(k)	CABLE CORPRN OF (I) LTD., CHENNAI
		(l)	RPG CABLES LTD., CHENNAI
		(m)	FORT GLOSTER INDUSTRIES LTD. KOLKATA
		(n)	DECO CABLES, DELHI
		(o)	KRISHNA CABLES, GWALIOR
		(p)	THERMAPADS (P) LTD
		(q)	ELKAY TELELINKS LTD.
		(r)	INCAB INDUSTRIES LTD
		(s)	TORRENT CABLE LTD.
8.3	COMPENSATING CABLES	(a)	DELTON CABLE

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		(b)	TOSHNIWAL, MUMBAI RELIANCE, BANGALORE
		(c)	LAPP INDIA, MUMBAI/ BANGALORE
		(d)	CORDS CABLES, RAJASTHAN
		(e)	PARAMOUNT CABLE
8.4	SPECIAL CABLES (PTFE /FEP INSULATED CABLES)	(a)	TOSHNIWAL CABLE
		(b)	RELIANCE CABLES
		(c)	LAPP INDIA, MUMBAI
		(d)	PARAMOUNT CABLES
		(e)	FINOLEX, PUNE
8.5	POWER CABLES (LT)	(a)	DELTON CABLES, FARIDABAD
		(b)	UNIVERSAL CABLES, SATNA
		(c)	NICCO CABLE, KOLKATA
		(d)	CORDS CABLES, RAJASTHAN
		(e)	FORTGLASTER INDUSTRIES
		(f)	INCAB, PUNE
		(g)	CCIL, BANGALORE
		(h)	KEI INDUSTRIES LTD., CHENNAI
		(i)	POLYCAB, DAMAN PARAMOUNT CABLES, ALWAR
9.0	<u>UPS / DC SYSTEM:</u>		
9.1	UPS WITH ACDB	(a)	HI-REL ELECTRONICS
		(b)	EMERSON NETWORK (FORMERLY TATA LIEBERT)
		(c)	DB POWER ELECTRONICS
9.2	24 VDC BATTERY CHARGER	(a)	CALDYNE, KOLKATA

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	WITH DCDB	(b)	AMARARAJA, TIRUPATI
		(c)	CHHABI ELECTRICALS, JALGAON
		(d)	HBL POWER SYSTEMS, HYDERABAD
		(e)	MASS TECH CONTROLS
9.3	BATTERY (TUBULAR/PLANTE) (TUBULAR) (TUBULAR)	(a)	EXIDE, KOLKATA
		(b)	HBL NIFE, HYDERABAD UNION BATTERY (BUI PUNE)
9.4	BATTERY (NICKEL- CADMIUM)	(a)	HBL POWER SYSTEMS, HYDERABAD
		(b)	AMCO, BANGALORE

Laboratory Instruments:

Bidder shall submit the vendor list with credentials for Mahagenco's approval.

NOTE : The vendors indicated in the above list are Mahgenco's approved vendors, however, the product of above vendors proposed for this project shall meet the requirements stipulated in 'Proven Product' Cl. No. 5.0 of Vol. V, Section I of Tender Specification.

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TITLE :
1x660 MW BHUSAWAL TPS

SPECIFICATION NO.: PE-TS-415-154-A101

**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

SUB-SECTION: IA

REV. NO. 00

DATE :01.06.2019

ANNEXURE III

DRAWING DOCUMENTS DISTRIBUTION SCHEDULE

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1.0 <u>GENERAL</u> 1.1 As part of the overall project management activity, the Contractor shall be responsible for proper engineering and co-ordination of activities during various phases of execution of the contract. The Contractor shall identify a person, designated as Project Manager, with whom the Owner, the Consulting Engineer or the Review Consultant shall interact on matters related to engineering as well as execution of the contract. The Project Manager shall be the single-point contact person on behalf of the Contractor and shall be responsible for all engineering co-ordination. The Owner/Consultant/ Review Consultant shall interact with the Project Manager only on all matters of co-ordination between the Owner and the Contractor or on matters involving the Contractor, his manufacturing units and sub-vendors. For the purpose of expediting, the Owner or his representative may sometimes interact with the manufacturing units or sub-vendors of the contractors. However, such interaction will not, under any circumstance, dilute the responsibility of the Contractor to provide a fully engineered and co-ordinated package under this contract. 1.2 On finalization of the contract, a procedure for exchange of engineering information will be mutually agreed and finalized between the Owner and the Contractor. 2.0 <u>DESIGN COORDINATION MEETING</u> The Contractor and his sub-vendors will be called upon to attend design co-ordination meetings with the Engineer, other Contractors and the Consultants of the Owner during the period of execution of contract. The Contractor including his sub-vendors shall attend such meetings at their own cost at Owner's or Consultant's office in Mumbai or at Bhusawal site or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions. 3.0 <u>GUIDELINES FOR ENGINEERING SERVICES</u> 3.1 Prior to commencement of the engineering work as part of design submissions, all aspects of design viz criteria for selection and sizing of all equipment and systems, design margins etc including that for structural steel		

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and civil work shall be outlined and these shall form the basis for the detailed engineering work. 3.2 Engineering work shall be performed on modern and proven concepts and internationally accepted good engineering practices but fully compatible with the Indian environments. Owner shall have the right to review and approve the engineering work by themselves and/or through consultant and ask for any clarifications and changes/modifications to the work performed by Contractor. 3.3 At any stage during the performance of assignment, the Contractor may be required to make certain changes/modification/improvements in design/drawing/other documents which are applicable to any unit of 660 MW individually or severally, which in the opinion of the Owner could result in better improved design, layout, operability, plant availability, maintainability, reliability or economy of the plant and its systems/sub-systems in view of revised and more accurate information/data available at a later date (s) or feedback (s) received during execution/operation of similar units. Such changes/modifications/improvements required could be identified by Owner and/or consultant and mutually discussed. Owner requires the Bidder to incorporate such action in the subject assignment appropriately without any additional cost liability and time implication to the Owner and same shall be within the responsibilities and scope of the Contractor. 3.4 During the course of review of detailed engineering stages, it may be essential in the opinion of Owner to obtain certain classified data for review purposes only. In case Owner so desires, the Bidder shall submit such data to Owner. 3.5 During the course of review of detailed engineering, it may be essential in Owner's opinion to obtain data and information on similar equipment and plants engineered by the Bidder. In case Owner so desires, the Bidder shall submit such data and information to the Owner. 3.6 It is not the intent to give details of every single task covered in the total engineering work to be carried out by Contractor, however, all engineering work required for the satisfactory completion of the plant/systems as		

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specified shall be carried out by the Contractor. Broadly, the following are the minimum requirements in respect of scope of major items of work: 4.6.1 Preparation, updating and finalisation of scheme drawings, control and interlock diagrams, detailed and fully dimensioned layout drawings (plant layout and equipment layout detailed plan, elevation and cross-sectional drawings at different elevations/ floor levels) covering all mechanical, electrical, C&I, civil and structural items, equipment, systems and facilities. Drawings and Schedules prepared by the Contractor from time to time, as detailed designs are developed, shall be submitted for Owner's/ Consultant's approval before the work is taken up. Revisions, corrections, additions to drawings and schedules shall not be considered to change the scope of work. 4.6.2 Preparation of detailed technical specifications including data sheets, tender drawings and bill of material for all bought out items and also finalisation of corresponding sub-contractors. 4.6.3 Review of sub-contractor's data, drawings, design calculations, schedules, bill of materials, instruction manuals etc. for all equipment, before forwarding them to Owner /Consultant for approval. 4.6.4 Preparation of civil construction drawings for all equipment showing foundation details and full details regarding equipment loads, floor openings, details of embedments etc required for preparation of civil construction drawings and also as referred at relevant sections of Scope, Terminal Points & Exclusions. These documents shall be preceded by appropriate design calculations, static and dynamic analysis, as necessary. 4.6.5 Preparation and finalisation of process piping and instrumentation diagrams and schematics, complete in all respects for all systems/packages of the power plant. 4.6.6 Preparation of consolidated schedules and bills of materials, including line numbers, tag numbers, source of supply, service conditions, specifications, materials, types and connections details, quantities for items of the plant including dampers, steam traps, strainers, instrumentations, ducting. 4.6.7 Sizing of all piping and equipment as per the stipulated design criteria, carrying out the flexibility analysis/dynamic analysis as necessary, hangers & support engineering.		

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4.6.8	Final revision of all documents including preparation and compilation of Instruction Manuals for installation, commissioning, operation and maintenance for all equipment and systems. Refer clause 5.0 for the specific requirement in this regard.	
4.6.9	Certification and submission of final as-built drawings for all areas.	
4.6.10	Preparation and compilation of all drawings, schedules and instructions which may be required at site, whether separately mentioned or not.	
4.6.11	All erection and assembly drawings which may be required at site.	
4.6.12	For all bought out item packages, the Contractor shall provide complete material/ component list along with detail specification, drawings, component part number etc during detail engineering stage prior to final approval. Such approved drawing / document shall be made available at site in adequate number prior to commencement of work. Moreover, such document/drawing shall be provided in soft form (CD).	
4.6.13	Preparation of necessary documentation, design calculations etc required for submission to statutory authorities like IBR, Chief Electric Inspector etc.	
4.0	<u>OPERATING MANUALS AND MAINTENANCE INSTRUCTIONS</u>	
4.1	The Contractor shall provide all necessary maintenance manuals and operating instructions at least six (6) months before the time of commissioning and before taking over of the plant and equipment. The instruction manual shall be submitted in the form of one (1) soft copy in CD and 15 hard copies.	
4.2	The information provided, which shall be contained in loose leaf stiff backed covers, shall include :	
4.2.1	A complete inventory of all main items of plant, with identification details.	
4.2.2	Service manuals for all plant and equipment giving full descriptions of the main items and auxiliary items such as power packs, hydraulic equipment, actuators, lubricating pumps etc.	

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4.2.3 A separate electrical manual covering items such as switchgear, cabling, instrumentation, controls, cabling layouts and wiring diagrams. 4.2.4 A schedule of recommendations for routine maintenance of all electrical and mechanical equipment, recommended inspection point, information on detection, cause and rectifications of troubles & faults. 4.2.5 A lubrication schedule with all necessary drawings, diagrams to identify the lubrication points. 4.2.6 Manufacturer's literature. 4.3 The instruction manual shall be subject to the approval of Owner. 4.4 The contractor shall submit the complete equipment list. The list shall be updated every three (3) months. 5.0 <u>PLANT HANDBOOK</u> The Contractor shall submit to the Engineer, a preliminary plant handbook preferably in A-4 size sheets which shall contain the design and performance data of various plant, equipment and systems, covering the complete project including single line flow diagrams, within twenty four (24) months from the date of his acceptance of the Letter of Award. The final plant handbook complete in all respects shall be submitted by the Contractor six (6) months before start-up and commissioning activities. The plant handbook shall be submitted in the form of two (2) soft copy in CD/DVD (one to Owner and one to Consultant) and twenty five (25) hard copies in decent bound forms. 6.0 <u>CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL PROCEDURE</u> 6.1 Within fifteen (15) days of issue of Letter of Award (LOA) by the Owner, the Contractor shall furnish a schedule of drawings and design document to be submitted by him to the Owner/Engineer indicating dates against each document. The documents shall be divided into two categories:		

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(a) for approval and (b) for information/further engineering and co-ordination by the Owner. This document submission schedule shall require approval by the Owner/Engineer. 6.2 All contract documents shall be marked, without fail, with the name of the Owner, the Project, the specification title and number and the unit designation. All dimensions shall be in metric units. All notes, markings etc. shall be in English. 6.3 Documents/Drawings, submitted during tender stage, shall be revalidated or revised as required and submitted as certified contract document for approval/information of the Owner/Engineer. 6.4 Unless specified otherwise, the following categories of documents/drawings would require approval of the Owner/Consultant: 6.4.1 List of sub-vendors (from Owner only) 6.4.2 System scheme and instrumentation diagrams 6.4.3 Design basis justifying selection of equipment & process parameters where not specified in the Contract 6.4.4 Equipment data sheets and general arrangement drawings 6.4.5 Predicted performance curves of equipment** 6.4.6 Materials of construction 6.4.7 Layout drawings		

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6.4.8	Operation logic diagrams	
6.4.9	Typical control circuit	
6.4.10	Drawings of Instrumentation and Control	
6.4.11	Any deviation from contract (by Owner)	
	** For all critical equipments (boiler and turbine auxiliaries etc), submission of this data shall be mandatory for approval of equipment data sheets / GA drawings.	
6.5	Unless specified otherwise, the following categories of documents/ drawings would be treated for information/further engineering by the Owner/Engineer. The Contractor shall, however, incorporate all additional information and clarifications in these documents/ drawings as and when desired by the Owner/Engineer.	
6.5.1	Equipment foundation drawings	
6.5.2	Equipment cross-section drawings, product literature etc which are of proprietary nature	
6.5.3	Various bills of quantity, schedules etc	
6.5.4	Piping fabrication drawings, isometrics etc	
6.5.5	Panel wiring diagrams	
6.5.6	Instruction/Operation manuals	
6.5.7	Service manuals and troubleshooting guide for C & I system including field instruments	
6.5.8	Cable schedule and interconnection chart	
6.5.9	Drive/feeder wise control scheme showing all external interfaces.	

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In essence, the Contractor is solely responsible for corrections and adequacy of design & engineering for documents under this category. 6.6 Upon review, the Owner/Engineer shall put his remarks and one of the following action stamps on the drawing/document: 6.6.1 Approved 6.6.2 Approved except as noted, forward final drawing 6.6.3 Approved except as noted, resubmission required 6.6.4 Disapproved 6.6.5 For information/reference only For action stamps in category (c) & (d), documents must be resubmitted for review by the Owner / Engineer. For action stamp in category (b), further review by Owner / Engineer would not be necessary provided the Contractor agrees & incorporates the minor comments made on the document. Except for action stamp under category (c) & (d), the Contractor can proceed with manufacturing and other sequential activities for those areas of a drawing/document which do not have any review comment by the Owner/Engineer. The Owner/Engineer may accord approval in category (c) or (d) in more than one submission of a document till he is satisfied that the intent of the specification has been fully complied with. The Contractor shall be responsible for delay in such cases and no extension of time shall ordinarily be allowed on such grounds. Approval of contract documents by the Owner/Engineer shall not relieve the Contractor of his responsibility for any errors and fulfillment of contract requirements. The Contractor's work shall be in strict accordance with the finally approved drawings and no deviation shall be permitted without written approval of the Owner/Engineer.		

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6.7	Except key plan/general yard plan, any layout drawing requiring scrutiny shall not be drawn to a scale less than 1:50.	
6.8	For review by the Consulting Engineer, the Contractor shall furnish three (3) prints of each drawing. Two (2) prints of such submission shall also be sent to the Owner. After review, one (1) stamped print will be returned to the Contractor. Upon action under category (a) or (c), the Contractor shall directly distribute the documents to the various offices of the Owner and other agencies in number of copies as specified in the contract document. Such distribution copies shall be marked with the reference and date of the letter by which the Owner/Engineer has accorded his final approval. Penal action shall be taken against the Contractor for any unauthorised revision in the drawings so distributed from the drawings approved by the Owner/Engineer. The contractor shall furnish three (3) CD's of all as built/final drawings for Owner / Consultant site.	
6.9	In case of contradiction between the stipulations above and those stated elsewhere in the specification, the stipulations herein shall prevail.	
6.10	For details of documentation for Civil, Structural and Architectural works, Volume VI may be referred.	
7.0	<u>TENDER STAGE DOCUMENT SUBMISSION</u>	
8.1	The Bidder shall submit along with his bid all documents/drawings as requested in respective specifications. The documents shall include but not be limited to the following:	
8.1.1	All Bid proposal sheets duly filled up. (The data mentioned in Bid proposal sheets is minimum required only. The Bidder shall submit the additional data asked for at any later stage).	
8.1.2	Detailed experience list and financial resources of the prime bidder, his collaborators/ associates in this bid as well as the sub-vendors proposed.	
8.1.3	Scheme drawings indicating scope of supply and service as offered by the Bidder indicating clearly exclusions, if any.	

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8.1.4	List of terminal points of the package offered together with quality and quantity of various input (i.e. water, air, electricity etc.) as required from the Owner at such interfaces.	
8.1.5	Equipment GA, Layout, Design Calculations, interlock and other write-up, catalogues/ literature etc as required for clear understanding of the bid submitted.	
8.1.6	L-1 network indicating target dates for intermediate milestones and final commissioning of equipment supplied. This network shall be supplemented by a detailed write-up on proposal procedure of project implementation, deployment schedule for Key personnel with their bio-data, schedule of construction machinery etc.	
8.1.7	List of suppliers for all bought out items.	

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NOTE:

- Quantity of prints may change during detailed engineering stage based on BHEL/ Customer requirement. However the same will be adhered by the bidder without any delivery/commercial implication to BHEL.
- All the drawing documents along with the O&M manual (of all the revisions) are necessarily to be submitted in soft copies in addition to hard copies.
- Bidder to submit soft copies of all the drawing and document along with quality plans for BHEL review and approval.
- The date of submission of drawing documents shall be considered as the date of submission of hard and soft copies whichever is later.
- All the drawings shall be prepared on computer auto cad and other documents (like datasheet etc.) on MS office software. Bidder not complying these requirements shall not be considered. For the execution of the contract regular meeting (generally once in 15 days or as per project requirement) is required.
- Bidder has to come for meeting with the concerned dealing persons as per BHEL or customer requirement in a short notice.
- Bidder to submit instrument schedule, cable schedule and valve schedule (as applicable) in MS-Excel format during detailed engineering.
- Bidder to also furnish the auto cad copy/ MS-word (as applicable) of the following documents after award of contract. However any other auto cad copy/ MS-Excel/ MS-word of any other document as per the insistence of BHEL/ customer will also be submitted by the bidder without any delivery/commercial implication to BHEL/ Customer.
 - P&IDs.
 - GA & Foundation Drawing.
 - Local Control Panel/ Junction Box Wiring Diagram.



TITLE :
1x660 MW BHUSAWAL TPS

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**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

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ANNEXURE-IV
PAINTING SPECIFICATION

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15.0 <u>PAINING</u> 15.1 <u>GENERAL</u> All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. Surfaces not easily accessible after shop assembly shall be treated before-hand and protected for life of the equipment. Surfaces to be finish painted after installation shall be shop painted with at least two (2) coats of primer. Steel surfaces, which are not to be painted, shall be coated with suitable rust preventive compound subject to the approval of the Owner. All paints shall be used in accordance with the manufacturer's instructions. No thinners or other substance shall be added to the coating material without the approval of the Engineer. The quality and vendor of the paints shall require approval of the Owner. All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects. All primers shall be well marked into the surface, particularly in areas where pitting is evident, and the first priming coat shall be applied as soon as possible after cleaning, within four hours maximum. The paint shall be applied by brush, roller or airless spray, according to the manufacturer's instructions. Spray painting shall be carried out by operators trained and thoroughly experienced in the use of the equipment. If the drying interval between successive coats, which should not exceed one week, has been so long as to endanger the adhesion of the following coat, the paint already applied shall be lightly rubbed down with fine abrasive paper before putting on the next coat. Paint spraying on large surfaces shall not normally be done indoors, except with the approval of the Engineer. Spray guns shall not be used outdoors in		

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windy weather or near unprotected surfaces of a contrasting colour and under no circumstances shall spray guns be used where spray may be carried into or onto exposed electrical equipment. Paint containers shall not be opened until required and the paint shall be mechanically mixed thoroughly before use, and agitated occasionally during use. Electrical equipment shall be shop finished with one or more coats of primer and two coats of high-grade oil resistant enamel. The interior of all panels' cabinets and enclosures shall be finished with gloss white enamel. The Contractor shall furnish sufficient touch-up paint for one complete finish coat on all exterior factory surfaces of each item of equipment. The touch-up paint shall be of the same type and colour as the factory applied paint and shall be carefully packed to avoid damage during shipment. Complete painting instructions shall be furnished. The Contractor shall select shop primer for steel and iron surfaces, which will have a continuous operating temperature below 35°C, in accordance to the relevant standard. Special high temperature primer shall be used on surface exposed to operating temperature above 35°C. The Owner/Engineer shall submit the colour scheme during execution of contract for approval.		
15.2	<u>PREPARATION</u> Oil and grease shall be removed from the surface by washing with a suitable detergent, rinsing with clean water, and drying. Surfaces to be shot blasted shall be cleaned to Swedish Standard SA 2.5 or equivalent, and all dust remaining after cleaning shall be removed. The priming coat shall be applied without delay.	
15.3	<u>DAMAGED PAINTWORK</u> Any damaged paintwork shall be made good as follows:	

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15.3.1	The damaged area, together with an area extending 25 mm around its boundary, shall be cleaned down to bare metal.	
15.3.2	A priming coat shall be immediately applied, followed by a full paint finish equal to that originally applied and extending 50 mm around the perimeter of the original damage.	
15.3.3	The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before and after priming	
15.4	<u>PAINTING SYSTEMS</u> The requirements for the Dry Film Thickness (DFT) of paint and the materials to be used shall be as stated below, unless otherwise specified elsewhere in this specification.	
15.4.1	Surfaces subject to Weathering All surfaces shall have a minimum of four coats of paint made up as follows: (a) Primer coat : 35 micron DFT (b) Tie coat : 35 micron DFT (c) Finishing coat (Two Nos.) : 35 micron DFT per coat (d) The total minimum DFT : 140 micron	
15.4.2	Surfaces Inside Buildings All surfaces shall have a minimum of three coats of paint made up as follows: (a) Primer coat : 35 micron DFT (b) Tie coat : 35 micron DFT (c) Finishing coat (Two Nos.) : 25 micron DFT per coat (d) The total minimum DFT : 120 micron	

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The Contractor shall select the type and colour of primer & finish coat after approval by the Owner. For detail painting on building & structural steel elements, please refer Volume VI / A & B of this specification. 16.0 <u>COLOUR CO-ORDINATION & FINISH</u> 16.1 Exterior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape. 16.2 Interior surfaces throughout the plant shall be finished in colours and textures which will blend harmoniously together and which will be conducive to; the comfort, well-being and high productivity of the operators. Operating plant and services provided shall be colour coded for ease of identification. 16.3 All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned. 16.4 Final colours and finishes shall be to the Approval of the Engineer.		



TITLE :
1x660 MW BHUSAWAL TPS

SPECIFICATION NO.: PE-TS-415-154-A101

**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

SUB-SECTION: IA

REV. NO. 00

DATE :01.06.2019

ANNEXURE-V
MANDATORY SPARES LIST


TITLE:

TECHNICAL SPECIFICATION FOR
OXYGEN DOSING SYSTEM
1X660 MW BHUSAWAL TPS U#6

BHEL DOCUMENTS NO.: PE-TS-415-154-12000-A001

VOLUME II-B

SECTION-C1

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ANNEXURE-V

LIST OF MANDATORY SPARES FOR OXYGEN DOSING SYSTEM			
SL. NO.	DESCRIPTION	QTY	UNIT OF MEASUREMENT
1	VOID		
2	LOW PRESSURE PIPING SYSTEM	1	
2.1	Valves	1	Lot (5% of the total population of each type, Size and class or minimum Two (2) of each type, size and class whichever is higher)
2.2	Valves including control valves	1	Lot (5% of the total population or minimum Two (2) of each type, material, size & Class, whichever is more)
	Note: Complete valve along with actuator and all other accessories which are the part of original supply shall be also be supplied		
3	415 V MOTORS	1	Lot consisting of following:
3.1	Terminal plates for motors upto 30kw for each rating	1	Lot (1 no. For each type & rating of Motor)
3.2	Terminal plates for motors above 30kw for each rating	1	Lot (1 no. For each type & rating of Motor)
3.3	Heaters	1	Lot (1 set For each type & rating of Motor)
3.4	Greasing arrangements	1	Lot (1 set For each type & rating of Motor)
3.5	Motor of each type and rating	1	Lot (10% of the installed quantity or minimum 1 number whichever is higher)
3.6	Bearings (DE and NDE)	1	Lot (1 set For each type & rating of Motor)
3.7	End shield cover driving and non-driving end	1	Lot (1 set For each type & rating of Motor)
3.8	Cooling fan	1	Lot (1 set For each type & rating of Motor)
3.9	Motor terminal block	1	Lot (1 set For each type & rating of Motor)
3.10	Complete set of coupling	1	Lot (1 set For each type & rating of Motor)
4	MEASURING INSTRUMENTS		
4.1	ELECTRONIC TRANSMITTERS	1	Lot consisting of following:
4.1.1	Transmitters of all types, ranges and model no. (for the measurement of Pressure, differential pressure flow, level etc.)	1	Lot (10% or 2 no. of each type and model, whichever is more)
4.1.2	Electronic cards / PCB's for each type and model and model of transmitters	1	Lot (10% or 5 nos. of each type, whichever is more)
4.2	TEMPERATURE ELEMENTS	1	Lot
4.3	INDICATORS/RECORDERS	1	Lot
4.3.1	Digital Indicators of each model, type & range (including relevant digital indicators of electrical system)	1	Lot (10 % or 2 nos. min. whichever is more)
4.3.2	Vertical Indicators of each type & model	1	Lot (5% or 1 no. of each model whichever is more)
4.4	Level transmitters (displacer type)		


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4.4.1	Electronic cards / PCB's of level transmitters	1	Lot (10% of total quantity used or 1 for each type/rating whichever is more)
4.4.2	Level transmitters	1	Lot (10% of total quantity used or 1 for each type/rating whichever is more)
4.5	SWITCHES		
4.5.1	Switches (Pressure, DP, Level, Flow, Temperature etc.)	1	Lot (10% of each type of total nos. used in the system or minimum 1 no. of each type, model & range whichever is more)
4.6	Rotameter	1	Lot (10% of each type of total nos. used in the system or minimum 2 no. of each type, model & range whichever is more)
4.7	SOLENOID VALVE		
4.7.1	Assembly (Solenoid Valve)	1	Lot (10% of total quantity used or minimum 2 no. of each type whichever is more)
4.7.2	Coil	1	Lot (10% of total quantity used or 5 no. whichever is more)
4.8	E/P Converter	1	Lot (10% of each type of total nos. used in the system or minimum 2 no. of each type, model & range whichever is more)
5	PROCESS CONNECTION PIPING (For impulse piping/tubing, sampling piping/tubing and air supply piping as applicable)	1	Lot consists of following
5.1	Valves of all types and models	1	Lot (10 % or 2 no. of each type, class, size and model whichever is more)
5.2	2 way, 3 way, 5 way valve manifolds	1	Lot (10 % or 2 no. of each type, class, size and model whichever is more)
5.3	Fittings	1	Lot (10 nos. of each type)
5.4	Purge meters	1	Lot (10% of each model or 2 Nos. whichever is more)
5.5	Filter regulators	1	Lot (10% of each model or 2 Nos. whichever is more)
5.6	Impulse pipe & tubing of all type	1	Lot (20 mtrs each type & size)
5.7	Impulse line root valve	1	Lot (10% of total quantity used or 4 no. whichever is more for each type and rating of each size)
5.8	SS tube	1	Lot (40 mtrs of each type/size)
5.9	Fitting for SS tube	1	Lot (40 nos. of each type/size)
6	INSTRUMENTATION CABLE, INTERNAL WIRING AND ELECTRICAL FIELD	1	Lot consists of following
6.1	Pre fabricated cable of each type	1	Lot (10% of installed quantity)
6.2	Pre fabricated cable connector	1	Lot (10% or 1 no. of each type and model, whichever is more)
6.3	Other cables		Lot (10% of each type, pair and size of actual installed quantity)
7.0	ELECTRICAL ACTUATORS	1	Lot consists of following
7.1	Actuators	1	Lot (10% or 1 no. of each type, model and rating, whichever is more.)
7.2	Power unit for modulating actuator	1	Lot (10% or 2 nos. of each type, whichever is more.)
7.3	DC-DC unit/power pack units	1	Lot (10% or 2 nos. of each type,


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			whichever is more.)
7.4	Electronic cards	1	Lot (10% or 2 nos. of each type, whichever is more.)
7.5	Brake assembly	1	Lot (10% or 2 nos. of each type, whichever is more.)
7.6	Brake calls	1	Lot (10% or 2 nos. of each type, whichever is more.)
7.7	Position feedback transmitters	1	Lot (10% or 2 nos. of each type, whichever is more.)
7.8	Contra! unit	1	Lot (10% or 2 nos. of each type, whichever is more.)
7.9	Torque and limit switch assembly of each unit	1	Lot (10% or 2 nos. of each type, whichever is more.)
7.10	O-ring	1	Lot (1 set of each size)
7.11	Motor	1	Lot (1 no. of each type & rating)
7.12	Auxiliary contact	1	Lot (10% of total quantity used or 2 nos. whichever is more for each type and rating of each size)
7.13	Seal kit	1	Lot (1 set of each type & size)
8	Pressure Gauge, Pressure Switch, Temperature Gauge, Temperature Switch, Isolating Valve, Solenoid Valve, Rota Meter etc.	1	Lot (10% of total quantity of each Item and type/rating used in the system or minimum 1 (one) no. whichever is higher.)
9	Annunciation System	1	
9.1	Each type of PCB	1	Lot (1 (one) No. each)
9.2	lamp Box with Facia & Lamps (LED type)	5	5 (five) Nos.
9.3	Hooter	1	1(one) No.
10	Auxiliary/Power Contact of, Push Button, Indicating Lamp, Fuse etc. for Chiller Unit	1	Lot (10% of total quantity of each type of items used in the system or minimum 2(two) nos. minimum 2(two) nos. whichever is more.)



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The vendor warrants:

1. That all spares supplied will be new and in accordance with the contract document and will be free from defects in design, material and workmanship and shall further guarantee as under:
2. In case of any failure in the original component/ equipment due to faulty designs, materials and workmanship, the corresponding spare parts if any, supplied will be replaced without any extra cost to the BHEL and customer unless a joint examination and analysis by BHEL and/ or customer of such spare parts prove that the defect found in the original part that failed can safely be assured not to be present in spare parts.
3. The long term availability of spares to the BHEL and the customer for the full life of the equipment covered under the contract and that before going out of production of spare parts of the equipment covered under the contract, vendor and his sub-vendors shall give the BHEL and the customer at least 24 (Twenty Four) months advance notice so that the latter may order his bulk requirements of spares, if he so desires. The same provision will also be applicable to the sub-vendors. Further, in case of discontinuance of manufacture of any spares by the vendors or his sub-vendors the vendors and his sub-vendors, will provide the BHEL and the customer, 2 (two) years in advance, with full manufacturing drawings, material specifications and technical information required by the BHEL and the customer for the purpose of manufacture of such items and also the right to manufacture such spares for their own requirements.
4. Further in case of discontinuance of supply of spares by the vendors or his sub-vendors, the vendor will provide the BHEL and the customer with full information for replacement of such spares with other equivalent makes, if so required by the BHEL and the customer.
5. Notwithstanding the above, the vendor shall be responsible for supply of spares for the lifetime of the package at reasonable prices. The prices of all future requirements of spares shall be derived from the corresponding ex-works price at which the orders for such spares have been placed by the BHEL and the customer as a part of the mandatory or long term or any other kind of spares. The base indices for calculating ex-works price shall be commissioning of last equipment under main contract.
 - i) In case of emergency requirements of spares, the vendor would make every effort to expedite the manufacture and delivery of such spares on the basis of mutually agreed time schedule.
 - ii) In case the vendor fails to supply the mandatory or long term or any other kind of spares on the terms stipulated above, the BHEL and the customer shall be entitled to purchase the same from the alternate sources at the risk and the cost of the vendor and recover from the vendor, the excess amount paid by the BHEL and the customer over the rates as per the contract. In the event of such risk purchase by the BHEL or the customer, the purchases will be as per the works and procurement policy of the BHEL and the customer prevalent at the time of such purchases and BHEL & the customer at his option may include a representative from the vendor in finalizing the purchases.
 - iii) It is expressly understood that the final settlement between the parties in terms of relevant clauses of the tender document shall not relieve the vendor of any of his obligations under the provision of long term availability of spares and such provisions shall continue to be enforced till the expiry of 30 (thirty) years period reckoned from the scheduled date of completion of trial operation of the last equipment unless otherwise discharged expressly in writing by the BHEL or the customer.



TITLE :
1x660 MW BHUSAWAL TPS

SPECIFICATION NO.: PE-TS-415-154-A101

**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

SUB-SECTION: IA

REV. NO. 00

DATE :01.06.2019

ANNEXURE VI

DRAWING/ DOCUMENTS SUBMISSION SCHEDULE



TITLE :
1x660 MW BHUSAWAL TPS

SPECIFICATION NO.: PE-TS-415-154-A101

**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

SUB-SECTION: IA

REV. NO. 00

DATE : 01.06.2019

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION

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

S. NO.	DOCUMENT NO.	DOCUMENT TITLE	No. of weeks from LOI dated for submission
1	PE-V0-435-154-A101	P&ID for Oxygen Dosing System	2
2	PE-V0-435-154-A102	GA drawing and foundation detail for Oxygen Dosing System	2
3	PE-V0-435-154-A103	Technical Data sheet for Oxygen Dosing System	4
4	PE-V0-435-154-A104	Junction Box Termination Dwgs. for Oxygen Dosing System	4
5	PE-V0-435-154-A109	QAP for Oxygen Dosing System	2
6	PE-V0-435-154-A106	O&M Manual for Oxygen Dosing System	16

For drawings/ documents submission procedure, please refer above details. Bidder has to submit the revised drawing/ document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments/ observations. Without compliance sheet the submission of the drawings/ documents will not be considered and the delay on this account will be solely on bidder's side only. The number of drawing/ documents to be submitted by the bidder shall be as per enclosed Annexure-III.

Bidder to note that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. Engineering meeting shall be held fort nightly, for which the bidder shall depute his concerned engineers along with project manager to PEM office or at customer office without fail.

Bidder to note that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account.

Drawing/document submission shall be done through web based Document Management System (DMS). Bidder would be provided access to the DMS for drawing/document approval. Detailed methodology would be finalized during detail engineering. Bidder to ensure following at their end:

- Internet explorer version – Minimum Internet Explorer 7
- Internet speed – 2 mbps (Minimum preferred)
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked
- Vendor's internal proxy setting should not block DMS application's link (<http://124.124.36.198/wrenchwebaccess/login.aspx>)



TITLE :
1x660 MW BHUSAWAL TPS

SPECIFICATION NO.: PE-TS-415-154-A101

**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

SUB-SECTION: IA

REV. NO. 00

DATE :01.06.2019

ANNEXURE –VII

FORMAT FOR OPERATION & MAINTENANCE MANUAL



TITLE :
1x660 MW BHUSAWAL TPS

SPECIFICATION NO.: PE-TS-415-154-A101

**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

SUB-SECTION: IA

REV. NO. 00

DATE : 01.06.2019

FORMAT FOR OPERATION AND MAINTENANCE MANUAL

Bidder to submit operation and Maintenance manual with minimum information as listed in below check list during contract stage.

CHECK LIST FOR OPERATION & MAINTENANCE MANUAL

Project name :
Project number :
Package Name :
PO reference :
Document number :
Revision number :

Sl.no. & Sections	Description	Tick (✓) if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	Cover page				
1.1	Project Name				
1.2	Customer/ consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address, Emergency Contact number				
1.5	Name and sign of prepared by, checked by & approved by				
1.6	Revision history with approval Details				
2.0	Index				
2.1	Showing the sections & related page nos. All the pages should be numbered section wise				
3.0	Description of Plant/ System				
3.1	Description/ write up of operating principle of system equipment/ associated sub-systems & accessories/controls system, operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/ for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface/ terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings, Actual photograph of items/ system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/ wiring diagrams				
3.8	Control philosophy/ control write-ups				



TITLE : 1x660 MW BHUSAWAL TPS	SPECIFICATION NO.: PE-TS-415-154-A101	
TECHNICAL SPECIFICATION FOR OXYGEN DOSING SYSTEM	SUB-SECTION: IA	
	REV. NO. 00	DATE : 01.06.2019

4.0	Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)				
4.1	Pre-Commissioning Checks				
4.2	Handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	Operation Guidelines for plant personal/ user/ operator				
5.1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5.2	Start up, normal operation and shut down procedure for equipment along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5.3	Do's & Don't of the equipment.				
5.4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5.5	Parameters to be monitored with normal values and limiting values				
5.6	Trouble shooting with causes and remedial measures				
5.7	Routine operational checks, recommended logs & records				
5.8	Changeover schedule if more than one auxiliary for the same purpose is given				
5.9	Painting requirement and schedule				
5.10	Inspection, repair, Testing and calibration procedures				
6.0	Maintenance guidelines for plant personal				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/ calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				



TITLE :
1x660 MW BHUSAWAL TPS

SPECIFICATION NO.: PE-TS-415-154-A101

**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

SUB-SECTION: IA

REV. NO. 00

DATE :01.06.2019

6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres, Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	Statutory and other specific requirements considerations.				
8.0	List of reference documents				
9.0	Binding as per requirement				



TITLE :
1x660 MW BHUSAWAL TPS

SPECIFICATION NO.: PE-TS-415-154-A101

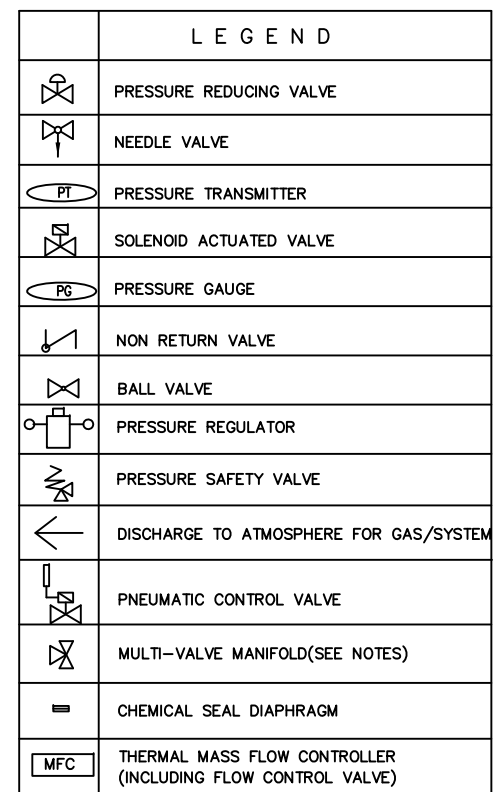
**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

SUB-SECTION: IA

REV. NO. 00

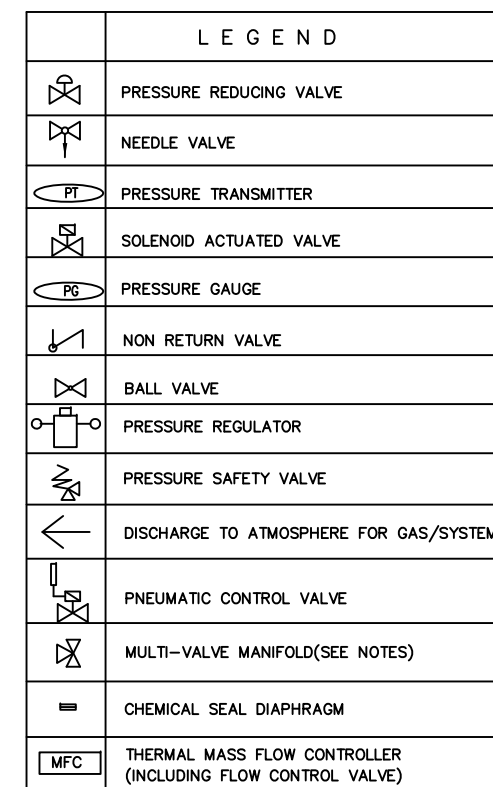
DATE :01.06.2019

P&IDs FOR OXYGEN DOSING SYSTEM



- NOTES: -
- 1 THE ENTIRE SYSTEM INCLUDING THE JUNCTION BOX SHALL BE SKID MOUNTED.
 - 2 ONE NUMBER SKID FOR UNIT SHALL BE PROVIDED FOR DOSING AT CEP DISCHARGE (TOTAL= 1 NOS).
 - 3 ONE NUMBER INJECTION ASSEMBLY FOR UNIT SHALL BE SUPPLIED LOOSE (TOTAL = 1 NOS).
 - 4 ALL THE VALVES SHALL BE OF SS 316.
 - 5 ALL TUBING SHALL BE OF SS 316, 15 NB AND 18 BWG.
 - 6 100 M OF TUBING PER UNIT (TOTAL 200 M) OF SAME SPECIFICATION SHALL BE LOOSE WITH THE SKID,
 - 7 ALL THE MULTI VALVE MANIFOLD SHALL BE 3-WAY VALVE MANIFOLDS (MOC: SS316).
 - 8 THE FOLLOWING SHALL BE THE TERMINAL POINT DETAILS:-,
- TP 1:- ALL FIELD INSTRUMENTS (PRESSURE AND FLOW TRANSMITTERS), AND SOLENOID VALVES (SV1 & 2 ONLY) SHALL BE TERMINATED AT THE JB BY OXYGEN DOSING VENDOR FOR FURTHER CONNECTION TO DDCMIS BY BHEL.
- TP 2:- ALL VENT CONNECTIONS SHALL BE TERMINATED AT ONE POINT BY OXYGEN DOSING VENDOR FOR FURTHER CONNECTION TO ATMOSPHERE, BY BHEL.
- TP 3:- DOSING TERMINAL POINT SHALL BE AFTER MCF AND TERMINATED BY THE OXYGEN DOSING SUPPLIER FOR FURTHER INTERCONNECTION TILL DOSING LOCATIONS BY BHEL.
- TP 4:- 24 V-DC CONNECTION TO SV-3 SHALL BE DIRECTLY CONNECTED BY BHEL.
- 9 THE SCHEME IS FOR ONE UNIT OF 660 MW.

										OWNER  MAHARASHTRA STATE POWER GENERATION CO. LTD.									
										CONSULTANT  DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS VASHI, NAVI MUMBAI									
JOB No. 415										PROJECT 1x660 MW BHUSAWAL TPS UNIT-6									
STATUS CONTRACT										DISTRIBUTION TO									
No. OFF										CONTRACTOR  BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA									
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										TITLE P&ID FOR OXYGEN DOSING SKID AT CPU OUTLET									
CUSTOMER PACKAGE CODE -										SCALE									
DISCIPLINE M C E I L										DRAWING No. PE-DG-415-154-A101									
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TITLE P&ID FOR OXYGEN DOSING AT DEAERATOR OUTLET	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">DEPT CODE</td> <td style="width: 10%;">DIN</td> <td style="width: 10%;">AR</td> <td style="width: 10%;">NAME</td> <td style="width: 10%;">SIGN</td> <td style="width: 10%;">DATE</td> </tr> <tr> <td>-</td> <td>001</td> <td>AR</td> <td>ANAR/BN</td> <td></td> <td></td> </tr> <tr> <td></td> <td>002</td> <td>CHD</td> <td>ANAR/BN</td> <td></td> <td></td> </tr> <tr> <td></td> <td>003</td> <td>APPD</td> <td>ANAR/BN</td> <td></td> <td></td> </tr> </table>	DEPT CODE	DIN	AR	NAME	SIGN	DATE	-	001	AR	ANAR/BN				002	CHD	ANAR/BN				003	APPD	ANAR/BN																		
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TITLE :
1x660 MW BHUSAWAL TPS

SPECIFICATION NO.: PE-TS-415-154-A101

**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

SUB-SECTION: IB

REV. NO. 00

DATE :05.06.2019

SECTION – IB
SPECIFIC TECHNICAL REQUIREMENTS (C&I)

	1X660 MW Bhusawal STPP	SECTION: SUB SECTION :

**CONTROL AND INSTRUMENTATION
SPECIFICATION
FOR
OXYGEN DOSING SYSTEM**

	1X660 MW Bhusawal STPP	SECTION: SUB SECTION :

SPECIFIC TECHNICAL REQUIREMENTS (C&I)

1. Oxygen Dosing System shall be controlled from DCS. The operation and control philosophy of Oxygen Dosing system has been elaborated in separate section in the specification. A local panel comprising of 'OPEN' push button, 'CLOSE' push button along with 'OPEN/CLOSE' indication for solenoid valves, local/ remote indication, MFC position indicator, raise/ lower push button for MFC operation and local annunciation shall be provided for local operation. The 'OPEN /CLOSE' push button shall be wired directly to DCS.
2. Bidder to supply the field instrumentation as required / shown in the P&ID.
3. The detailed specification of instruments, JB etc. are given in detail as below.
4. 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 shall prevail.
5. 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.
6. Two nos feeders of 415 V AC shall be provided for LCP of oxygen dosing system .Necessary power supply for panel, instruments, Mass Flow Controller etc and any other supply like 24 V DC, 110 V AC etc. shall be derived from these two feeders by the bidder. The necessary hardware for the same shall be in Bidder's scope. Suitable Automatic changeover arrangement of the input feeders shall also be provided by the bidder in the LCP.
7. Drawings/Documents and data to be furnished after award of the contract:
 - Field instruments data sheet.
 - JB grouping document.
 - Cable schedule and cable interconnection drawing.
 - Instrument schedule/hook-up.

	1X660 MW Bhusawal STPP	SECTION: SUB SECTION :
• Drive List and Analog / Binary Input / output List • Recommended Control write-up • Control panel wiring diagram • Any other document decided during detailed engineering.		

	1X660 MW Bhusawal STPP	SECTION: SUB SECTION :

SPECIFICATION FOR FIELD INSTRUMENTS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 221 of 718
SR. NO.	ITEM	DESCRIPTION	
1.0	<u>FIELD INSTRUMENTS</u>		
	This section provides general hardware guidelines for field instruments and equipment to be supplied under this specification.		
1.1	<u>PRESSURE TRANSMITTER</u>		
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	

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 222 of 718
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/cm ² b) +/- 0.25% of calibrated span for 5 years for ranges more than 70 kg/cm ² (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.	

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 223 of 718
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	<u>DIFFERENTIAL PRESSURE TRANSMITTER/FLOW TRANSMITTER</u>		
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.	

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 224 of 718
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/cm ² b) +/- 0.25% of calibrated span for 5 years for ranges more than 70 kg/cm ² (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.	

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 225 of 718
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	<u>DISPLACER TYPE LEVEL TRANSMITTERS</u>		
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.	

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1.6	<u>MASS FLOW METER</u>		
1.6.1	Sensor	Thermal dispersion	
1.6.2	Measuring Principle	The typical thermal mass sensing element contains two thermowell-protected Resistance Temperature Detectors (platinum RTDs). When placed in the process, one RTD is heated and the other RTD senses the process temperature. The temperature difference between the two RTDs is related to the process flow rate as well as the properties of the process medium.	
1.6.3	Primary Element	316 stainless steel body with Hastelloy C thermowell sensors, 316 stainless steel compression fitting with teflon or stainless steel ferrule	
1.6.4	Pressure (Maximum Operating with Damage)		
1.6.4.1	Stainless Steel Ferrule	-18°C to 121°C	
1.6.4.2	Teflon Ferrule	-18°C to 93°C	
1.6.5	Process Connection	1/2" MNPT or 3/4" MNPT with stainless steel or Teflon ferrule	
1.6.6	Transmitter		
1.6.7	Measured quantities	Mass Flow rate, Total Mass Flow	
1.6.8	Input Signal Processing	Digital Processing.	
1.6.9	Display	LCD, ±9999 counts, user scalable to flow rate	

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		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	<u>PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE</u>		
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 ° arc.	

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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 °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.	

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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 ° 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.	

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SR. NO.	ITEM	DESCRIPTION	
1.37	<u>SOLENOID VALVE</u>		
1.37.1	Operating Principle	Electromagnetic. (noiseless)	
1.37.2	Coil voltage rating	240 V AC/220 V DC(as required. Any other voltage, if necessary, to be arranged by Bidder)	
1.37.3	Ways	Generally 3-ways other depending on requirement	
1.37.4	Port size	1/4" NPT all ports.	
1.37.5	Body	SS bar stock.	
1.37.6	Trim	SS-316.	
1.37.7	Duty	Suitable for continuous energization.	
1.37.8	Sealing	Airtight and leak proof.	
1.37.9	Ambient Temperature	0 - 50 °C.	
1.37.10	Fluid Temperature	0-150 °C (approx.)	
1.37.11	Coil Enclosure	Stainless Steel.	
1.37.12	Insulation	Class-H.	
1.37.13	Coil Casing	IP-65 (Explosion proof for NEC Class-1, Division-1 area)	
1.37.14	Mounting	On pipe or on panel.	
1.37.15	Cable Connection	3/4" ET.	
1.37.16	Accessories	Mounting brackets, nuts and bolts.	
1.37.17	Preferred feature	(a) Solenoid valve directly integral to actuator body shall have NAMOOR interface for uniformity.	

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SR. NO.	ITEM	DESCRIPTION	
		(b) Local indication for power.	
1.38	<u>SIGHT GLASS</u>		
1.38.1	Type	Flap-type.	
1.38.2	End connection	Screwed / Flanged.	
1.38.3	Material		
(a)	Body	CS/SS as per process medium.	
(b)	Indicator	Stainless steel.	
1.38.4	Sight Glass	Toughened Borosilicate.	
1.38.5	Gasket	Neoprene.	
1.38.6	Bolts & Nuts	High tensile steel.	
1.38.7	Hydraulic Test Pressure	1.5 times maximum working pressure.	
1.38.8	Accessories	As required.	
1.39	<u>LEVEL GAUGE (FLOAT & TAPE)</u>		
1.39.1	Type	Float and Tape	
1.39.2	Float & Tape MOC	AISI 316	
1.39.3	Pulley material	Aluminium	
1.39.4	Guide wire	SS 316 Stainless steel	
1.39.5	Accuracy	± 2 mm	
1.39.6	Indication	On circular or vertical dial	
1.39.7	Rating	Twice the design pressure	

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	(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 °C	
	(u) Accuracy	± 0.5% FS range	
2.0	<u>CONTROL PANELS/DESK MOUNTED INSTRUMENTS AND ELECTRICAL SYSTEM ACCESSORIES</u>		
2.1	<u>COUPLING RELAY</u>		
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.	

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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	<u>DISTRIBUTION BOARDS</u>		
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	<u>RECEIVER RECORDER</u>		
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.	

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2.3.8	Colour of trends	Selectable.	
2.3.9	Performance		
(a)	Accuracy	$\pm 0.1\%$ 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 °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.	

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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	<u>MULTIPOINT RECORDER</u>		
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.	

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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 °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 °C.	
(b)	Relative Humidity	25%-90%.	

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(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	<u>BAR GRAPH INDICATOR</u>		
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.	

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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 °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	

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		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	<u>VALVE POSITION INDICATOR</u>		
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	<u>DIGITAL INDICATOR</u>		
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)	

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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 $\pm 10\%$, 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	<u>TOTALIZER / COUNTER</u>	
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	$\pm 0.5\%$ of span.
2.8.8	Operating ambient temp.	0 - 50 $^{\circ}\text{C}$.
2.8.9	Accessories	Engraved phenolic nameplate affixed to front flange to identify tag number and measured variable.

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2.8.10	Preferred Features	Power supply on/failure LED visible from front.	
2.9	<u>PUSH BUTTON</u>		
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	<u>ILLUMINATED PUSH BUTTON</u>		
2.10.1	Type	Square format.	
2.10.2	Face Dimension	32 x 32 mm. (maximum)	

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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	<u>SELECTOR SWITCH</u>		
2.11.1	Type	2/3/4 position stay put type with rotary lever actuator.	

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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	<u>INDICATING LAMP</u>		
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.	

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SR. NO.	ITEM	DESCRIPTION	
2.12.9	Legend	Engraving.	
2.13	<u>INDICATING METERS (A.C)</u>		
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	<u>INDICATING METERS (D.C)</u>		
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.	

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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	<u>AUXILIARY RELAY</u>		
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.	

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2.16	<u>ELECTRICAL TRANSDUCER</u>	
	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	<u>SYNCHROSCOPE</u>	
	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	<u>ANNUNCIATION</u>	
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	

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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	<u>OTHER TECHNICAL PARTICULARS</u>	
	(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.)

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	(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.		

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4.0	<u>CONTROL DESK / PANELS / RACKS</u> (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.
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4.1 <u>CONTROL DESK</u> 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 <u>BACK UP PANEL</u> 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.		

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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.

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<table border="0"> <tr> <td data-bbox="199 376 231 409">(i)</td> <td data-bbox="352 376 469 409">Painting</td> <td data-bbox="788 376 1278 409">: Epoxy powder coated or better.</td> </tr> <tr> <td data-bbox="199 443 231 477">(j)</td> <td data-bbox="352 443 528 477">Gland plates</td> <td data-bbox="788 443 1299 477">: Removable 3 mm thick. (bottom)</td> </tr> <tr> <td data-bbox="199 510 231 544">(k)</td> <td data-bbox="352 510 512 544">Cable entry</td> <td data-bbox="788 510 948 544">: Bottom.</td> </tr> <tr> <td data-bbox="199 577 231 611">(l)</td> <td data-bbox="352 577 496 611">Hardware</td> <td data-bbox="788 577 1422 1395"> : (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. </td> </tr> <tr> <td data-bbox="199 1440 247 1473">(m)</td> <td data-bbox="352 1440 639 1473">Enclosure Protection</td> <td data-bbox="788 1440 1417 1507">: As per environment condition of the area of installation. Refer section-1 of this vol.</td> </tr> </table>			(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.
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(m)	Enclosure Protection	: As per environment condition of the area of installation. Refer section-1 of this vol.															
4.3	<u>LOCAL INSTRUMENT RACKS & ENCLOSURE</u>																
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.																

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(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.		

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(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.		

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(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		

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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. 5.0 <u>DISTRIBUTED CONTROL SYSTEM (DCS)</u> 5.1 <u>SYSTEM FUNCTIONAL DESCRIPTION</u> 5.1.1 Integrated functionally & geographically distributed and hierarchically structured real time control (both binary and modulating), Data acquisition, Man machine interface, Historization units and Management Information System (MIS) system synthesized from one general family of identical interchangeable multifunction hardware has been envisaged. 5.1.2 System shall be highly reliable with the availability of not less than 99.7% with adequate redundancy and fault tolerant configuration. 5.1.3 The system shall be unitized and connectivity with other plant control system & Plant wide network has been envisaged. 5.1.4 Remote input output stations as a data concentrator for acquisition and monitoring of non critical parameters like Boiler metal temperature and Generator winding temperature etc, are foreseen. RIO shall be industrially ruggedized and shall be provided with integral air conditioner considering the harsh environment. 5.1.5 For Power supply to DCS system refer Volume V , Section-10.		

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10.0	<u>CONTROL & INSTRUMENTATION CABLE</u>	
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 $\pm$ 5% length. Drum shall be anti rodent, anti termite and smooth finish. Both end of cable shall be capped by means of non hygroscopic sealing material.	
10.4	<u>THERMOCOUPLE EXTENSION & COMPENSATING CABLE</u>	
	(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.

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(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 $^{\circ}\text{C}$. (p) Insulation at 20$^{\circ}\text{C}$: 100 MOhms/Km [Min]. (q) Capacitance at 800 Hz : 120 nf/km.			

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- (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.

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(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).			

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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 : 100 MOhms/Km [Min] Deg.C (q) Capacitance at 800 : 120 nf/km Hz (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).		

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(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) <table border="1"> <thead> <tr> <th>PAIR</th><th>CORE</th><th>COLOR</th></tr> </thead> <tbody> <tr> <td>1st</td><td>1st</td><td>Blue</td></tr> <tr> <td>1st</td><td>2nd</td><td>Red</td></tr> <tr> <td>2nd</td><td>1st</td><td>Gray</td></tr> <tr> <td>2nd</td><td>2nd</td><td>Yellow</td></tr> <tr> <td>3rd</td><td>1st</td><td>Green</td></tr> <tr> <td>3rd</td><td>2nd</td><td>Brown</td></tr> <tr> <td>4th</td><td>1st</td><td>White</td></tr> <tr> <td>4th</td><td>2nd</td><td>Black</td></tr> </tbody> </table>			PAIR	CORE	COLOR	1 st	1 st	Blue	1 st	2 nd	Red	2 nd	1 st	Gray	2 nd	2 nd	Yellow	3 rd	1 st	Green	3 rd	2 nd	Brown	4 th	1 st	White	4 th	2 nd	Black
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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 ASTM D 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.

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(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.		

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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		

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(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 <u>PROCESS HOOK UP ACCESSORIES & SPECIFICATION</u> 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		

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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		

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± 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		

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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		

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(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		

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<table border="0"> <tr> <td></td><td></td><td>Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited</td></tr> <tr> <td>(g)</td><td>Packing</td><td>: Teflon as required</td></tr> <tr> <td>(h)</td><td>Yoke</td><td>: ASTM A182 F316</td></tr> <tr> <td>(i)</td><td>Handwheel</td><td>: Carbon steel</td></tr> <tr> <td>(j)</td><td>Design standard</td><td>: As per ANSI B 16.34</td></tr> <tr> <td>11.2.11</td><td>Alloy Steel Globe Valve</td><td></td></tr> <tr> <td>(a)</td><td>Reference</td><td>: ASTM A-182 F22</td></tr> <tr> <td>(b)</td><td>Type</td><td>: Globe</td></tr> <tr> <td>(c)</td><td>Construction</td><td>: Forged Body</td></tr> <tr> <td>(d)</td><td>End Connection</td><td>: ½" Socket Weld</td></tr> <tr> <td>(e)</td><td>Rating</td><td>: CL. 2500</td></tr> <tr> <td>(f)</td><td>Material</td><td>: Body - Alloy steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited</td></tr> <tr> <td>(g)</td><td>Packing</td><td>: Grafoil as required</td></tr> <tr> <td>(h)</td><td>Yoke</td><td>: ASTM A182 F22</td></tr> <tr> <td>(i)</td><td>Handwheel</td><td>: Carbon steel</td></tr> <tr> <td>(j)</td><td>Design standard</td><td>: As per ANSI B 16.34</td></tr> <tr> <td>11.2.12</td><td>Condensate Pot</td><td></td></tr> <tr> <td>(a)</td><td>Reference</td><td>: ASTM A182 F22 /ASTM A105</td></tr> <tr> <td>(b)</td><td>Material</td><td>: Alloy steel/carbon steel as per applicatio</td></tr> </table>					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
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(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.		

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11.3	<u>PNEUMATIC HOOK UP ACCESSORIES</u>		
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	

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(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	<u>SPECIAL TOOLS & TACKLE AND TEST EQUIPMENT FOR DCS/PLC AND OTHER SYSTEMS</u>	
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.	

	1X660 MW Bhusawal STPP	SECTION: SUB SECTION :
CONTROL PANELS SPECIFICATION		

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7.9.1 Elevated Temperature Test (a) During the first 48 hours the ambient temperature shall be maintained at 50^o 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 <u>PANELS, CUBICLES AND ENCLOSURES</u> 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.		

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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.		

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(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.		

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(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 gasketed cable gland plates and cable glands. Split type grommets shall be used for prefab cables. (n) Wire shall be multistranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-1981. (o) Wire sizes used for internal wiring shall not be lower than the followings: (i) Control wiring : 1.5 Sq.mm (switches, pushbuttons etc.) (ii) Power supply/receptacle : 2.5 sq. mm or higher as /illumination wiring per load/ (iii) 4-20mA DC current : 0.5 Sq. mm and low voltage signal upto 24V DC		

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(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.		

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(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 Environmental Protections (a) Panels, cabinets, desks, distribution boxes, junction boxes, terminal boxes and all other field mounted equipment / enclosures shall suit the environmental condition of the area and shall not be inferior than the requirement indicated in the following table: <table border="1" data-bbox="434 797 1410 1619"> <thead> <tr> <th>SR. NO.</th><th>LOCATION</th><th>ENCLOSURE TYPE</th></tr> </thead> <tbody> <tr> <td>(i)</td><td>Indoor type non- ventilated enclosure in non-hazardous area</td><td>IP-54.</td></tr> <tr> <td>(ii)</td><td>Indoor type ventilated enclosure in non-hazardous area</td><td>IP -42.</td></tr> <tr> <td>(iii)</td><td>Enclosure in Air conditioned area</td><td>IP-22 with suitable canopy at top to prevent ingress of dripping water.</td></tr> <tr> <td>(iv)</td><td>Outdoor type in non-hazardous areas</td><td>IP-55.</td></tr> <tr> <td>(v)</td><td>Outdoor in hazardous areas</td><td>As per requirements of the NEC Code for the location.</td></tr> </tbody> </table> 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.			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.
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.																		

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(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:		

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(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.		

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(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 ₂ O column/Kg/cm ² .
(c)	Draught	:	mm of H ₂ O 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.



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1.0 SCOPE

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

2.0 CODES AND STANDARDS

2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.

2.2 As a minimum requirement, the following standards shall be complied with:

- a) IS-6005 : 1998 : Code of practice for phosphating of iron and steel.
- b) IS-5 : 2007 : Colors for ready mixed paints and enamels.
- c) IS-1248:2003 : Direct Acting Indicating Analog Elec Measuring Instruments.
- d) IS/IEC 60947:Part 1:2004 : Low Voltage switchgear & control gear: Part-I (General Rules)
- e) IS-8828:1996 : Circuit breaker for household and similar installations.
- f) IS-13947 (Part-I):1993 : Low Voltage switchgear & control gear : Part-I (General Rules)
- g) ISA-18.1:1979 : Annunciator Sequences and Specification
- h) NFPA-496:2003 : Purged & Pressurised Enclosure for Electrical Equipment in Hazardous Locations.

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

3.1.1 The local panels shall house the secondary instruments, annunciation system, Single loop controller, Control switches / push buttons, indicating lamps/LED cluster, relays, timers and other devices required for operation and monitoring of the equipment locally.

3.1.2 The panels shall be of free standing type either welded construction on angle iron (minimum section of 50 x 50 x 4 mm) structure or folded construction by sheet metal formation depending upon the equipments to be mounted on it. The panels shall be robustly built and stiffeners as necessary shall be provided.

3.1.3 The panel shall be suitably reinforced to ensure adequate support for all instruments mounted thereon. All welds on exposed panel surfaces shall be ground smooth.

3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel

Frame thickness: Not less than 3.0mm

Enclosure thickness: Not less than 3.0 mm for load bearing sections (Mounted with instruments)
2.0 mm for doors and Not less than 2.0 mm for others

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.



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



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

3.1.18 Vendor shall furnish electric load and heat load list (in case panel is to be placed in ac environment) of each panel.

3.2 Hazardous Area Panel Requirement

3.2.1 The Local Panel located in hazardous area shall be pressurized as per NFPA-496 requirements to render it non-hazardous. Alarms shall be provided for local and remote annunciation when pressurisation falls below 2.5 mm of water column. Protection shall be of type Z of NFPA-496. It shall not be possible to switch ON the power of purged section unless it is purged as per the recommendation of NFPA-496. Vendor must provide a protective device on the panel to protect the panel from over pressurisation.

3.2.2 Vendor shall supply pressurisation kit consisting of valves, restriction orifices, dual filter regulation, pressure gauges, pressure switches, rotameter etc. Pressurisation kit shall be surface mounting on a metal board and located outside the local panel. Pressurisation kit shall further consist of solenoid valve flow switch, timer blow off safety device etc., so as to make purging fully automatic. However final start shall be manual. Panel protection against over pressure to be provided as per NFPA-496.

3.2.3 Pressurised local control panel pressurization kit assembly design shall provide minimum leakage flow through the Local Control Panel. Panel venting shall be as per NFPA-496.

3.2.4 All components in the local panel like indicating instruments, push buttons switches, lamps etc., which are required to be energized without panel pressurization or before completion of purge cycle shall be explosion proof as per NEMA-7 & suitable for area classification.

3.2.5 All push buttons etc. requiring frequent operation during machine running shall have good positive sealing. Weatherproof housing or cover to be provided wherever necessary. Vendor shall provide pressurisation bypass switch outside explosion proof enclosure of pressurized panel with lamp indication. This shall be used only during maintenance. All hinges, screws, other non-painted metallic parts shall be of stainless steel material.

3.2.6 Provision to switch off manually all types of power shall be provided in the panel. In addition, it shall also be possible to switch off power circuits / components which are powered from motor control centre or control room manually in case of pressurization failure. All such cables from MCC and main control room shall be terminated in explosion proof boxes (NEMA-7).

3.3 Control & Monitoring devices

3.3.1 Instruments like Indicators, recorders, single loop controllers etc. as applicable and specified elsewhere for the plant / equipment shall be supplied and mounted on the panel.

3.3.2 Alarm Annunciator System

It shall be solid state discrete facia type having a sequence of ISA-S18.1A or as specified, opaque facia windows of 70 mm x 50 mm size, having two (2) lamps per window, and hooter of 10W, and provision for repeat group alarm at remote. The annunciator shall be provided with ten (10) percent spare windows or minimum two (2) windows along with electronics.

3.3.3 Relays

The relays shall be electromagnetic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable. There shall be ten (10) percent spare contacts.

3.3.4 Timers

The timers shall be electronic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However, minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable.



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3.3.5 Control / Selector Switches

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

3.3.6 Push Buttons / Indicating Lights

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

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

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

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

3.3.7 Ammeters

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

3.3.8 Miniature Circuit Breaker (MCB)

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

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

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

4.0 TESTING AND INSPECTION

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

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



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

4.3.1 Routine Tests

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

4.3.2 Type Tests

1. Enclosure Class Test

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

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

5.2. Mandatory Spares

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

5.3. Recommended Spares

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

6.0 DRAWINGS AND DOCUMENTS

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

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

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

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

7.0 MARKING AND PACKING

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



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

8.0 APPLICABLE DATA SHEET FORMS

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

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



STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: **PE-QP-999-145-I056**

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

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

^s P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL
2 - Vendor
3 - Sub-vendor



PEM :: C&I

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: **PE-QP-999-145-I056**

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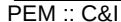
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
		3. Conductor a) Resistance b) Size c) Sheet colour	MA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

LEGEND: * CR - Critical characteristics
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1 - BHEL
2 - Vendor
3 - Sub-vendor



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IIB

D

01

DATE: 22-02-2008

3

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

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STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

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

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 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056				
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
12.	FINAL Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

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बी एच ई एल BHEL PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056					
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks	
									P	W	V		
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.	
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1		
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1		
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1		
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1		

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

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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

	DATA SHEET FOR LOCAL PANELS			SPECIFICATION NO.: PES-145-054A	
				VOLUME	
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TAG No. Qty.....			Data Sheet No.: PES-145A-DS1-0		
Data Sheet A & B					
DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)				DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
* TO BE CO-ORDINATED WITH PEM ELECTRICAL					
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL NAME: SIGNATURE: DATE:	

	1X660 MW Bhusawal STPP	SECTION: SUB SECTION :
APPLICABLE CODES AND STANDARDS		

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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 <u>PROVEN PRODUCT</u> 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 <u>CODES AND STANDARDS</u> 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.		

CONSULTANT : PROCON ENGINEERS

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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).		

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(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.		

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(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.		

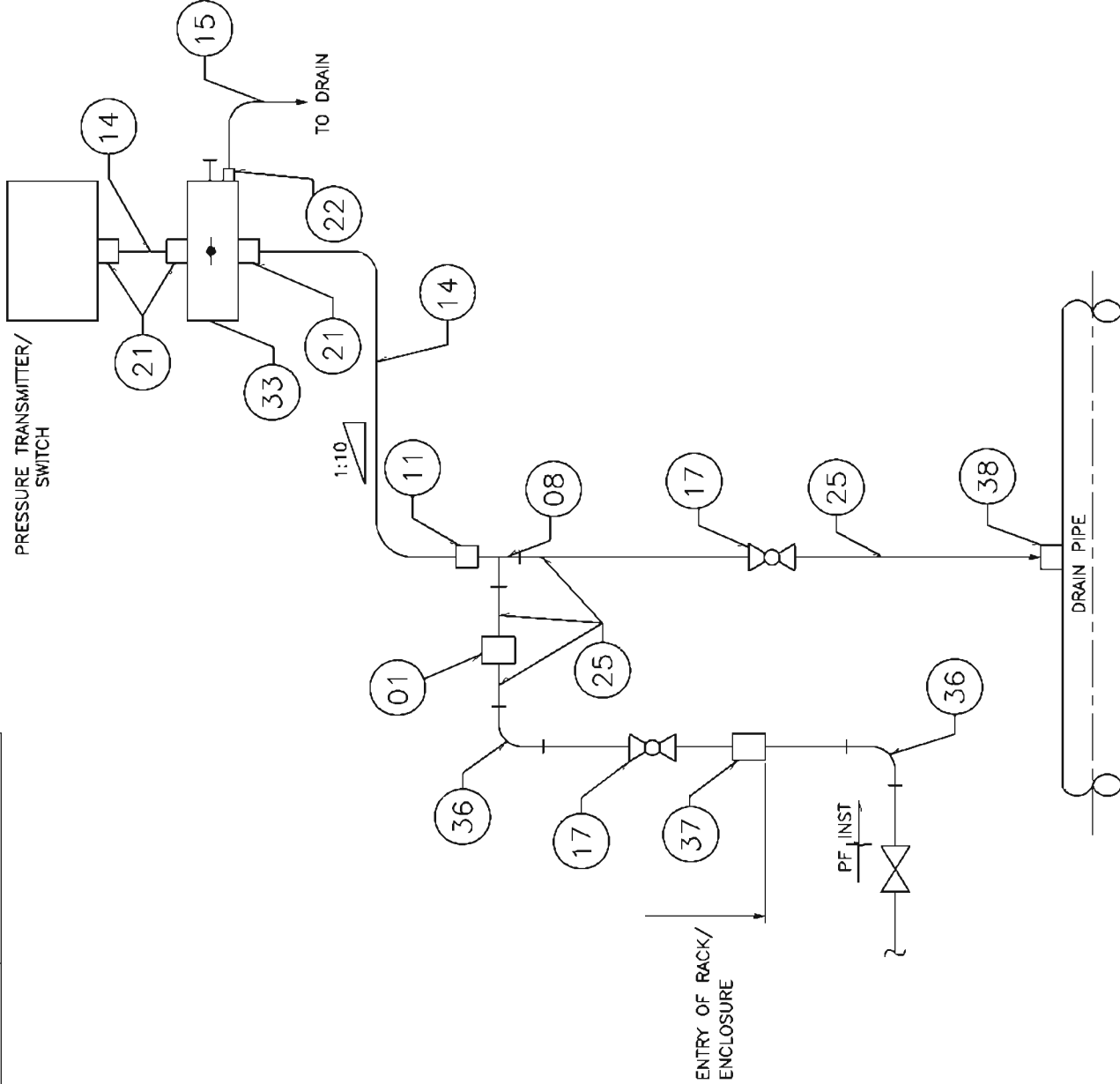
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(b) Relays and relay systems associated with electrical power apparatus IEEE Standard - 3.13. (c) Surge withstand capability tests - ANSI C 70.90 A/1971, IEC-255.4. (d) Recommended practice for sizing large lead storage batteries for generating stations 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.		

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(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		

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	(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	<u>DESIGN CRITERIA</u> This section lays down the general design criteria to be adapted in designing the instrumentation and control system of the plant.	
7.1	<u>GENERAL REQUIREMENTS</u>	
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.	

	1X660 MW Bhusawal STPP	SECTION: SUB SECTION :
DRAWINGS		

PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED ABOVE SOURCE POINT



SERVICE : CONDENSER PRESSURE, INSTRUMENT AIR ETC.

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 3000 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

FOR BID PURPOSE ONLY

DO NOT SCALE	PROCON ENGINEERS (DIVISION OF INMOTO CONSULTING ENGINEERS PVT.LTD.)
SCALE	DATE (DD MM YY)
APPROVED	DATE (DD MM YY)
CHK. P.N.Z.	DATE (DD MM YY)
CHK. D.J.P.	DATE (DD MM YY)
PE-189-IN-SK-8003	3 of 30

MAHARASHTRA STATE POWER GENERATION CO.LTD.	BRUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT
TYPICAL INSTRUMENT INSTALLATION DIAGRAM	

FOR RO ISSUE ONLY	CLEAR	DATE
DEPT	SIGNATURE	DATE
CHEM		
CIVIL		
ELEC		
MECH		

BY	CHEM	CIVIL	ELEC	MECH

REVISIONS	DATE	APPD



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 6000 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

FOR BID PURPOSE ONLY

DO NOT SCALE

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

[illegible]

G.A. DRAWING – TRANSMITTER RACK

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

G.A. DRAWING-TRANSMITTER RACK

SCALE ~

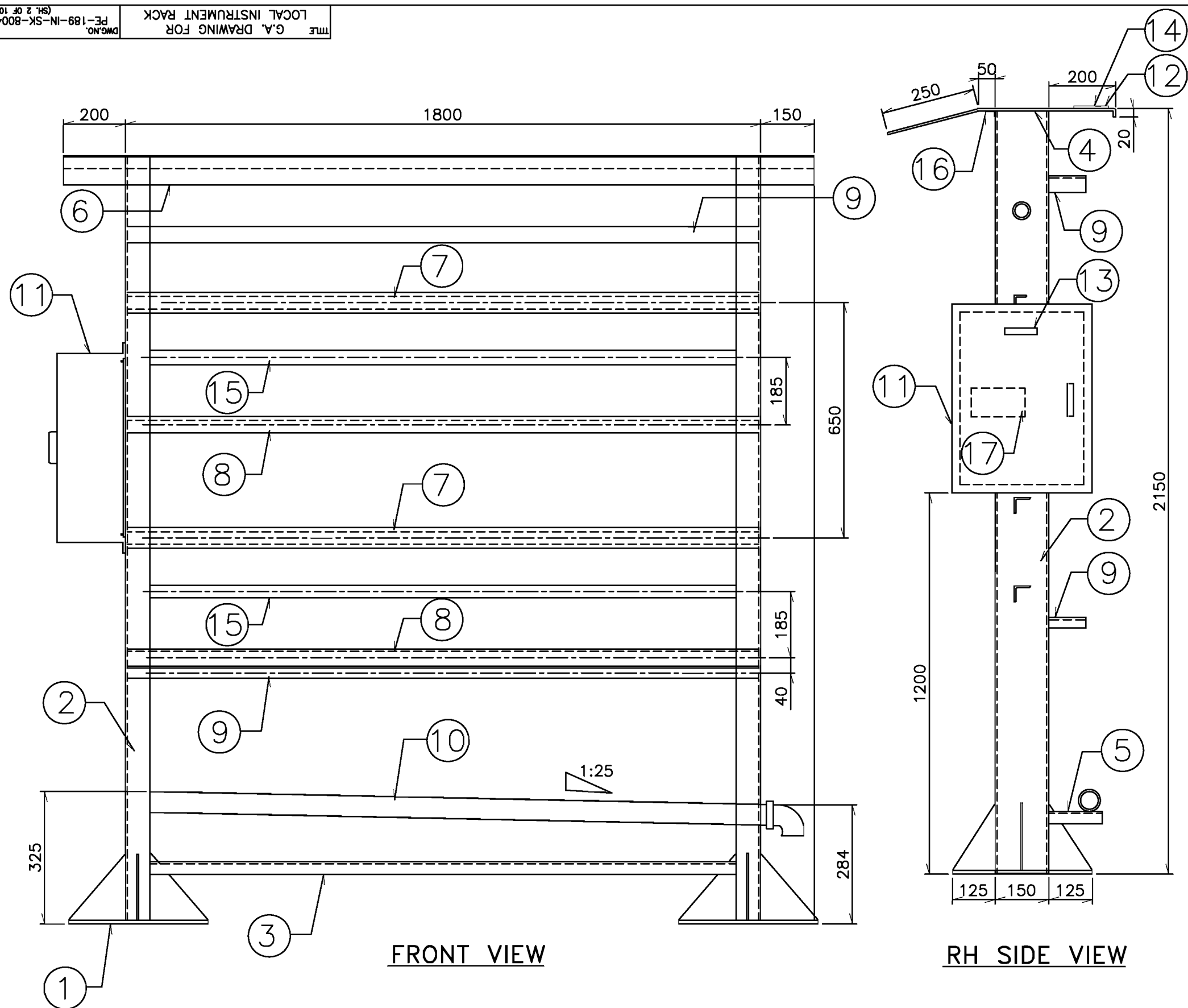
APPROVED

DIV INST.

DR P.N.Z.

CH D.J.P.

DWG.NO.PE-189-IN-SK-8004 (SH. 1 of 10) PO



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

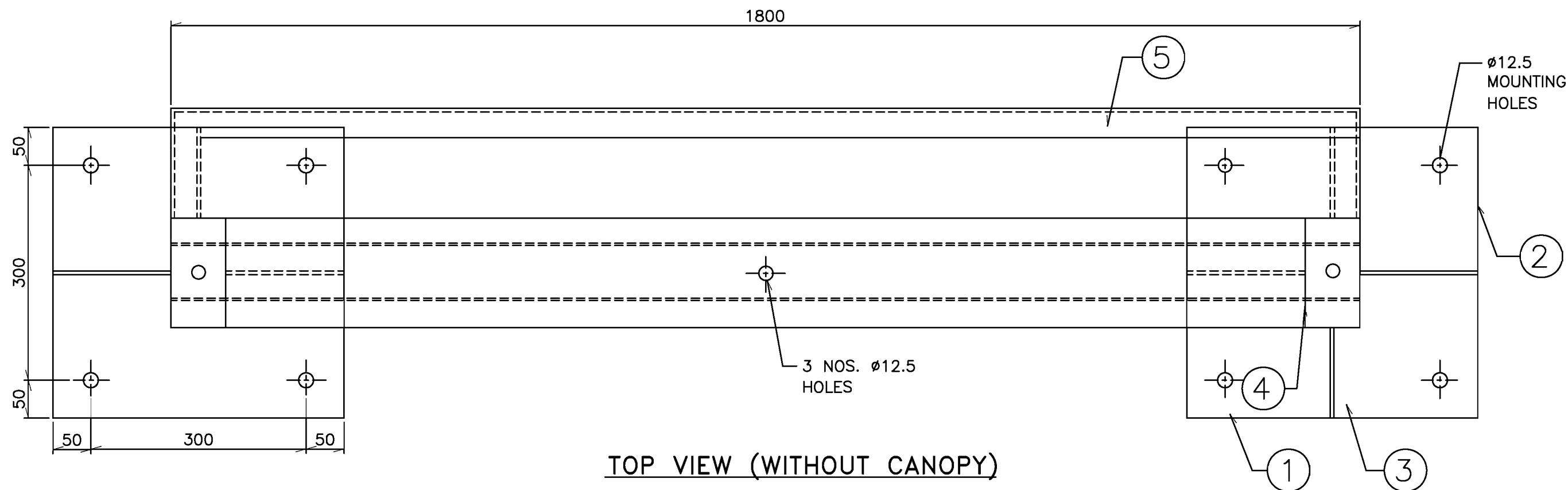
ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			1" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK. CONSTRUCTION / FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY. INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION / FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR 'HOLD' IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION / FABRICATION WORK RELATED TO 'HOLD'. DRAWINGS SIGNED BY PROCON ENGINEERS' AUTHORIZED REPRESENTATIVE ONLY ARE CONSIDERED VALID DRAWINGS.
			CHEM	CIVIL	ELEC	I&C	MECH			DEPT	SIGNATURE	DATE	



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)	
DR. P.N.Z.		23-08-2011	
CH. D.J.P.	DWG.NO.	PE-189-IN-SK-8004(SH. 2 OF 10)	
		PO	



TOP VIEW (WITHOUT CANOPY)

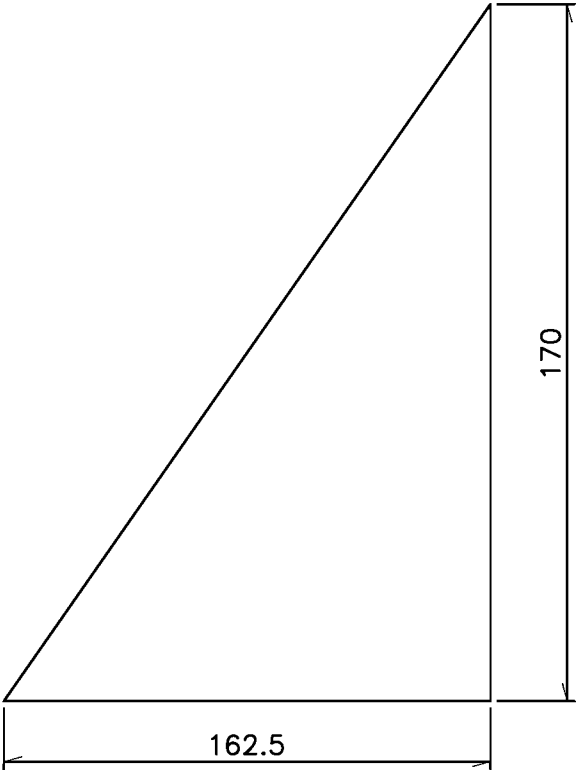
NOTES:

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.

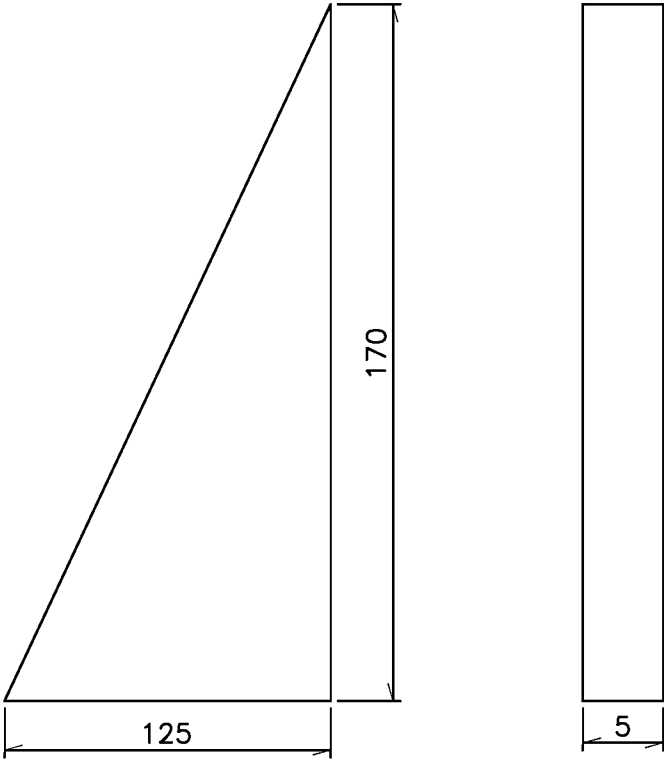
FOR BID PURPOSE ONLY

DO NOT SCALE

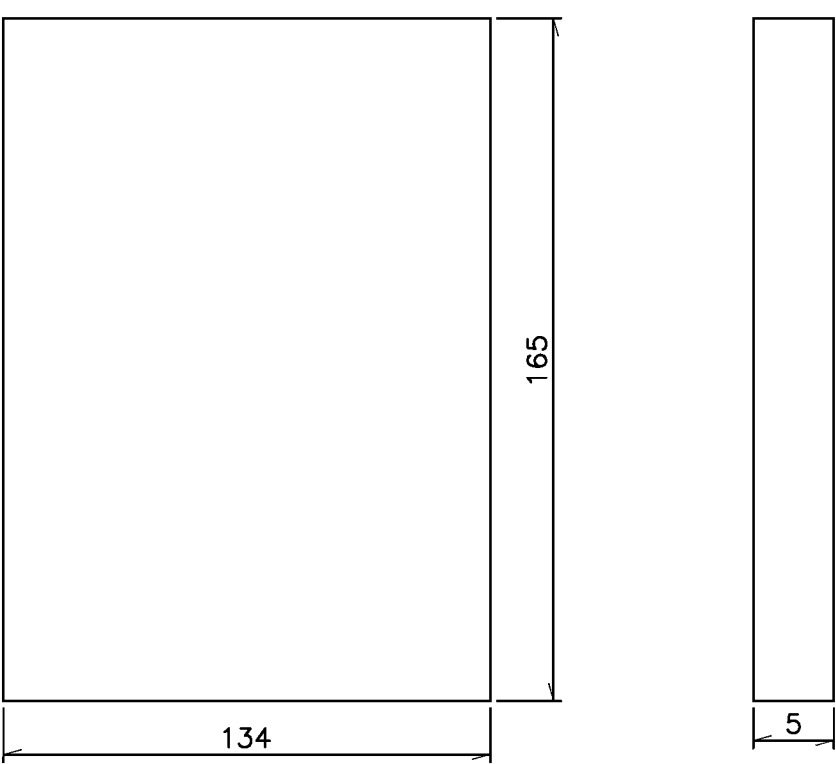
ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			*P* (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK. CONSTRUCTION / FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY. INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION / FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR 'HOLDS' IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION / FABRICATION WORK RELATED TO 'HOLDS'. DRAWINGS SIGNED BY PROCON ENGINEERS' AUTHORIZED REPRESENTATIVE ONLY ARE CONSIDERED VALID DRAWINGS.	 MAHARASHTRA STATE POWER GENERATION CO.LTD. MAHAGENCO BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT				PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)			
			CLEARED			SCALE				APPROVED		DATE(RO ISSUE)									
			DEPT	SIGNATURE	DATE	DIV. INST.						DATE(CURRENT ISSUE)									
			CHEM			DR. P.N.Z.						23-08-2011									
			CIVIL			CH. D.J.P.				DWG.NO.		PF-189-IN-SK-8004 (SH. 3 OF 10)									
			ELEC			VIEW OF				LOCAL INSTRUMENT RACK W/O CANOPY											
			I&C																		
MECH																					



DETAIL OF-1



DETAIL OF-2



DETAIL OF-3

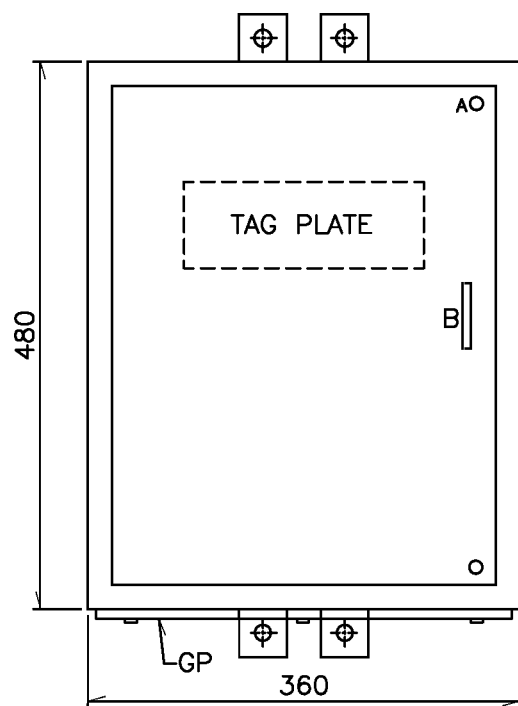
NOTES:

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

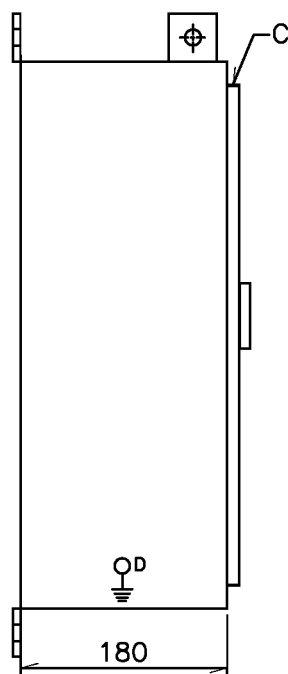
FOR BID PURPOSE ONLY

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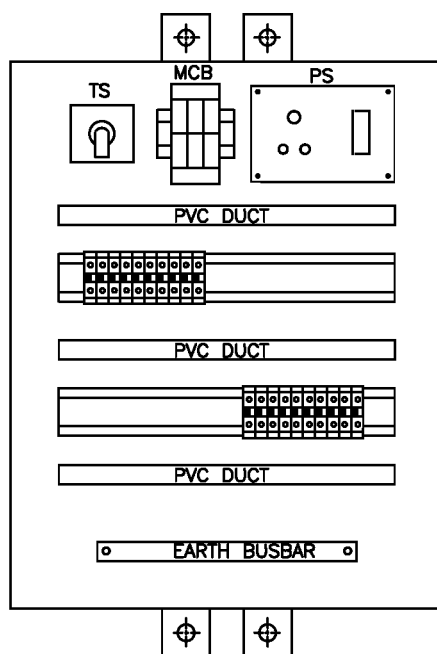
ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR R0 ISSUE ONLY			MAHAGENCO MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT G.A. DRAWING OF CLEATS FOR LOCAL INSTRUMENT RACK	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)			
			CHEM	CIVIL	ELEC	I&C	MECH			CLEARED				SCALE ~		APPROVED	
										DEPT	SIGNATURE	DATE		DIV.	INST.	23-08-2011	
										CHEM				DR.	P.N.Z.		
										CIVIL				CH.	D.J.P.		
										ELEC			DWG.NO.		PE-189-IN-SK-8004 (SH. 4 OF 10)		P0
I&C																	
										MECH							



FRONT VIEW



SIDE 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

INTERNAL FRONT VIEW

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

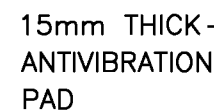
DO NOT SCALE

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 (SHEET 5 OF 10) PO



FRONT VIEW



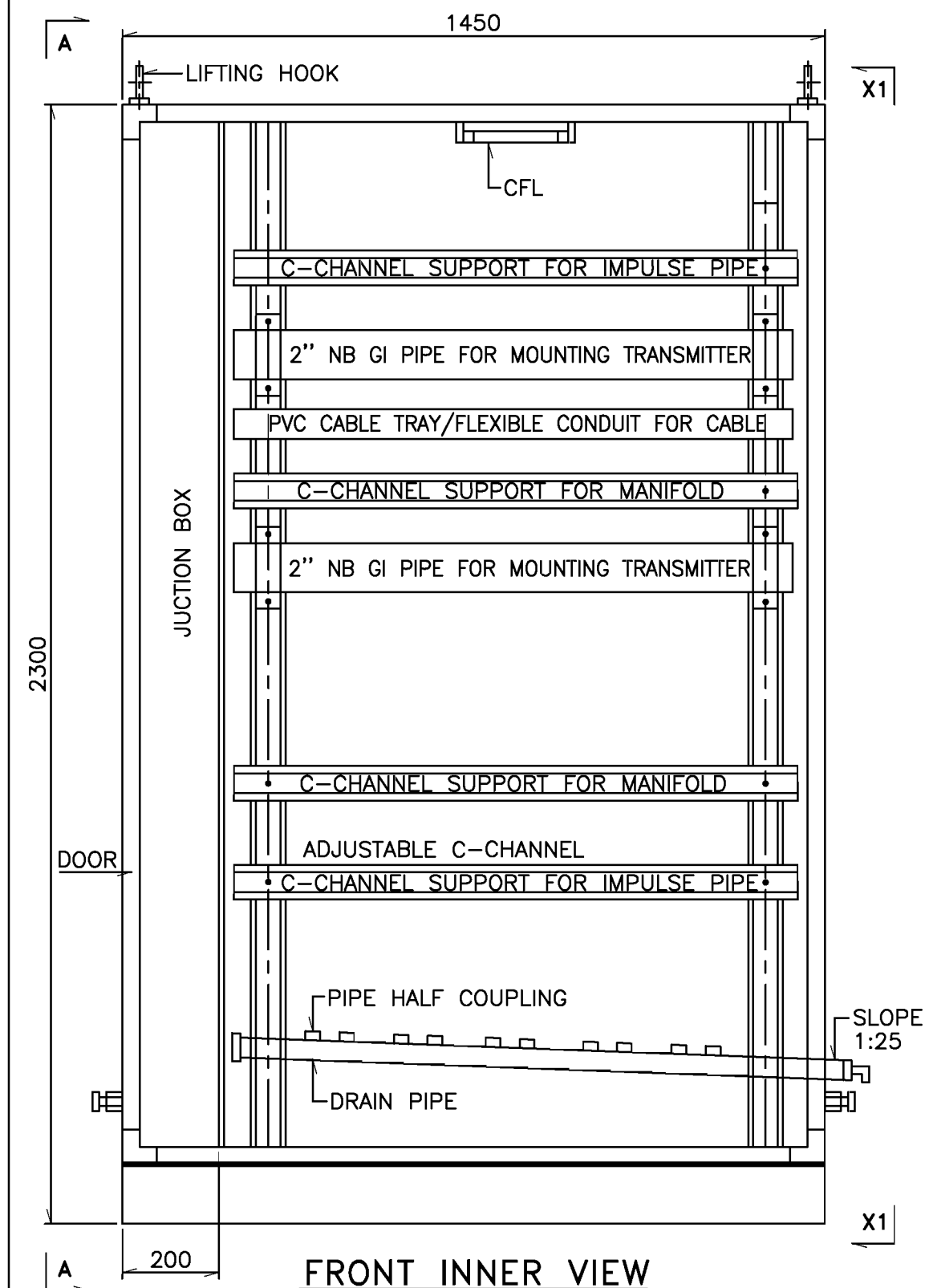
NOTES:

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 JUNCTION BOX.
8. ENCLOSURE PROTECTION CLASS SHALL IP-65.
9. TERMINALS INSIDE JUNCTION 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. COMMON 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.

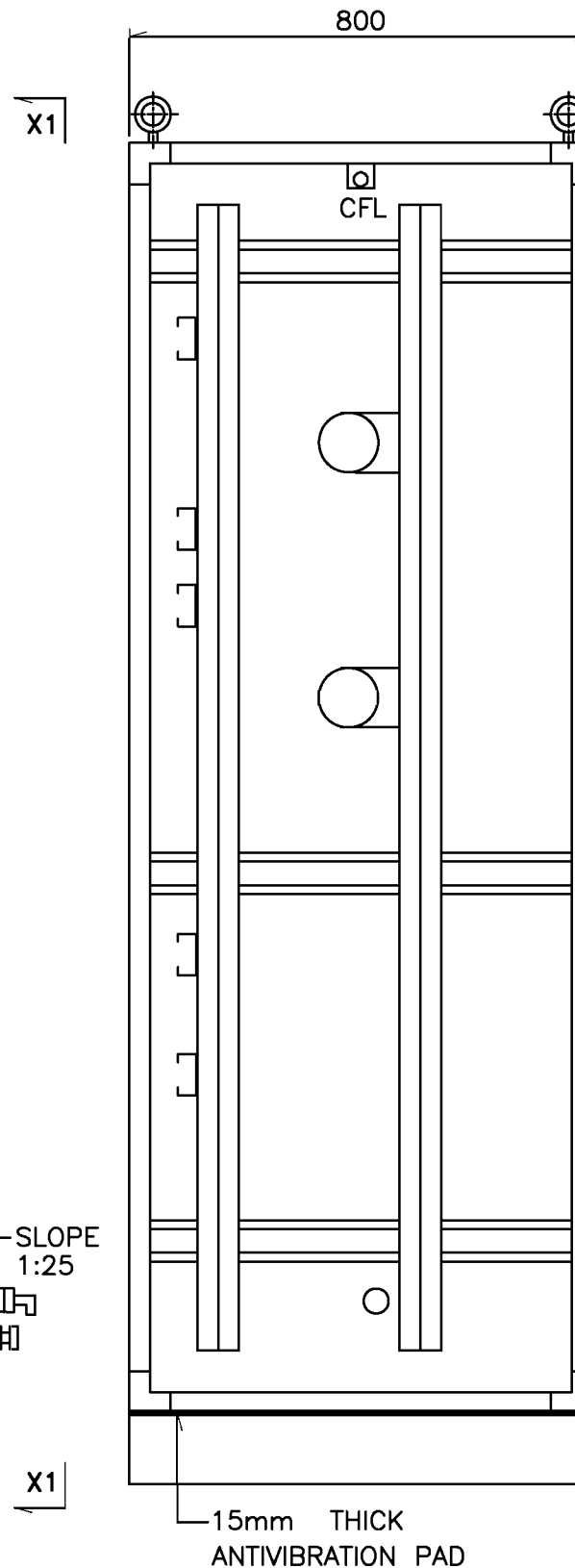
FOR BID PURPOSE ONLY

DO NOT SCALE

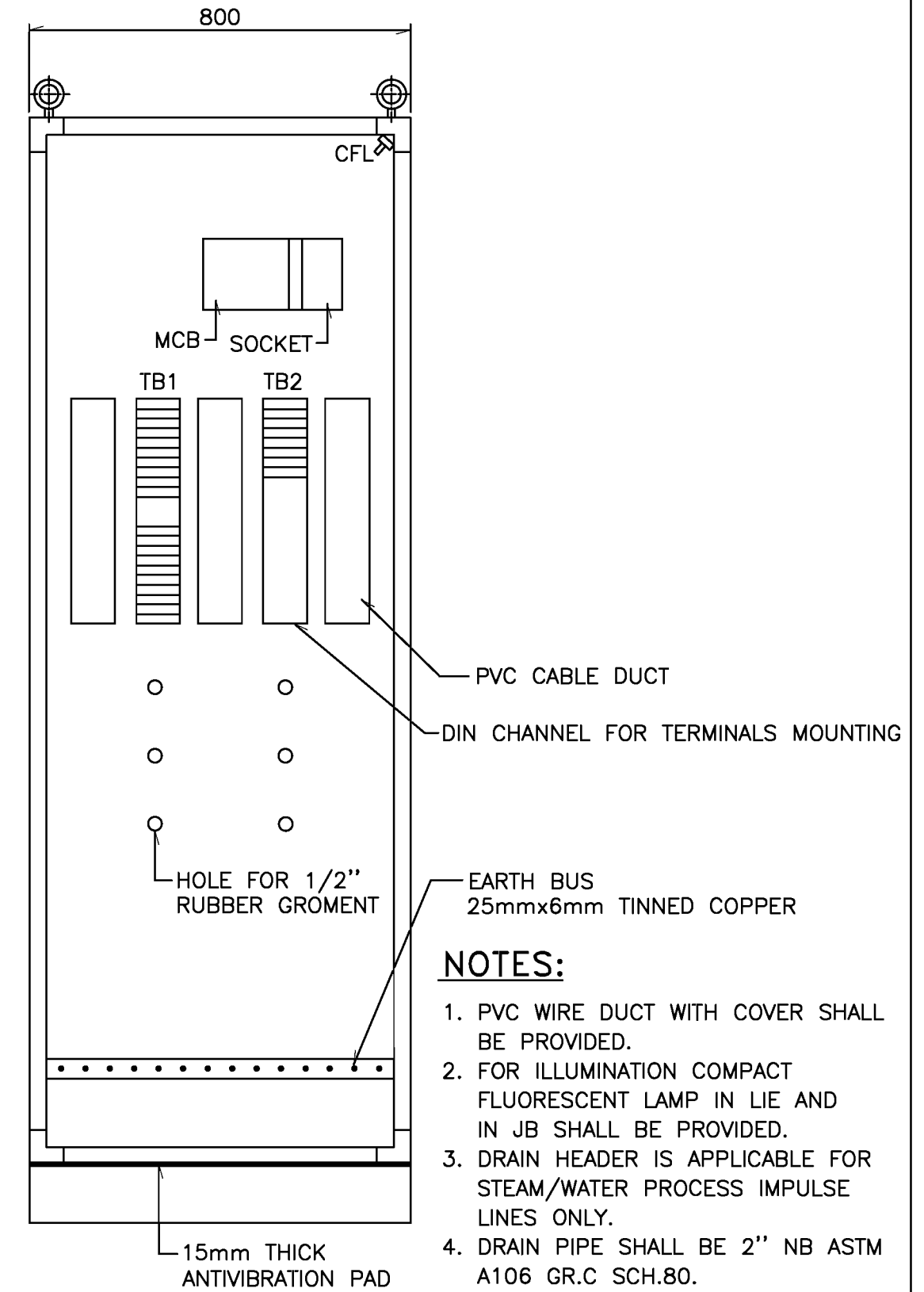
ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK. CONSTRUCTION WORK IS PERMITTED ON "R" (RELEASED) ISSUES ONLY. INFORMATION CONTAINED WITHIN "HOLD" IS NOT RELEASED FOR CONSTRUCTION / FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR "HOLDS" IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION / FABRICATION WORK RELATED TO "HOLDS". DRAWINGS SIGNED BY PROCON ENGINEERS' AUTHORIZED REPRESENTATIVE ONLY ARE CONSIDERED VALID DRAWINGS.	 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.)			
			CHEM	CIVIL	ELEC	I&C	MECH			DEPT	SIGNATURE	DATE		SCALE ~	APPROVED		DATE(RO ISSUE)				
										CHEM				DIV. INST.			DATE(CURRENT ISSUE)				
										CIVIL				DR. P.N.Z.			23-08-2011				
										ELEC				CH. D.J.P.	DWG.NO. PF-189-IN-SK-8004 (SH. 6 OF 10)		ISSUE NO. PO				
										I&C											
										MECH											



FRONT INNER VIEW



SIDE VIEW FROM X1-X1



SIDE VIEW FROM A-A

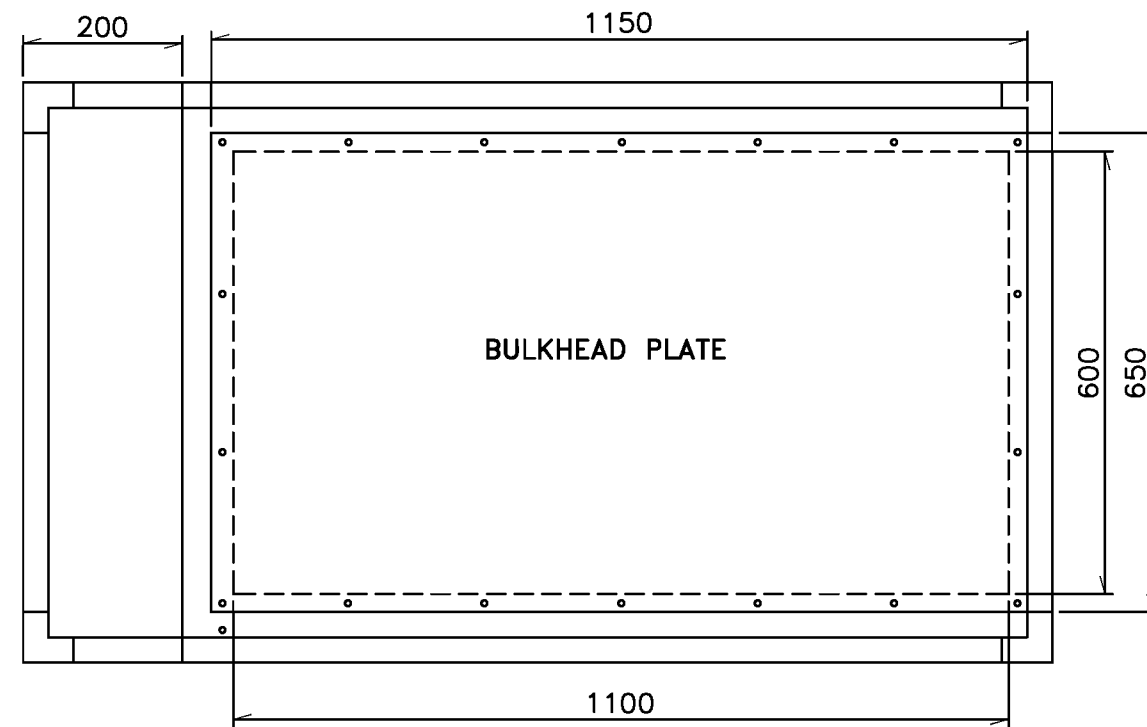
- NOTES:

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.

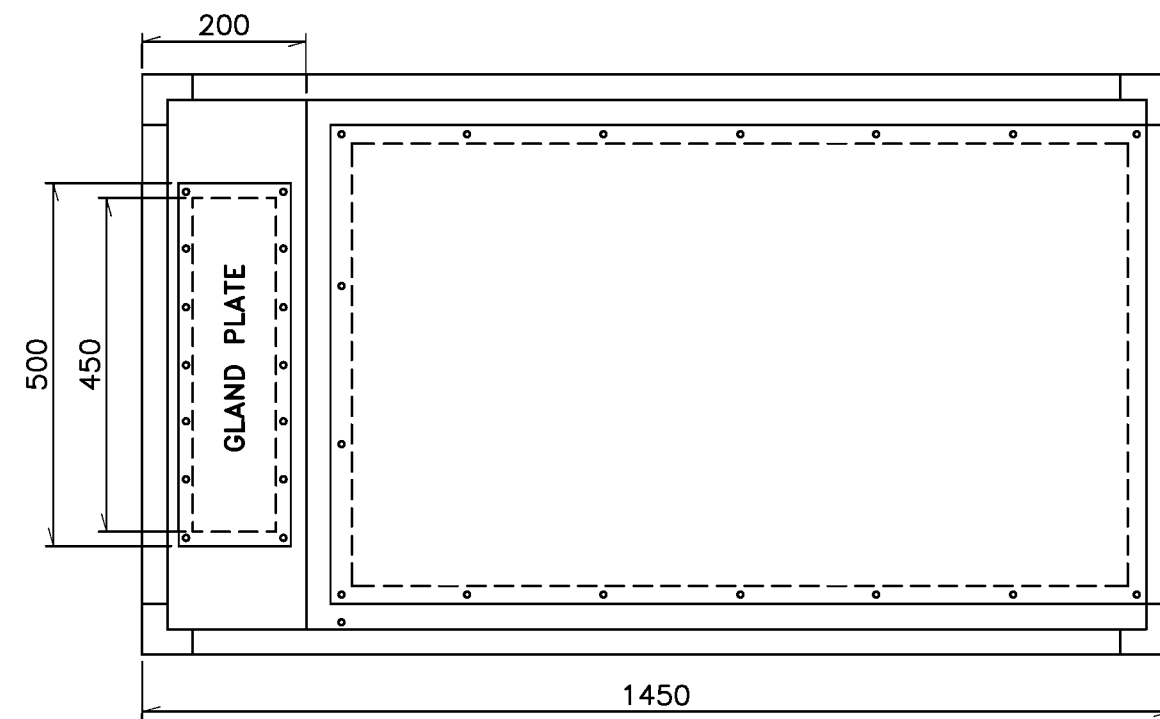
FOR BID PURPOSE ONLY

DO NOT SCALE

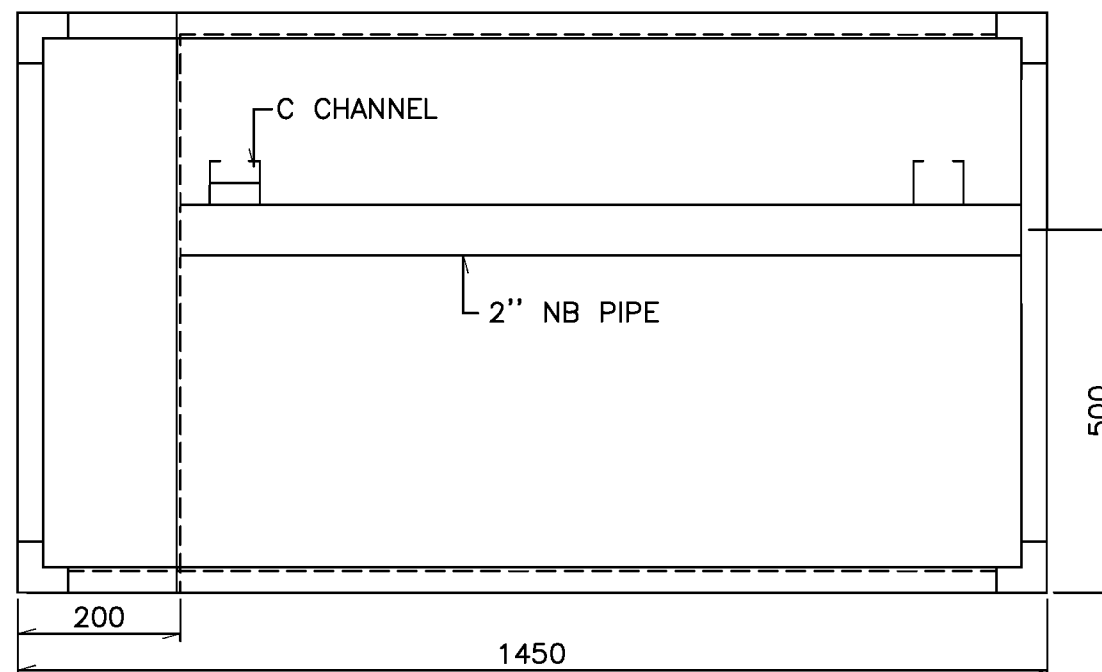
ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK. CONSTRUCTION WORK IS PERMITTED ON "I" (RELEASED) ISSUES ONLY. INFORMATION CONTAINED WITHIN "HOLD" IS NOT RELEASED FOR CONSTRUCTION / FABRICATION. FIELD MUST GET 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.	MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT INNER G.A. DRAWING FOR LOCAL INSTRUMENT ENCLOSURE						PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)			
			CHEM	CIVIL	ELEC	I&C	MECH			DEPT	SIGNATURE	DATE								SCALE ~	APPROVED	DATE(RO ISSUE)	
										CHEM										DIV. INST.		DATE(CURRENT ISSUE)	
										CIVIL										DR. P.N.Z.		23-08-2011	
										ELEC										CH. D.J.P.	DWG.NO.	PE-189-IN-SK-8004 (SH. 7 OF 10)	
										I&C											ISSUE NO.	P.O.	
										MECH													



TOP VIEW



BOTTOM VIEW



TOP VIEW WITHOUT BULKHEAD PLATE

NOTES:

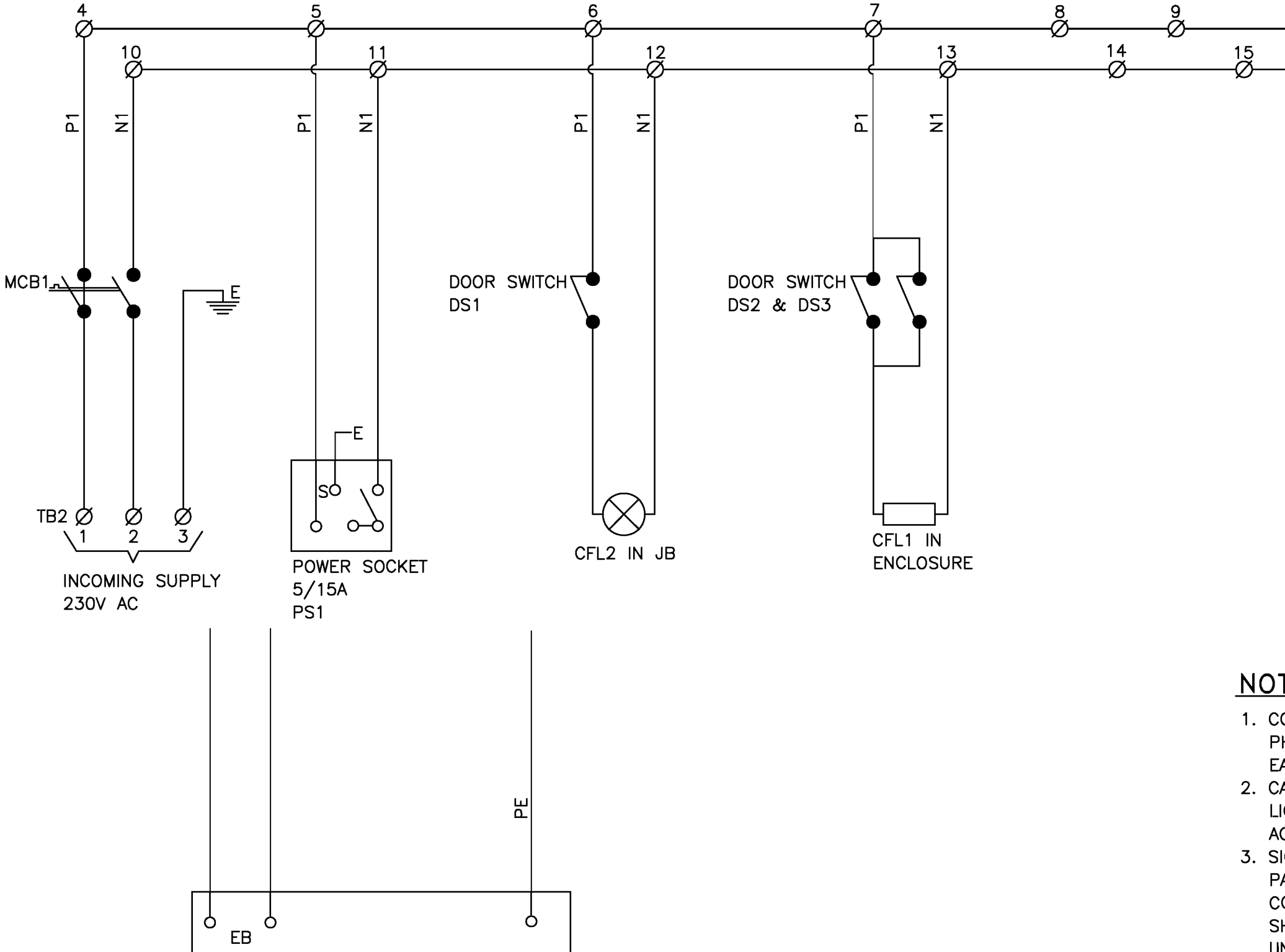
1. BULK HEAD PLATE DIMENSION ARE 1150 x 650 x 6.
2. IMPULSE PIPE ENTRY: BOTTOM ENTRY FOR AIR/FLUE GAS APPLICATIONS.
3. IMPULSE ENTRY: TOP ENTRY FOR STEAM/WATER APPLICATIONS.
4. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK. CONSTRUCTION WORK IS PERMITTED ON "R" (RELEASED) ISSUES ONLY. INFORMATION CONTAINED WITHIN "HOLD" IS NOT RELEASED FOR CONSTRUCTION / FABRICATION. FIELD MUST GET 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.	MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT BULKHEAD DETAILS FOR LOCAL INSTRUMENT ENCLOSURE PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.) SCALE ~ APPROVED DATE(RO ISSUE) DIV. INST. DATE(CURRENT ISSUE) DR. P.N.Z. 23-08-2011 DR. D.J.P. DWG.NO. PE-189-IN-SK-8004 (SH. 8 OF 10) ISSUE PO			
			CHEM	CIVIL	ELEC	I&C	MECH			DEPT	SIGNATURE	DATE					
										CHEM							
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										I&C							
										MECH							

POWER WIRING CIRCUIT



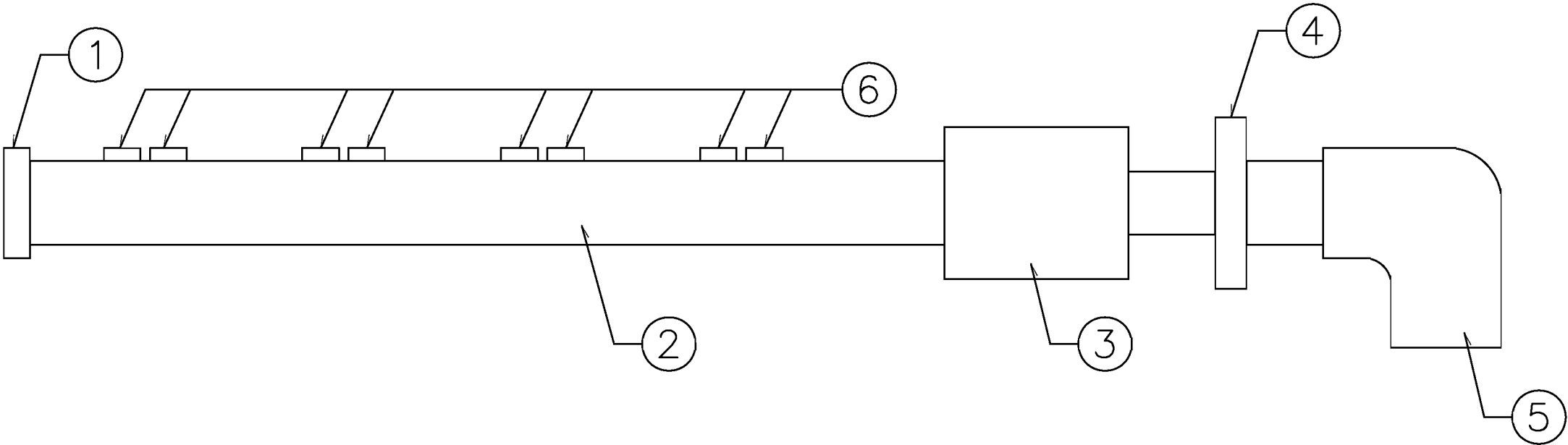
NOTES:

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.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			* IF (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. INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION / FABRICATION. FIELD MUST GET 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.	 MAHARASHTRA STATE POWER GENERATION CO.LTD. MAHAGENCO BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT		PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)			
			CHEM	CIVIL	ELEC	I&C	MECH			CLEARED									
			DEPT	SIGNATURE	DATE														
			CHEM																
			CIVIL																
			ELEC																
			I&C																
MECH																			
ELECTRICAL WIRING AND TERMINATION DRAWING FOR LOCAL INSTRUMENT ENCLOSURE													SCALE ~		APPROVED		DATE(RO ISSUE)		
													DR. INST.				DATE(CURRENT ISSUE)		
													DR. P.N.Z.				23-08-2011		
													CH. D.J.P.		DWG.NO. PE-189-IN-SK-8004 (SH. 8 OF 10)		ISSUE NO. PO		



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.

FOR BID PURPOSE ONLY

ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR R0 ISSUE ONLY			 MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT DRAIN HEADER DETAIL FOR LOCAL INSTRUMENT ENCLOSURE	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)			
			CHEM	CIVIL	ELEC	I&C	MECH			CLEARED				SCALE ~		DATE(RO ISSUE)	
									DEPT	SIGNATURE	DATE	APPROVED		DATE(CURRENT ISSUE)			
									CHEM			DIV. INST.		23-08-2011			
									CIVIL			DR. P.N.Z.					
									ELEC			DWG.NO.		ISSUE			
									I&C			(SH. 10 OF 10)		PO			
									MECH								
1" (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. INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION / FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR 'HOLD' IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION / FABRICATION WORK RELATED TO 'HOLD'. DRAWINGS SIGNED BY PROCON ENGINEERS' AUTHORISED REPRESENTATIVE ONLY ARE CONSIDERED VALID DRAWINGS.																	

	1X660 MW Bhusawal STPP	SECTION: SUB SECTION :
MANDATORY SPARES		

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
	measurement used.	
3.0	<u>MEASURING INSTRUMENTS</u>	
3.1	<u>ELECTRONIC TRANSMITTERS</u>	
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	<u>TEMPERATURE ELEMENTS</u>	
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	<u>INDICATORS/RECORDERS</u>	
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

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
3.6	<u>SOLENOID VALVE</u>	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 total 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	<u>SPECIAL INSTRUMENTS</u>	
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 minimum 1 no. of each type and range whichever is more

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5.0	<u>PROCESS CONNECTION PIPING</u> (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	

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
17.0	<u>CONTROL PANEL AND LOCAL/REMOTE CONTROL DESK (AS APPLICABLE)</u>	
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	<u>ANNUNCIATION SYSTEM</u> (For offsite / Auxiliary Plants)	
17.8.1	Each type of PCB (for non-PLC driven system)	1(one) No. each

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17.8.2	Lamp Box with Facia & Lamps (LED type)	10% with minimum 2 nos.	
17.8.3	Hooter	1(one) No.	

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
27.0	Gauges of all types	10% of total quantity used or 1 nos. whichever is max. for each type/rating

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<u>SR. NO.</u>	<u>EQUIPMENT/PACKAGE NAME</u>	<u>QUANTITY</u>
29.7	Solenoid Coil for Pneumatic type Power Cylinder	5Nos. for each type & ratings
29.8	Position Limit Switch for Pneumatic type Power Cylinder	10Nos. for each type & ratings
29.9	Air Lock Relay	10Nos. for each type
29.10	Signal Air Booster Unit	2Nos. for each type
30.0	<u>MANDATORY SPARES NOT COVERED ABOVE</u>	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.

CONSULTANT : PROCON ENGINEERS



TITLE :
1x660 MW BHUSAWAL TPS

SPECIFICATION NO.: PE-TS-415-154-A101

**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

SUB-SECTION: II

REV. NO. 00

DATE :01.05.2019

SECTION II



TITLE :
1x660 MW BHUSAWAL TPS

SPECIFICATION NO.: PE-TS-415-154-A101

**TECHNICAL SPECIFICATION FOR OXYGEN
DOSING SYSTEM**

SUB-SECTION: II

REV. NO. 00

DATE :01.05.2019

SCHEDULE OF PRE-BID CLARIFICATION

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

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

Note: Bidder to furnish all the pre bid in the above indicated pre bid clarification format only. General Pre bid clarification will not be considered.

THIS IS A PART OF TECHNICAL SPECIFICATION PE-TS-415-154-A101

	<u>SCHEDULE OF DEVIATIONS WITH COST OF WITHDRAWAL</u>								
	<u>PROJECT:- 1x660 MW BHUSAWAL TPS</u>								
	<u>PACKAGE:- OXYGEN DOSING SYSTEM</u>								
	<u>TENDER ENQUIRY REFERENCE:-</u>								

NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWAL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWAL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWAL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
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TECHNICAL DEVIATIONS

COMMERCIAL DEVIATIONS

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	DESIGNATIONS	SIGN & DATE

NOTES:

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



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DOSING SYSTEM**

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DATE :01.05.2019

COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate (every sheet) 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 other than those mentioned under "exclusion" in section IA and those resolved as per 'Schedule of Deviations', if applicable, with regard to same.
- b) There are no other deviations w.r.t. specifications 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 approval & 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. This shall be within the contracted price with no extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets/ calculations etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ CUSTOMER approval in the event of order.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified/ intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre - bid discussions, otherwise BHEL/ Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

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' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL/ CUSTOMER approval in the event of order.
- h) Guarantee for plant /equipment shall be as per relevant clause of GCC /SCC /Other Commercial Terms & Conditions.
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price and within purview of the tender specification even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities.
- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

	TITLE : 1x660 MW BHUSAWAL TPS		SPECIFICATION NO.: PE-TS-415-154-A101	
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- k) As built drawings shall be submitted as and when required during the project execution.
- l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.



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DECLARATIONS

I.....certify that all the technical data and information pertaining to this specification are correct and are true representation of the equipment/system covered by our format proposal number Dated and there is no deviation to the specification.

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

Bidders Company Name

.....

Authorized Representative's
Signature

.....

Name

.....

Bidder's Name

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