

		QUALITY PLAN		CUSTOMER : MAHAGENCO		PROJECT 1X660 MW BHUSAWAL TPP TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
		SHEET 5 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ ASTM-E165	MANUF'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER : MAHAGENCO		PROJECT 1X660 MW BHUSAWAL TPP TITLE		SPECIFICATION : NUMBER :				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
		SHEET 6 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	FOR MV MOTOR
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 7 OF 9		CUSTOMER : MAHAGENCO		PROJECT 1X660 MW BHUSAWAL TPP TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	VERIFICATION FOR MV MOTOR ONLY
2.8	BRAZING/COMPRESSION JOINT	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.9	COMPLETE ROTOR ASSEMBLY	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.10	ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
		1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE		BIDDER'S/VENDORS COMPANY SEAL							

		QUALITY PLAN SHEET 8 OF 9		CUSTOMER : MAHAGENCO		PROJECT 1X660 MW BHUSAWAL TPP TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	13
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC CLAUSE 8.1.2	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1	1	
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^{\$}	1	\$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1 ^{\$}	1	\$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	1*	1	* REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^{\$}	1	\$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^{\$}	1	\$ NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1 ^{\$}	1	\$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR.
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1 ^{\$}	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY \$ NOTE - 2
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			



		QUALITY PLAN		CUSTOMER : MAHAGENCO		PROJECT : 1X660 MW BHUSAWAL TPP TITLE		SPECIFICATION : NUMBER :				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
		SHEET 9 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
NOTES: 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED. 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON. 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED FOR FIRST NUMERAL OF IP-XX. SECOND NUMERAL TEST SHALL BE CARRIED OUT ON ONE MOTOR OF EACH TYPE & RATING. 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE									
												BIDDER'S/VENDORS COMPANY SEAL



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM
TECHNICAL SPECIFICATION
(C&I PORTION)**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : I

SUB-SECTION : C-4

REV. 00

SECTION: I

**SUB-SECTION: C-4
TECHNICAL SPECIFICATION (C&I PORTION)**



**1X660 MW BHUSAWAL STPP UNIT-6,
MAHARASHTRA, INDIA**

C&I TECHNICAL SPECIFICATION

FOR

AC SYSTEM



**CONTROL AND INSTRUMENTATION DEPARTMENT
PROJECT ENGINEERING MANAGEMENT
BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
NOIDA**

PREPARED BY	CHECKED BY	APPROVED BY
ANJALI RAMAN	VIPUL KUMAR VERMA	SC SHARMA
DY. MNGR. (C&I)	MGR. (C&I)	DGM (SH-I02,C&I)

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	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
GENERAL & SPECIFIC TECHNICAL REQUIREMENT		

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
GENERAL REQUIREMENT 1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems. 2.0. The quantity of instruments for auxiliary system shall be as per tender P &ID, wherever provided, for the respective system as a minimum for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe &reliable operation of plant, bidder shall supply the same without any price and delivery implication to BHEL. 3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering. 4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg / Cm². The contacts of equipment mounted instruments; sensors, switches etc. for external connection including spare contacts shall be wired out to suitably located junction boxes. 5.0 In case of any contradiction most stringent clause/condition shall prevail.		

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
Specific Technical Requirements (C&I): 1) The control of Air Conditioning system shall be through DCS based control system (in BHEL scope). The operation and control philosophy of AC system shall be as per design memorandum given elsewhere in the specification. The DCS panel along with OEWS and printer (in BHEL scope) shall be located in AC Plant Control Room. 2) Bidder to provide Local Control Panel for AC system given elsewhere in the specification. 3) Bidder to keep the provision for accepting fire signals from Fire Alarm & Protection System (supplied by others) and the closure of relevant fire dampers in Air Conditioning and Ventilation System. the no of IO & other specifications in this regard shall be finalized during detail engineering. 4) Provision for redundant soft interfacing and Hardwired interfacing shall be included for signal exchange between Air conditioning DDCMIS and chiller's Microprocessor based control panel. Bidder shall include required hardware at MP end. 5) Time synchronization of MP with DCS is to be carried out. Necessary hardware/software for same at MP end to be provided by Bidder. 6) VFD panels for applicable drives are in Bidders scope. Typical signal exchange with DCS has been indicated in the specification elsewhere. 7) All electrical actuators shall be integral type. Non-contact type electronic 2-wire position transmitters shall be provided for all inching type motorised valves. The detailed specification is attached elsewhere in the specification. 8) The solenoid valves shall have limit switches for open/close feedback. 9) Interface of MCC, HT SWGR, Actuators, solenoid drives, control valves etc. with DCS based control system shall be as per Drive Control Philosophy attached in the specification. 10) All the instruments/drives shall be terminated on JB's/Panels in field. JB's/Panels shall be in Bidder's scope. Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 12-15 mtrs) and trunk cable. 11) RTD's shall be of duplex type. Both the elements of duplex temperature sensors shall be terminated to junction boxes. Temperature measurement shall have up scale / down scale drive to protect from process upset in case of sensor failure. 12) Each pneumatic device requiring air supply and intended for field mounting shall include a filter regulator air set with gauge, to owner's approval.		

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
13) All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible. 14) All field instruments enclosure shall be IP65. Local panel/cabinet enclosure shall be IP 55, unless otherwise specified. 15) Primary sensor redundancy for Control/measurement shall be decided as per following general criteria: - Critical controls and respective measurements- Triple redundant. - Non-critical but important control & measurements- Dual redundant. - Only measurement- No redundancy. 16) All the instruments/ sensors/transmitters/switches meant for redundant applications shall have completely separate and independent impulse pipes/ root valves etc. No redundant instrument shall share a single process tapping. There will be separate and independent tapping for every individual instrument. 17) Bidder to comply with codes and standards as mentioned in the specification. 18) Instrument installation shall be as per the attached "Standard Hook-up diagram of instrument." 19) Bidder shall provide erection hardware as per installation drawings. 20) Bidder to provide mandatory spares as per mandatory spares list attached elsewhere in the specification. 21) Bidder to perform tests of C&I items/instruments/systems as per Quality plans/type test attached in the specification. 22) Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system. 23) Redundant 230 VAC UPS feeders shall be provided by BHEL at a single point. Further distribution to various instruments shall be in Bidder's scope. Bidder to include necessary power distribution board (ACDB) (as per details attached elsewhere in this specification) in his scope. Any power supply other than the above, if required by any instrument/device, has to be derived by the Bidder from the above supply and all necessary hardware for the same shall be in bidder's scope. Bidder to furnish UPS power requirement along with the bid. 24) All cables terminated in the terminal block, power distribution scheme instruments shall be ferruled. Ferruling shall be double cross ferruling (i.e.) source and destination addresses shall be marked on both sides of the tube ferruling.		

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
25) Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification. Any cable in Bidder's scope shall be as per specification. 26) Number of pairs to be selected for Screen /Control cable (Size : 0.5 mm²) a) F-Type: 2P/4P/8P/12P/20P b) G-Type: 4P/8P/12P 27) Number of cores to be selected for Control cable (Size: 2.5 mm²): a) 3 Core b) 5 Core c) 12 Core 28) Any part/module of the C&I system which are not listed under recommended spares shall be deemed as having life expectancy not less than the expected life of the plant i.e. 30 years. 29) Instrument ranges shall be selected to have the normal reading, preferably between 50% and 70% of full scale for linear parameters and 70% to 80% for flow measurements. Deviation indicators shall have the null position at mid-scale. The normal operating parameter shall be identified with a clear green mark. 30) The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL. 31) Bidder to delegate /depute their persons/experts (15 working days for minimum 3 tours) as per owner/consultants' requirement without any additional cost at site during commissioning. 32) Bidder's presence is required for 3 Man days (Excluding travel time) at EDN Bangalore during FAT of DDCMIS for certifying correctness & completeness of implementation of Control logic. Intimation to attained FAT shall be informed in 2 days advance. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope. 33) Bidder to ensure participation of their senior personnel and experts in discussions with Owners and other equipment bidders during various stages of contract implementation as required by the Owner.		

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
C&I DELIVERABLES LIST		

LIST OF VENDOR DELIVERABLES FOR C&I FOR AC SYSTEM (1X660 MW Bhusawal STPP)			
DOCUMENT NUMBER PE-GL-415-553-I001		SHEET 1 of 1	
Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY
1	PE-V9-415-553-I901	INSTRUMENT DATA SHEETS	A
2	PE-V9-415-553-I902	INSTRUMENT SCHEDULE	I
3	PE-V9-415-553-I903	INSTRUMENT INSTALLATION/ HOOK UP DRAWINGS	A
4	PE-V9-415-553-I904	INSTRUMENT QP/CHECK LIST	A
5	PE-V9-415-553-I905	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM	A
6	PE-V9-415-553-I906	CONTROL SCHEMES/LOGIC DIAGRAM (TO BE IMPLEMENTED IN DCS)	A
7	PE-V9-415-553-I907	FIELD JB TERMINATIONS /GROUPING DOCUMENT	A
8	PE-V9-415-553-I908	DCS INPUT / OUTPUT LIST (ANALOG & BINARY)	I
9	PE-V9-415-553-I909	ANNUNCIATION & SOE LIST	I
10	PE-V9-415-553-I910	PROCESS GRAPHIC MANUSCRIPTS FOR DDCMIS	I
11	PE-V9-415-553-I911	CABLE SCHEDULE & INTERCONNECTION	I
12	PE-V9-415-553-I912	BILL OF MATERIAL	A
13	PE-V9-415-553-I913	LOCAL CONTROL PANEL DATA SHEET & WIRING DIAGRAM	A
14	PE-V9-415-553-I914	PANEL LAYOUT & EXTERNAL/INTERNAL GA DRAWING (INCLUDING FOUNDATION DETAILS & FLOOR CUT-OUT)	A
15	PE-V9-415-553-I915	LIST OF SIGNAL EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE)	A
16	PE-V9-415-553-I916	LCP QUALITY PLAN	A
NOTES: 1. ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION. 2. CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/CUSTOMER APPROVED FORMATS LIKE MS EXCEL,MS ACCESS OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST,FIELD JB TERMINATIONS, CABLE SCHEDULE & INTERCONNECTION, etc. SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.			

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
SPECIFICATION FOR MOTORISED VALVE ACTUATOR		

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 11
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 385 of 440
1.0 <u>SCOPE</u> 1.1 This Section covers the general requirements of Electric Motor Actuators for valves, dampers and gates. 1.2 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification. 2.0 <u>STANDARDS</u> 2.1 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification. 2.2 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed: (a) IS-9334 (b) IS-325 3.0 <u>SERVICE CONDITIONS</u> 3.1 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash. 3.2 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the general specification. 4.0 <u>RATING</u> 4.1 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer. 4.2 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 11
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 386 of 440

5.0 **PERFORMANCE**

The actuator shall meet the following performance requirements:

- 5.1 Open and close the valve completely and make leak-tight valve closure without jamming.
- 5.2 Attain full speed operation before valve load is encountered and impart an unseating blow to start the valve in motion (hammer blow effect).
- 5.3 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.
- 5.4 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.
- 5.5 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

6.0 **SPECIFIC REQUIREMENT**

6.1 **CONSTRUCTION**

- 6.1.1 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring. Actuator shall be integral type. Integral starter shall have facility to hook-up with Plant DCS for positioning of limit and torque switches.
- 6.1.2 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy.
- 6.1.3 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.
- 6.1.4 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

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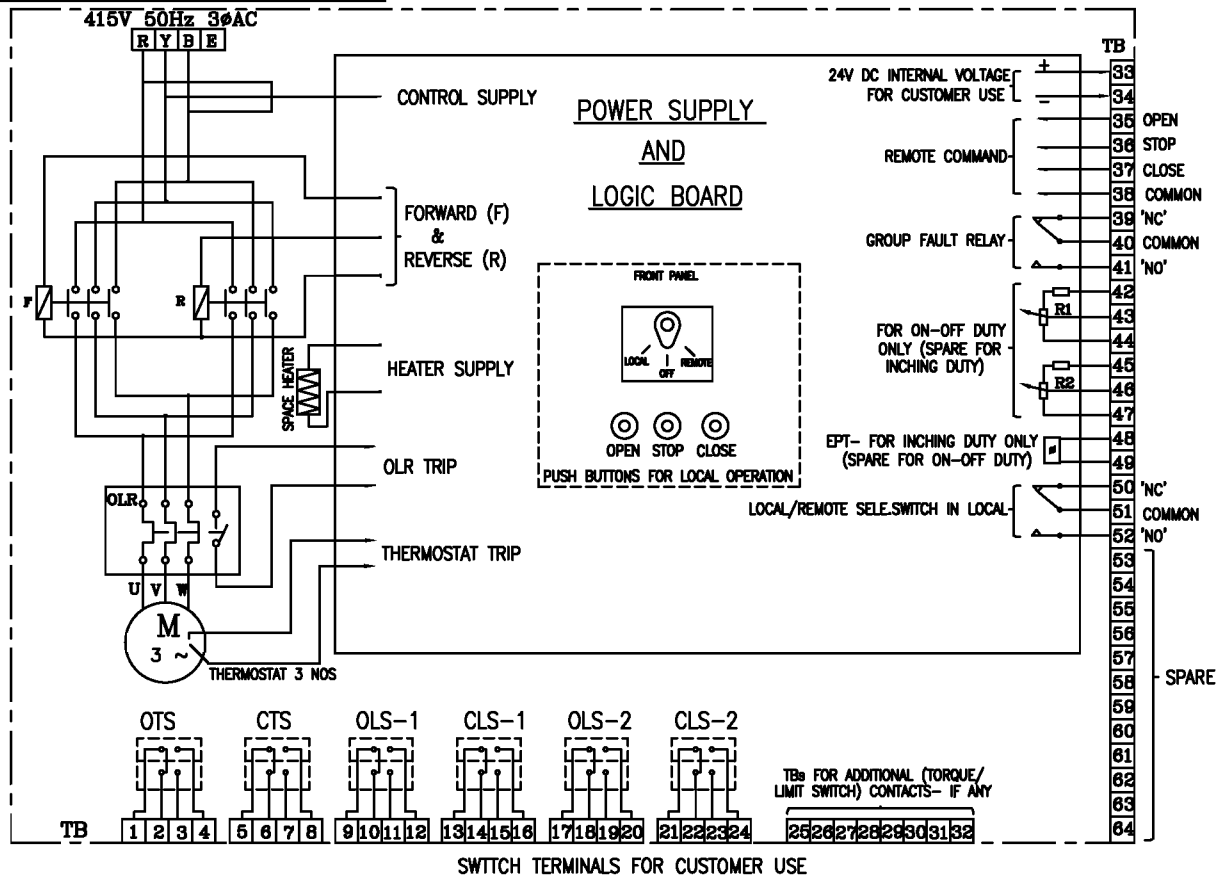
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6.2	<u>MOTOR</u>	
6.2.1	The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service.	
6.2.2	The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.	
6.2.3	The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.	
6.2.4	Earthing terminals shall be provided on either side of the motor.	
6.3	<u>LIMIT SWITCHES</u>	
	Each actuator shall be provided with following limit switches:	
6.3.1	Two (2) torque limit switches, one for each direction of travel, self-locking, adjustable torque type.	
6.3.2	Four (4) end-of-travel limit switches, two for each direction of travel.	
6.3.3	Two (2) position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.	
6.3.4	Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.	
6.4	<u>HAND WHEEL</u>	
	Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.	

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6.5	<u>POSITION INDICATOR/TRANSMITTER</u> The actuator shall have:	
6.5.1	One (1) built-in local position indicator for 0-100% travel	
6.5.2	One (1) position transmitter, potentiometer type, for remote indicator.	
6.6	<u>SPACE HEATER</u> A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.	
6.7	<u>WIRING</u> All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules.	
6.8	<u>TERMINAL BOX</u> The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.	
7.0	<u>TEST</u>	
7.1	The actuator and all components thereof shall be subject to tests as per relevant Standards. In addition, if any special test is called for in equipment specification, the same shall be performed.	
7.2	<u>TEST WITNESS:</u> Test shall be performed in presence of Owner/Purchaser's representative so desired by the Owner/Purchaser. The Contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.	

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3-V-MISC-24227

DRAWING NO.



CONTACT DEVELOPMENT DIAGRAM

OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL				
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL				
CTS	5-8	OPEN AT OVER TORQUE DURING CLOSING TRAVEL				
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL				
OLS-1	9-10					
	11-12					
CLS-1	13-14					
	15-16					
OLS-2	17-18					
	19-20					
CLS-2	21-22					
	23-24					
SWITCH	TERMINAL NO.	FULL OPEN	a	INTERMEDIATE	b	FULL CLOSE
		VALVE POSITION				

————— INDICATES CONTACT CLOSED

----- INDICATES CONTACT OPEN

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

SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH

VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS	#
# - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT				
* - BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)				

NOTE:-

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

REV	DATE	ALTERED
		CHD & APPD

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

 365-121 DEPT VL CODE TITLE WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER	DRN	NAME N.P.ESWAR	SIGN N.P	DATE 07.10.04	NO.OF VAR.
	CHD	D.DINAKARAN	D.D	07.10.04	
	APPD	K.ARUNACHALAM	K.A	07.10.04	
SCALE	WEIGHT (KG).	REFERENCE INFORMATION			NO. OF THICK
CARD CODE	U 01	DRAWING NO. 3-V-MISC-24227			REV 0

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
SPECIFICATION FOR FIELD INSTRUMENTS		

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
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7.2 <u>INSTRUMENT ACCURACY, STANDARD SCALES AND RANGES</u> 7.2.1 Instrument Accuracy Instruments shall meet the following general requirements: (a) Pressure measurement shall be linear with respect to the measured pressure. (b) Flow meter shall meet the specified accuracy criteria when operating between 25 and 100 % of full-scale flow. The accuracy shall include the effect of errors in the differential head measuring device, square root converter and signal generator. (c) Level measurement shall be linear with respect to the measured level based on a water specific gravity of 1.00.		

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(e) Temperature compensation shall produce corrections over a flow range from 10 percent to 100 percent of maximum flow subject to a plus or minus tolerance of one-half of one percent of the maximum flow. 7.2.2 Instrument Scale Displays (a) All displays shall be in engineering units. Instrument scales displayed on screen will have graduations with scale divisions based on multiples of 10. The smallest division shall preferably be a whole number approximately 1% of the scale range if not otherwise impracticable. (b) Pressure instrument shall have the unit suffixed with 'a' or 'g' to indicate absolute or gauge pressure, respectively. (c) Scales and charts of all instruments shall have linear graduations. 7.2.3 Instrument Ranges Instrument range shall be selected to have the normal reading, preferably between 50% and 70% of full scale for linear parameters and 70% to 80% for flow measurements. Deviation indicators shall have the null position at mid scale. The normal operating parameter shall be identified with a clear green mark.		

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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	

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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.	

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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.	

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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.	

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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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SR. NO.	ITEM	DESCRIPTION	
1.3.8	Static / overload pressure	Maximum static pressure without permanent deformation or loss of accuracy.	
1.3.9	Turn-down ratio	10 : 1 or better.	
1.3.10	Zero & Span	Easily accessible (local zero & span adjustment and non-interactive type).	
1.3.11	Enclosure Class	IP-65.	
1.3.12	Output Indicator	LCD type.	
1.3.13	Nameplate	Tag number and Service engraved in stainless steel tag plate.	
1.3.14	Ambient Temperature	0 - 50° C.	
1.3.15	Load Impedance	600 Ohms at 24 Volts (minimum).	
1.3.16	Process Connection	2" Companion flange with nuts, bolts and gaskets.	
1.3.17	Performance -		
	(a) Accuracy	±0.5 % of span or better.	
	(b) 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)	
1.3.18	Accessories	(a) Counter Flange, nuts, bolts, gaskets etc.	

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SR. NO.	ITEM	DESCRIPTION	
		(b) Weights for 5 point calibration of instruments.	
		(c) Vent and drain plugs.	
		(d) Special calibration tool / configuration, if any.	
		(e) ½"NPT cable gland.	
1.3.19	Preferred Features	(a) Test plug connection and cutout terminals physically separated from other electronics.	
		(b) Electronic Damping facility (adjustable).	
1.4	<u>MASS FLOW METER</u>		
1.4.1	Sensor		
1.4.1.1	Measuring Principle	Coriolis Mass flow.	
1.4.1.2	Primary Element	Flow Tube of 316SS or better.	
1.4.1.3	Heating Arrangement	Integral.	
1.4.1.4	Temperature Control	For heavy fuel oil application.	
1.4.1.5	Process Connection	Flanged of rating as per process requirement.	
1.4.1.6	Drain	Self-draining facility.	
1.4.1.7	Enclosure	Stainless steel.	
1.4.1.8	Accessories	Counter flanges, Mounting nuts, bolts, gaskets etc.	
1.4.2	Transmitter		

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SR. NO.	ITEM	DESCRIPTION	
		engineering units or 0-100%	
1.6.10	Output	2 off isolated 4-20mA DC output	
1.6.11	Load	< 750 ohms.	
1.6.12	Power supply	240V AC, 50 Hz.	
1.6.13	Turn Down	100:1.	
1.6.14	Accuracy	± 0.2 % of measured value.	
1.6.15	Enclosure	NEMA4X (IP67) aluminum, Epoxy coated	
1.6.16	Nameplate	Tag number, service engraved in stainless steel tag plate.	
	Notes:		
1.	The above on-line flow meter shall not create any obstruction on flow.		
2.	Users' list shall be submitted to support on proven satisfactory performance for similar process applications.		
1.7	<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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SR. NO.	ITEM	DESCRIPTION	
1.7.7	Window	Shatterproof glass.	
1.7.8	Range Selection	Normal process pressure: 50~70% of range.	
1.7.9	Over-range Protection	125% of maximum range by internal stop. External stop at zero.	
1.7.10	Adjustment	Micrometer screw for zero. Internal micrometer screw for range.	
1.7.11	Element Connection	Argon welding.	
1.7.12	Process Connection	1/2" NPT(M) Bottom for local, back for panel mounting.	
1.7.13	Performance	Accuracy of ± 1.0 % of span or better.	
1.7.14	Operating ambient	0 - 50 °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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SR. NO.	ITEM	DESCRIPTION	
1.7.17	Applicable standard	IS-3624 / 1996.	
1.7.18	Nameplate	Tag number, service engraved in stainless steel tag plate.	
1.8	<u>TEMPERATURE GAUGE</u>		
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	
1.8.17	Window	Shatterproof glass.	
1.8.18	Accuracy	± 1 % or better.	
1.8.19	Enclosure Class	IP-65.	
1.8.20	Capillary	5 meters (local surface)/15.0 meters (local panel) - armoured stainless steel.	
1.8.21	Compensation	Capillary and Case Compensation.	
1.8.22	Accessories	(a) Forged barstock thermowell screwed as per ASME PTC code. Process connection M 33X2 (M). Material of construction of Thermowell: (i) SS 316: In general. (ii) Inconel: For flue gas application. (iii) Tungsten carbide: For coal mill application.	
1.8.23	Nameplate	Tag number, service engraved in stainless steel tag plate.	
1.9	<u>THERMOCOUPLES</u>		
1.9.1	Type	(a) Type-J (Iron Constantan) / Type-K (Chromel Alumel) / Type-R (Pt.-Rhodium Pt.). [As per application]	
		(b) Duplex.	
		(c) Ungrounded.	

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SR. NO.	ITEM	DESCRIPTION	
		thermowells.	
1.9.8	Accessories	(a) Adjustable nipple-union-nipple (½", Sch 80 x ½" NPT M) with thermowell connection.	
		(b) Compression fittings/unions.	
		(c) Flanges etc. (for flanged connections only).	
		(d) Forged barstock thermowell as per ASME PTC code. Process connection M 33 x 2 (M) in general or 1½" Flanged for Flue gas / Furnace / Air etc. application. Material of construction of Thermowell: SS 316 : In general Inconel: For flue gas application Tungsten carbide : For coal mill application.	
1.9.9	Name plate	Tag number, service engraved in stainless steel tag plate.	
1.10	<u>RESISTANCE TEMPERATURE DETECTOR</u>		
1.10.1	Type	Platinum (Duplex), Ungrounded.	
1.10.2	Resistance	100 ohm at 0 °C.	
1.10.3	Base	Wound on ceramic (anti-inductive).	
1.10.4	Wiring	3 / 4 Wire.	

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SR. NO.	ITEM	DESCRIPTION	
1.10.5	Protecting Tube		
(a)	O.D.	8 mm.	
(b)	Material	SS-316, Seamless.	
(c)	Filling	Magnesium oxide (Purity above 99.4%).	
1.10.6	Response time	(a) < 20 seconds for measurement.	
		(b) < 10 seconds for control.	
1.10.7	Calibration	DIN 43760.	
1.10.8	Accuracy	± 0.5%.	
1.10.9	Head:		
(a)	Type	IP-65 universal screwed type.	
(b)	Material	Die cast aluminium or better.	
(c)	Terminal blocks	Nickel plated Brass-screw type / silver plated.	
(d)	Cable connection	½" NPT gland and grommet.	
(e)	Others	Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells.	
1.10.10	Accessories	(a) Adjustable nipple-union-nipple (½" Sch 80 x ½" NPT M) with Thermowell connection.	

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		(b) Compression fittings / unions.	
		(c) Flanges etc. (for flanged connections only)	
		(d) Forged / barstock Thermowell as per ASME PTC code. Process connection M33 x 2 (M). Material of construction of Thermowell: SS 316: In general. Inconel: For flue gas application. Tungsten carbide: For coal mill application.	
1.10.11	Name plate	Tag number, service engraved in stainless steel tag plate	
1.11	<u>PRESSURE SWITCH</u>		
1.11.1	Type	(a) Piston for high pressure application.	
		(b) Bellow / Diaphragm for low pressure application.	
1.11.2	Sensing element material	AISI SS-316. All other wetted part SS316.	
1.11.3	Case Material	Die-cast aluminium alloy, neoprene gasket.	
1.11.4	Setter Scale	Black graduation on white linear scale. Graduation 0-100% with red pointer for set points.	

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1.11.5	Over range	150 % of maximum pressure.	
1.11.6	Adjustments	(a) Internal Set Point.	
		(b) Differential adjustment.	
1.11.7	End Connection	½" NPT (M) bottom connected.	
1.11.8	Switch configuration	Two SPDT.	
1.11.9	Switch Rating	240V, 5A AC / 220V, 0.5A DC.	
1.11.10	Switch Type	Snap acting, hermetically sealed, shock & vibration proof.	
1.11.11	Terminal Block	Suitable for full ring lugs.	
1.11.12	Cable connection	½" NPT conduit connection.	
1.11.13	Enclosure Class	IP-65.	
1.11.14	Performance	(a) Repeat accuracy $\pm 1.0\%$.	
		(b) Accuracy of Setting Indication of $\pm 1.5\%$.	
1.11.15	Ambient temperature	0 – 50 Deg C.	
1.11.16	Nameplate	Tag number, service engraved in SS tag plate.	
1.11.17	Accessories	(a) Remote diaphragm seal with SS-316 capillary for viscous & corrosive application.	
		(b) Siphons for steam and hot water services.	
		(c) Retention ring and screws for surface mounting.	

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		(d) 1/2" NPT 2 Valve SS-316 barstock manifold.	
		(e) ½" NPT cable gland.	
1.12	<u>DIFFERENTIAL PRESSURE SWITCH</u>		
1.12.1	Type	Bellows/Diaphragm/Piston actuated.	
1.12.2	Sensing element material	AISI SS-316. For all other wetted part SS 316.	
1.12.3	Case Material	Die-cast aluminium alloy with neoprene gasket.	
1.12.4	Setter Scale	Black graduation on white scale with 0-100% graduation and provided with red pointer for set point adjustment.	
1.12.5	Over range	Static pressure on any one side, the other side being open to atmosphere.	
1.12.6	Adjustments	(a) Internal set point adjustment.	
		(b) Differential adjustment.	
1.12.7	Process Connection	1/2" NPT (M) bottom / back connected.	
1.12.8	Switch configuration	Two SPDT.	
1.12.9	Switch rating	240V, 5A AC/220V, 0.5A DC.	
1.12.10	Switch type	Snap acting type contacts, shock and vibration proof.	
1.12.11	Terminal Blocks	Suitable for full ring lugs for cable	

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		connection.	
1.12.12	Cable Connection	½" NPT conduit connection or compression gland.	
1.12.13	Performance	(a) Repeat accuracy $\pm 1.0\%$.	
		(b) Accuracy of set point Indication: $\pm 1.5\%$	
1.12.14	Operating Ambient	0 - 50 °C (Maximum Continuous).	
1.12.15	Enclosure	IP-65.	
1.12.16	Accessories	(a) Snubbers for pulsating fluid application.	
		(b) Syphons for steam and hot water services.	
		(c) Retention ring and screws for surface mounting.	
		(d) 1/2" NPT 3-Valve SS-316 manifold constructed from barstock.	
		(e) 1/2" NPT Cable gland.	
1.12.17	Nameplate	Tag number, service engraved in stainless steel tag plate.	
1.12.18	Remote Seal type for special application	(a) Silicone oil/fluorolube filled remote diaphragm seal for dirty/viscous/corrosive fluid.	
		(b) SS armoured capillary at least 3 meters each.	

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		(c) Adapter flanges with nuts, bolts and gaskets for instrument and process side.	
1.13	<u>LEVEL SWITCH</u>		
1.13.1	Type	External cage float operated. Magnetically coupled.	
1.13.2	Float Material	AISI-316 stainless steel or better.	
1.13.3	Other wetted parts	AISI-316 stainless steel or better.	
1.13.4	External Cage	Carbon steel/Stainless steel as per process requirements, welded type/ flanged construction. Cage pressure rating shall equal or exceed the rating of the main vessel.	
1.13.5	External cage mounting	Side-Side.	
1.13.6	External cage connection	25 NB socket welded.	
1.13.7	Switch housing	Epoxy coated die-cast aluminium alloy with neoprene gasket conforming to IP-65.	
1.13.8	Type of switch configuration	2 SPDT (two nos.).	
1.13.9	Contact rating	5A, 240V/ AC, 0.25A, 220V DC.	
1.13.10	Accessories	(a) Counter flange, nuts & bolts, suitable gasket etc.	
		(b) Steel globe type drain valve.	
		(c) ½"NPT cable gland.	
		(d) Stainless steel nameplate with	

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		alpha-numeric engraved for service and tag.	
1.13.11	Preferred feature	Switch operating point marked on cage.	
1.13.12	Mounting	On standpipe.	
1.14	<u>CONDUCTIVITY TYPE LEVEL SWITCH</u>		
1.14.1	Type	Conductivity discrimination.	
1.14.2	Application	Drain pots viz. on CRH line.	
1.14.3	Mounting	Flanged – on external cage.	
1.14.4	Probe MOC	Stainless steel with high purity ceramic.	
1.14.5	Probe rating	> Maximum design pressure of vessel.	
1.14.6	Input	Four independent channel with selectable switching threshold for water conductivity.	
1.14.7	Relay Output	Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.	
1.14.8	Contact type & rating	2 SPDT or 1 DPDT @ 5A 30V DC.	
1.14.9	Local Display	Coloured LEDs for Hi, Lo, Hi-Hi, Lo-Lo, Power & fault.	
1.14.10	Power supply	Dual 240V AC, 50 Hz, 1Ph.	
1.14.11	Enclosure	IP-65, corrosion resistant & wall mounting type (Explosion proof for NEC Class-1, Division-1 area).	

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SR. NO.	ITEM 1.16 (ORIFICE PLATE)	DESCRIPTION	
1.16.1	Application	Low fluid velocity flow measurement.	
1.16.2	Design Standard	BS-1042, Part-I.	
1.16.3	Number of Tapings	As required plus one additional pair of taps.	
1.16.4	Diameter Ratio	Between 0.4 to 0.7.	
1.16.5	Thickness	3 mm for main pipe diameter upto 250 mm, 6 mm for main pipe diameter above 250 mm and upto 500 mm and 10 mm for main pipe diameter of 500 mm and above.	
1.16.6	Document	Beta ratio calculation, assembly drawing and Flow vs. DP curve.	
1.16.7	Meter run pipe	Same as pipe material.	
1.16.8	Accessories	Flanges, gaskets, nuts & bolts, root valves jack screw, meter run pipe, Drain & vent hole as per application etc.	
1.17	<u>FLOW NOZZLE</u>		
1.17.1	Application	High fluid velocity flow measurement.	
1.17.2	Design Standard	ASME PTC 19.5.	
1.17.3	Number of Tapings	As required plus one additional pair of taps.	
1.17.4	Diameter Ratio	Between 0.4 and 0.7.	
1.17.5	Thickness	Suitable for the application.	
1.17.6	Document	Beta ratio calculation, assembly	

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		drawing and Flow vs. DP curve.	
1.17.7	Meter run pipe	Same as pipe material.	
1.17.8	Accessories	Meter run pipe, nipples and root valves (Inspection port assembly for nozzles used in plant performance purpose).	
1.18	<u>GAUGE GLASS</u>		
1.18.1	Type	Reflex.	
1.18.2	Glass	Toughened borosilicate Resistant to mechanical and thermal shocks.	
1.18.3	Body material	Carbon steel / stainless steel - As per process requirements (Flanged Connection).	
1.18.4	Pressure rating	Twice the maximum working pressure.	
1.18.5	Temperature rating	As required.	
1.18.6	Bolts and nuts	Rust proof alloy steel.	
1.18.7	Accessories	Suitable ball check valves of SS-304 /316 body, gaskets, companion flange etc.	
1.19	<u>POWER CYLINDERS (PNEUMATIC)</u>		
1.19.1	Mounting Type	(a) Fixed position mounting. (End mounting)	
		(b) Trunnion mounting.	
1.19.2	Control Signal	4-20 mA DC to SMART positioner with Superimposed HART protocol for	

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		modulating purposes. 24V DC operated solenoid valve operating on pneumatic line for open & closing purpose of on & off drive.	
1.19.3	Supply Air	7 Kg / cm ² .	
1.19.4	Selection	Based upon thrust/torque, stroke length, angular movement, full-scale travel time, repeatability, space factor etc Provision for air-to-open and air-to-close operation.	
1.19.5	Casing	IP-65.	
1.19.6	Accessories	(a) Air lock relay.	
		(b) Hand wheel.	
		(c) Air filter regulator with gauge.	
		(d) Volume Booster.	
		(e) Limit Switches.	
		(f) Smart Positioner with Input and Output pressure gauges, local keypad & display.	
		(g) Solenoid Valve.	
		(h) Integral non contact type position Transmitter. (4-20 mA DC linear output)	
		(i) Junction box with cable gland.	
1.19.7	Fail-safe operation	For regulating duty- stay put against	

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		power & air fail.	
1.19.8	Repeatability	Better than 0.5% of full travel.	
1.19.9	Hysteresis	Less than ±1% of full travel.	
1.19.10	Operating Temp. limit	80 Deg. C (min.)	
1.19.11	Operating Temp. limit		
1.19.12	Operating Temp. limit		
1.19.13	Operating Temp. limit		
1.19.14	Operating Temp. limit		
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1.19.97	Operating Temp. limit		
1.19.98	Operating Temp. limit		
1.19.99	Operating Temp. limit		
1.19.100	Operating Temp. limit		

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1.25.16	Enclosure	Flame Proof.	
1.25.17	Accessories	Calibration gas, mounting accessories and others as required to be provided	
1.25.18	Application	Generator Gas Purity.	
1.26	<u>RADAR TYPE LEVEL MEASUREMENT</u>		
1.26.1	Type	Radar based on Time Domain Reflectometry.	
1.26.2	Antenna	Co axial / single rod type guided wave or Horn type as required for the application.	
1.26.3	Communication	Two wire 4-20mA DC, HART protocol.	
1.26.4	Environmental temperature	0 – 50 °C.	
1.26.5	Enclosure	Explosion proof/IP 65 as per application.	
1.26.6	Cable Entry	½" NPT.	
1.26.7	Calibration	Self calibration with internal reference.	
		Zero & Span calibration.	
1.26.8	Programming	Handheld programmer & Local keypad.	
1.26.9	Process Connection	Flanged /screwed.	
1.26.10	Electronic Housing	Epoxy painted Die-Cast aluminium alloy.	

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1.26.11	Antenna / Flange assembly	316 SS or Hest alloy. (as required)	
1.26.12	Output Indicator	Digital Integral Display.	
1.26.13	Accuracy	5 mm or 0.1% of probe length.	
1.26.14	Accessories	(a) Programming tool kit.	
		(b) Gasket.	
1.27	<u>ULTRASONIC LEVEL TRANSMITTER</u>		
1.27.1	Principle of operation	Detection of reflected ultrasonic pulse, HART Protocol	
1.27.2	Measuring ranges	Up to 30 meters (typical)	
1.27.3	Signal processing	Microprocessor Controlled Signal Processing	
1.27.4	Operating frequency	10 KHz to 50 KHz (typical)	
1.27.5	Display	Large alpha-numeric back lit LCD/ LED	
1.27.6	Calibration & Configuration	Accessible from front of panel	
1.27.7	Diagnosis	On-line	
1.27.8	Status	For power, Hi/Lo/V. Hi/V. Lo - level indication, fault etc.	
1.27.9	Construction	Plug-on board	
1.27.10	Power supply	240 V AC 50 Hz / 24V DC	
1.27.11	Signal Output	4-20 mA DC - 600 Ohm load.	

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1.27.12	Hysteresis	Fully adjustable preferred	
1.27.13	Output contacts	2 SPDT Potential free changeover contacts @ 240V, 5A AC/220V, 0.5A DC.	
1.27.14	Accuracy & Repeatability	0.25% of span or better	
1.27.15	Resolution	0.1% of span	
1.27.16	Operating Temperature	Transmitter- 50 °C and Sensor – 80 °C	
1.27.17	MOC Sensor	Body- PVC and Face – Polyurethane	
1.27.18	Humidity	1% to 95% non condensing.	
1.27.19	Enclosure	IP-65 Epoxy painted die cast aluminium or Polycarbonate housing.	
1.27.20	Cable connection	3/4" ET	
1.27.21	Mounting	2" for sensor and Transmitter on panel.	
1.27.22	Accessories	Cable gland, prefab cable, mounting accessories.	
1.28	<u>CAPACITANCE TYPE LEVEL SWITCH</u>		
1.28.1	Type	Capacitance type	
1.28.2	Probe	(i) Rod or suspended electrode	
		(ii) Rope type probes may be used only where required probe length is greater than 3 meters.	
1.28.3	Probe Mounting	Stainless steel 1½" ANSI RF Flange / ¾" NPT (M)	

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1.28.4	Material of construction	316 SS	
1.28.5	Insulation	PTFE Part/ Full as per service.	
1.28.6	Enclosure	Powder/Epoxy coated Die cast aluminium with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).	
1.28.7	Ambient temperature	0-60 °C.	
1.28.8	Mounting	On Tap	
1.28.9	Supply voltage	240V AC, 50Hz /24V DC	
1.28.10	Relay output	2 SPDT	
1.28.11	Contact rating	240V, 5A AC/220V, 0.5A DC.	
1.28.12	Response time	100 mSec or better	
1.28.13	Cable connection	¾" ET	
1.28.14	Accessories	Counter flange, Cable gland, prefab cable and stainless steel name plate engraved with alpha-numeric.	
1.29	<u>TEMPERATURE SWITCH</u>		
1.29.1	Type	Mercury filled-in.	
1.29.2	Sensing Element Material	Bellow / Bourdon AISI SS-316.	
1.29.3	Bulb Material	AISI SS-316.	
1.29.4	Capillary	Stainless steel armoured.	
1.29.5	Movement Material	AISI SS-304.	
1.29.6	Case material	Epoxy coated steel plate or die-cast aluminium alloy with neoprene gasket	

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		and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).	
1.29.7	Scale	Black lettering on white background.	
1.29.8	Over range Protection	120 %.	
1.29.9	Instrument connection	Bottom.	
1.29.10	Switch configuration	Two SPDT.	
1.29.11	Switch rating	240V, 5A AC/220V, 0.5A DC.	
1.29.12	Switch type	Snap acting, shock and vibration-proof.	
1.29.13	Adjustability	Internal Set point adjustable over span range.	
1.29.14	Cable connection	3/4" ET conduit connection or compression gland.	
1.29.15	Compensation	(a) Capillary compensation with invar wire throughout the capillary length.	
		(b) Case compensation.	
1.29.16	Performance :		
(a)	Scale Accuracy	±1.0 % of full scale.	
(b)	Repeatability	< 0.5 % of full range.	
(c)	Response time	Less than 40 seconds with thermowell.	
1.29.17	Capillary length	5 meters (minimum) for local mounting/15 meters for local panel mounting.	

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1.29.18	Nameplate	Tag number, service engraved in stainless steel tag plate.	
1.29.19	Accessories	Mounting accessories, 3/4"ET cable gland.	
1.30	<u>ROTAMETER</u>		
1.30.1	Type	On-line up to 2". By-pass above 2".	
1.30.2	Metering tube	Borosilicate glass.	
1.30.3	Float	AISI 316-SS unless the process fluid demands some other material.	
1.30.4	Body MOC	AISI 316-SS.	
1.30.5	Scale	Graduated- Engraved black on white background.	
1.30.6	Process connection	Flanged.	
1.30.7	Accuracy	$\pm 2\%$ of full scale detection or better for on-line type and $\pm 4\%$ of full-scale detection or better for by-pass type.	
1.30.8	Nameplate	Tag number, service engraved in stainless steel tag plate.	
1.30.9	Accessories	Slip-on orifice plate of 316-SS and taps of Stainless Steel as per application requirements. Applicable SS Isolation valves and SS Range Orifice - for bypass type rotameters.	
1.31	<u>TURBIDITY ANALYSER</u>		
1.31.1	Type	Microprocessor based continuous	

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1.35	<u>I/P CONVERTER</u>		
1.35.1	Type	Electro-pneumatic (Outdoor Type)	
1.35.2	Input level	4-20 mA DC	
1.35.3	Output range	0.2 to 1.0 Kg/Sq. cm With 'Fail Freeze' feature. (i.e in case of wire snapping the last good value of pneumatic signal out put will hold for at least six hours)	
1.35.4	Split range	For typical application wherever required.	
1.35.5	Control Action	Selectable air to close, air to open and fail freeze application.	
1.35.6	Supply pressure	1.2 to 1.6 Kg/cm ² (1.4 typical)	
1.35.7	Max. supply pressure	7 Kg/ sq.cm.	
1.35.8	Response Time	5 Seconds for 0 to 90% output pressure.	
1.35.9	Housing	IP 55.	
1.35.10	Repeatability	±0.1% of span.	
1.35.11	Accuracy	± 0.25% of span.	
1.35.12	Supply pressure effect	Less than 1%.	
1.35.13	Span and Zero adjustments	Screw.	
1.35.14	Pneumatic connection	¼" NPT.	

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1.35.15	Stability	Less than 0.25% of Span / Zero for six months.	
1.35.16	Cable connection	¾" ET.	
1.35.17	Mounting	Field (pipe/wall mounting).	
1.35.18	Accessories	Air filter regulator, mounting accessories, cable gland etc.	
1.36	<u>AIR FILTER REGULATOR</u>		
1.36.1	Filter Element	Sintered Bronze.	
1.36.2	Filter Size	5 microns.	
1.36.3	Input Air	10.0 Kg/Sq. cm (maximum)	
1.36.4	Output	Adjustable from 0-2.0 Kg / Sq. cm or 0-7.0 Kg/Sq. cm (continuous) as applicable for I/P converter, control drives and control valve.	
1.36.5	Effect of Supply	Maximum 0.02 Kg/Sq. cm for a change pressure variation in supply pressure of 4 Kg/Sq. cm.	
1.36.6	Bowl Material	Metallic cover around high temperature area/clear transparent polycarbonate with metallic cover for ordinary applications.	
1.36.7	Accessories	2" dial size output pressure gauge.	
1.36.8	Desirable Feature	No perceptible drop of pressure on opening the drain port.	

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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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			(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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SR. NO.	ITEM	DESCRIPTION	
1.40	<u>FLOW INDICATING SWITCH</u>		
1.40.1	Type	On line metal tube Rotameter.	
1.40.2	End connection	Flanged.	
1.40.3	Material		
(a)	Body	CS/SS as per process medium.	
(b)	Float	Stainless steel.	
(c)	End fittings/flange	Stainless steel.	
(d)	Other wetted part	Stainless steel.	
(e)	Casing	Di cast Aluminium.	
1.40.4	Accuracy	+/- 2.0% of FSR.	
1.40.5	Rangeability	10:1.	
1.40.6	Electrical connection	¾" ET.	
1.40.7	Switch type	Snap acting hermitically sealed 2 nos. SPDT.	
1.40.8	Contact rating	5A, 240V AC.	
1.40.9	Protection class	IP-65.	
1.40.10	Accessories	As required.	
1.41	<u>ZERO SPEED SWITCH</u>		
1.41.1	Probe		
	(a) Type	Magnetic pick up (inductive type)	
	(b) Size	As per requirement	

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3.03.39 Humidity & Temperature Sensor with LCD display for AC Plant in respective building.

Humidity Sensor		
Measurement range	:	0-100%r.h.
Range of use	:	0-100%r.h.
Measurement accuracy at 23° C 0-100% r.h.	:	±2%
Temperature dependency	:	≤0.05% r.h./ ° C
Output signal, linear (terminal I1)	:	DC4-20mA = 0-100%r.h.
Temperature Sensor		
Range of use	:	0-50° C & -35 to 35° C
Sensing element	:	Pt1000 class A
Measurement accuracy at 15-35° C	:	±0.5K
Output signal, linear (terminal I2)	:	DC4-20mA = 0-50° C & -35 to 35° C
General Sensor Data		
Power supply		
Operating voltage	:	AC 24V ±20%
Degree of Protection & Safety Class		
Degree of protection of housing		
With enclosed cable gland	:	IP 65 to IEC 529
Safety class	:	III to EN 60 730

Environmental Condition		
Temperature (housing with electronics)	:	-40 to 70° C
Humidity	:	5 to 95% r.h. (non condensing)
Location	:	In each AHU room, return air line and each Control room, cubicle room, meeting room, training room, & conference room etc.

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SR. NO.	ITEM	DESCRIPTION	
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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SR. NO.	ITEM	DESCRIPTION	
2.14.6	Zero Adjustment	Screw on meter face.	
2.14.7	Enclosure	Shielded case.	
2.14.8	Mounting	Flush Panel.	
2.14.9	End Scale Suppression	2 times the measuring range only for motor ammeters.	
	For electrical system's meter and for synchronization, Bidder shall refer to electrical volume of the specification.		
2.15	<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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SR. NO.	ITEM	DESCRIPTION	
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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SR. NO.	ITEM		DESCRIPTION	
2.18.5	ANNUNCIATOR LOGIC			
	(a)	The circuit components for individual windows shall be mounted on plug -in circuit cards.		
	(b)	Input shall be provided with contact bounce filtering. The filter shall delay contact inputs for 15 milliseconds to protect against input device bounce and electrical noise on input lines.		
	(c)	Critical alarms shall be hardwired to the input card of annunciator controller.		
2.18.6	OTHER TECHNICAL PARTICULARS			
	(a)	Type of contact	NO or NC configurable	
	(b)	Contact interrogation voltage	24 V DC	
	(c)	Window drivers.	Electronically short circuit protected, current limiting with automatic recovery	
	(d)	Facia dimension	75 mm (W) X 50 mm (H)	
	(e)	LED per facia	8 nos./Window	
	(f)	Flash rate	Adjustable (slow, fast, intermittent)	
	(g)	Inscription Type	Etched on photo film (sandwiched)	
	(h)	Inscription letter height	5 mm (min.)	
	(i)	No. of row of inscription/ facia	4 (max.)	
	(j)	No. of letters/row	14 (max.)	

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SR. NO.	ITEM	DESCRIPTION
	(k) Colour of letters	Black (for white windows)
	(l) Facia front cover	Hi-impact polystyrene
	(m) Facia rear plate	Translucent plastic
	(n) Colour of background	Milk white and red for critical / trip.
	(o) Fascia block plate	Cold rolled sheet steel epoxy painted.
	(p) Audible alarm	Cone type speaker
	(q) Tone generator	Electronic with adjustable tone, amplitude and frequency
	(r) Preferred sequence	(i) Ordinary Channel : ISA-S-18.1-1979-R
		(ii) First-up channel : ISA-S-16.1-1979- F3M3
NOTE: 1. Instruments which are open to atmosphere should be covered with proper canopy.		
3.0 <u>CONTROL VALVES, ACTUATORS & ACCESSORIES</u> General Technical Guidelines for the Control Valves shall be as follows : (a) Bidder shall exercise caution in selecting severe service control valves like BFP recirculation valves, HP & LP bypass valves, superheater & reheater attemperator valves, PRDS valves for Boiler & Turbine, Soot blower steam pressure control valve, control valves whose down stream are connected to vacuum such as HP/LP heater emergency level control, condenser make up water control valve, separator level control and CEP minimum flow control valve. For such critical applications, Bidder shall offer valves which are proven		

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for similar application. Above valves shall have leakage class equal or better than class-V with metal-to-metal seating. (b) Wherever, steam conditioning calls for Pressure reducing & desuperheating, combined PRDS type valves shall be offered. (c) Bidder shall provide redundant control valves for Main condensate flow control, Superheat attemperation control and Reheat attemperation control as a minimum for high availability. For other application, if the availability criteria for the plant cannot be met even with the best established product, redundant control valves shall be provided. (d) Control valves shall be located near floor or platform for ease of access and with adequate clearances for maintenance and lay-down and shall be placed as station with upstream motorized isolating valve, down-stream isolating valve, inching duty motorized bypass valve and manual drain valves. Each redundant control valve shall have its upstream motorized and down-stream manual isolating valves. Where quick shut off requirement is foreseen such as in case of SH & RH attemperation valves, upstream isolation valve shall be pneumatic type. 3.1 <u>GENERAL</u> 3.1.1 Control valves for regulating service shall normally be globe body, preferably cage guided, metal-to-metal seated, pneumatically operated and shall be provided with characterized plugs having ANSI leakage class-IV except for the control valves indicated above. 3.1.2 Where the operating time is critical for the operation of the plant, as in case of HP or LP bypass valves, hydraulic actuators with electro-hydraulic interface shall be offered. 3.1.3 Bonnet joints for all control valves shall be of flanged and bolted type. 3.1.4 Flanged valve shall be rated at no less than class 300 lbs.		

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3.2	<u>VALVE BODY/END CONNECTIONS</u>	
3.2.1	Valve end to end dimension and connection shall be according to ANSI standard, straight through pattern. However, Bidder may offer angle body valve for high pressure drop applications. For high pressure drop applications, construction of the valve shall be such that the gland is not exposed to inlet pressure.	
3.2.2	Control valves of 40 mm. size and above with line pressure up to 50 Kg/Sq. cm may have flanged or welded end connections.	
3.2.3	Control valves, used in high pressure services shall have butt welded end connections for size 65mm and above and socket weld end connection for size 50 mm or below.	
3.2.4	Control valve body shall be selected as per the ISA guideline. Generally control valve body shall be cast and machined for pressure rating up to 1500 lbs. Above 1500 lbs, valve body shall be of forged steel. For Demineralized Water application, valve body shall be Stainless Steel.	
3.2.5	The direction of flow shall be clearly engraved on the body.	
3.2.6	Valve Body Material	
	SR.NO. SERVICE	MATERIAL
	(a) Non corrosive, non-flashing and non cavitating service for fluid temperature upto 275°C	: Cast carbon steel ASTM A216 Gr. WCB
	(b) Non corrosive, non-flashing and non cavitating service for fluid temperature above 275°C	: Cast alloy steel ASTM A217 Gr. WC9
	(c) Severe flashing / cavitating services	: Cast alloy steel ASTM A217 Gr. WC9
	(d) Low flashing / cavitating services	: Cast alloy steel ASTM A217 Gr. WC6

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SR.NO. SERVICE (e) DM water application (condenser hotwell normal, emergency make up etc.) MATERIAL : Cast type 316 stainless steel ASTM A351 Gr. CF8M 3.3 VALVE SIZE The control valve sizing (Cv/Kv) shall be based on following guidelines : (a) The valves shall pass normal flow (MCR condition) with 60 to 70 percent opening for linear characterized valves and between 70 to 80 percent opening for equal percentage characterized valves. (b) The valves shall have adequate rangeability to pass the minimum and maximum flows at 10% and 85% of the valve opening respectively. Valve stem travel range from minimum to maximum flow condition shall not be less than 50% of the total valve stem travel. (c) Valve CV shall be selected in such a way that the valve shall be capable of handling at least 120% of required maximum flow. (d) The valve selection shall be based on the highest size dictated by the above considerations unless noise, flashing or other factors dictate the final selection. (e) Trim outlet velocity for the control valves shall be no more than 7 m/sec for water service and Mach number less than 1/3 for steam and air service application. (f) The sizing procedure followed shall be as per latest edition of ANSI/ISA or equivalent standard. 3.4 VALVE TOP WORK 3.4.1 Top work shall be sized so that the valve shall operate properly when upstream pressure is 10 percent above maximum inlet pressure and downstream pressure is atmospheric.		

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3.4.2

Extended bonnet/Finned bonnet and high temperature packing shall be used for high temperature application.

3.4.3

The gland material shall be chosen to suit the operating temperature. PTFE may be chosen for lower temperature application (232°C maximum) and for high temperature application graphite asbestos glands are to be provided. For vacuum services, the glands shall be of dry seal type.

3.5

VALVE TRIM

3.5.1

Valve trim for applications up to leakage class-V shall be stainless steel 316 SS for pressure drop up to 7 Kg/Sq. cm. For pressure drops above 7 Kg/Sq. cm hard trim (stelliting or equivalent) shall be used. Other alloys or treatment such as nitride shall be used if severe erosion is expected.

3.5.2

Balanced trim valves shall be offered for high shut-off pressure or high pressure drop condition to reduce the size of the actuators.

3.5.3

For flashing services and two stage mixtures, the trim material shall be 17-4 PH SS or equivalent.

3.5.4

If cavitating condition is foreseen, Bidder shall offer multistage or labyrinth trim valves. Trim of severe service valves shall be of multistage and multipath design with number of discrete pressure drop stages to eliminate the chances of erosion, cavitation, noise and vibration throughout the control range of the valve.

3.5.5

Quick replacement type trim shall be considered for easy maintenance.

3.5.6

Trim Material

SR. NO.	SERVICE	MATERIAL
(a)	Non corrosive, non-flashing and non cavitating service for fluid temperature upto 275°C.	: SS 316 stellited
(b)	Non corrosive, non-flashing and non cavitating service for fluid	: SS 316 stellited

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SR. NO. SERVICE MATERIAL temperature above 275°C. (c) Severe flashing /cavitating services : 440 C (d) Low flashing /cavitating services : 17-4 PH SS (e) DM water application (condenser hotwell normal, emergency make up etc.) : 17-4 PH SS 3.6 <u>NOISE LEVEL</u> The equivalent sound level measured at 1.5M above nearest floor level in elevation and 1 M horizontally from the control valve expressed in decibels to a reference of 0.0002 microbar shall not exceed 85 dB. If the calculated noise is more than the above limit, even with low noise trim design, diffusers shall be included. Diffusers shall be made of stainless steel and shall be integrally connected to the control valve with spool piece. The spool piece shall be in conformity with the main line piping specification. 3.7 <u>VALVE ACTUATORS</u> Spring-diaphragm type actuators shall generally be used. Piston type actuators shall be offered in case of high shut-off pressure & quick response requirement. 3.7.1 The actuator shall be designed for 150% thrust required for the valve (at shut-off pressure) at an air line supply pressure of 5.5 Kg/Sq. cm. 3.7.2 Diaphragms shall be designed for 200% maximum operating pressure. 3.7.3 Nylon reinforced neoprene is preferred as diaphragm material. 3.7.4 Valve actuators shall be capable of operating at 80°C ambient, continuously. 3.7.5 Entire actuator assembly shall be painted with corrosion inhibiting paint.		

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3.7.6	Air connection size shall be ¼" NPT (F) unless otherwise dictated by process response time. Integral tubing shall be stainless steel.	
3.7.7	Bidder shall indicate the stroking time of the valve assemblies with positioner and ensure that the stroke time shall meet the process and equipment dynamics and shall be better than 20 seconds.	
3.7.8	All actuators shall be of fail safe design signifying that the spring direction will tend to move the valve (open or close) in a direction safe for the process. "Failure to Open" or "Failure to Close" shall be marked on the actuator.	
3.8	<u>VALVE POSITIONERS</u>	
3.8.1	Regulating duty valves shall be offered with SMART Electro Pneumatic Positioners to ensure accuracy and repeatability of response.	
3.8.2	Positioners shall have integral non contact type position transmitter, input and output gauges, local keypad & display.	
3.8.3	Positioners shall be capable of functioning under hot, humid and vibrating conditions.	
3.8.4	Positioner casings shall be dust tight, corrosion resistant and weatherproof.	
3.8.5	In general, positioner shall operate at signal range 4 - 20 mA DC for the full travel of the valve. Remote calibration from control room shall be possible through HART management station for main plant positioners. However the calibration of positioner of off-site plants shall be carried out from hand held station.	
3.9	<u>VALVE ACCESSORIES</u>	
	Accessories shall include side mounted hand wheels, limit switches, junction boxes, airlock relays etc.. Solenoid valve wherever required shall be furnished.	

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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.		

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
CONTROL PANELS SPECIFICATION		

Local control panel shall be provided for AHU's with the following instruments and controls mounted on it:

- (a) Hand switches
- (b) Indicating Lamps
- (c) Differential pressure gauges
- (d) Electric Thermostat/Pneumatic thermostat
- (e) Temperature Indicator
- (f) Humidity Indicator
- (g) Temperature Controller
- (h) Any other instruments needed for controls
- (i) Solenoid valve
- (j) Any other loose instruments required

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6.9 <u>LOCAL CONTROL PANEL (LCP)</u> 6.9.1 The following control panels are to be used for control metering, process and safety interlocks, indication and audio-visual annunciation. (a) One for the Central Chilled Water Plant. (i) One for each AHU. Such Local Control Panels shall provide: (b) ON/OFF control of each drive and equipment (ii) Status indication of each drive by indicating lamps Following Safety Controls: (a) With LCP of Central Plant		

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(i) Overload trip of Condenser Cooling Water and chilled water pump motors (ii) Overload trip of cooling tower fan motor (b) With LCP of each AHU room (i) Overload trip of AHU/FCU fan motor. (ii) High temperature and/or "no air flow cut out" with strip heaters. (iii) Closing of Fire Dampers in case of fire The LCP in each AHU room shall also perform operating control of three way control valve with the sense of return air thermostat and on/off control of strip heaters and the pan humidifier. 6.9.2 Audio-Visual annunciation shall be provided at the Local Control Panel of central AC plant room through annunciation windows. A set of "Accept", "Reset" & "System Test" push buttons shall be incorporated. One hooter for any kind of malfunctions shall be provided on the top of the panel for audio effect of the complete system. 6.9.3 Following Audio-Visual Annunciations are to be provided in the LCP of central AC Plant: (a) Low Oil Pressure of Compressor, if semi sealed (b) Low Condenser Water Flow (c) Low Suction Pressure of Compressor (d) High Discharge Pressure of Compressor (e) Compressor Motor Overload (f) Low Chilled Water Flow		

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(g) Low Chilled Water Temperature (h) Chilled Water Pump Motor Overload (i) Condenser Water Pump Motor Overload (j) Cooling Tower Fan Motor Overload (k) AHU Motor Overload (for each AHU) (l) Fresh Air Fan Motor Overload <u>Note</u> 10% spare annunciation windows shall be provided over and above the annunciation as listed. Provision of additional annunciation (s) may be decided depending on Bidder's requirement. The spare windows shall be equipped with all devices as provided for active windows.		

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6.13.3 General Design Requirement The equipments to be supplied shall be suitably constructed for safe and proper operation under all conditions described or supplied in this specification without undue vibration, strain, corrosion or other difficulties. Contractor's scope of work with respect to design and procurement of control and procurement of control and instrumentation is specified elsewhere in this specification. For each damper, following instrumentation shall be provided. (a) Local control panel complete with solenoid valve, PRV (if needed), terminal blocks and any other instrument required. Minimum Ten (10) of spare terminals shall also be provided for Owner's future use. Solenoid valve shall be wired to the terminal block. Solenoid valve shall get de-energised on receiving signal from smoke detector or any other control logic to close the damper. (b) Limit switches mounted on damper actuator shall be suitably wired to the terminal block in the control panel. (c) Copper tubes of suitable size shall be laid from solenoid valve, installed in control panel to the actuator. All parts subject to substantial temperature changes shall be designed and supported so as to permit free expansion or contraction without resulting in leakage, distortion and excessive strains in the equipment. Parts subject to wear, corrosion or other deterioration or requiring adjustment, inspection or repairs shall be accessible and have reasonable convenience for removal, replacement and repair. All such parts shall be of suitable material or suitably lined for keeping maintenance to a minimum.		

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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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(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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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: <table border="0" style="margin-left: 40px;"> <tr> <td style="padding-right: 20px;">(i) Control wiring (switches, pushbuttons etc.)</td> <td style="padding-right: 20px;">:</td> <td>1.5 Sq.mm</td> </tr> <tr> <td style="padding-right: 20px;">(ii) Power supply/receptacle /illumination wiring</td> <td style="padding-right: 20px;">:</td> <td>2.5 sq. mm or higher as per load/</td> </tr> <tr> <td style="padding-right: 20px;">(iii) 4-20mA DC current and low voltage signal upto 24V DC</td> <td style="padding-right: 20px;">:</td> <td>0.5 Sq. mm</td> </tr> </table>			(i) Control wiring (switches, pushbuttons etc.)	:	1.5 Sq.mm	(ii) Power supply/receptacle /illumination wiring	:	2.5 sq. mm or higher as per load/	(iii) 4-20mA DC current and low voltage signal upto 24V DC	:	0.5 Sq. mm
(i) Control wiring (switches, pushbuttons etc.)	:	1.5 Sq.mm									
(ii) Power supply/receptacle /illumination wiring	:	2.5 sq. mm or higher as per load/									
(iii) 4-20mA DC current and low voltage signal upto 24V DC	:	0.5 Sq. mm									

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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"> <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.
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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		

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SPECIFICATION FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS -999- 145 -054A	
VOLUME	II B
SECTION	D
REV. NO. 03	DATE : 16-09-2013
SHEET	1 OF 6

1.0 SCOPE

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

2.0 CODES AND STANDARDS

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

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

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

3.0 TECHNICAL REQUIREMENTS

3.1 Panel Construction

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

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

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

3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel

Frame thickness: Not less than 3.0mm

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

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.



SPECIFICATION FOR LOCAL PANELS

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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

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								VOLUME		IIB			
								SECTION		D			
								REV. NO.		01		DATE: 22-02-2008	
								SHEET		1		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^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													

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								SHEET 2 OF 7				
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			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.
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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

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	
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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2 - Vendor
3 - Sub-vendor

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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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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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									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

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TAG No. Qty.....

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

Data Sheet A & B

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

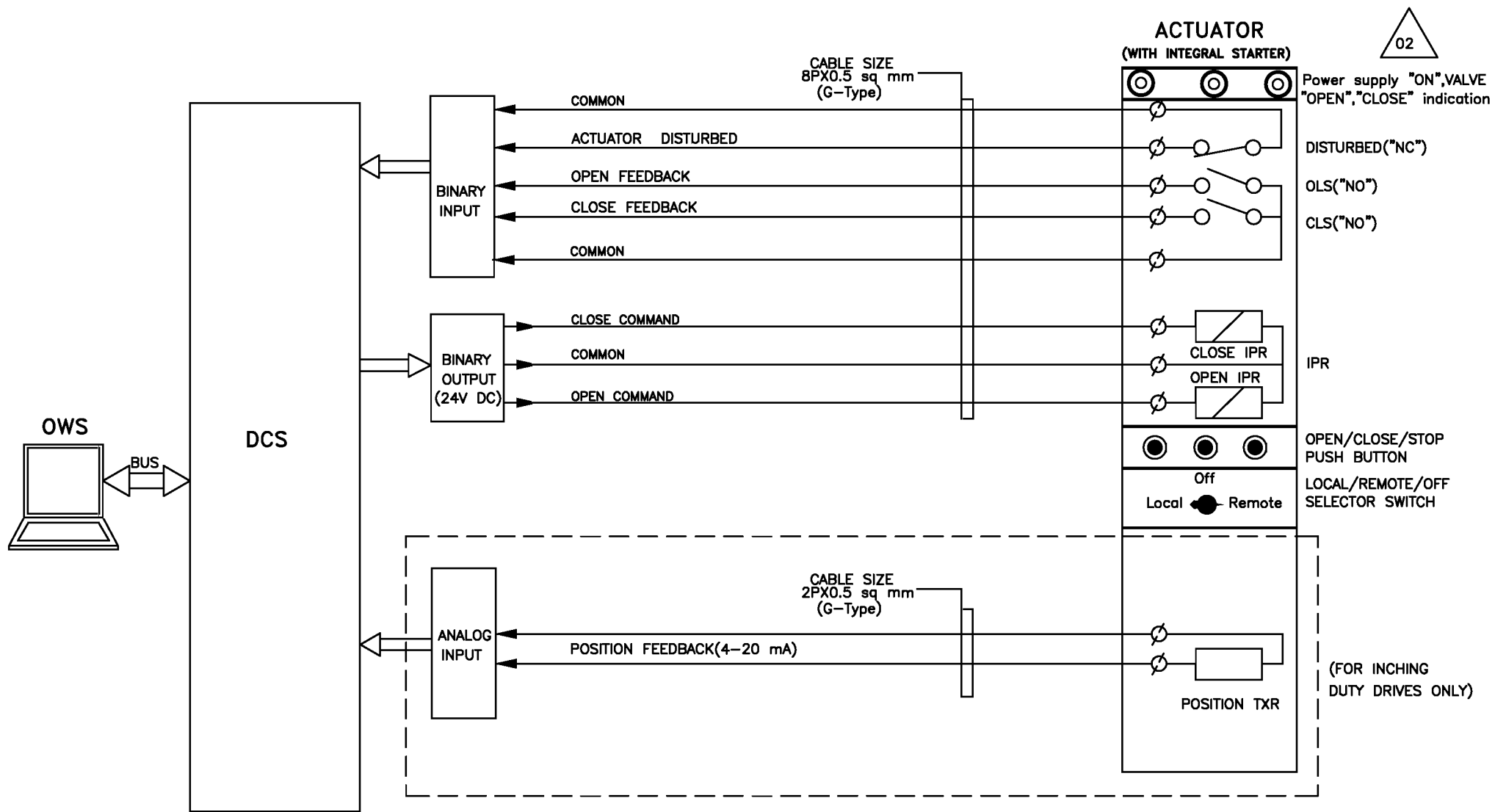
DATA SHEET-B
(TO BE FILLED-UP BY
BIDDER)

GENERAL	MANUFACTURER		
	CONSTRUCTION		☐ 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	
				SECTION	
				REV. NO. 01	DATE: 24.01.2019
				SHEET 2	OF 2
TAG No. Qty.....			Data Sheet No.: PES-145A-DS1-0		
Data Sheet A & B					
DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)				DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
* TO BE CO-ORDINATED WITH PEM ELECTRICAL					
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL NAME: SIGNATURE: DATE:	

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
DRIVE CONTROL PHILOSOPHY		

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)

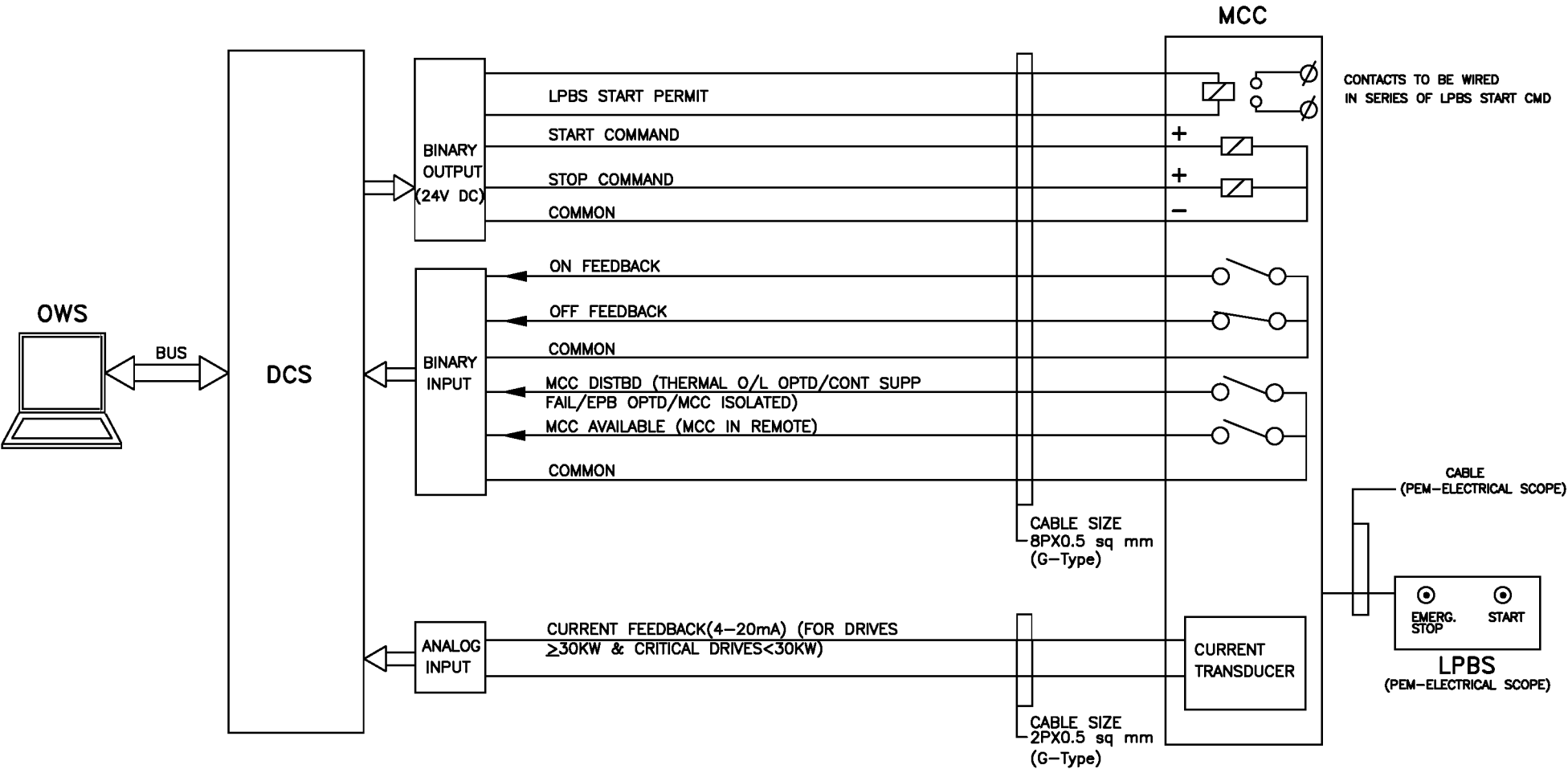


NOTE:

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

	PROJECT:	1x660 MW BHUSAWAL STPP	DRG.NO.	PE-DM-415-145-I002
	TITLE	DDCMIS INTERFACE FOR BIDIRECTIONAL DRIVE	DATE	10.08.2018
			REV.NO.	03
			SHT	8 OF 12

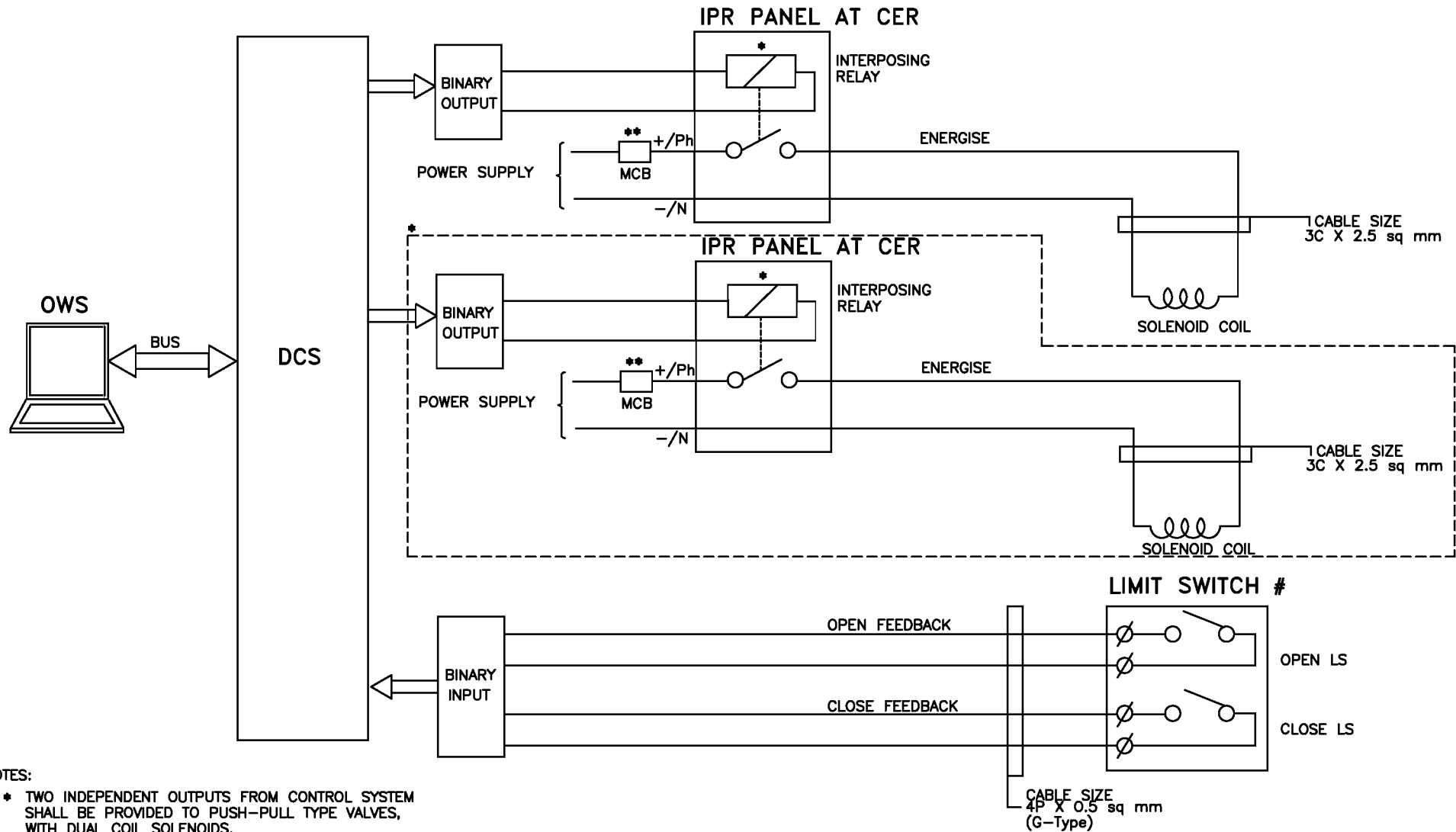
DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE(CONTACTOR OPERATED)



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

	PROJECT:	1x660 MW BHUSAWAL STPP		DRG.NO.	PE-DM-415-145-I002
	TITLE	DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE		DATE	10.08.2018
				REV.NO.	03
				SHT	9 OF 12 ⁴⁰⁷

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



NOTES:

* TWO INDEPENDENT OUTPUTS FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.

** MCB SHALL BE PROVIDED FOR EACH SOLENOID

FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.



PROJECT:

1x660 MW BHUSAWAL STPP

TITLE

DDCMIS INTERFACE FOR
SOLENOID DRIVE

DRG.NO.

PE-DM-415-145-I002

DATE

10.08.2018

REV.NO.

03

SHT

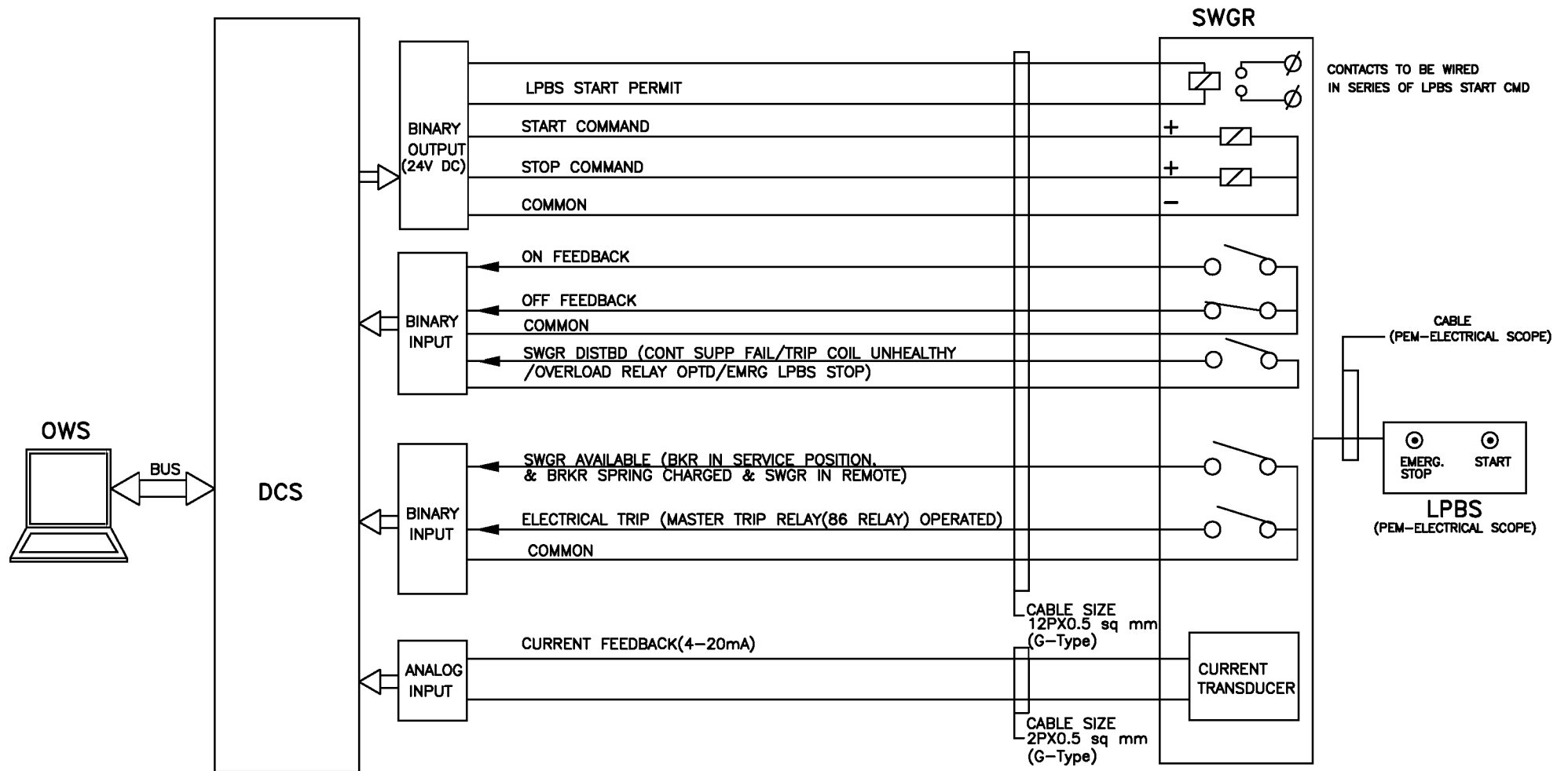
10

OF

12

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

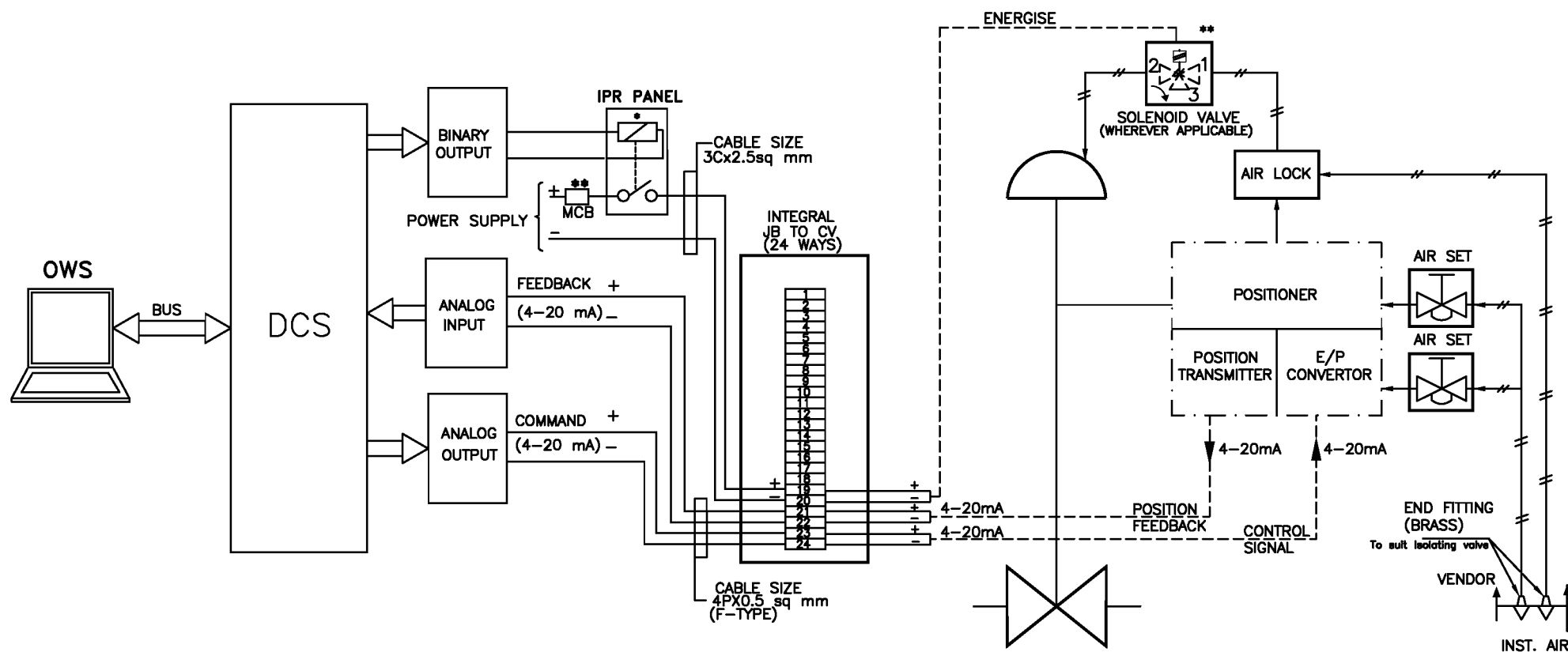


NOTE:- INTERPOSING RELAYS(IPRs) TO BE SUPPLIED ALONG WITH SWITCHGEAR.



PROJECT:	1x660 MW BHUSAWAL STPP	DRG.NO.	PE-DM-415-145-I002	
		DATE	10.08.2018	
TITLE	DDCMIS INTERFACE FOR UNIDIRECTIONAL HT DRIVE	REV.NO.	03	
		SHT	11	OF 12 ¹⁰⁹

DCS INTERFACE FOR ANALOG DRIVE



NOTES:

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



PROJECT:

1x660 MW BHUSAWAL STPP

TITLE

TYPICAL HOOK-UP DIAGRAM
ANALOG DRIVE

DRG.NO.

PE-DM-415-145-I002

DATE

10.08.2018

REV.NO.

03

SHT

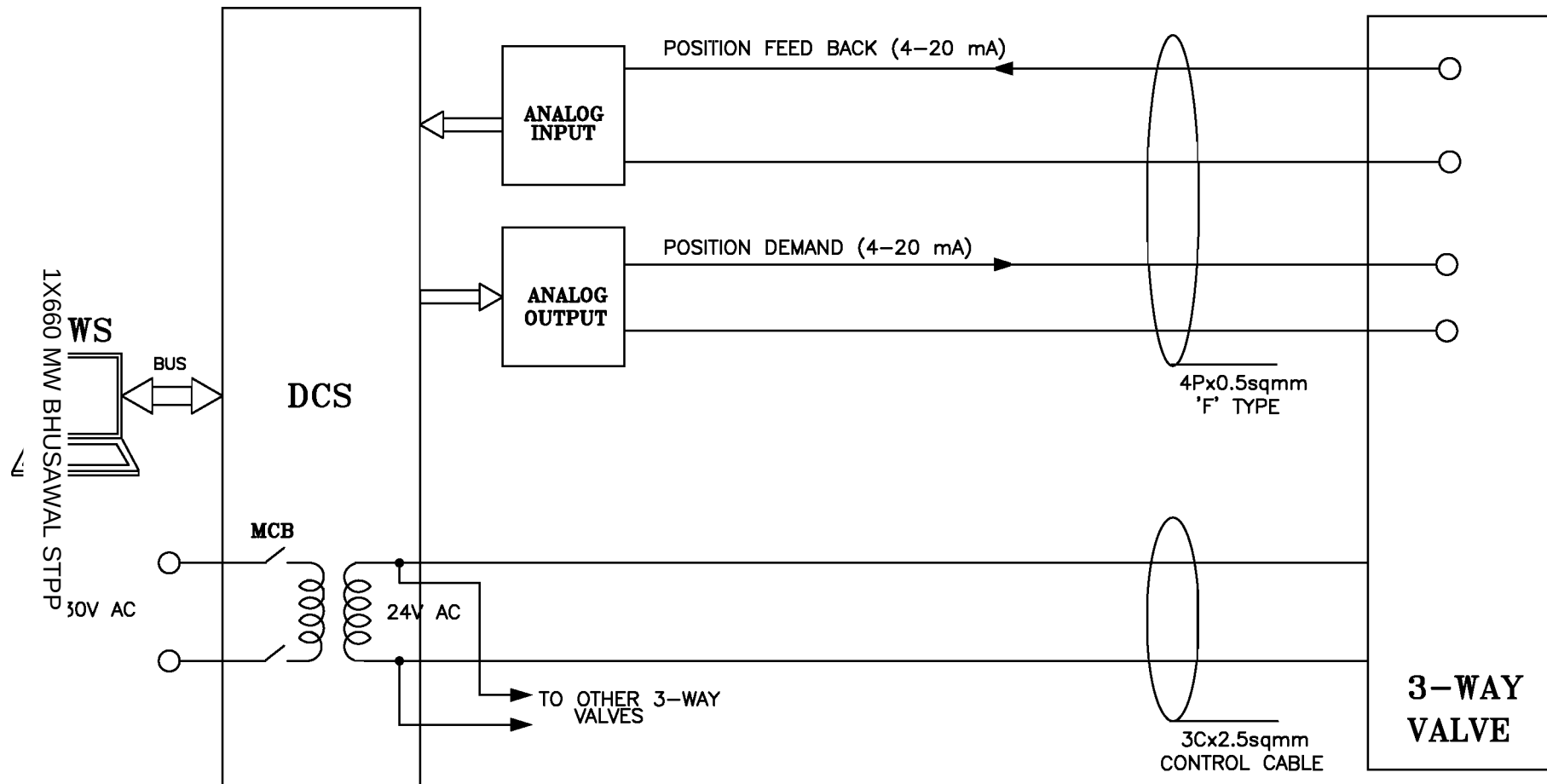
12

OF

12

10

DCS INTERFACE FOR 3-WAY MIXING VALVE (MOD-AC)

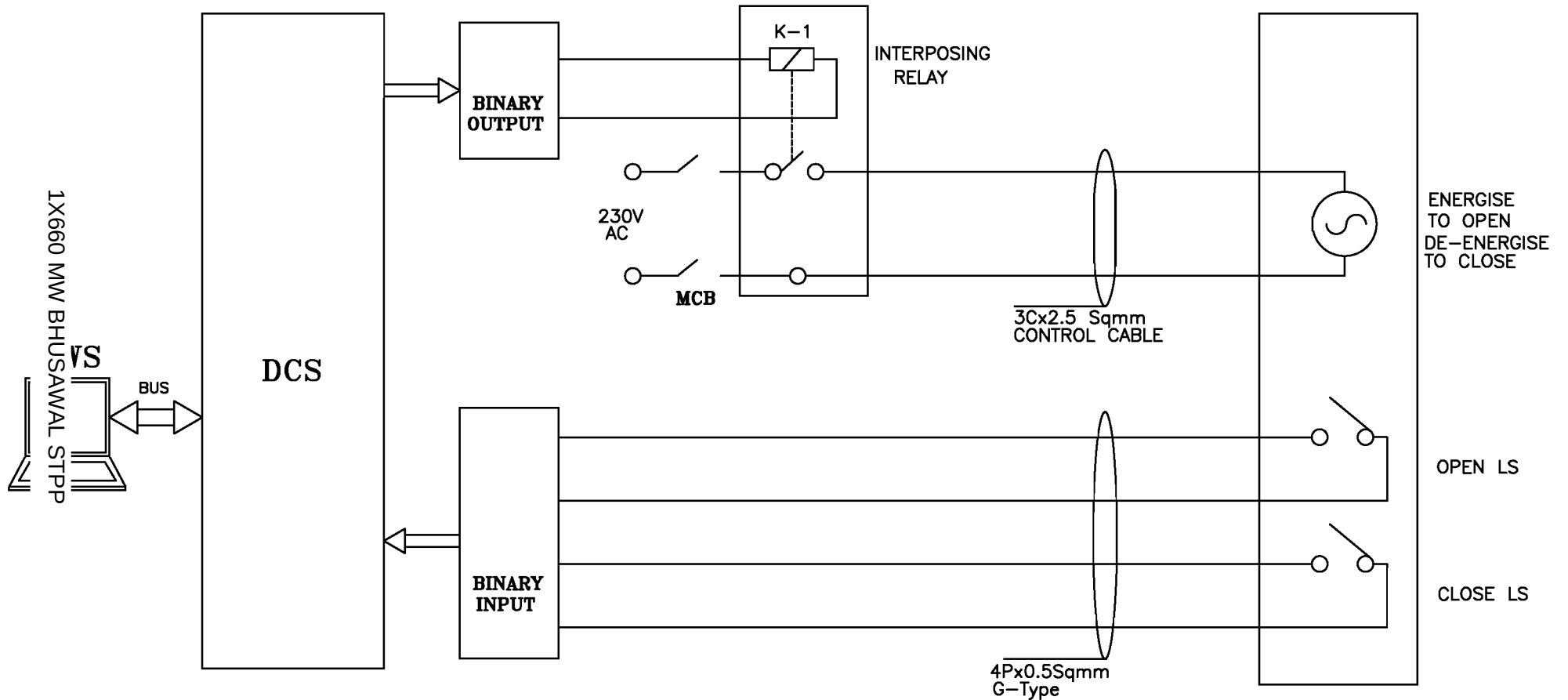


PROJECT: NORTH KARANPURA STPP
3 X 660 MW

TITLE: REFERENCE DRIVE INTERFACE SCHEME
FOR HVAC PACKAGE

DRG.NO.	
DATE	18.01.2017
REV.NO.	00
SHT 2	OF 46

DCS INTERFACE FOR MOTORIZED OPERATED FIRE DAMPER (BID-FD)

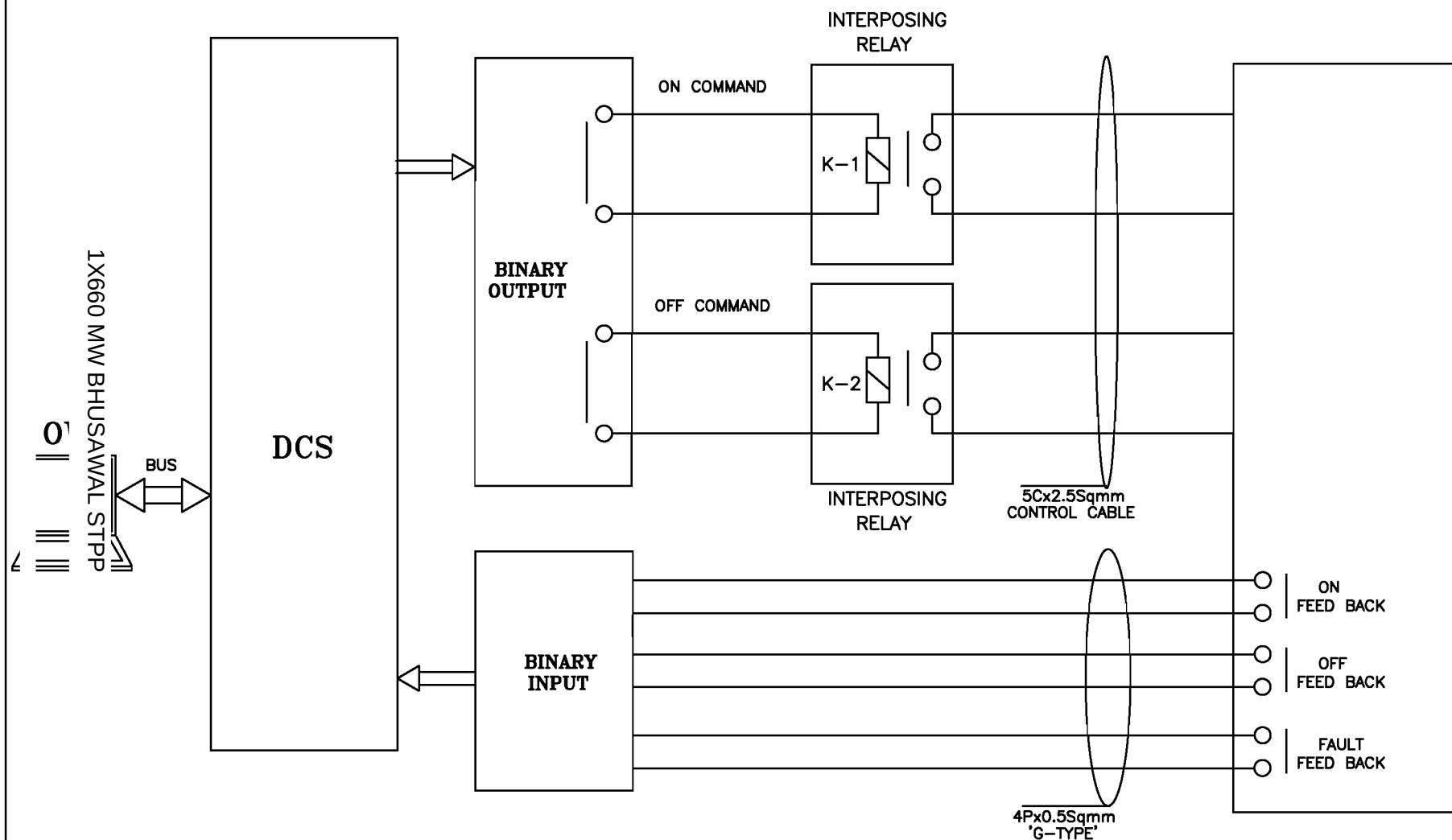


PROJECT: NORTH KARANPURA STPP
3 X 660 MW

TITLE: REFERENCE DRIVE INTERFACE SCHEME
FOR HVAC PACKAGE

DRG.NO.	
DATE	18.01.2017
REV.NO.	00
SHT 3	OF 42

HOOK-UP DIAGRAM FOR SCREW CHILLER MACHINE(SCM)/ACCU

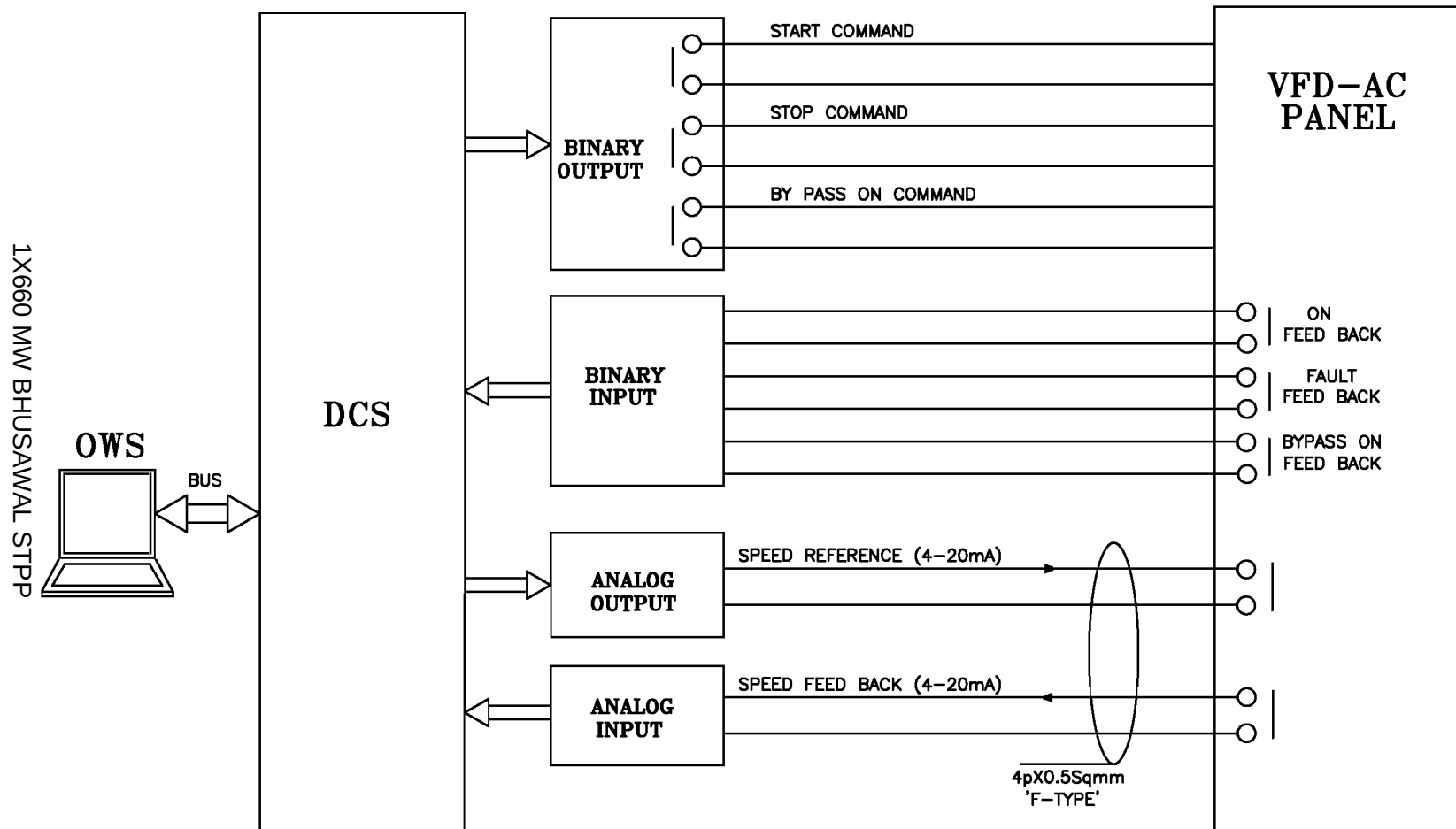


PROJECT: NORTH KARANPURA STPP
3 X 660 MW

TITLE: REFERENCE DRIVE INTERFACE SCHEME
FOR HVAC PACKAGE

DRG.NO.	
DATE	18.01.2017
REV.NO.	00
SHT 4	OF 6

DCS INTERFACE FOR AHUs VFD(VFD-AC)

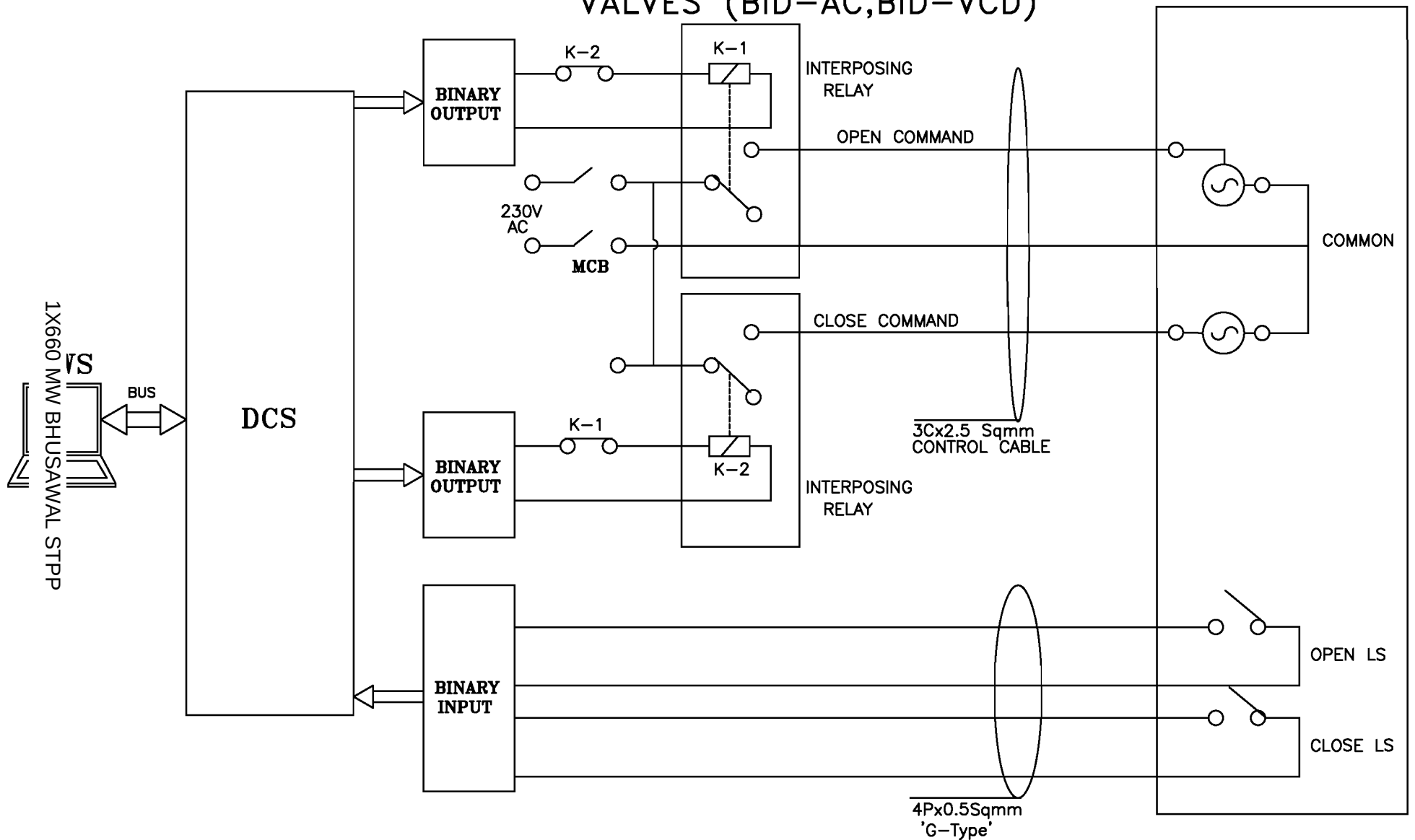


PROJECT: NORTH KARANPURA STPP
3 X 660 MW

TITLE: REFERENCE DRIVE INTERFACE SCHEME
FOR HVAC PACKAGE

DRG.NO.	
DATE	18.01.2017
REV.NO.	00
SHT 5	OF 6

DCS INTERFACE FOR MOTORIZED OPERATED VALVES (BID-AC,BID-VCD)



PROJECT: NORTH KARANPURA STPP
3 X 660 MW

TITLE: REFERENCE DRIVE INTERFACE SCHEME
FOR HVAC PACKAGE

DRG.NO.	
DATE	18.01.2017
REV.NO.	00
SHT 6	OF 6

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

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	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 1
REV: R0	CONTROL & INSTRUMENTATION	Page 37 of 718
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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	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
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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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 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
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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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 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
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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.		

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	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
QUALITY ASSURANCE PLAN/CHECK LIST		

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: II
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 7
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1.0 <u>QUALITY ASSURANCE PROGRAMME</u> 1.1 To ensure that the equipment and services under the scope of Contract whether manufactured or performed within the Contractor's works or at his Sub-contractor's premises or at the Owner's site or at any other place or work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Owner/Authorised representative after discussions before the award of contract. A quality assurance programme of the Contractor shall generally cover the following: 1.1.1 His organisation structure for the management and implementation of the proposed quality assurance programme. 1.1.2 Documentation control system. 1.1.3 Qualification data for Bidder's key personnel. 1.1.4 The procedure for purchase of materials, parts, components and selection of Sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc. 1.1.5 System for shop manufacturing and site erection control including process controls and fabrication and assembly controls. 1.1.6 Control of non-conforming items and system for corrective actions. 1.1.7 Inspection and test procedure both for manufacture and all site related works. 1.1.8 Control of calibration and testing of measuring and testing equipments. 1.1.9 System for quality audit. 1.1.10 System for indication and appraisal of inspection status. 1.1.11 System for authorising of release of manufactured product to the Owner.		

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1.1.12 System for handling storage and delivery. 1.1.13 System for maintenance of records. 1.1.14 Furnishing of quality plans for manufacturing and field activities, detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component. 2.0 <u>GENERAL REQUIREMENTS - QUALITY ASSURANCE</u> 2.1 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection /tests to be carried out by the Contractor for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Contractor's responsibility to draw up and implement such programme duly approved by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder, separately in the format attached at Annexures and shall be submitted to Owner/ Authorised representative for approval. Schedule of finalisation of such quality plans will be finalised before award. 2.2 Manufacturing Quality Plan shall detail out for all the components and equipment, various tests/inspection to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's Quality Control organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc, during all stages of materials procurement, manufacture, assembly and final testing/performance testing. 2.3 Field Quality Plans shall detail out for all the equipment, the quality practices and procedures etc to be followed by the Contractor's site Quality Control organisation, during various stages of site activities from receipt of materials/equipment at site. 2.4 The Bidder shall also furnish copies of the reference documents / plant standards / acceptance norms/tests and inspection procedure etc as referred		

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in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc shall be subject to Owner's approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, Owner/Authorised representative shall identify Customer Hold Points (CHP), test/ checks which shall be carried out in presence of the Owner's Engineer or his authorised representative and beyond which the work will not proceed without consent of Owner/Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/Authorised representative for approval and disposal. 2.5 No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Owner's Engineer/Authorised representative and duly authorised for despatch issuance of Material Despatch Clearance Certificate (MDCC). 2.6 All materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report. These certificates and reports shall indicate the sheet numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it. 2.7 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record and mechanical property test results shall be furnished. 2.8 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section-IX/BS-4870 or other International equivalent standard acceptable to the Owner. All brazers, welders etc employed on any part of the contract at Contractor's / Sub-Contractor's works or at site shall be qualified as per ASME Section-IX or BS- 4871 or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner/his authorised representative.		

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For welding of pressure parts and high pressure piping, the requirements of IBR shall also be complied with.		
2.9	All Non-Destructive Tests (NDT) shall be carried out in accordance with approved International Standard. The NDT operator shall be qualified as per SNT-TC-1A (of American Society of non- destructive examination). Results of NDT shall be properly recorded and submitted for approval.	
2.10	List of all the sub-vendors proposed by the Contractor for procurement of major bought out items including castings, forgings, semi-finished and finished components/ equipment shall be drawn up by the Contractor and finalised with the Owner. Such list shall be subject to Owner's approval. Quality Plans of the successful vendors shall be discussed, finalised and approved by the Owner/Authorised representative and form part of the Purchase Order between the Contractor and the Vendor.	
2.11	All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Contractor and finalised with the Owner shall be furnished to the Owner for comments and subsequent approval before orders are placed. Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-vendor's quality management and control activities. The Contractor shall provide all necessary assistance to enable the Owner carry out such audit and surveillance. Quality audit/approval of the results of tests and inspection will not prejudice the right of the Owner to reject equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Contractor in earning satisfactory performance of equipment as per specification.	
2.12	Quality requirements for main equipment shall equally apply for spares and replacement items.	
2.13	Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the approval of the Owner.	

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2.14	For quality assurance of all civil works refer to the specifications for civil works.	
3.0	<u>QUALITY ASSURANCE DOCUMENTS</u>	
3.1	The Contractor shall be required to submit two (2) copies and two (2) sets of softcopies in the form of CD of the following Quality Assurance documents within three (3) weeks after despatch of the equipment :	
3.1.1	Material mill test reports on components as specified by the specification.	
3.1.2	The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.	
3.1.3	Non-destructive examination results/reports including radiography interpretation reports.	
3.1.4	Factory tests results for testing required as per applicable codes and standards referred in the specification.	
3.1.5	Welder identification list incorporating welder's and welding operator's qualification procedure and welding identification symbols.	
3.1.6	Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.	
3.1.7	Stress relief time temperature charts.	
3.1.8	Inspection reports duly signed by QA personnel of the Owner and Contractor for the agreed inspection hold points. During the course of inspection, the following shall also be recorded :	
	(a) When some important repair work is involved to make the job acceptable.	
	(b) The repair work remains part of the accepted product quality.	

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3.2	Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.	
4.0	<u>INSPECTION, TESTING AND INSPECTION CERTIFICATES</u>	
4.1	The Engineer, his duly authorised representative and/or an outside inspection agency acting on behalf of the Owner shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Engineer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.	
4.2	The Contractor shall give the Engineer/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Engineer/Inspector, unless the witnessing of the tests is virtually waived, shall attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection failing which the Contractor may proceed with test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified Six (6) copies of test reports.	
4.3	The Engineer or Inspector shall within fifteen (15) days from the date of Inspection as defined herein give notice in writing to the Contractor, on any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall confirm in writing to the Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.	
4.4	When the factory tests have been completed at the Contractor's or sub-contractor's works, the Engineer/Inspector shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Engineer/ Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Engineer/Inspector. Failure of the Engineer/ Inspector to issue such a	

CONSULTANT : PROCON ENGINEERS

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	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 7
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certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract. 4.5 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Engineer/ Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Engineer/ Inspector or to his authorised representative to accomplish testing. 4.6 To facilitate advance planning of inspection in addition to giving inspection notice, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans shall be made for each three consecutive months and shall be furnished before beginning of each calendar month.		

CONSULTANT : PROCON ENGINEERS



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

CHECK LIST FOR TRANSMITTER

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

Legend :

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

Note :

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



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

CHECK LIST FOR TEMPERATURE ELEMENT

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	MODEL No./TAG No.						
	PROCESS CONNECTION						
2	STABILITY			P	W	V	
3	INSULATION RESISTANCE			P	W	V	
4	ENCLOSURE CLASS			P	W	V	
5	RESPONSE TIME			P	W	V	
7	ACCURACY			P	W	V	
8	HYDROSTATIC TEST			P	W	V	
9	ELECTRICAL CHARACTERISTIC OF SENSOR (CONTINUITY OF T/C WIRES & INSULATION RESISTANCE OF RTD LEADS w.r.t. BODY			P	W	V	
10	TEMP CURVES / CHARTS			P	V	V	
11	AMBIENT TEMP. EFFECT CHECK			P	W	V	
12	HV TEST			P	W	V	

Legend :

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

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.
- IBR certificate to be provided, if applicable



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

CHECK LIST FOR TEMPERATURE GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	DIAL SIZE						
	MODEL NO./TAG NO./TYPE						
	RANGE/SCALE						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	HYSTERESIS						
3	OVER TEMP. TEST	P		W	V		
4	AMBIENT TEMP. COMPENSATION CHECK	1 OF TYPE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	THERMOWELL						
	HOUSING						
	6			REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST	V	
7	THERMOWELL	SEE NOTE-1 BELOW	AS PER APPD DWG		V	V	
	MATERIAL TC & DIMN. CHECK						
	HYD.TEST						
	OVER RANGE TEST						

Legend :

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

Note :

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



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

CHECK LIST FOR PRESSURE & DP GAUGE

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

Legend :

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

Note :

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



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

CHECK LIST FOR LEVEL GAUGE

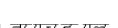
Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS / DRWGS	P	W	V	
	TYPE						
	MODEL/ TAG NO.						
	DAIL SIZE						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS, PROCESS CONNECTION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

Legend :

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

Note :

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

 PEM :: C&I	QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)			QUALITY PLAN NO.: PE-QP-415-145-I 006		
				VOLUME IIB		
				SECTION C		
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				SHEET 2	OF 7	

Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
1.0	INCOMING MATERIAL											
1.1	Body & Bonnet casting / forgings, plug, valve stem, seat ring/cage.	1. Physical, Chemical properties	MA	Physical, Chemical tests	One/ Heat(HT Batch)	Approved drg. / data sheet /	Approved drg. / data sheet /	Test Certificate	3	---	2,1	TC for body/bonnet from foundry only
		2. Heat Treatment	MA	Review of H.T. Chart	Each H.T.	Approved drg. / data sheet /	Approved drg. / data sheet /	Test Certificate	3/2	2	1	1.IBR Certification (if applicable) to be verified by BHEL. 2.Applicable for body /bonnet only
		3. Internal quality of castings	MA	RT for Body & UT for Bonnet	100%	ASME B 16.34	ASME B 16.34	Test Report / FILM	3/2	2	1	Applicable for body and bonnet for rating ANSI 900 and above.
		4. Surface Quality	MA	1. Visual	100%	MSS-SP-55	MSS-SP-55	Test Certificate	3/2	---	2	
				2. MT/PT	100%	ASME B 16.34	ASME B 16.34	Test Certificate	3	2	1	After Machining on machined surface only
		5. Pressure test for shell	MA	Hyd. Test	100%	ISA-S-75.19/ ASME B 16.34	ISA-S-75.19/ ASME B 16.34	Test Certificate	2	2	1	For Body & Bonnet after machining.
1.2	Diaphragm	1. Surface Quality	MA	Visual	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2,1	

1

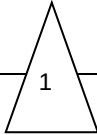
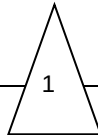
LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

RT- Radiographic Test
UT – Ultrasonic Test

PT – Dye penetrant Test
MT- Magnetic Test

\$ P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL 4-MAHAGENCO
2 - Vendor
3 - Sub-vendor

 PEM :: C&I		QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)						QUALITY PLAN NO.: PE-QP-415-145-I 006				
								VOLUME IIB				
								SECTION C				
								ISSUE NO. 2		REV. NO. 3		DATE: 06.12.18
								SHEET 3		OF		7
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
		2. Hardness	MA	Measurement	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2,1	
		3. Endurance / Life cycle	MA	Cyclic test 10,000 cycles	One / Type	10,000 cycles/ Mfr. standard.	No damage	Test Certificate	3/2	---	2,1	
1.3	Spring	1. Composition	MA	Chemical-Analysis	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
		2. Mech. Properties	MA	Mech. Test	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
		3. Performance	MA	1. Stiffness ratio	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
				2. Scragging	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
				3. Cyclic test (Endurance)	One / type	10,000 cycles	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
				4. Dimension (Measurement)	One sample/ Lot	Mfr. standard	Mfr. standard	Record	3	---	2,1	
1.4	Electrical items [Limit switches, Solenoids, Position Transmitter(if provided externally)]	1. Routine Test	MA	HV, IR, Continuity function	100%	Relevant Standards	Relevant Standards	Test Certificate	3	---	2,1	
		2. Degree of protection	MA	IP/NEMA Tests	One sample / type	Approved Data sheet	Approved Data sheet	Test Certificate	3	---	2,1	

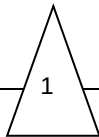
LEGEND: * CR - Critical characteristics
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1 - BHEL 4-MAHAGENCO
2 - Vendor
3 - Sub-vendor

 PEM :: C&I	QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)							QUALITY PLAN NO.: PE-QP-415-145-I 006						
								VOLUME IIB						
								SECTION C						
								ISSUE NO. 2 REV. NO. 3 DATE: 06.12.18 ;						
					SHEET 4 OF 7									
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks		
									P	W	V			
1.5	Pressure Gauges	1. Performance	MA	Review of calibration certificates	100%	Mfr. Standard	Mfr. Standard	Test Certificate	3	---	2,1			
		2. Marking	MA	Visual	100%	Mfr. standard	Mfr. standard	Records	3	---	2,1			
2.0	IN PROCESS INSPECTION													
2.1	After machining, i Body ii Bonnet iii Plug iv Valve Stem v seat ring/cage	1. Surface flaws	MA	Visual & MT/PT	100% (on accessible surfaces)	ASME B 16.34	ASME B 16.34	Test Records	2	---	1	Butt weld ends shall be included.		
		2. Dimensional checks	MA	Measurement	100%	Mfr. Standard	Mfr. Standard	Records	2	---	1			
		3. Hard facing (wherever applicable)	MA	Hardness Measurement	One sample/Lot	Mfr. Standard	Mfr. Standard	Records	2	---	1			
3.0	TESTS ON COMPLETED VALVE													
3.1	Actuator Chamber	Leakage & Strength	MA	Pneumatic test	100%	Mfr. Standard	No Leakage	Test Certificate	2	1	1	Refer Note-4		
3.2	Body	Leakage and Pressure test (Body Mount Leakage)	MA	Hydro test	100%	ISA - S-75.19/ ASME B16.34	No Leakage	Test Certificate	2	1,4	1	Refer Note-4		
3.3	Seat leakage test for completed valve	Seat Leakage	MA	Pneumatic Test	100%	FCI-70.2	FCI-70.2	Test Certificate	2	1,4	1	Refer Note-4		
4.0	OPERATION TEST ON COMPLETED VALVE (Final inspection)	1. Valve Travel	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1,4	1	Refer Note-4		
		2. Opening/Closing time	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1,4	1	Refer Note-4		
		3. Linearity/cam characteristic	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1,4	1	Refer Note-4		
LEGEND: * CR - Critical characteristics RT- Radiographic Test PT – Dye penetrant Test \$ P - Agency Performing the Test. 1 - BHEL 4-MAHAGENCO MA - Major characteristics UT – Ultrasonic Test MT- Magnetic Test W - Agency Witnessing the Test. 2 - Vendor MI - Minor characteristics V - Agency Verifying the Test. 3 - Sub-vendor														

 PEM :: C&I		QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)						QUALITY PLAN NO.: PE-QP-415-145-I 006				
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								SHEET 5		OF 7		
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
		4. Repeatability	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1,4	1	Refer Note-4
		5. Hysteresis	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1,4	1	Refer Note-4
		6. Sensitivity	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1,4	1	Refer Note-4
		7. Accuracy (Overall)	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1,4	1	Refer Note-4
		8. Control Valve characteristics / CV Test	MA	♦ Measurement (Press. vs. discharge and discharge vs. opening 0-100% in steps of 10%)	100%	Mfr. Procedure	Approved drg. / data sheet	Test Certificate	2	1,4	1	♦ Size = Body & port size Or Body size & CV for non std port. Refer Note 1.
		9. Operation of limit switch & solenoids and other accessories	MA	Function	100%	Mfr. Procedure	Approved drg./ data sheet	Test Report	2	1,4	1	On assembled valve Refer Note-4
		10. Overall dimensions	MI	Visual and dimensional	100%	Approved drg. / data sheet	Approved drg./ data sheet	Records	2	1,4	1	Refer Note-4
		11. Pre defined valve position in case of air failure	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	1,4	1	
		12. Cleanliness, painting, stamping (for direction of flow), Tag No.	MA	Visual and dimensional, paint thickness	100%	Mfr. Procedure	Approved drg./ data sheet	Test Certificate	2	1,4	1	
		13. Surface Quality	MA	Visual	100%	MSS-SP-55	MSS-SP-55	Test Certificate	3/2	---	2,1	

LEGEND:

* CR

MA

MI

- Critical characteristics

- Major characteristics

- Minor characteristics

RT- Radiographic Test

UT – Ultrasonic Test

PT – Dye penetrant Test

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\$ P - Agency Performing the Test.

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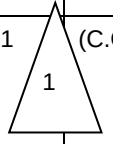
1 - BHEL

2 - Vendor

3 - Sub-vendor

4-MAHAGENCO

 PEM :: C&I		QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)						QUALITY PLAN NO.: PE-QP-415-145-I 006				
								VOLUME IIB				
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Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
5.0	AUXILIARY ITEMS (Performance test of auxiliary items shall be performed on the completely assembled valve)											
5.1	Positioner	Overall leakage after assembly including Nozzles leakage	MA	Leak Test (in the steady state input signal)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	Certificate of Conformance (C.O.C)
5.2	Air filter regulator	1. Normal air consumption	MA	Measurement	Each type	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	(C.O.C)
		2. Overall leakage	MA	Visual (soap solution)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	(C.O.C)
5.3	Air lock relay	Performance Test	MA	Leakage test	100%	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	(C.O.C)
5.4	Electronic position transmitter(not applicable if provided integral to smart positioner)	1. Accuracy	MA	Operation	100%	Approved data sheet /	Approved data sheet /	Test Certificate	2	1	1	(C.O.C)
5.5	Current to Pneumatic converter(not applicable for smart positioner)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	1	(C.O.C)
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	1	(C.O.C)
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	1	(C.O.C)
		4. Hysteresis	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	1	(C.O.C)
5.6	Smart Positioner	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	1	(C.O.C)

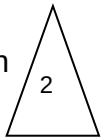


LEGEND: * CR - Critical characteristics RT- Radiographic Test PT – Dye penetrant Test \$ P - Agency Performing the Test. 1 - BHEL 4-MAHAGENCO
 MA - Major characteristics UT – Ultrasonic Test MT- Magnetic Test W - Agency Witnessing the Test. 2 - Vendor
 MI - Minor characteristics V - Agency Verifying the Test. 3 - Sub-vendor

 PEM :: C&I		QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)						QUALITY PLAN NO.: PE-QP-415-145-I 006						
								VOLUME IIB						
								SECTION C						
								ISSUE NO. 2		REV. NO. 3		DATE: 06.12.18		
								SHEET 7		OF 7				
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks		
									P	W	V			
	(As Applicable)	2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	1		(C.O.C)	
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	1		1	(C.O.C)
		4. Hysterisis	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	1			(C.O.C)
		5. Calibration with Hand Held Communicator	MA	Measurement	Each type	Mfr. Standard	Mfr. Standard	Test Certificate	2	---	1			(C.O.C)
6.0	PAINTING	Soundness of Painting	MA	Visual and Measurement	100%	Mfr. Standard	Mfr. Standard	Inspection Report	2	---	---		Refer Note-2	
7.0	PACKING	Soundness of Packing against transit damage	MA	Visual	100%	Mfr. Standard	Mfr. Standard	Inspection Report	2	---	---		Refer Note-3	

NOTES:

1. In case valid CV test certificate for a similar control valve (same size, same CV, same trim characteristics) is not submitted to BHEL by the vendor, CV test shall be conducted at FCRI/Any govt. approved laboratory/ BHEL approved Laboratory.
2. In the absence of BHEL spec. for painting, vendor to obtain BHEL's approval on their painting specification / procedure.
3. Sea worthy packing shall be provided, if called for in the Data sheets.
4. The quantum of check shall be 100% for manufacturer and 100% for Customer/BHEL/BHEL nominated inspection agency.
5. IBR certificates in Form III-C shall be submitted if called for in the specification/datasheet.
6. Copies of all TC's (Test Certificates) for materials duly correlated with Heat Nos., TC's for electrical items and mechanical tests (Leak/Operation), C.O.C's (Certificates of Conformance) shall be submitted to BHEL for verification and acceptance.



LEGEND: *		CR - Critical characteristics	RT- Radiographic Test	PT – Dye penetrant Test	\$ P - Agency Performing the Test.	1 - BHEL	4-MAHAGENCO
		MA - Major characteristics	UT – Ultrasonic Test	MT- Magnetic Test	W - Agency Witnessing the Test.	2 - Vendor	
		MI - Minor characteristics			V - Agency Verifying the Test.	3 - Sub-vendor	

 PEM :: C&I		QUALITY PLAN FOR FLOW ORIFICE PLATE ASSEMBLY						QUALITY PLAN NO.: PE-QP-415-145-I005					
								VOLUME		IIB			
								SECTION		D			
								REV. NO.		02		DATE: 07.12.18	
								SHEET		6		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks	
									P	W	V		
1.0	MATERIAL Orifice Plate	1. Physical, Chemical properties	MA	Physical, Chemical Tests	One / Plate OR One/ Heat	AP / DS / SP	AP / DS / SP	Lab Report	3/2	---	2,1	IBR certification (if applicable) to be verified by BHEL	
1.1		2. Dimensions	MA	Measurement	100%	AP	AP	IR	3/2		1		
1.2	Flanges A. Forgings	Chemical,Mech Properties, UT & Heat Treatment	MA	Chem & Mech UT test	Sample	Material Spec as per ASTM A 388 for UT	ANSI B 16.34	MTC,UT cert,HT cert	3/2	---	1		
	B. Machining	Dimensions	MA	Measurement	100 %	AP / DS	AP / DS	IR	3/2	----	1		
2.0	IN PROCESS Machine	1. Dimension	MA	Measurement	100%	AP	AP	IR	3/2	2	2		
		2. Surface finish	MA	Visual	100%	-----	Mirror Finish	-----	3/2	2	---		
		3. Surface flaw on machined surface	MA	Penetrant test	100%	ASTM 165 / IS:3658	No surface flaw	IR / TC	3/2	2	1		
3.0	ASSEMBLY and FINAL INSPECTION	1. Overall dimensions	MA	Measurement	100%	AP	AP	IR	3/2	2,1	----		
		2. Marking, Tag no. Direction of flow	MA	Visual	100%	AP / DS	AP / DS	IR	3/2	2	1		
		3. Calibration	MA	Performance Test	100%	-----	SP	TC	3/2	---	1,4		
		4. Painting	MA	Visual	100%	SP / MS	SP / MS	IR / MR	3/2	---	1		
		5. Root valve BOQ	MA	Measurement	100%	AP / DS	AP / DS	IR	2		1		

LEGEND: *

CR

MA

MI

- Critical characteristics

- Major characteristics

- Minor characteristics

IR - Inspection Reports

TC - Test Certificates

AP – Approved Drawings/doc

DS – Data Sheet

SP – Tech. Spec.

MR- Manufacturer records

MS- Manufacturer standards

^{\$} P - Agency Performing the Test. 1- BHEL4-MAHAGENCO

W - Agency Witnessing the Test. 2 - Vendor

V - Agency Verifying the Test. 3 - Sub-vendor

 PEM :: C&I		QUALITY PLAN FOR FLOW ORIFICE PLATE ASSEMBLY						QUALITY PLAN NO.: PE-QP-415-145-I005					
								VOLUME		IIB			
								SECTION		D			
								REV. NO.		02		DATE: 07.12.18	
								SHEET		7		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks	
									P	W	V		
4.0	PACKING	Soundness of Packing against transit damage	MA	Visual	100%	SP / MS	SP / MS	----	3/2	----	----	Refer Note 4	

NOTE:

1. All test reports & dimension reports shall be verified by BHEL wherever verification is by BHEL at the time of Final Inspection. Positive material identification testing shall be performed by vendor and the same shall be witnessed by BHEL.
2. Minimum 2 coats of primer paint to be applied before dispatch.
3. CALIBRATION Test to be carried out at IIT-DELHI / FCRI or BHEL approved laboratory.
4. Sea Worthy packing, if applicable.

LEGEND: * CR - Critical characteristics IR - Inspection Reports DS – Data Sheet MR- Manufacturer records \$ P - Agency Performing the Test. 1- BHEL4-MAHAGENCO MA - Major characteristics TC - Test Certificates SP – Tech. Spec. MS- Manufacturer standards W - Agency Witnessing the Test. 2 - Vendor MI - Minor characteristics AP – Approved Drawings/doc V - Agency Verifying the Test. 3 - Sub-vendor											
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	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
ERECTION HARDWARE		

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11.0 <u>ERECTION HARDWARE</u> 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 <u>ELECTRICAL ACCESSORIES</u> 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.		

CONSULTANT : PROCON ENGINEERS

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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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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 (f) Type : (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. (r) Accessories : (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.	

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2.2 <u>ERECTION</u> 2.2.1 Scope of Erection In general, all items supplied by Bidder shall be erected by Bidder. Sound engineering practice of international standard shall be adopted throughout. Scope of works shall not be limited to the following: (a) Installation of equipment, system, control room panels, desks, cabinets, junction boxes, instruments, gadgets and other accessories supplied as per this specification. (b) Cable interconnection amongst different panels/cubicle/field instruments etc. (c) Installation of field mounted instruments and devices including primary elements along with impulse pipe laying and wiring etc. Installation of thermo wells at the stubs provided at the tapping points. (d) Installation of all transmitter racks & enclosure, cubicles, brackets, laying of impulse pipes and cable termination etc. (e) Hook up of pneumatic tubes and interconnection between air supply point and all accessories of final control element as required. (f) Laying of all cables including erection of sub-trays, G.I. conduits along with accessories, termination and ferruling at both ends of all cables laid. (g) Termination & testing/checking of cable. (h) Supply of the erection hardware, consumables, tools and tackle, test instruments and deployment of experienced personnel needed for		

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completing the erection of the total instrumentation & control system under this package. (i) Painting of site mounted structures and impulse lines after completion of erection. All panels, cabinets will be retouched/repainted if required after erection & commissioning. (j) Providing a tentative programme of manufacture, erection, testing and commissioning. (k) All Erection activities shall comply with stipulated project schedule. 2.3 <u>SCOPE OF TESTING, CALIBRATION & COMMISSIONING</u> Scope of works shall not be limited to the following: 2.3.1 Testing / calibration / configuring / software development, loading, commissioning of instruments and systems supplied by Bidder as per the guidelines laid down in the specification. 2.3.2 Setting up of site instrument laboratory equipped with testing equipment for running and maintenance of the plant and instruments needed to carryout the testing, calibration and commissioning. 2.3.3 The contractor shall perform continuity and insulation checking of cables & wired laid. 2.3.4 The contractor shall perform leak test on process impulse pipe/tube and pneumatic tube. 2.3.5 The contractor shall perform loop check for all inputs & outputs to eliminate the possibility of mal-operation or damage of equipments. 2.3.6 Site modifications shall be documented and issued to Owner as design change notification and shall be signed by Owner. Subsequently, all such approved and agreed changes shall be incorporated in relevant design documents to elevate all documents to "As Built" status.		

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	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
INSTRUMENT INSTALLATION & HOOKUP DIAGRAM		

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9.0

PROCESS CONNECTION & INSTRUMENT HOOK UP

9.1

Instrument connection to the process system (piping, vessel etc.) shall be according to the process & piping specification upto and including the root valves. Root valves shall be installed as close as possible to the piping or vessel. Each instrument shall have its own independent connection to the process except for instruments located on standpipe. Each instrument shall be connected independently to the standpipe through isolation valve.

9.2

Isolation and blowdown drain valves adequate for duty and capable of withstanding continuous design condition of main process shall be provided. Instrument blow down valve near to the instrument shall be of gradual opening type. For process pressure equal or above 40 kg/ sq.cm double blowdown valves shall be used connecting to blowdown header. Instrument manifold /gauge valve shall be installed close to the instrument.

9.3

The nominal size of the takeoff connections on line shall not be less than NPS ½" for source conditions not in excess of either 900 psi or 425°C and NPS ¾" (for adequate physical strength) for design conditions exceed either of these limits. Where the size of the main is smaller than the limits given above, the takeoff connections shall not be less than the size of the main line.

9.4

Process connection for instruments lines and vessels shall be in accordance to standards such as ASME or other recognized international standards. Table below indicates the type of connection generally to be used.

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

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

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	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – I																				
REV: R0	CONTROL & INSTRUMENTATION		Page 63 of 718																				
<table><tr><th>SR. NO.</th><th>INSTRUMENTS</th><th>EQUIPMENT/PIPE SIDE</th><th>INSTRUMENT SIDE</th></tr><tr><td>(d)</td><td>Temperature Instruments</td><td></td><td></td></tr><tr><td></td><td>(i) Thermowell</td><td>Generally - M 33 X2 (M). 1½" Flanged- For air /FG path application.</td><td>½" NPT.</td></tr><tr><td>(e)</td><td>Analyzer</td><td></td><td></td></tr><tr><td></td><td>(i) Liquid analyzer</td><td>½" - 1" – welded.</td><td>½".</td></tr></table>				SR. NO.	INSTRUMENTS	EQUIPMENT/PIPE SIDE	INSTRUMENT SIDE	(d)	Temperature Instruments				(i) Thermowell	Generally - M 33 X2 (M). 1½" Flanged- For air /FG path application.	½" NPT.	(e)	Analyzer				(i) Liquid analyzer	½" - 1" – welded.	½".
SR. NO.	INSTRUMENTS	EQUIPMENT/PIPE SIDE	INSTRUMENT SIDE																				
(d)	Temperature Instruments																						
	(i) Thermowell	Generally - M 33 X2 (M). 1½" Flanged- For air /FG path application.	½" NPT.																				
(e)	Analyzer																						
	(i) Liquid analyzer	½" - 1" – welded.	½".																				
9.5	Size of impulse pipe for pressure measurement in air and flue gas duct path of boiler shall not be less than ¾" NB.																						
9.6	Separate stubs and take-off points with thermo well/root valves shall be provided for performance guarantee test.																						
9.7	Impulse pipes shall be clamped at suitable interval not exceeding 1.5 meter. Process pipe shall not be used for supporting the impulse pipe.																						
9.8	Fittings shall conform to ANSI B 16.11. Threads of piping component shall be of tapered construction.																						
9.9	Instrument blow down header shall in no case be lower than the material grade ASTM A 106 Gr. C.																						
9.10	Impulse pipe shall be laid at least with slope of gradient 1:10 to avoid any air pocket or water accumulation.																						
9.11	Expansion loop shall be provided at least at every 2.5 meter interval without affecting the gradient of slope in long run impulse pipe to avoid stress on the piping.																						

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
REV: R0	CONTROL & INSTRUMENTATION	Page 64 of 718
9.12 Siphon shall be provided in the impulse pipe or tube to protect the instruments where fluid temperature is 100 °C or more. 9.13 Orientation of tappings shall be as follows : (a) For liquid service within 45° at lower half of the pipe horizontal plane. (b) For gas service within 90° at upper half of the pipe horizontal plane. (c) For steam service within 45° at upper half of the pipe horizontal plane. As a rule tap orientation of high and low pressure side should be parallel and symmetrical. 9.14 Pressure & Differential pressure instruments in steam and liquid services shall be located below the taps and the piping shall be sloped to avoid formation of air pocket. 9.15 Pressure & Differential pressure instruments in air and flue gas service shall be located above the taps and the piping shall be sloped back to process to avoid formation of any liquid. 9.16 Impulse pipe including taps for furnace, flue gas and coal mill application shall be provided with air purge connection. Differential instruments for such application shall have continuous and as well as intermittent purging. Whereas, pressure measurement shall have only intermittent purging. 9.17 Material of impulse pipe for the instruments mounted on rack and enclosure shall be same as that of main process pipe except stainless steel tube of Gr. 316H or better shall be provided for connection in between impulse pipe (from tee connection on impulse pipe) and instrument manifold valve & instruments. Impulse pipe, tubes, fittings and accessories shall have the same design pressure and temperature applicable for the related main pipe.		

CONSULTANT : PROCON ENGINEERS

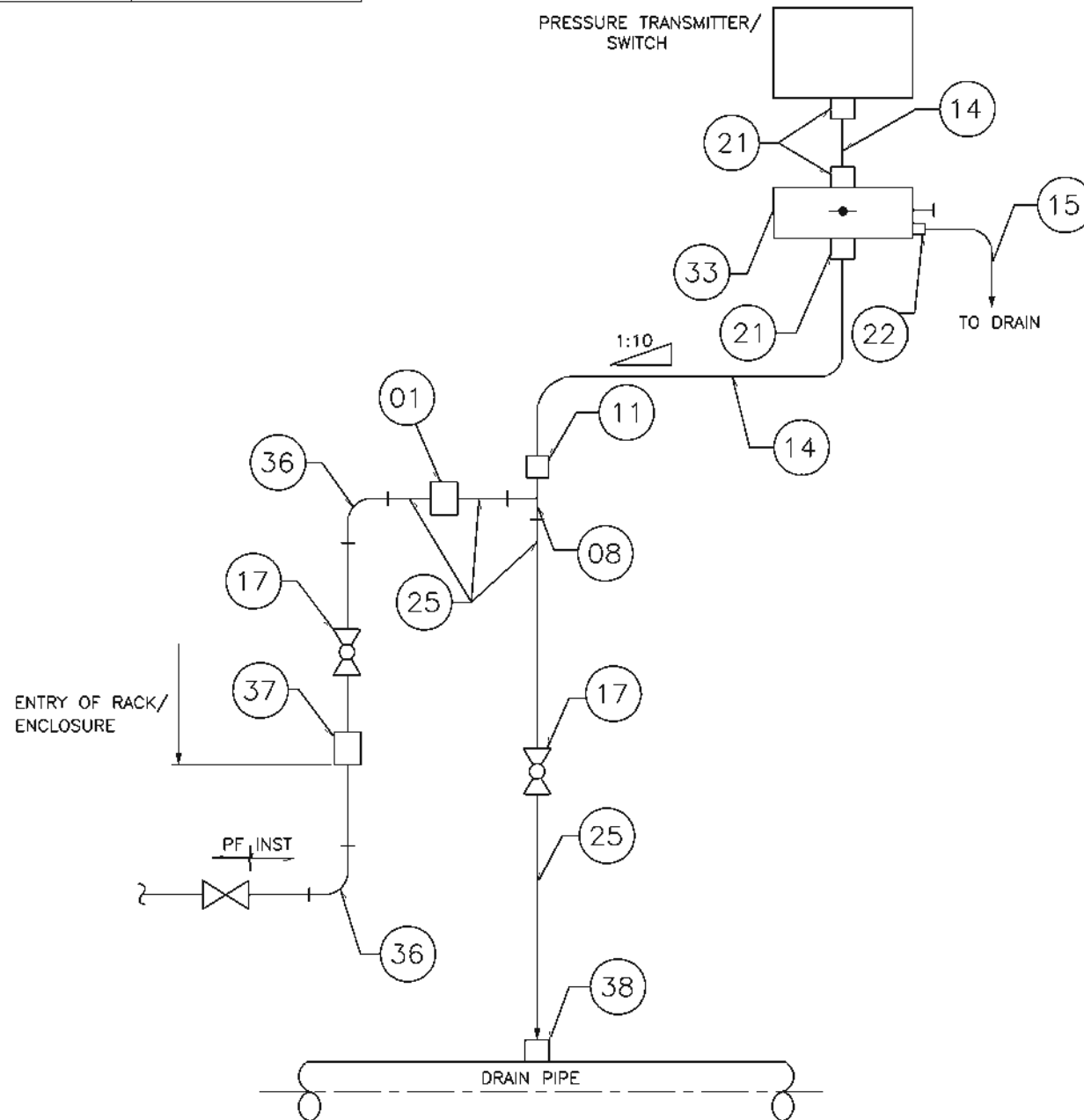
	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
REV: R0	CONTROL & INSTRUMENTATION	Page 65 of 718
10.0	<u>POWER SUPPLY SYSTEMS</u> 10.1 Instrumentation power supply system shall include all conditioning equipment required to accommodate normal variations in the electrical supply. All panels and cabinets shall accept redundant power feeds from two different sources. 10.2 Type of power supply systems envisaged are as follows: (a) 240V AC UPS. (b) 24V DC battery system. The battery system shall be dual floating with each stream having its own float cum boost charger. Care shall be taken so that the control system is not damaged during boost charging and also that the cables are properly sized so that the voltage drop does not cause the terminal voltage at the consumer end to fall below the minimum recommended value.	
11.0	<u>ENVIRONMENTAL CONSIDERATIONS</u> 11.1 I&C components should operate properly with no degradation in expected lifetime or in operation parameter in the normal power plant environment. C&I system shall be designed considering all the operating conditions which may be encountered during installation and operation. 11.2 <u>TEMPERATURE</u> 11.2.1 Where the environmental extreme exceeds the capabilities of the selected system, Bidder should take appropriate steps to control the environment. 11.3 <u>HUMIDITY</u> I&C system shall be designed to withstand the humidity limits specified for the project. Condensation shall not be allowed to form in the cabinets nor should water be allowed to be admitted through conduit entering the cabinets from top or sides.	

CONSULTANT : PROCON ENGINEERS

NOTES:

1. PROVISION OF SINGLE OR DOUBLE ROOT VALVE AND DRAIN VALVE SHALL BE IN ACCORDANCE WITH THE PRESSURE/ TEMPERATURE REQUIREMENT. FOR LINE PRESSURE EQUAL TO OR GREATER THAN 40 KG/SQ. CM. 2 NOS ROOT VALVE AND 2 NOS DRAIN VALVE SHALL BE REQUIRED.
2. MATERIAL, SIZE AND RATING OF THE PROCESS HOOK UP ITEMS SHOWN IN THE DRAWING ARE INDICATIVE ONLY. ACTUAL REQUIREMENT SHALL BE AS PER PROCESS CONDITION AND SPECIFICATION OF CONTROL & INSTRUMENTATION.
3. DRAIN PIPE IN RACK AND ENCLOSURE SHALL BE 2" NB SCH 80.

				FOR BID PURPOSE ONLY	
				DO NOT SCALE	DATE : 23-08-2011
ISSUE	BY	CH	DATE	TYPICAL INSTRUMENT INSTALLATION DIAGRAM	
				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	
				SCALE ~ DIV INST. DR P.N.Z. CH D.J.P.	APPROVED DWG.NO. PE-189-IN-SK-8003 (Srl. 2 of 20) PD



PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED ABOVE SOURCE POINT

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
08	1	EQUAL TEE (FEMALE) 1/2" SW 3000lbs, CS/AS
11	1	MALE CONNECTOR 1/2" PE x 1/2" OD 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

SERVICE : CONDENSER PRESSURE, INSTRUMENT AIR ETC.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS					BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			IF PREPARATION OF THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION / FABRICATION, BUT ONLY FOR REFERENCE, THE DRAWING SHOULD BE MARKED AS "FOR REFERENCE ONLY". CONSTRUCTION / FABRICATION WORKS SHOULD BE DONE ON THE BASIS OF THE DRAWING INFORMATION CONTAINED THEREIN IF AND NOT FOLLOWED FOR CONSTRUCTION / FABRICATION WORKS IN THE ABOVE PRECEDENCE WITH REFERENCE TO "HIGHER". REVISIONS SHOULD BE PROVIDED BY PROCON ENGINEERS' AUTHORIZED REPRESENTATIVE ONLY AND CONSIDERED VALID OTHERWISE.		MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)			
														DEPT. CLEARED						SCALE ~		DATE/RO ISSUE	
														SIGNATURE DATE						APPROVED		DATE/CURRENT ISSUE	
														CH-CH CIVIL ELEC MECH						DR. P.N.Z.		468 23-08-2011	
													TYPICAL INSTRUMENT INSTALLATION DIAGRAM			DWG.NO. PF-189-IN-SK-R001, 3 of 20			ISSUE				



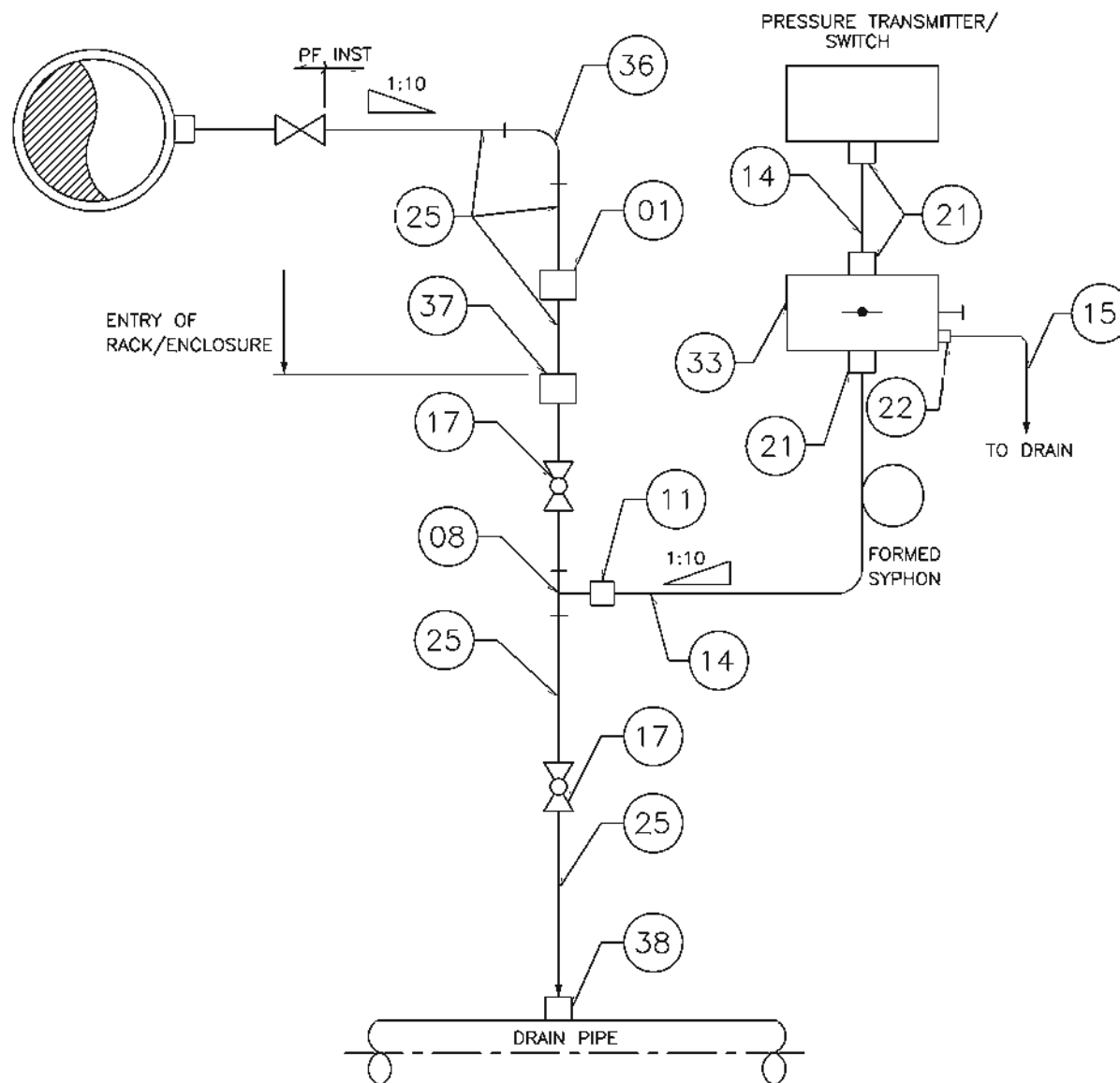
SERVICE : CONDENSATE, FEED WATER ETC.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY	* (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION AND SHOULD BE LIMITED TO PLANNING ONLY. SO ANY CHANGES TO BE MADE TO THE PROJECT BEFORE HAND DURING OF THE TENDR SUBCOMMISSION / FABRICATION WORK ARE PERMITTED ON Y. (CLEARED) ISSUE ONLY. INFORMATION CONTAINED WITHIN "HOLD" IS NOT FORWARDED FOR CONSTRUCTION. INFORMATION FIELD MUST GET DESIGN OFFICE TO CLEAN UP/REWORK AS PER ANY PROVISIONS WITH ANY CONSTRUCTION / FABRICATION WORK RELATED TO PROJECT. DRAWINGS SIGNED BY PROCON ENGINEERS' ALPHANUMERIC APPROPRIATE ONLY ARE CONSIDERED VALID OTHERWISE.	 MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)				DO NOT SCALE	
			CHEM	CIVIL	ELEC	I&C	MECH						DEPT SIGNATURE DATE	SCALE ~ APPROVED DATE (RO ISSUE)	DR. INST. DR. P.N.Z. CH. D.J.P.	DWG.NO. OF-189-IN-SK-8003/24 OF 2011	DATE (CURRENT ISSUE) 23-08-2011	PAGE
TYPICAL INSTRUMENT INSTALLATION DIAGRAM																		

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



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, CS/AS
17	2	GLOBE VALVES 1/2" SW 800lbs, CS/AS
14	3 MTRS.	TUBE 1/2" OD, 2.1mm THK.
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, 1.0 mm THK. SS 316
22	1	MALE CONNECTOR 1/4" NPT(M) x 8mm OD 3000 lbs, SS 316
36	1	90° ELBOW 1/2" SW 3000lbs, CS/AS
37	1	BULKHEAD UNION/COUPLING CL:3000 lbs/ 1/2"NB-SW, AS PER ANSI B16.11, CS/AS
38	1	HALF COUPLING CL:3000 lbs/ 1/2" NB-SW, AS PER ANSI B16.11, CS/AS

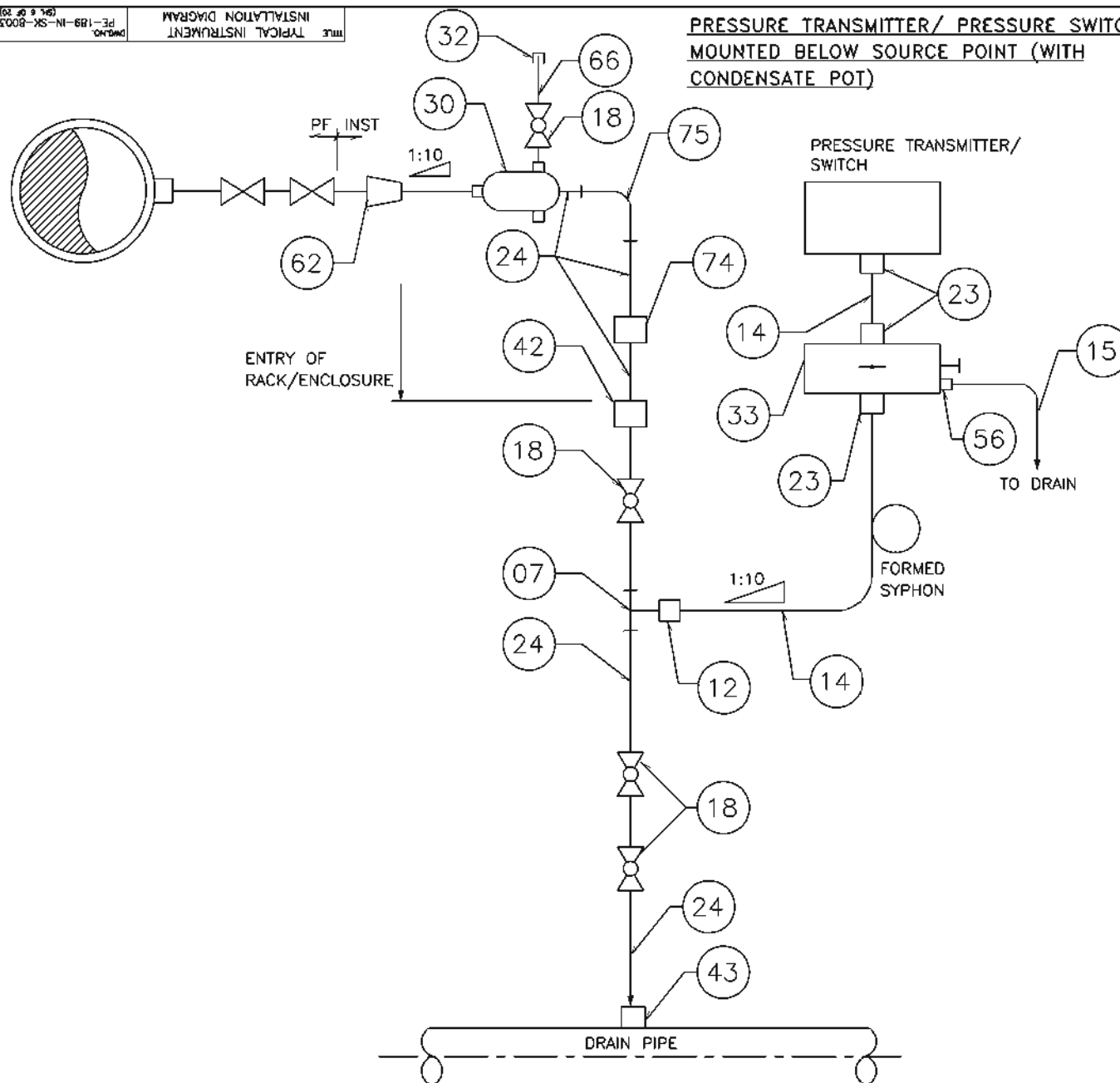
SERVICE : LOW PRESSURE STEAM.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY		MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT TYPICAL INSTRUMENT INSTALLATION DIAGRAM	PROCON ENGINEERS (DIVISION OF NIDGOT CONSULTING ENGINEERS PVT.LTD.)	DO NOT SCALE			
			CHEM	CIVIL	ELEC	I&C	MECH			CLEARED				SCALE ~	APPROVED	DATE(RO ISSUE)	
										DEPT	SIGNATURE			DATE	DR. INST.		DATE(CURRENT ISSUE)
										CHEM					DR. P.N.Z.		
										CIVIL					CH. D.J.P.	DWG.NO.	REV
										ELEC						PF-189-IN-SK-R003/Sk. 5 of 20	P.O
					I&C												
					MECH												

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



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
62	1	REDUCER 1"SW x 1/2" SW 9000lbs, CS/AS
07	1	EQUAL TEE (FEMALE)1/2" SW 9000 lbs, CS/AS
12	1	MALE CONNECTOR 1/2" PE x 1/2" OD 9000 lbs, CS/AS
18	4	GLOBE VALVES 1/2" SW 1500 lbs, CS/AS
14	3 MTRS.	TUBE 1/2" OD, 2mm THK, SS 316
23	3	MALE CONNECTOR 1/2" NPT(M) x 1/2" OD 9000 lbs, SS 316
24	15 MTRS.	IMPULSE PIPE 15 NB SCH. 80, CS/AS
33	1	2 VALVES MANIFOLD 1/2" NPT(F), SS 316
74	1	FULL COUPLING 1/2" SW 9000lbs, CS/AS
15	0.15 MTRS.	TUBE 8mm OD, 1.0mm THK, SS 316
56	1	MALE CONNECTOR 1/4" NPT(M) x 8mm OD, 9000 lbs, SS 316
42	1	BULKHEAD UNION/COUPLING CL:9000 lbs- AS PER ANSI B16.11, 1/2" NB-SW, CS/AS
43	1	HALF COUPLING CL:9000 lbs, 1/2" NB-SW, AS PER ANSI B16.11, CS/AS
75	1	90° ELBOW 1/2" SW CL:9000 lbs, CS/AS
32	1	PLUG 1/2" NPT(F) 9000lbs, CS/AS
30	1	CONDENSATE POT 1/2" SW NPT(F) 9000lbs, CS/AS
66	1	15 NB SCH 80, SW x 1/2" NPT(M), SEAMLESS NIPPLE 6000 lbs, CS/AS

SERVICE : MEDIUM AND HIGH PRESSURE STEAM

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY	
			CHEM	CIVIL	ELEC	I&C	MECH			CLEAR	DATE
										DEPT	SIGNATURE
										CHEM	
										CIVIL	
										ELEC	
										I&C	
										MECH	

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

TYPICAL INSTRUMENT
INSTALLATION DIAGRAM

PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)		
SCALE ~	APPROVED	DATE(RO ISSUE)
DR. P.N.Z.		471
CH. D.J.P.	DWG.NO.	PE-189-IN-SK-8003 (Rev. 6 of 20)



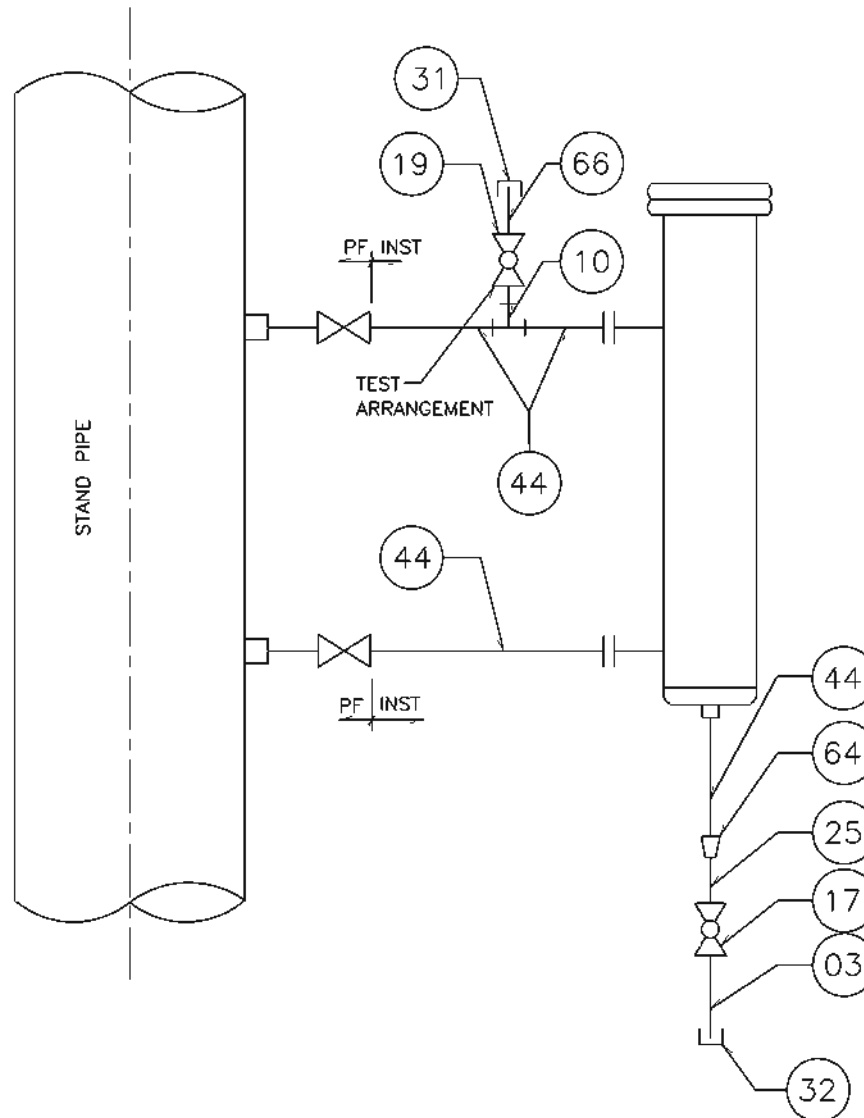
SERVICE : CONDENSATE, FEED WATER ETC.
PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE.

DO NOT SCALE

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

⌘

FLOAT OPERATED LEVEL SWITCH



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

SERVICE : CONDENSATE.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			 MAHARASHTRA STATE POWER GENERATION CO. LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT	PROCON ENGINEERS (DIVISION OF NIWATO CONSULTING ENGINEERS PVT.LTD.)				
			CHEM	CIVIL	ELEC	MECH	DATE			CHEM	CIVIL	ELEC		MECH	DATE	SCALE ~	APPROVED	DATE(RO ISSUE)
											DEPT	SIGNATURE	DATE					
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											CIVIL							
											ELEC							
											MECH							
											MECH							

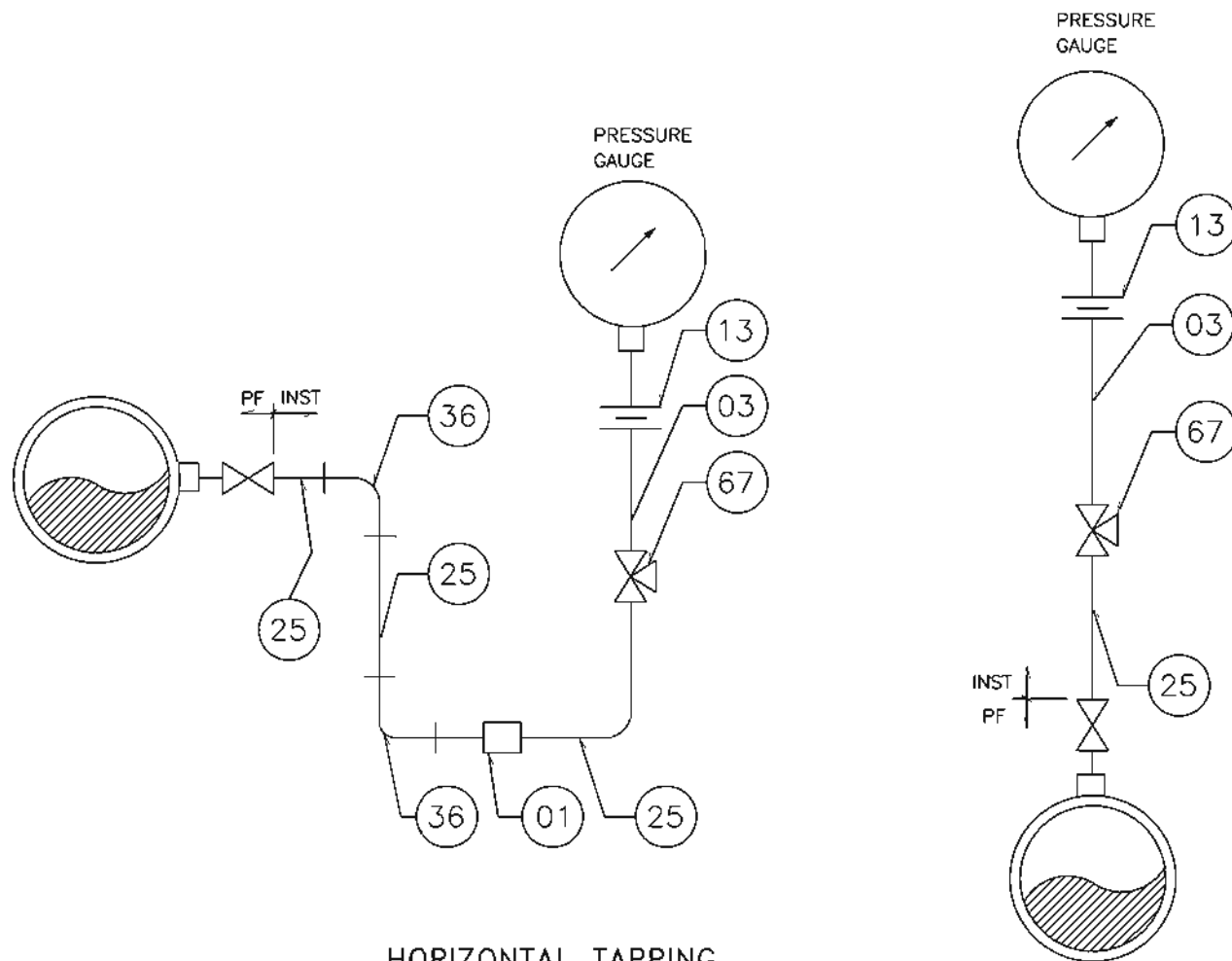


MAHARASHTRA STATE POWER GENERATION CO.LTD.
BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

TYPICAL INSTRUMENT
INSTALLATION DIAGRAM

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

SCALE	~	APPROVED	DATE(RO ISSUE)
DR. INST.			
DR. P.N.Z.			473
CH. D.J.P.	DWG.DWG.	PE-189-IN-SK-8003	23-08-2011



HORIZONTAL TAPPING

VERTICAL TAPPING

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

SERVICE : WATER, CONDENSATE ETC.

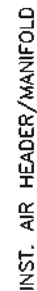
FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			TYPICAL INSTRUMENT INSTALLATION DIAGRAM	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)			
			CHEM	CIVIL	ELEC	INSTR	MECH			DCPT	SIGNATURE	DATE		SCALE	APPROVED	DATE(RO ISSUE)	DATE(CURRENT ISSUE)
														~			
														DR. P.N.Z.		474	23-08-2011
														CH. D.J.P.	DWG.NO.	PE-189-IN-SK-8003(SK 11 OF 20)	P0



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



A/R - AS PER REQUIREMENT
SOV - SOLENOID VALVE
AFR - AIR FILTER REGULATOR

- NOTE - 3

NOTES:

1. ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.
2. QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.
3. TUBE & FITTINGS MARKED ARE ■ INTEGRAL TO THE VALVE.
4. JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.
5. ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY	* (PARALLEL) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE SUBJECT FOR CONSTRUCTION ONLY & NO CONSTRUCTION / FABRICATION WORK IS TO BE DONE UNTIL THE ISSUE IS CANCELLED BY THE TRC. BLOCK.	 MAHARASHTRA STATE POWER GENERATION CO.LTD. 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						DEPT SIGNATURE DATE	* (PARALLEL) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE SUBJECT FOR CONSTRUCTION ONLY & NO CONSTRUCTION / FABRICATION WORK IS TO BE DONE UNTIL THE ISSUE IS CANCELLED BY THE TRC. BLOCK.	SCALE ~ APPROVED DATE/RO ISSUE 23-08-2011
											TYPICAL INSTRUMENT INSTALLATION DIAGRAM	DR. INST. DR. P.N.Z. CH. D.J.W.	DWG.NO. 475 OF-189-N-SK-8003 (Rev. 10 of 20)	DATE/CURRENT ISSUE 23-08-2011	



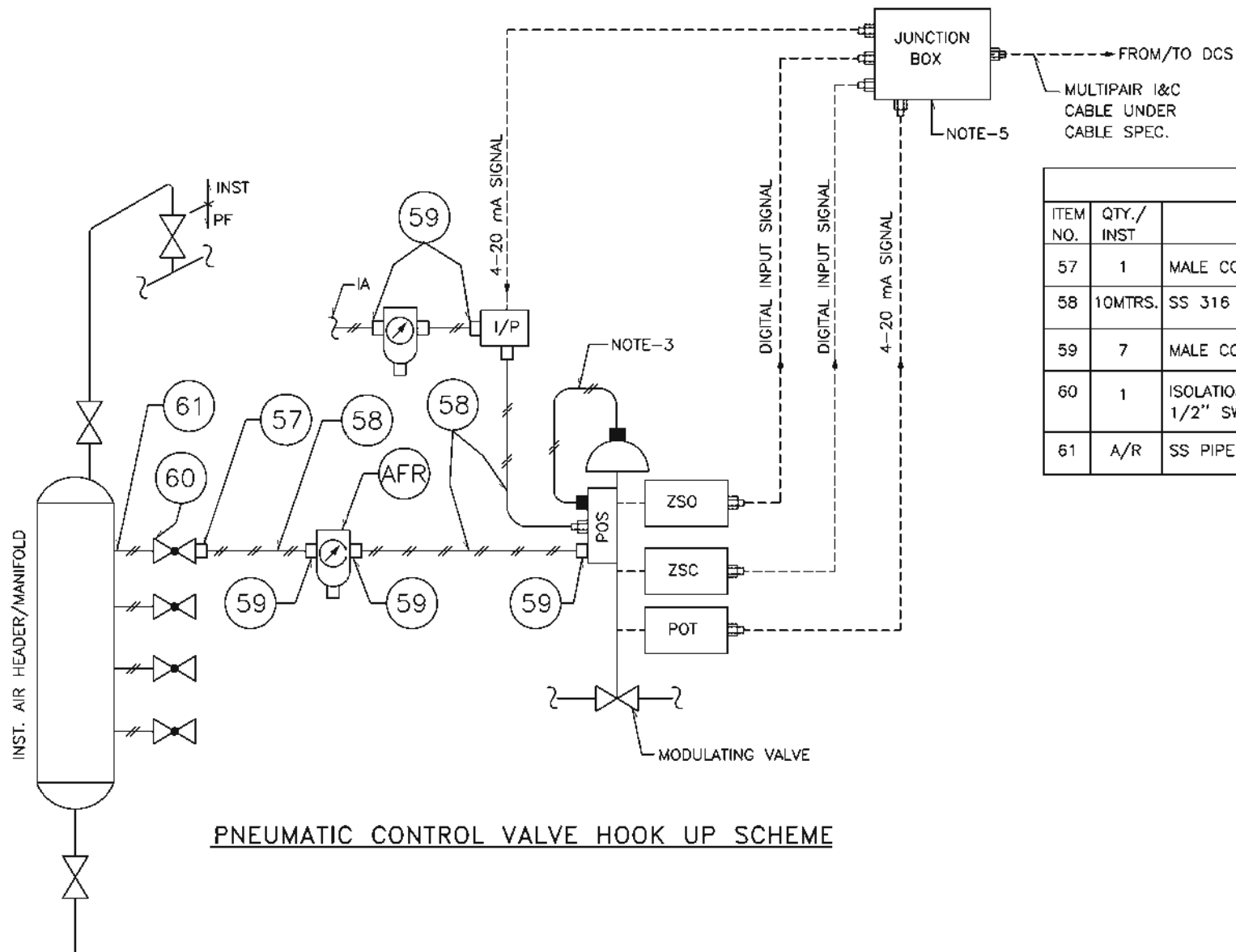
MAHAGONI

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

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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

SCALE ~			DATE (PO ISSUE)
DAY, INST.	APPROVED		
DR. P.N.Z.		475	DATE (CURRENT ISSUE) 23-08-2011
CH. D.J.P.	DWG. NO.	PE-189-N-SK-8003 (18 of 20)	REUSE P0



PNEUMATIC CONTROL VALVE HOOK UP SCHEME

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
57	1	MALE CONNECTOR 1/2" NPT(M) x 6mm OD COMPRN.
58	10MTRS.	SS 316 TUBE 6mm OD x 1mm THK.
59	7	MALE CONNECTOR 1/4"NPT(M) x 6mm OD COMPRN.
60	1	ISOLATION VALVE BALL TYPE 600 lbs 1/2" SW x 1/2" NPT(F), SS 316.
61	A/R	SS PIPE 1/2" NB SCH 40S.

LEGEND:

A/R - AS PER REQUIREMENT
 POT - POSITIONER TRANSMITTER
 AFR - AIR FILTER REGULATOR
 IA - INSTRUMENT AIR

NOTES:

- ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.
- QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.
- TUBE & FITTINGS MARKED ARE ■ INTEGRAL TO THE VALVE.
- LIMIT SWITCHES WILL BE CONNECTED WHEREVER APPLICABLE.
- JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.
- ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			TYPICAL INSTRUMENT INSTALLATION DIAGRAM
			CHEM	CIVIL	ELEC	I&C	MECH			CLEAR	SIGNATURE	DATE	

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

PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)			
SCALE ~	APPROVED	DATE/RO ISSUE	
DR. INST.		23-08-2011	
DR. P.N.Z.		476	
CH. D.J.P.	DWG.NO.	PE-189-IN-SK-8003 (20 OF 203)	

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
DRAWINGS		

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 ~

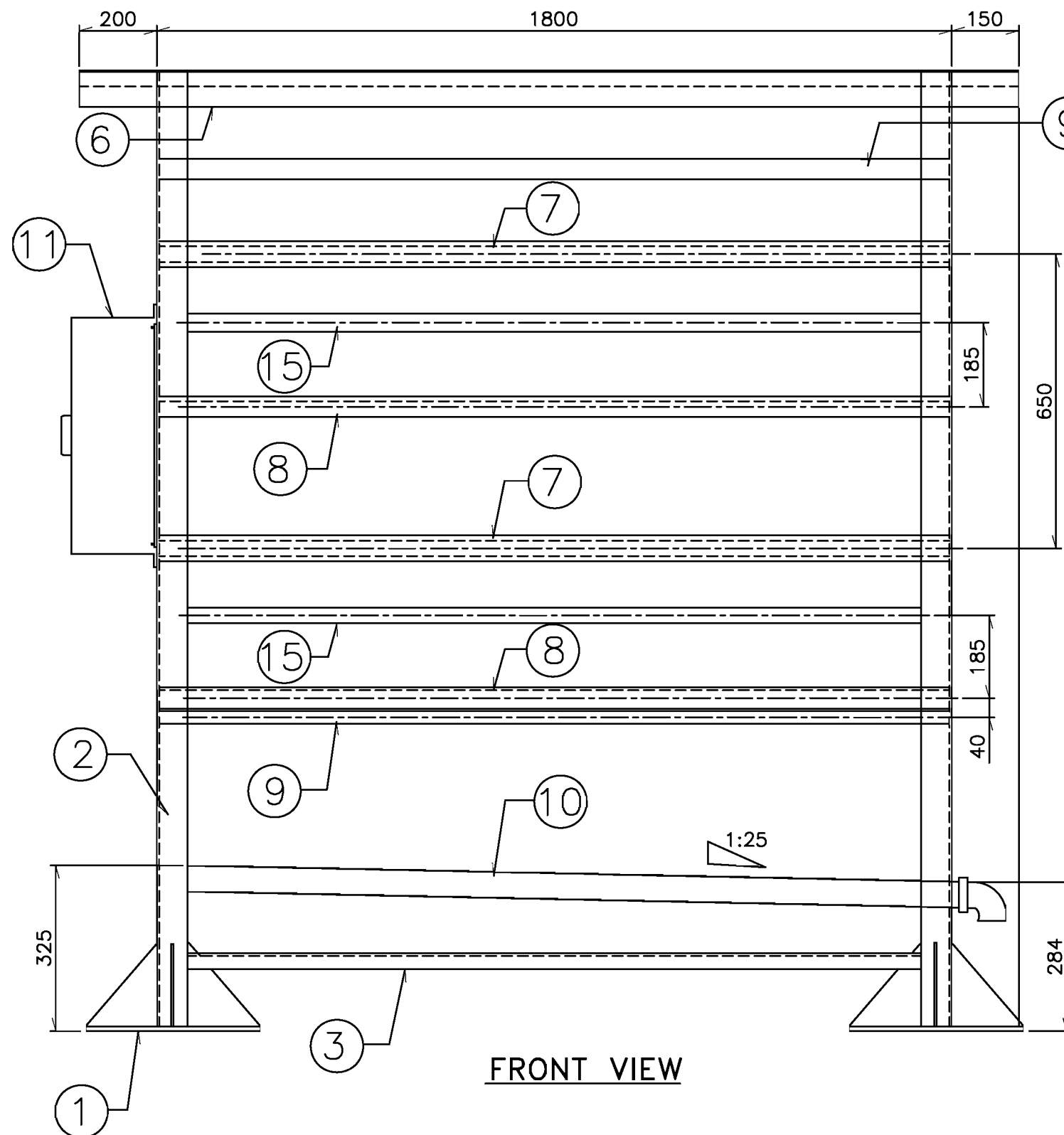
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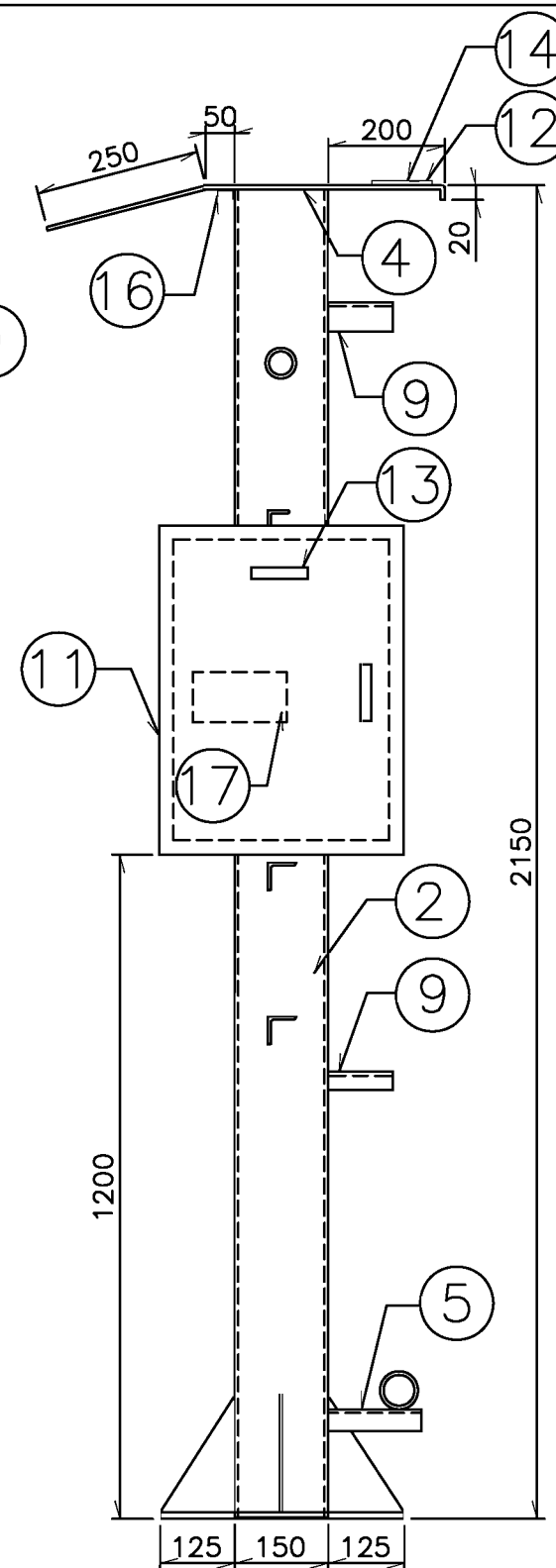
DR P.N.Z.

CH D.J.P.

DWG.NO.PE-189-IN-SK-8004 (SHEET 1 OF 10) PO



FRONT VIEW



RH SIDE VIEW

LEGEND:

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

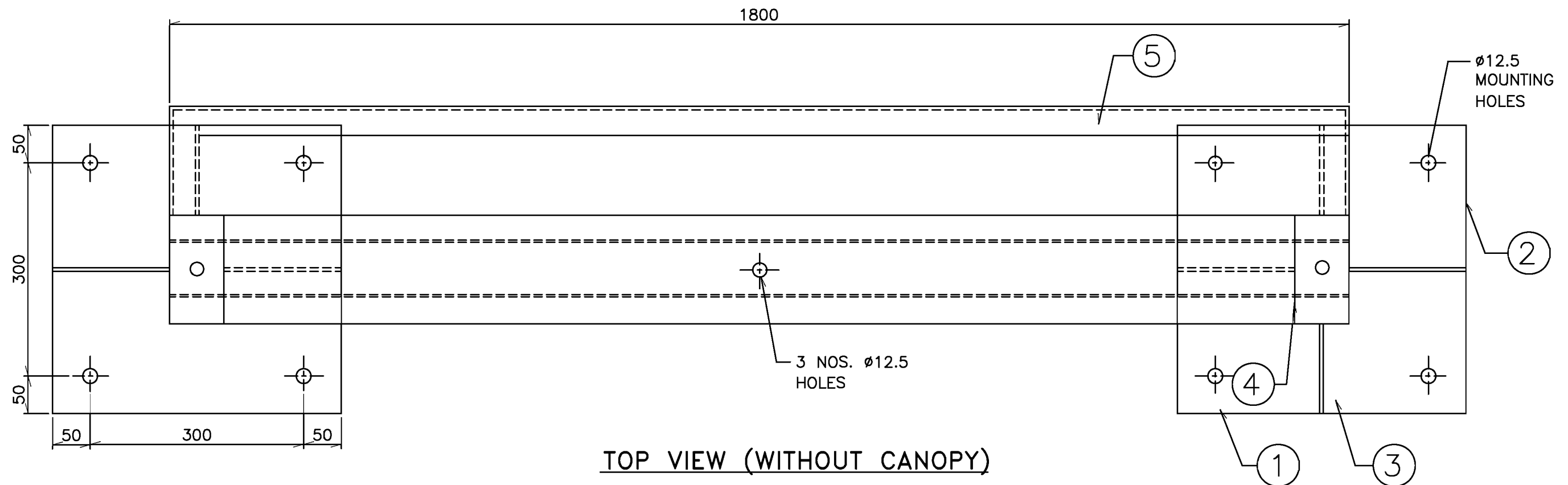
NOTES:

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

FOR BID PURPOSE ONLY

DO NOT SCALE

[illegible]



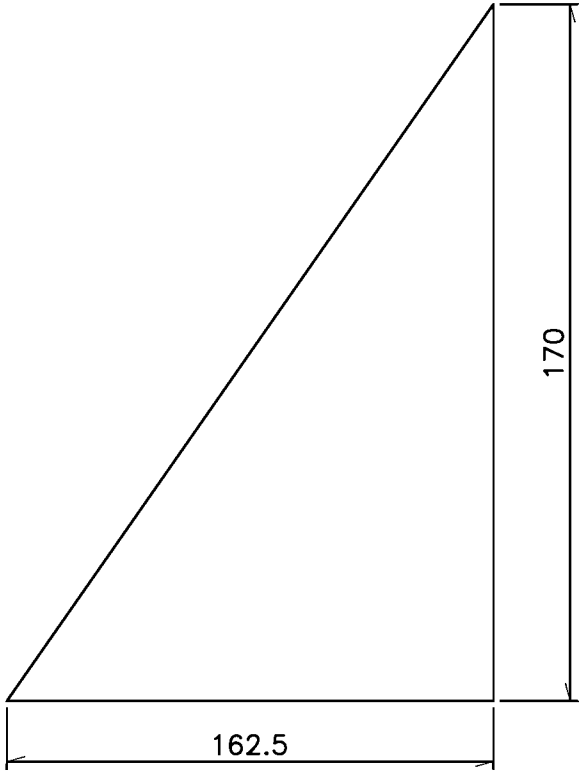
NOTES:

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.

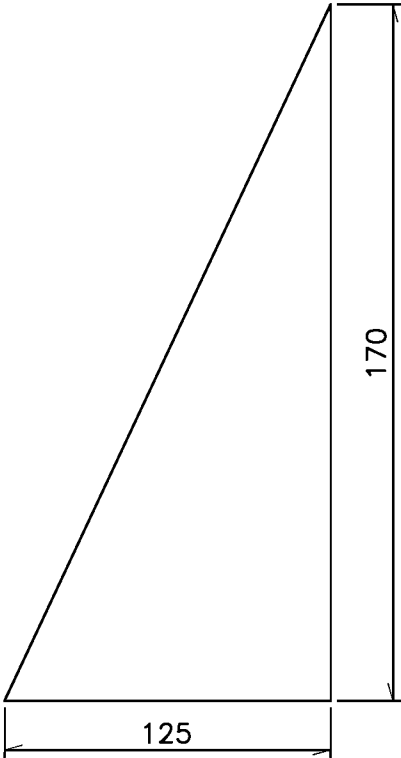
FOR BID PURPOSE ONLY

DO NOT SCALE

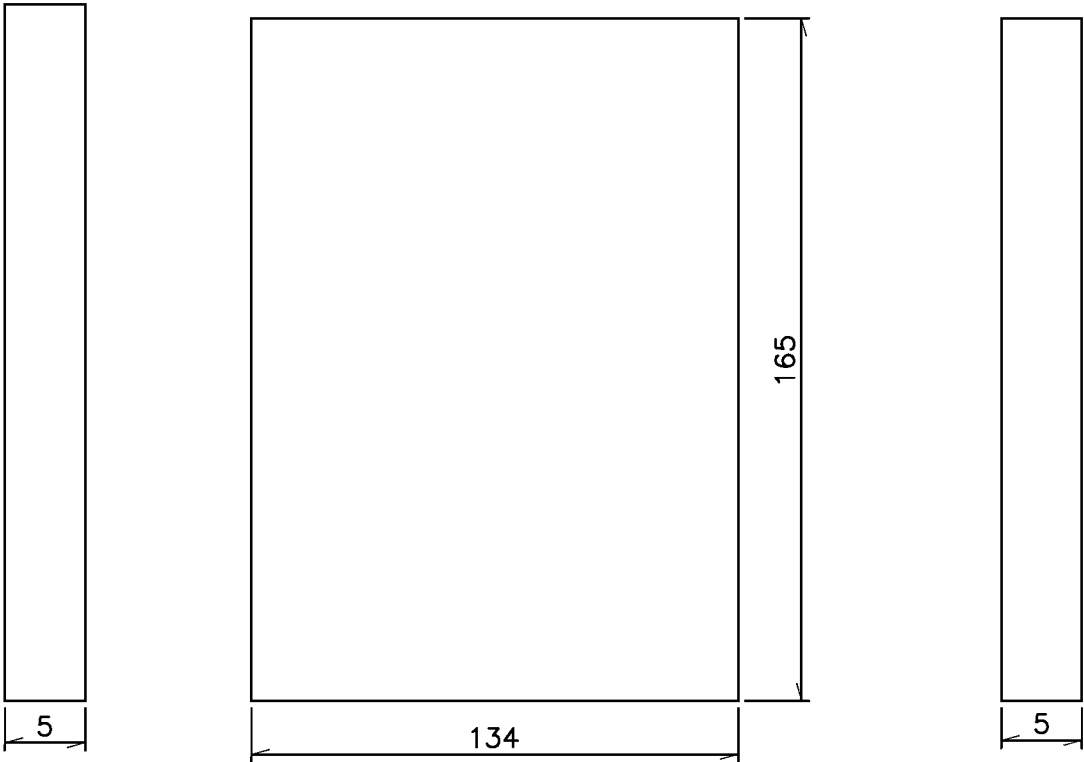
ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION, BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK. CONSTRUCTION / FABRICATION WORK IS PERMITTED 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. 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	DR. INST.				DATE(CURRENT ISSUE)							
			CHEM			DR. P.N.Z.				23-08-2011							
			CIVIL			CH. D.J.P.	DWG.NO.			PF-189-IN-SK-8004(SK 3 OF 4)							
			ELEC			VIEW OF LOCAL INSTRUMENT RACK W/O CANOPY											
			I&C														
MECH																	



DETAIL OF-1



DETAIL OF-2



DETAIL OF-3

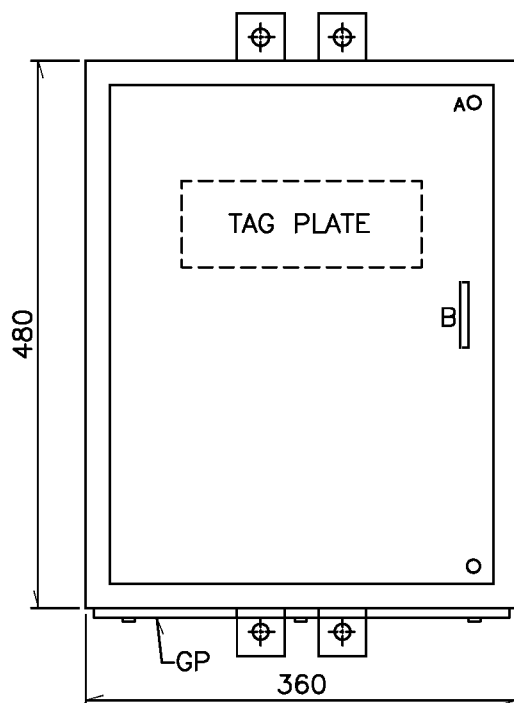
NOTES:

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.

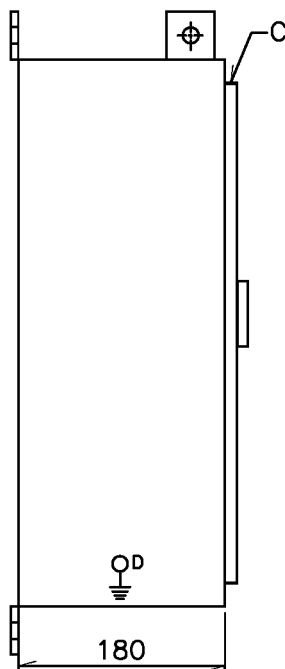
FOR BID PURPOSE ONLY

DO NOT SCALE

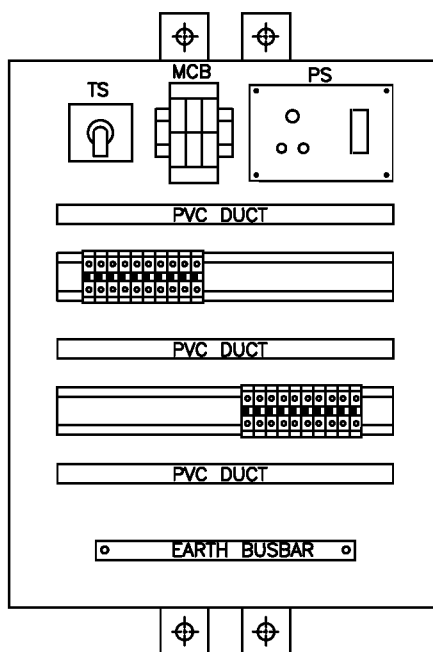
ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR R0 ISSUE ONLY			MAHAGENCO MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT G.A. DRAWING OF CLEATS FOR LOCAL INSTRUMENT RACK	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)					
			CHEM	CIVIL	ELEC	I&C	MECH			CLEARED				SCALE ~	APPROVED		DATE(R0 ISSUE)		
										DEPT	SIGNATURE	DATE			DIV. INST.			DATE(CURRENT ISSUE)	



FRONT VIEW



SIDE VIEW



INTERNAL FRONT VIEW

LEGEND:

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

NOTES:

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

FOR BID PURPOSE ONLY

ISSUE	BY	CH	DATE

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

CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

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

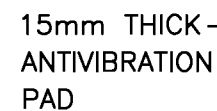
DO NOT SCALE

DATE : 23-08-2011

G.A. OF JB LOCAL INSTRUMENT RACK

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

DWG.NO.PE-189-IN-SK-8004 (SHEET 5 OF 10) PO



FRONT VIEW

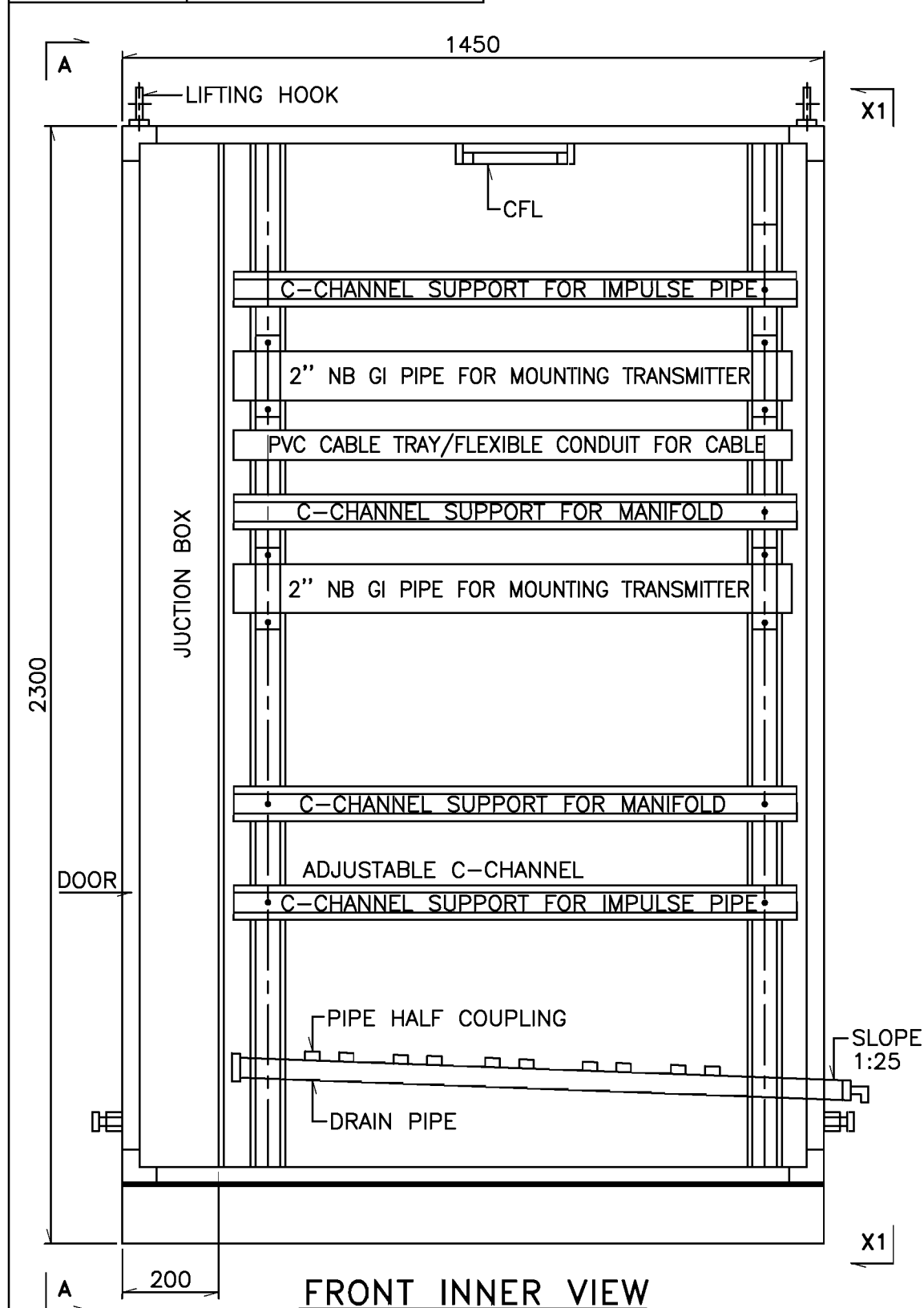


1. DIMENSIONS SHOWN ARE TENTATIVE AND SHALL BE FINALIZED AT DETAILING.
2. ALL SHEETS SHALL BE 3mm THICK CRCA SHEET.
3. ALL DOORS SHALL BE FLUSH/CONCEALED TYPE.
4. COLOR:
EXTERIOR : RAL 7032.
INTERIOR : BRILLIANT WHITE OVER ALL THICKNESS WILL BE > 100 MICRONS.
5. BASE FRAME WILL BE MADE OUT OF ISMC 100 AND COLOR WILL BE BLACK PAINT FINISH.
6. BULKHEAD PLATE FOR TOP AND BOTTOM SHALL BE 1150 x 650 x 6.
7. CABLE GLAND PLATE OF THICKNESS 3mm CRCA SHEET SHALL BE PROVIDED BOTTOM OF JUCTION BOX.
8. ENCLOSURE PROTECTION CLASS SHALL IP-65.
9. TERMINALS INSIDE JUCTION BOX SHALL BE SCREWLESS CAGE CLAMP TYPE.
10. DOORS SHALL BE PROVIDED WITH CONCEALED HINGES, THREE POINT LOCKING FOR FRONT, REAR AND SIDE DOOR HINGES SHALL BE OF STAINLESS STEEL.
11. XLPE GASKET SHALL BE PROVIDED BETWEEN BULKHEAD PLATE & ENCLOSURE.
12. EARTH BUSBAR 25 x 6 TINNED COPPER.
13. DRAIN PIPE SLOPE SHALL BE 1:25 APPROX.
14. 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.

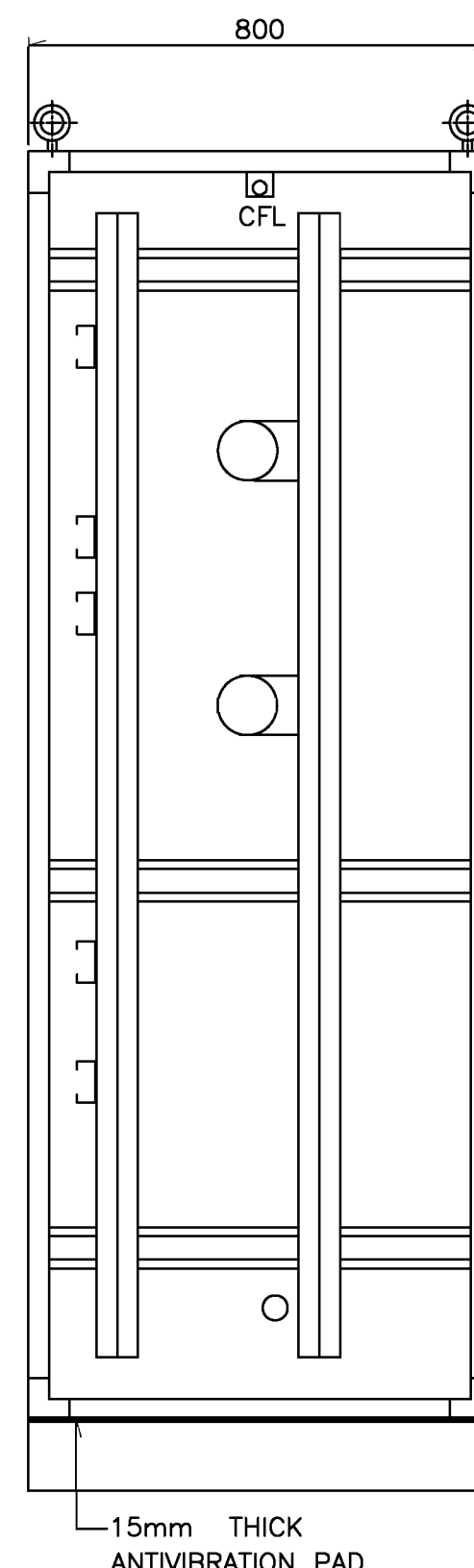
FOR BID PURPOSE ONLY

DO NOT SCALE

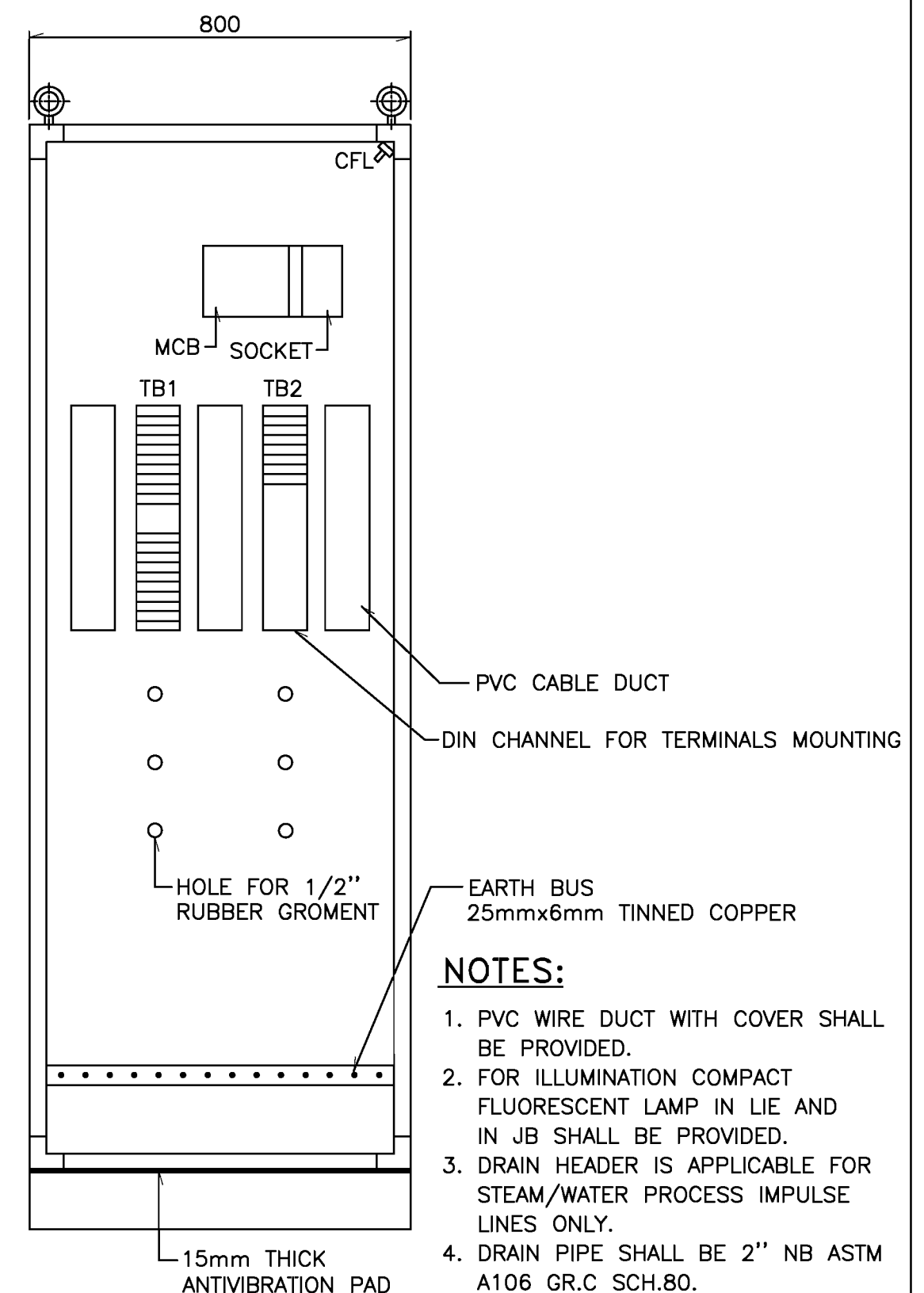
ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK. CONSTRUCTION WORK IS PERMITTED ON "R" (RELEASED) 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				DO NOT SCALE			
			PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)																		
			CHEM	CIVIL	ELEC	I&C	MECH			DEPT	SIGNATURE	DATE		SCALE ~	APPROVED		DATE(RO ISSUE)				
										CHEM				DR. INST.			DATE(CURRENT ISSUE)				
										CIVIL				DR. P.N.Z.			23-08-2011				
										ELEC				CH. D.J.P.							
										I&C				DWG.NO. PF-189-IN-SK-R004 (Sd/-) (63)					ISSUE NO. _____		
					MECH			G.A. DRAWING FOR LOCAL INSTRUMENT ENCLOSURE					P.O. _____								



FRONT INNER VIEW



SIDE VIEW FROM X1-X1



SIDE VIEW FROM A-A

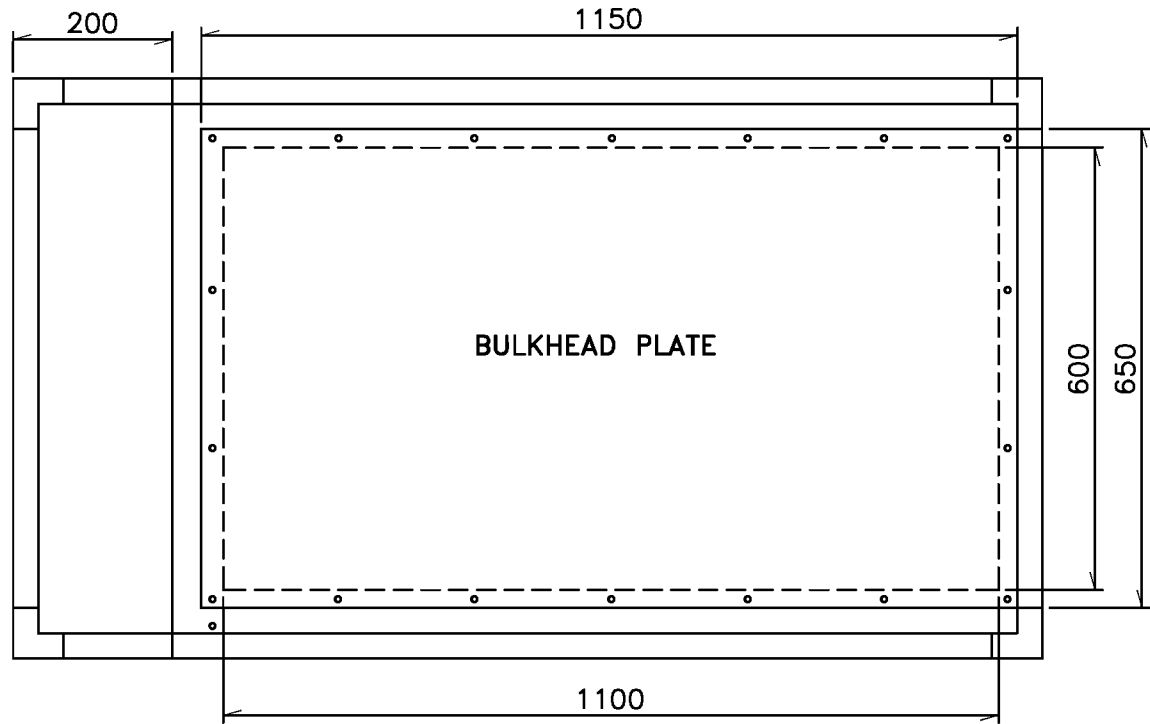
- NOTES:

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.

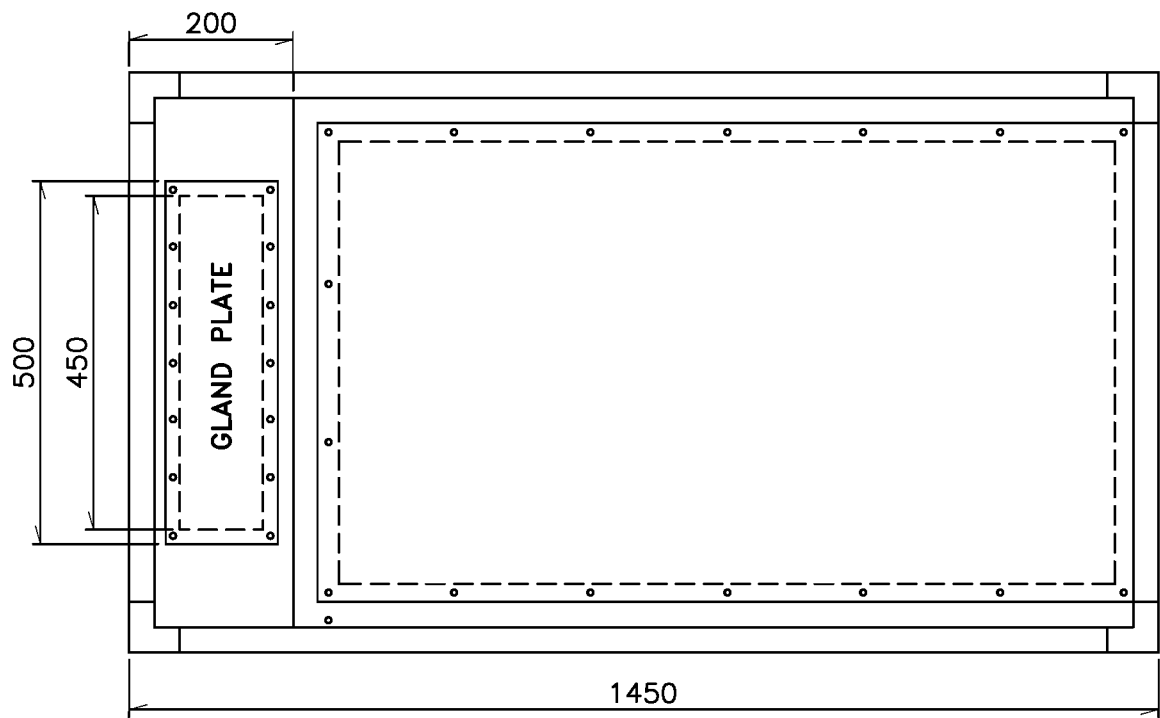
FOR BID PURPOSE ONLY

DO NOT SCALE

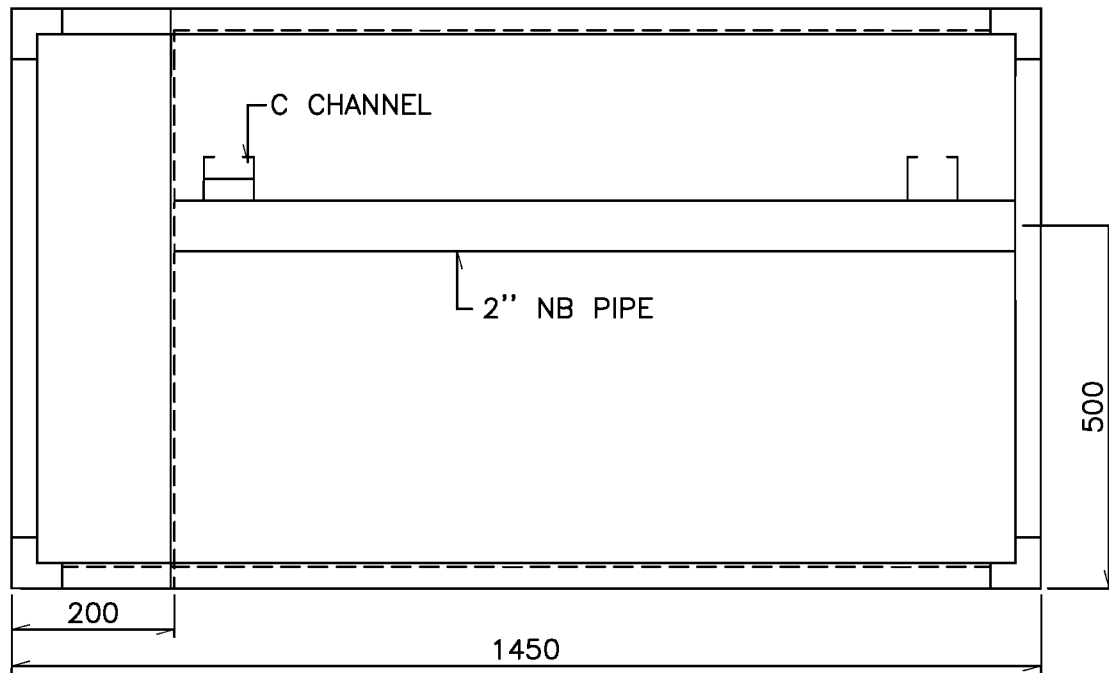
ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK. CONSTRUCTION WORK IS PERMITTED ON "I" (RELEASED) 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' AUTHORIZED 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.			
										ELEC					CH. D.J.P.	DWG.NO.	ISSUE NO.	
										I&C						PE-189-IN-SK-8004 (SH. 7 OF 49)	P.O.	
										MECH								



TOP VIEW



BOTTOM VIEW



TOP VIEW WITHOUT BULKHEAD PLATE

NOTES:

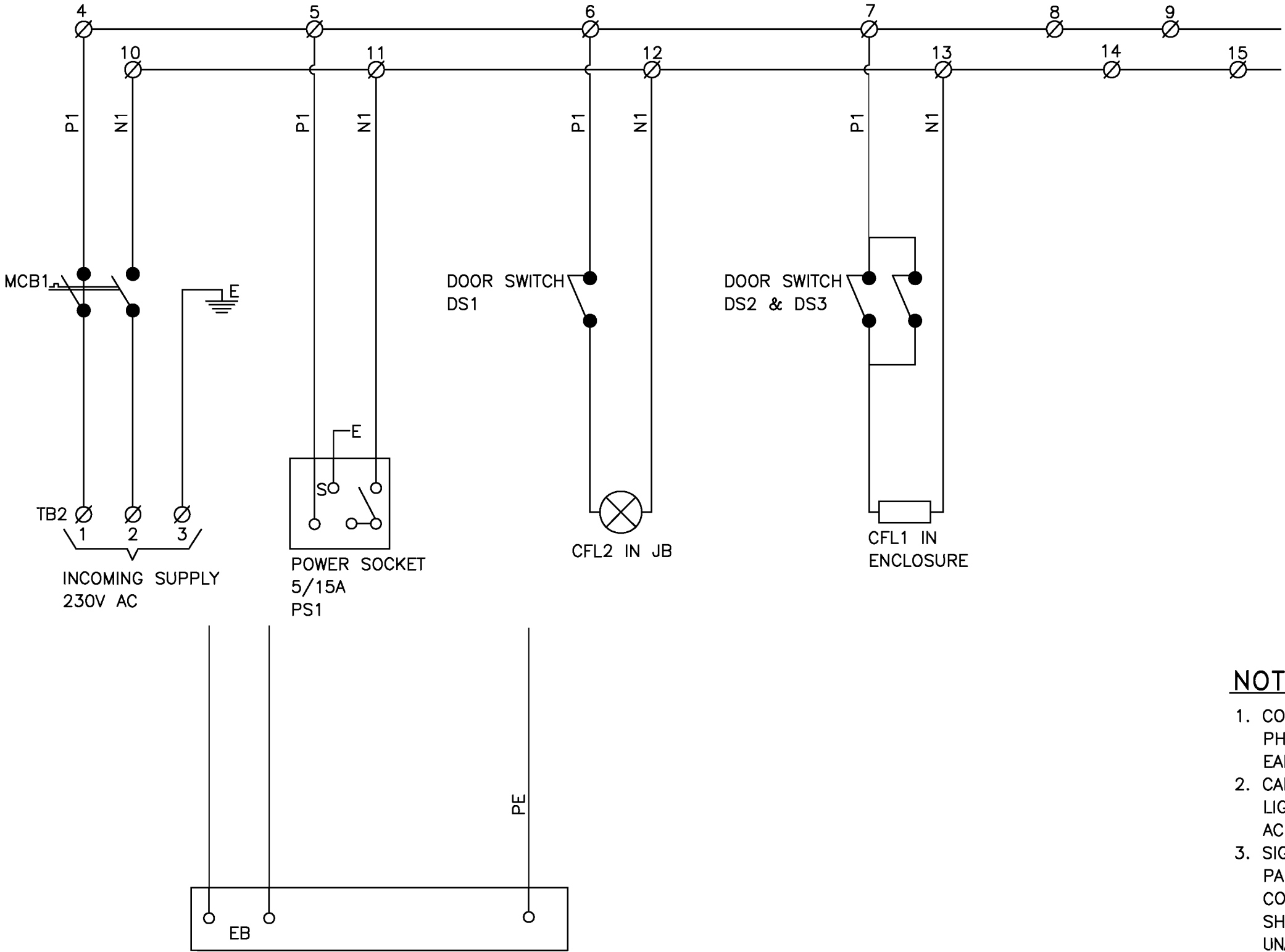
1. BULK HEAD PLATE DIMENSION ARE 1150 x 650 x 6.
2. IMPULSE PIPE ENTRY: BOTTOM ENTRY FOR AIR/FLUE GAS APPLICATIONS.
3. IMPULSE ENTRY: TOP ENTRY FOR STEAM/WATER APPLICATIONS.
4. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR R0 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 '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.	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.)		
			CHEM	CIVIL	ELEC	I&C	MECH			DEPT	SIGNATURE	DATE			SCALE ~	APPROVED	DATE(R0 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 (Sht. 8 of 10)	ISSUE
										I&C							P0
										MECH							

POWER WIRING CIRCUIT



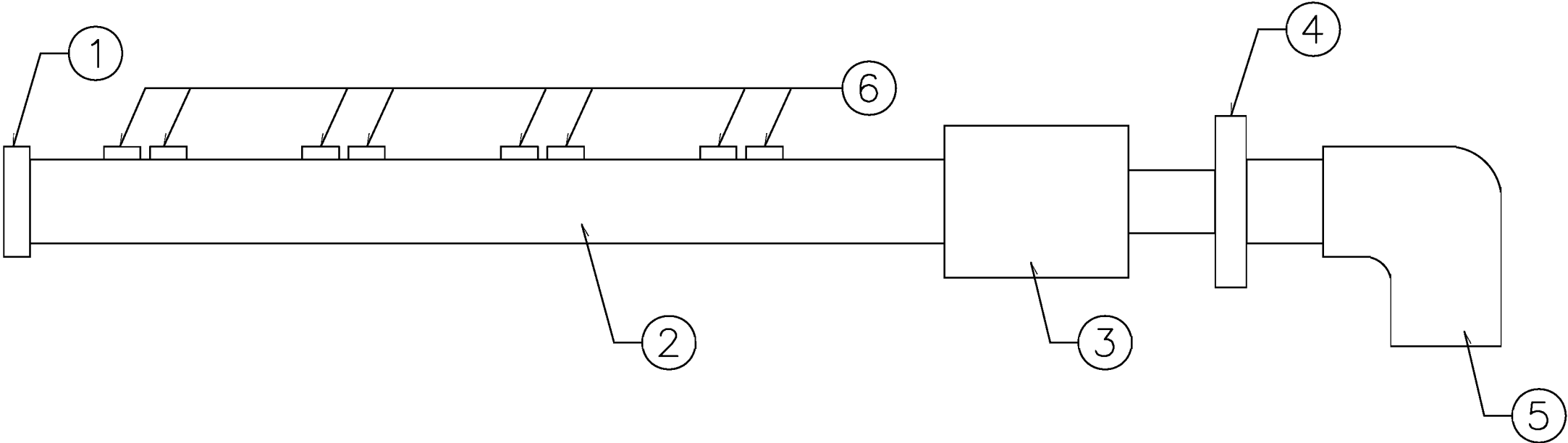
NOTES:

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.

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			CHEM	CIVIL	ELEC	I&C	MECH			DEPT	SIGNATURE	DATE			SCALE ~	APPROVED	DATE(R0 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. 9 OF 10)	ISSUE
										I&C							P0
										MECH							



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

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			CHEM	CIVIL	ELEC	I&C	MECH			CLEARED						
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										ELEC						
										I&C						
										MECH						
MAHAGENCO 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.)			
SCALE ~		APPROVED						DATE(R0 ISSUE)								
DIV. INST.								DATE(CURRENT ISSUE)								
DR. P.N.Z.								23-08-2011								
CH. D.J.P.		DWG.NO		PE-189-IN-SK-8004						ISSUE						
				(SH. 10 OF 10)						497 PO						

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
VENDOR LIST		

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume: II
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1		Section – II
REV: R0	MASTER SPECIFICATIONS		Page 525 of 555
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, UDAIPUR
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

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume: II
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1		Section – II
REV: R0	MASTER SPECIFICATIONS		Page 526 of 555
SR. NO.	NAME OF EQUIPMENT / ITEM		APPROVED VENDORS
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

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume: II
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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

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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

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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)	WIKA INSTRUMENTS INDIA PVT. LTD., PUNE
		(g)	WAREE, DADRA GOA INSTRUMENTS PVT. LTD.,
		(h)	BELLS CONTROLS LTD., KOLKATA
		(i)	SWITZER INSTRUMENTS LTD., CHENNAI
		(j)	WIKA 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)

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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

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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	RMCMS (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)	GOSEN / 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)	GOSEN / 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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		(d)	EMERSON
		(e)	ABB
		(f)	FUJI (AIC)
5.6	NOX / SO2 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	(a)	MIL CONTROLS LTD.
	SH/RH SPRAY BLOCK VALVES	(b)	INSTRUMENTATION LTD. PALGHAT
	FEED CONTROL VALVES	(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 (T) 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 (CCT)

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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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<u>SR. NO.</u>	<u>NAME OF EQUIPMENT / ITEM</u>		<u>APPROVED VENDORS</u>
		(c)	BALDOTA VALVE & FITTING CO. PVT. LTD., MUMBAI
		(d)	AURA INC., NEW DELHI
		(e)	PRECISION 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)	PRECISION 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)	MANNESEMAN AG, GERMANY

CONSULTANT : PROCON ENGINEERS

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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

CONSULTANT : PROCON ENGINEERS

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<u>SR. NO.</u>	<u>NAME OF EQUIPMENT / ITEM</u>	<u>APPROVED VENDORS</u>	
		(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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<u>SR. NO.</u>	<u>NAME OF EQUIPMENT / ITEM</u>		<u>APPROVED VENDORS</u>
		(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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<u>SR. NO.</u>	<u>NAME OF EQUIPMENT / ITEM</u>		<u>APPROVED VENDORS</u>
	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 Mahagenco'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.

Notes:-

- 1) The above sub-vendor list is tentative & reference only. However sub-vendor list is subject to BHEL/end user approval without any commercial/delivery implication.
- 2) New subvendor if proposed by vendor during contract stage shall be subject to BHEL/end user approval without any commercial/delivery implication.

CONSULTANT : PROCON ENGINEERS



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM
STANDARD TECHNICAL SPECIFICATIONS**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : I

SUB-SECTION : D

REV. 00

SECTION: I

SUB-SECTION: D

STANDARD TECHNICAL SPECIFICATIONS



**STANDARD TECHNICAL
SPECIFICATION
FOR
CENTRAL AIR-CONDITIONING**

SPECIFICATION NO.PES-553-01

VOLUME II B

SECTION D

REV. 02

SHEET 1 OF 6

**STANDARD TECHNICAL SPECIFICATION
FOR
CENTRAL AIR-CONDITIONING PLANT**

	STANDARD TECHNICAL SPECIFICATION FOR CENTRAL AIR-CONDITIONING	SPECIFICATION NO.PES-553-01
		VOLUME II B
		SECTION D
		SHEET 2 OF 6

1.

GENERAL

1.1

This specification covers the design, manufacture, testing at Manufacturer’s works, delivery to site, handling at site, installation, commissioning and carrying out acceptance tests and final painting at site of various equipment of the central air conditioning plant, as specified hereinafter.

2.

CODES & STANDARDS

2.1

The design, manufacture and performance of air conditioning equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment are to be installed. The equipment shall also conform to the latest applicable Indian/British/American standards. Nothing in this specification shall be construed to relieve the tenderer of this responsibility. In particular the equipment shall conform to the latest editions of the following standards.

2.1.1

IS-660 : Safety code for Mechanical Refrigeration.

2.1.2

ARI 520-90 : Standard for Positive Displacement Refrigerant compressors and condensing units.

2.1.3

IS-5111 : Code of Practice of Measurement for Testing Refrigeration compressors.

2.1.4

ASHRAE/23-93 : Method of Testing for Rating Positive Displacement Refrigerant compressors and condensing units.

2.1.5

ARI-450: Standard for water-cooled Refrigerant condensers, Remote Type.

2.1.6

ASME : Unfired pressure Vessels Code.
(Section VIII)

2.1.7

IS-2825 : -do-

2.1.8

IS-4503 : Shell and tube type heat exchangers.

2.1.9

ASHRAE/22-92 : Method of Testing for rating of Water Cooled refrigerant condensers.

2.1.10

IS-659 : Safety code for Air conditioning.

2.1.11

IS-2379 : Color Code for Identification of pipe lines.

2.1.12

TEMA : Standards of Tubular Exchanger manufacturers Association.

2.1.13

IS-1239 (Part-I) : Seamless steel tubes (Up to & including 168.2 mm OD.).

2.1.14

IS-3589 : For piping above 168.2mm to 2032mm Outside Diameter.

2.1.15

IS-778 : Valves up to 50 MM.

2.1.16

IS-780 : Valves 50 MM to 300 MM.

2.1.17

ASHRAE 24 : Method of Testing for Rating liquid coolers.

	STANDARD TECHNICAL SPECIFICATION FOR CENTRAL AIR-CONDITIONING	SPECIFICATION NO.PES-553-01
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		SHEET 3 OF 6

2.1.18	ARI-480:	Standard for refrigerant cooled liquid coolers-Remote type.
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3.	<u>DESIGN & CONSTRUCTION REQUIREMENTS</u>	
3.1	The components of Central air conditioning plant comprising compressor, chiller refrigerant piping, valves and fittings etc. Shall be as given in Data sheet A. The type of all accessories, controls and instrumentation shall also be as indicated in data sheet A.	
3.2	The various equipments supplied under this specification shall be fully compatible with each other & capable of operating as fully balanced integrated system to deliver the specified output under design conditions.	

4.	<u>TESTING AND INSPECTION</u>	
	(Refer standard quality plan)	
4.1	Hydrostatic, Volumetric and refrigerant leak tests etc. shall be carried out at manufacturers works before dispatch of equipment in accordance with the applicable codes and standards.	
	Following minimum tests amongst others shall be conducted.	
4.1.1	Material analysis, testing and identification (Data sheet/ Drg. Shall clearly indicate the specification, grade, class and Heat treatment condition of material for which TC will be furnished)	
4.1.2	Hydrostatic pressure test of all pressure parts.(Testing pressure shall be clearly indicated for each component/ subassembly/ assembly)	
4.1.3	Static and Dynamic balancing test of rotating parts at rated and over speed and to determine vibration & noise level.(Grade of balancing, type- whether dynamic or single plane balancing for components/ subassembly/ assembly shall be clearly indicated in data sheet/ approved drg.. Permissible vibration (velocity and displacement –peak to peak and noise level in dB(A) to be indicated in Data Sheet/Approved Drg.)	
4.1.4	Radiography & magna-flux examination of materials & welds.(Components to be subjected to NDT with applicable, procedures and acceptance norms to be clearly indicated in Data sheet/ approved drg. If in a component only certain areas are to be subjected to NDT same shall be clearly brought out else it will be understood that the entire component is subject to NDT)	
4.1.5	Ultrasonic test of castings & forgings.(Procedure and acceptance norms with areas subject to NDT to be clearly indicated in Quality Plan).	
4.1.6	Performance test including determination of capacity, efficiency & characteristics etc.(Applicable standard, Acceptance norms, Procedure for test (if not covered in applicable standard),performance characteristics with applicable tolerances and drive to be used during shop test to be clearly indicated in Quality Plan). Performance data to be indicated in Approved Drg./ Data Sheet)	

	STANDARD TECHNICAL SPECIFICATION FOR CENTRAL AIR-CONDITIONING	SPECIFICATION NO.PES-553-01
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		SECTION D
		SHEET 4 OF 6
4.1.7	Functional checks and adjustments of controls & instrumentation. (Functional checks required to be clearly indicated with extent of check and applicable standard in approved check list / Quality plan. Class of instruments / tolerances and performance data to be incorporated in Approved Data Sheet / Drg.)	
4.1.8	Checking of working clearances.(desired working clearances to be indicated in approved Drg.)	
4.1.9	Examination after selective opening up after testing.(basis/ reasons for selective opening up, areas to be examined and parameters to be checked to be brought out in Quality Plan)	
4.2	TESTS AT SITE Tests to prove guaranteed performance of the air conditioning plant, shall also be carried out at site after proper installation. The site test shall include performance testing (as per FQP) of equipment for 72 continuous hours each in all three seasons i.e. Summer, Winter and Monsoon. Unless specified elsewhere. All instruments, tools etc. as may be required to carry out site tests shall be arranged by the tenderer.	
5.	<u>PERFORMANCE GUARANTEE</u>	
5.1	Each equipment of air conditioning system shall be guaranteed for its rated capacity under the specified site conditions.	
5.2	If the shop/site performance tests indicate failure of equipment to meet specified requirement, it would be tenderer's responsibility to carry out required alterations at no extra cost to purchaser. Tests shall be repeated after carrying out the modifications to demonstrate the performance.	
5.3	The air conditioning plant before being taken over by purchaser shall be subjected to running test for a minimum period of one week during which all readings shall be recorded. Any deficiencies noted during this period, shall be rectified by the tenderer /at no extra cost to purchaser. These running tests shall be in addition to the seasonal performance test specified under clause 4.2. The inside design conditions shall be guaranteed throughout the year.	

	STANDARD TECHNICAL SPECIFICATION FOR CENTRAL AIR-CONDITIONING	SPECIFICATION NO.PES-553-01
		VOLUME II B
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		SHEET 5 OF 6
6.	<u>DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT</u>	
6.1		
6.2	Drawings including equipment layout, foundation & loading details etc. for civil works for the entire plant. These drawings must cover sufficient details so that design of civil works can be completed.	
6.3	Inspection, operation & Maintenance Manuals.	
6.4	Manuals for method of testing & calibration of all instruments.	
6.5	Equipment description giving complete design calculations, basis of design, selection criteria etc.	
6.6	Schematic piping diagrams.	
6.7	Layout of piping.	
6.8	Electrical drawings.	
6.9	Test Certificates.	
6.10	Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere.	



CENTRAL AIR-CONDITIONING PLANT
DATA SHEET - A

VOLUME II-B

SECTION D

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SHEET 1 OF 4

DESCRIPTION

DATA

1. GENERAL

- | | | |
|-----|---|---|
| 1.1 | Type of AC plant | : Chilled Water Type. |
| 1.2 | Plant configuration/capacity. | : Refer to Section-C of Specific Technical Requirements. |
| 1.3 | Location of AC plant rooms | : As per Tender drawings. |
| 1.4 | | |
| 1.5 | Electrical work scope: - | |
| | i) MCC for AC plant | : By Others |
| | ii) Power cables / Control cables. | : By Others |
| | iii) Drives | : By Bidder. |
| | iv) Whether separate alarm/annunciation Panel/control panels required | : Yes (By bidder), Refer to Section-C of Specific Technical Requirements. |
| | v) Termination of cabling & earthing at Equipment end. | : By Bidder for bidder supplied equipment. |

2. REFRIGERATION COMPRESSOR

- | | | |
|-------|--------------------------|--|
| 2.1. | Type | : SCREW CHILLE |
| 2.2. | Nos. (working + standby) | : Refer to Section-C of Specific Technical Requirements. |
| 2.3. | Type of capacity control | : Automatic. |
| 2.4. | Type of drive | : Direct driven. |
| 2.5. | Restart after tripping | : Manual. |
| 2.6. | Type of start | : As per manufacturing standard. |
| 2.7. | Shaft Seal | : Mechanical shaft seal. |
| 2.8. | Purge Recovery unit | : As per manufacturing standard. |
| 2.9. | Type of lubrication | : As per manufacturing standard. |
| 2.10. | Refrigerant used | : Environment friendly HCFC,
(CFC is not acceptable) |



CENTRAL AIR-CONDITIONING PLANT
DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

SHEET 2 OF 4

3. DESIGN REQUIREMENTS

- | | |
|--|--|
| 3.1. Minimum capacity at Design conditions | : Refer to Section-C of Specific Technical Requirements. |
| 3.2. Capacity control | : Microprocessor based Control Panel sheet metal panel, located on each Compressor/chiller unit including protection devices |
| 3.3. Vibration isolator | : Neoprene rubber pads/Equivalent approved to suit chiller package. |
| 3.4. Type of foundation | : Floating / As per manufacturing standard |

4.0 CONDENSER

- | | |
|---|--|
| 4.1 Type | : Horizontal shell & tube type water-cooled |
| 4.2 Number required | : One no. for each machine. |
| 4.3 <u>Design requirements</u> | |
| 4.3.1 Fluid | : Refrigerant (Shell side) Water (tube side) |
| 4.3.2 Cooling Water Quantity | : To suit requirement. |
| 4.3.3 Capacity of condensers | : To match compressor & to provide at least 2°C sub cooling. |
| 4.3.4 Cooling water inlet temp. | : Refer to Section-C of Specific Technical Requirements. |
| 4.3.5 Leaving Water Differential. | : Refer to Section-C of Specific Technical Requirements. |
| 4.3.6 Max. flow velocity through tubes. | : 2.5 m/sec. |
| 4.3.7 Design fouling factor | : 0.0002 (MKS Unit) |
| 4.3.8 Maximum pressure drop. | : 0.6 Kg/cm ² (g) |
| 4.3.9 Tube wall Thickness | : Not less than 18 SWG |
| 4.4 Materials of construction | |
| i/ Shell | : M.S. Plate fusion welded. |
| ii/ Tube | : Integrally bonded Seamless copper |



CENTRAL AIR-CONDITIONING PLANT
DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

SHEET 3 OF 4

- | | |
|---|---|
| iii/ Head ends | : Cast Iron. |
| iv/ Tube sheet material | : Steel |
| v/ Baffle plate | : Steel. |
| 4.5 Accessories required | |
| i/ Purge & drain connections with valves. | : Yes |
| ii/ Relief valves | : Yes |
| iii/ Liquid line shut off valve. | : Yes |
| iv/ Isolating valves on water side. | : Yes |
| v/ Flow switch | : Yes (interlocked with control of individual refrigeration system) |
| vi/ Pressure/temperature gauges at inlet/outlet | : Yes |
| vii/ Descaling tee | : Yes |
| viii/Charging valve | : Yes |
| ix/ MS supporting frame work | : Yes |
| viii/Cooling thermostat | : Yes |
| ix/ MS supporting frame work. | : Yes |
| 5.0 <u>CHILLER</u> (Applicable for chilled water type plant only.) | |
| 5.1 Type | : Horizontal shell & tube flooded type |
| 5.2 Number required/standby | : One no. for each chiller package. |
| 5.3 <u>Design requirements</u> | |
| 5.3.1 Fluid to be cooled | : Water |
| 5.3.2 Water flow rate (Inside tube) | : To suit requirement. |
| 5.3.3 Water inlet temperature | : 12 °C approx. |
| 5.3.4 Water outlet temperature | : 7 °C approx. |
| 5.3.5 Super heating of refrigerant material | : By at least 3 deg. C. |
| 5.3.6 Insulation /thickness/finish | : As per the manufacture standard. |
| 5.3.7 Design fouling factor | : 0.00010(MKS Unit) |



CENTRAL AIR-CONDITIONING PLANT
DATA SHEET - A

VOLUME II-B

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REV 00

SHEET 4 OF 4

- 5.3.8 Maximum pressure drop. : 0.6 Kg/cm² (g)
- 5.3.9 Tube wall Thickness : Not less than 22 SWG.
- 5.4 Materials of construction
- i/ Shell : M.S. Plate fusion welded.
 - ii/ Tube : Integrally Seamless copper (internally Corrugated)
 - iii/ Head ends : Cast Iron.
 - iv/ Tube sheet material : Steel.
 - v/ Baffle plate : Steel.
- 5.5 Accessories required
- i/ Purge & drain : Yes
 - ii/ Gate valves at water inlet/outlet. : Yes
 - iii/ Flow switch : Yes
 - iv/ Pressure/temperature gauges at inlet/outlet : Yes
 - v/ Anti-freeze thermostat : Yes
 - vi/ Thermostatic expansion valves : Yes
 - vii/ Pilot solenoid valve : Yes
 - viii/ Cooling thermostat : Yes
 - ix/ MS supporting frame work. : Yes

Note :-

The system shall also incorporate:

- 1) Auto operation of chilling plant for operation of the whole AC system.
- 2) A Central Control Panel with fault annunciators with provision for remote extension besides local control kiosks.
- 3) Water Chiller package shall be skid-mounted unit with microprocessor based control panel complete with all accessories and controls are assembled at manufacturing works on single unit.
- 4) Screw chiller shall be suitable for 415V $\pm$ 10 %/50 Hz $\pm$ 3%/3 phase operation with voltage & frequency variation as specified with built in starter etc.
- 5) Only supply feeders shall be provided for chillers.



TECHNICAL SPECIFICATION
AIR HANDLING UNITS

SPECIFICATION NO.PES-553-02

VOLUME II B

SECTION D

SHEET 1 OF 6

**STANDARD TECHNICAL SPECIFICATION
FOR
AIR HANDLING UNITS**

	TECHNICAL SPECIFICATION AIR HANDLING UNITS	SPECIFICATION NO.PES-553-02
		VOLUME II B
		SECTION D
		SHEET 2 OF 6
1.	<u>GENERAL</u>	
1.1	This specification covers the design, manufacture, Construction features, installation, commissioning, inspection and performance testing at site of AHUs.	
2.	<u>CODES AND STANDARDS</u>	
2.1	The design manufacture and performance of AHU shall comply with all currently applicable statutes, regulations and safety codes in the locality where the AHU is to be installed. The equipments shall also conform to the requirements of the latest editions of applicable Indian/British/US standards. Nothing in this spec. shall be construed to relieve vendor of this responsibility. In particular the equipment shall conform to the latest editions of the following standards:	
2.1.1	IS-659	: Safety code for air conditioning
2.1.2	IS-660	: Safety code for mechanical refrigeration
2.1.3	ASHRAE: Method of testing forced circulation air-cooling and air heating coils. standard 33	
2.1.4	ARI 41	: Standard for forced circulation air cooling and air heating coils.
2.1.5	ARI 430/435 : Air-cooling and air heating coils Central Station AHU / Application of Central Station AHU.	
2.1.6	AMCA	: 211 and 311
	In case of any conflict in the standards and this specification the decision of PEM,BHEL shall be final and binding.	
3.	<u>CONSTRUCTION FEATURES</u>	
3.1	The casing of AHU shall be made of insulated double wall construction of min. 24 gauge galvanized sheet steel - IS 277 Gr. 120 (parent sheet: D/DD-IS-513) ribbed and reinforced for structural strength and rigidity with 25 mm thick polyurethane insulation of minimum 40 kg/m ³ density in between. The external wall will be pre-plasticised over GI coating on the outside. Angle irons or channel sections made of 16 gauge galvanized sheet steel shall be used for reinforcing. The casing shall be of sectionalized construction with proper sealing at the joints to make them air tight. Fan section and panels with bearing support shall be reinforced with heavy gauge channels (min. 5 mm thick). Suitable number of forged hot dip galvanized (610 gm/sq.m) U brackets shall be provided for AHU suspended from ceiling/roof. Necessary arrangement shall be provided on the casing for measuring temperature and pressure in cooling/heating coil. Class of instruments shall be min. 2.	
3.2	Fan impeller shall be forwardly/backwardly inclined curved blade centrifugal type. Impeller shall be double width double inlet type. Fans shall be preferably low rpm (<=1500) to minimize vibration and noise. Noise shall be within 85 dB(A) at 1 metre distance from AHU casing. Max. Vibration level shall be acceptance and norms to be specified. Two to three wheels (impellers) shall be provided for each AHU. Impeller blades shall be fabricated from (min. 1.0 mm) galvanized/ epoxy powder coated sheet steel. Fan shall be of epoxy powder coated / galvanized sheet steel (min. 1.6	

	TECHNICAL SPECIFICATION AIR HANDLING UNITS	SPECIFICATION NO.PES-553-02
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		SHEET 3 OF 6
	mm) scroll with die formed inlets for uniform air flow. Fan shafts shall be solid cold rolled carbon steel (EN8 normalised), ground and polished. Fan shaft bearings shall be of heavy duty type selected for average operating life of 100,00 hours. Bearings shall be self-aligning, permanently lubricated type. Make of Brgs(SKF/FAG/NORMA/TATA) to be specified. Bearing Housing shall be of casting of min. IS Gr. 210, split type and suitably supported. The V-belt drive with belt guard shall be provided. Motors shall have minimum 15% margin over maximum BHP in working range.	
3.3	DX or chilled water cooling coils and steam/hot water coils shall be internally corrugated copper/ cupronickel tubes (as per manufacturer's standard) with smooth non corrugated external fins of aluminium (thickness 0.14 mm and grade 1100 as per spec) unless specified otherwise in specification. At least 5 fins /per cm. shall be provided. The chilled water/hot water coils shall have suitable (standardize class, size, threading) drain and vent connections.	
3.4	The filters in the filter section shall be provided as detailed in data sheet A.	
3.5	Humidifier shall be Pan type/as specified in the specification. Pan type Humidifier consisting of SS304/316 tank, heater, geyserstat with piping connection to supply air duct shall be provided unless specified otherwise in data sheet A. Heaters and branch line shall be of galvanized steel and nozzles shall be of brass (matl. grade) /SS 304.	
3.6	Condenser water from coil or surplus water from spray humidifier shall be collected in 16 gauge SS-304 pan. Minimum 50mm dia GI pipe nipple shall be provided on each end for drain connection. The drains for these points shall be extended to the main drain in AHU room. Condensate drain pipe (GI) of required length with sealing loop shall be provided and insulated as specified in the specification for insulation. Minimum requirement For GI Pipes and fittings shall be ERW/Seamless of medium thickness as per IS-1239/3589 and Hot dip galvanized	
3.7	Suitable number of Spring type vibration isolators shall be provided for fan and motor assembly. Neoprene rubber pads shall be provided below the AHU. The AHU shall be provided with 18 G SS drain pan.	

	TECHNICAL SPECIFICATION AIR HANDLING UNITS	SPECIFICATION NO.PES-553-02
		VOLUME II B
		SECTION D
		SHEET 4 OF 6
4. <u>TESTING AND INSPECTION AT MANUFACTURERS WORKS:</u> List of TCs arranged as per Approved Quality Plan shall be furnished along with copy of TCs at the time of inspection.		

	TECHNICAL SPECIFICATION AIR HANDLING UNITS	SPECIFICATION NO.PES-553-02
		VOLUME II B
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		SHEET 5 OF 6
4.1	Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting , lamination in angles and channels shall be avoided.	
4.2	Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating. For pipes and fittings compliance report shall be furnished by Manufacturer for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.	
4.3	Shaft: Mechanical and chemical.	
4.4	Motors (of approved make): Routine TC.	
4.5	Workmanship and dimensional check as per manufacturing drg. and approved Drgs.	
4.6	Balancing of impellers- Dynamic balancing certificates shall be furnished –grade 6.3 or better to ISO-1940. Balancing weights shall be positively locked to avoid loosening. Balancing weights and fasteners used shall be galvanized.	
4.7	Performance test of one Centrifugal fan/per type/per size as per AMCA standard (for indigenous make).	
4.8	Centrifugal fans for AHUs will be 100% run tested by main contractor of BHEL. One centrifugal fan/per type/per size will be run tested. Vibration shall be within good zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.	
4.9	Complete assembly of one AHU/per type/ per size (excluding cooling coil and filter) shall be witnessed.	
4.10	Run test of one complete assembly/per type/per size (excluding cooling coil and filter). Vibration shall be within satisfactory zone of VDI 2056 / ISO 10816-1(group- K) machines when measured on bearing housing and noise level <85 dbA at 1 metre distance. Max. Temp. on bearing housing- 40 degrees Centigrade + ambient.	

	TECHNICAL SPECIFICATION AIR HANDLING UNITS	SPECIFICATION NO.PES-553-02
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		SHEET 6 OF 6
5. <u>DRAWINGS/DOCUMENT/DATA REQUIRED AFTER AWARD OF CONTRACT</u> 5.1 5.2 Drawing including equipment layout, foundation & loading details etc. for civil works. These drawings must cover sufficient details so that design of civil works can be completed. 5.3 Inspection, operation & Maintenance Manuals. 5.4 Equipment description giving complete design calculations, basis of design, selection criteria etc. 5.5 Test Certificates. 5.6 Final as built documentation i.e. final-version of all drawings, data & information as per the requirement specified elsewhere. 5.7 Performance Test Certificates.		



AIR HANDLING UNIT
DATA SHEET - A

VOLUME - II-B

SECTION - D

SHEET 1 OF 2

DESCRIPTION

DATA

- | | |
|--|--|
| 1. Nos. required/working | : Refer to Section-C of Specific technical requirement. |
| 2. Location | : Refer to Section-C of Specific technical requirement. |
| 3. Service/type | : Air Conditioning /Double skin. |
| 4. Fan type | : Centrifugal (forward/backward curve Blade) limit load. |
| a) Capacity | : To Suit as per calculation. |
| b) Static pressure | : To suit but not less than 60 mm wc for AHU's Micro-V filters. |
| c) Discharge direction | : To suit layout. |
| d) Motor | : By Bidder, |
| e) Local push button station (Start/Stop) | : By Others |
| f) Motor location | : Inside AHU Casing. |
| g) Drive | : Belt, pulley, belt guard. |
| 5. Face and Bypass Damper | : Required (Opposed blade type) DX AHU's having |
| 6. Cooling coil | |
| a) Duty sensible heat | : To suit as per calculations |
| b) Duty latent heat | : -do- |
| c) Type of coil | : Chilled Water/DX/Hot Water. |
| d) No. of rows | : To suit but not less than four (4) |
| e) Material of tube /Thickness | : Seamless Copper to ASTM E-75/Equivalent. |
| f) Material of fins | : Aluminium to SAE-1100-/1145-0 |
| g) Number of fins | : Not greater than 5 per cm (13 per inch). |
| h) Max. face velocity | : 2.5 m/sec. |
| i) Air flow quantity | : To suit as per tender drawings/documents. |
| 7. 3 - way motorised mixing valve with thermostat. | : Required with thermostat & actuator for chilled water system for each AHU. |



AIR HANDLING UNIT
DATA SHEET - A

VOLUME - II-B

SECTION - D

SHEET 2 OF 2

- | | | |
|-----|------------------------------|--|
| 8. | Damper at discharge | : Manually operated at discharge of each AHU outlet. |
| | a) Material of construction | : Mild Steel, galvanised. |
| 9. | Filters (Pre-filters) | |
| | a) Type & thickness | : Dry panel type/ 50 mm |
| | b) Filter area. | : To suit as per velocity requirements. "V" - Bank. |
| | c) Filter efficiency | : Average arrestance efficiency of 65-80 % |
| | d) Press drop (Clean) | : Not to exceed 2.5 mmwc when clean & 6.5 mmwc while dirty. |
| 10. | Humidification section | : As per the System requirement. |
| | a) Type | : Pan type, unless otherwise specified. |
| | b) Operation | : Automatic with Humidification. |
| 11. | Fresh air arrangement | : Required. |
| | a) Fresh air fan | : Tube axial flow fans with motor. |
| | b) Accessories | : i) Inlet cone with Bird screen.
: ii) Dry panel pre-filters,
: iii) High efficiency filters for control room areas.
: iv) Volume Control Dampers,
: v) Supports etc. |
| 12. | Vibration isolator required. | : Yes |
| 13. | Type of vibration isolator. | : Neoprene ribbed Rubber for AHU's. |
| 14. | Any other requirement | : i) In addition to dry panel filters on AHU, High efficiency filters(average arrestance efficiency of 80-90 %) shall be provided in supply air duct side of AHU for all control room and allied areas.

: ii) Bidder to also provide suitable electrical strip heaters for winter heating & monsoon reheating with Contactor box etc. Heaters to be interlocked with airstat. |
| 15. | Instrument & controls | : Lot.(including Control box for strip heaters, pan humidifiers etc. in each AHU room.) |
| 16. | Insulation of drain piping | : Lot. |



**STANDARD TECHNICAL
SPECIFICATION
FOR
COOLING TOWER**

SPECIFICATION NO.PES-553-03

VOLUME II B

SECTION D

SHEET 1 OF 5

**STANDARD TECHNICAL SPECIFICATION
FOR
COOLING TOWER**

	TECHNICAL SPECIFICATION COOLING TOWER	SPECIFICATION NO.PES-553-03
		VOLUME II B
		SECTION D
		SHEET 2 OF 5

1.

GENERAL

1.1

this standard specification covers the design, manufacture assembly, inspection & testing at manufacturer’s works, suitable painting & packing, delivery, erection & commissioning at site of all materials and equipments for mechanical induced draught cooling tower complete with all accessories as specified hereinafter.

2.

CODES & STANDARDS

2.1

the design, manufacture, inspection & testing and performance of the cooling tower as specified hereinafter shall comply with the requirements of all applicable latest Indian/British/American standards and codes of practice. the latest editions of the following standards & publications shall be followed in particular:

2.1.1

Cooling tower institute USA bulletin ATP-10S: Acceptance test procedure for industrial water-cooling tower.

2.1.2

PTC-23 ASME performance test code for Atmospheric water-cooling equipment.

2.1.3

In case of any conflict between the above codes & standards and-this specification, the later shall prevail.

3.

DESIGN REQUIREMENTS

3.1

the cooling tower shall be designed for continuous operation to cool not less than design flow of water from specified inlet temperature to the outlet temperature at a design ambient wet bulb temperature as indicated under data sheet a.

3.2

all the components shall be capable of safe, proper and continuous operation at all cooling water flows upto & including those specified under data sheet a & shall be designed with regard to case of maintenance, repair, cleaning & inspection.

3.3

the cooling tower shall be of induced draught cross flow or counter flow type and with multiple cells (if specified in data sheet a.) the cooling tower shall be suitable for handling the fluid and also for achieving the specified parameter as per data sheet a. the cooling tower shall be designed such that the drift losses & evaporation losses are minimum.

4.

CONSTRUCTIONAL FEATURES

4.1

CASING & LOUVERS

4.1.1

The cooling tower casing shall be made of FRP/as specified in data sheet A. The louvers shall be made of FRP/as specified. Louvers, if provided, shall be designed for air entry to the tower with low velocity for minimum pressure drop & less chance of recirculation of moist air. To eliminate splash out, louvers shall slope to shed water inwards. Air intake shall be all along the base circumference of the casing & hotdip galvanised expanded metal mesh shall be provided to protect the air intake.

	TECHNICAL SPECIFICATION COOLING TOWER	SPECIFICATION NO.PES-553-03
		VOLUME II B
		SECTION D
		SHEET 3 OF 5
4.2	FILL	
4.2.1	Cooling tower fills shall be made of noncombustible PVC/as specified in data sheet A. The design & arrangement of the fills shall be so as to expose maximum air/water surface with minimum pressure drop.	
4.3	Drift Eliminators	
4.3.1	Multi-pass drift eliminators with minimum two pass zig-zag path shall be provided so to minimise the drift losses.	
4.3.2	In case of FRP cooling tower the drift eliminators shall be of multi-blade rotary type.	
4.4	Fans & Accessories	
4.4.1	The fans shall be multiple blade, low speed, high efficiency axial flow type located above the top deck level of the cooling tower. Fan rotating assembly shall be statically & dynamically balanced. The fan blades shall be preferably adjustable in stand still condition for propeller action. The fan shall be either directly mounted on the shaft of a totally enclosed weather proof motor or shall be suitable for V-belt drive.	
4.4.2	The rating of drive motor shall have at least 15% margin over maximum fan power consumption. The design & construction of the drive motor shall be in accordance with enclosed specification for LVAC motors.	
4.5	Water basin	
4.5.1	The material of construction of water basin shall be FRP or RCC as specified in data sheet A. The basin shall be provided as a part of cooling tower in case of FRP construction. The sump shall have sufficient storage capacity for safe operation of AC plant.	
4.6	Hot water distribution system	
4.6.1	Manually operated flow control valves shall be provided in hot water distribution piping such that each cooling tower can be isolated without affecting the operation of other cells.	
4.6.2	The nozzles shall be spaced to give even distribution of water over entire space occupied by top row of fills. The nozzles shall be made of brass /SS 304/316/316L (brass shall be as per manufacturer's standard) unless specified in data sheet A:	
4.6.3	In case of FRP tower water shall be distributed over the fill by means of a multiple area fail safe rotary sprinkler made of PVC pipes fitted on a aluminium alloy (as per manufacturers standard) rotary head and mounted on sealed ball bearings (make) .	
4.7	Access	
4.7.1	A stair case paddle ladder (as per manufacturer's standard) shall be provided external to the cooling tower at one end of each tower along with stairways hand rails etc give safe & convenient access to the top deck from ground level.	

	TECHNICAL SPECIFICATION COOLING TOWER	SPECIFICATION NO.PES-553-03
		VOLUME II B
		SECTION D
		SHEET 4 OF 5
4.8	Painting	
4.8.1	The cooling towers shall be painted with suitable anti-corrosive paint as per approval of purchaser. All galvanized external surfaces shall be painted to match colouring scheme. Before painting galvanized surfaces -etch primer to be applied.	
5.	<u>SHOP INSPECTION & TESTING</u>	
5.1	Compliance certificates for nozzles (Or rotary sprinkler), piping, fill material, drift eliminator, louvers components etc.	
5.2	Certificate of conformance for all other material components.	
5.3	Balancing report for Static & dynamic balancing of fan assembly.	
6.	<u>TESTS AT SITE</u>	
6.1	Hydrostatic testing of complete hot water distribution piping at site.	
7.	<u>PERFORMANCE GUARANTEE</u>	
7.1	The cooling tower shall be guaranteed to meet the performance requirements as specified & when tested in accordance with ATP-105.	
7.2	The vendor shall furnish performance curves for the cooling tower showing variations in performance from design duty point with change in approach to wet bulb temperature, cooling range, water loading of cooling tower.	

	TECHNICAL SPECIFICATION COOLING TOWER	SPECIFICATION NO.PES-553-03
		VOLUME II B
		SECTION D
		SHEET 5 OF 5
8. DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT		
8.1	General arrangement drawing of complete cooling tower (showing plan, front elevation and side elevation) incorporating principal dimensions, limits of scope of supply of piping, limits of civil works included showing extent of platforms, walkways, handrails, access doors, staircase etc. and the limits of scope of supply of electrical works.	
8.2	General arrangement and sectional assembly drawings pertaining to the following components of the cooling tower: i) Tower fill with supporting arrangement. ii) Drift eliminator installation and details. iii) Complete hot water distribution system including flow regulating valves, distribution basin/pipes and nozzles etc.	
8.3	Cooling tower performance curves showing WBT Vs cold-water temperature for design cooling range, 90% cooling range and 110% cooling range at 100%, 90%, and 110% design flow.	
8.4	Performance curves of cooling tower fans.	
8.5	Test procedure along with details of tests to be conducted for the offered cooling tower.	
8.6	Quality Plan along with complete details of the testing and inspection requirements of mechanical and electrical items of the cooling tower in BHEL format.	
8.7	Operation and maintenance instructions.	



**COOLING TOWER
DATA SHEET - A**

VOLUME II-B

SECTION D

REV 00

SHEET 1 OF 2

A. GENERAL DATA

- 1) Service : Cooling of condenser water of AC plant.
- 2) Type : Fibreglass reinforced plastic construction induced draught.
- 3) Quantity : Refer to Section-C of Specific Technical Requirements.
- 4) Place of installation : Refer to Section-C of Specific Technical Requirements.

B. DESIGN DATA

- 1) Capacity at specified conditions. : To suit the system requirement.
- 2) Water flow rate : To suit the system requirement.
- 3) Design wet bulb temperature : 25 Deg. C.
- 4) Hot water inlet temperature : To suit requirement.
- 5) Cooled water temperature : To suit requirement.
- 6) Depth of sump Tank : As per manufacturer's standard.

C. MATERIAL

- 1) Sump tank & Casing : FRP
- 2) Louvers : FRP/PVC/Aluminium.
- 3) Type of fill : Non-combustible PVC/Eq.
- 4) Nozzles : Brass with chrome plating/polypropylene.
- 5) Ladder : Hot dip galvanized steel ladder for each tower.
- 6) Bird screen : 25 mm square made of GI/SS wire mesh of 16 gauge.
- 7) Fan impeller : Cast Aluminium Alloy/FRP propeller type and multi-blade aerofoil construction with adjustable pitch..
- 8) Supporting structure : MS with spray galvanization of epoxy painting.
- 9) Strainer : Plant strainer made of GI/SS wire mesh of 16 gauge.

D. ACCESSORIES

- 1) Make up connection : Yes.



COOLING TOWER
DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

SHEET 2 OF 2

- 2) Quick fill connection : Yes.
- 3) Overflow & drain & blow down connection : Yes.
- 4) Access door in louvers/fan deck : Yes (if applicable).
- 5) Supports & supporting structure for mounting : Yes.
- 6) Level switch : Yes.
- 7) Rain protection for motor : Yes (suitable Canopy by Bidder)
- E. ELECTRICAL DATA
- i) Power supply : 415 V $\pm$ 10%/50 Hz $\pm$ 3%/3 phase.
- ii) Motor : As per specification attached.
- F. INSPECTION & TESTING : As per approved quality plan.



TECHNICAL SPECIFICATION
LOW PRESSURE AIR DISTRIBUTION
SYSTEM

SPECIFICATION NO.PES-553-07

VOLUME II B

SECTION D

SHEET 1 OF 9

STANDARD TECHNICAL SPECIFICATION
FOR
LOW PRESSURE AIR DISTRIBUTION SYSTEM

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO.PES-553-07
		VOLUME II B
		SECTION D
		SHEET 2 OF 9

1.

GENERAL

1.1

This specification covers the design, manufacture, construction features, installation, inspection testing and air balancing of air distribution system upto a total pressure of 95mm w.g. The specification is intended to cover the air distribution for air conditioning system and ventilation system not involving localised exhaust.

2.

CODES AND STANDARDS

2.1

The design, construction and performance of complete system shall conform to all currently applicable statutes, regulations, safety codes in the locality where the equipment are to installed

2.2

Unless specified otherwise the equipments shall generally conform to latest applicable Indian Standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. In particular the equipment shall generally conform to latest editions by the following standards:-

a) IS: 655

-

Specifications for metal air ducts.

b) IS:277

-

Specifications for galvanised steel sheets.

c) IS:737

-

Specification for wrought aluminium and aluminium alloy sheet and strip.

3.

MATERIAL

3.1

Metal air ducts shall be either of galvanised steel sheets or aluminium sheets, as indicated in data sheet-A.

3.2

The rolled steel sheets before galvanising shall be properly annealed or normalised so as to allow fabrication of ducts without developing cracks. Zinc coating on the steel shall be as per technical requirement refer to Section-C of Specific Technical Requirements.

3.3

The aluminium sheets shall be of grade S1C or NS3 and shall be suitable for duct fabrication work as per IS-737 latest

4.

CONSTRUCTION/FABRICATION

4.1

The thickness of sheets, the type of bracing and other fabrication details shall generally conform to requirements given hereunder unless specified otherwise in data sheet A and/or indicated on drawings.

4.2

RECTANGULAR DUCTS

4.2.1

S.No.	Max Side	Sheet Thickness	Type of transverse	Bracings



TECHNICAL SPECIFICATION
LOW PRESSURE AIR DISTRIBUTION
SYSTEM

SPECIFICATION NO.PES-553-07

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SECTION D

SHEET 3 OF 9

		(mm) GI	(mm) AI	Joint connections	
a)	Up to 600	0.63 (24G)	0.80	S-drive, pocket or bar slips or flanged joints on 2.5m centres	None
b)	601 to 750	0.63 (24G)	0.80	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
c)	751 to 1000	0.80 (22G)	1.00	S-drive, 25mm pocket or 25mm bar slips or flanged joints on 2.5m centres	25x25x3 mm MS angles, 1.2m from joints
d)	1001 to 1500	0.80 (22G)	1.00	40x40x3mm MS angle, flanged connections or 40mm pocket or 40mm bar slips with 35x3mm bar reinforcing on 2.5m centres	40x40x3 mm MS angles, 1.2m from joints
e)	1501 to 2250	1.00 (20G)	1.50	40x40x3mm MS angle, flanged connections or 40mm pocket or 40mm bar slips, 1M maximum centres, with 35x3mm bar reinforcing	40x40x3 mm diagonal angles or 40x40x3mm angles, 600mm from joints
f)	2251 & above	1.25 (18G)	1.80	50x50x3mm MS angles, connections or 40mm pocket or 40 mm bar slips, 1M maximum centres with 35x3mm bar reinforcing.	50x50x3mm diagonal angles or 50x50x3mm angles 600 mm from joints.
g)	No bracing is required if transverse joints are less than 600mm apart				
h)	For ducts larger than 2250mm, special handling and supporting methods shall be provided as per the approval of Purchaser				

4.2.2 All rectangular ducts having either dimension larger than 450mm shall be cross broken except these ducts which are insulated with sand cement plaster. Air outlet connections on ducts need not be cross broken.

4.2.3 The seams on duct cones shall be of Pittsburgh type. Longitudinal seams shall be smooth inside the ducts.

4.2.4 The flanges used for transverse joints shall be joined together with GI bolts (grade 4.6) and nuts spaced at 125mm centres as per following:

- a) Upto 1000mm - 6 mm dia GI bolts
- b) 1001 to 1500 - 8 mm dia GI bolts
- c) 1501 and above - 10mm dia GI bolts

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO.PES-553-07
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4.2.5 The MS angle flanges shall be connected to ducts with rivets at approx. 100mm centres. The flanged joints shall have 6mm thick felt packing stuck to flanges with shellac varnish. The holes in the felt packing shall be burnt through. The ducts are to be tapped 6mm across the MS flanges.

4.2.6 MS angles used for bracings shall be tack welded to the ducts or rivetted at 125mm centres, as applicable.

4.3 **ROUND DUCTS**

4.3.1

S.No.	Duct dia-mm	Sheet Thickness		Reinforcing
		(mm) GI	(mm) Al	
a)	Up to 150	0.63 (24G)	0.80	None
b)	151 to 600	0.80 (22G)	1.00	None
c)	601 to 1000	1.00 (20G)	1.50	40x40x3mm girth MS
d)	1001 to1250	1.00 (20G)	1.50	40x40x3mm girth MS angles at 2.0 meter centres
e)	1251 & above	1.25 (18G)	1.80	40x40x3mm girth MS angles at 1.2m centres

4.3.2 The seams on round ducts may be continuously welded or grooved longitudinal seam. In case of welding of GI sheet, zinc rich paint shall be applied on the welded zone.

4.3.3 Round ducts shall either be joined by welding or the ducts shall be swedged 40mm from the ends such that larger end will butt against the swedge and is held in place with sheet metal screws.

4.4 **DUCT SUPPORTS**

Unless specified otherwise on drawings, rectangular ducts with larger side of 2250mm or above shall be supported by 15mm MS rods and 50x50x3mm and MS angles while those below 2250 mm shall be supported by 10mm MS rods and all angles shall be given a coat of primer paint. The duct supports shall be at a distance not exceeding 1800mm. The MS rods shall be fixed to MS angle cleats, which in turn are fixed to ceiling slab by suitable anchor fasteners. All anchor fasteners, MS angle cleats, coach screws, hooks and other supporting material required shall be provided by vendor.

However, If ducts are thermally insulated, the MS angles and supports shall not be in

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO.PES-553-07
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	direct contact with ducts, for which purpose wooden pieces/ Resin bonded fibre glass sheets (50 mm thick) shall be used in between.	
4.5	FLEXIBLE CONNECTIONS	Wherever the sheet metal ducts connects to intake or discharge of fan units a flexible connection of at least 150mm width made by closely woven double layer Fire resistant or canvas shall be provided. The same shall be attached to angle iron frames on equipment and to similar frame on duct or casing by means of a steel band 9r (or) collar fitting over the end of the flexible connection and bolted through angle iron frame so as to clamp securely between the band and the angle frame.
4.6	TRANSFORMATIONS AND BREACHES	All curves, bends, offsets and other transformations shall be made for easy and noiseless flow of air. The throat of every branch duct shall be sized to have a velocity not exceeding that in the main duct to which the branch is connected.
4.7	CAULKING	Wherever duct passes through wall, the opening between masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to adjoin by space with a rated fire resistant material.
4.8	EASEMENT	Normally pipe hangers, light fitting rods etc. shall not be allowed to pass through the ducts. Wherever, It becomes absolutely essential to pass these hangers/rods etc. Through the ducts, prior approval of purchaser shall be taken and light streamlines easement around the same shall be provided to maintain smooth air flow.
4.9	ACCESS DOORS	Access doors shall be provided in ducts, plenums etc. on both sides to allow access and servicing of equipment viz. pipes, dampers, coils, valves, heaters etc. All access doors shall be adequately sized and lined suitably with felt to prevent air leakage. The doors shall be of built-up construction, structurally strong and shall have at least two hinges each, and shall be with two rust proof window sash locks of approved type. All doors shall be so set as to flush with outer finish of duct insulation etc.
4.10	DAMPERS AND SPLITTERS	
4.10.1		Dampers and splitters shall be provided at suitable points for proportional volume control of the system. Splitters and dampers shall be made of minimum 18 gauge GSS of quadrant type with locking device mounted outside the duct at accessible location.
4.10.2	FIRE DAMPERS	Fire dampers shall be provided as specified in Data Sheet -A and shall be installed at locations indicated on drawings and/or as required/approved by purchaser, including all openings in passage of duct work through fire walls and floors etc. The fire damper shall be of electrical type with damper motor actuated by thermal

	TECHNICAL SPECIFICATION LOW PRESSURE AIR DISTRIBUTION SYSTEM	SPECIFICATION NO.PES-553-07
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	sensor or fusible link type.	
4.10.3	VANES	Unless otherwise shown in the drawings all elbows shall be such that the throat radius is 75% of the duct width. In case throat radius is smaller, suitable single thickness vanes of approved details shall be provided.
4.10.4	FLASHING	For the ducts penetrating roofs or outside walls, provision of flashing shall be made by the ducting vendor.
4.11	DIFFUSERS AND GRILLS	The type and quantity of diffusers and grills is indicated on enclosed drawings/data sheet A. The size/quantity of diffusers/ grills indicated in the drawing/data sheet is indicative and is for vendor's reference purpose only. Vendor shall ensure that the diffusers/grills offered are of requisite capacity, throw and terminal velocity. The pressure drop and noise levels shall be as per data sheet. A enclosed. The diffusers/grills shall be approved by purchaser. Unless specified otherwise the diffusers/grills shall be of mild steel land painted with two coats of primer paint. Supply air grills shall be complete with volume control dampers. Supply air grills shall be double deflection type while Return Air grills can be single deflection type. Ceiling outlets/diffusers shall have volume control dampers, fixed grids and blanking baffles. All volume control dampers shall be operated by a key from the front of grills/diffusers. Suitable vanes shall be provided in duct collars to have uniform air distribution. Blank-off baffles wherever required, shall also be provided.
4.12	PLENUMS AND RA BOXING	All plenum chambers and/or connections to fans, dampers etc. shall be constructed in 18 gauge GI sheet. supported on 40x40x6mm MS angle frames. All vertical angles shall be riveted at appox. 125mm. centres to the casing. Suitable caulking compound (Pecora or equivalent) shall be inserted between the base of the angle and all masonry construction to which angles are fastened. Return air boxing requirements if any are indicated in data sheet-A and the same shall be provided by vendor. The return air box shall be fabricated out of GI sheets shall be insulated with 25mm thick fibre-glass.
4.13	ACCOUSTIC LINING	The ducts shall be lined acoustically from inside as given in data- sheet A and/or section C of the specification.
4.14	PAINTING	Wherever specified the ducts shall be painted or lined with suitable anti-corrosive paint/ lining as per approval of purchaser. In particular the ducts coming in contact with acid fumes shall be epoxy coated, inside and outside.

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		VOLUME II B
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		SHEET 7 OF 9
4.15	THERMAL INSULATION Thermal insulation shall be as per data sheet - A and the insulation shall conform to enclosed spec. no. PES-553-08.	
5.	<u>INSPECTION AND TESTING</u>	
5.1	INSPECTION & TESTING DURING FABRICATION	
5.1.1	Visual inspection of GI sheets and angles, channels etc. – dents, black spots, chipping of zinc coating, white dust on galvanised sheets shall be avoided. Pitting , lamination in angles and channels shall be avoided.	
5.1.2	Galvanised sheets - Test certificate shall be furnished for visual check, coating thickness, adhesion test, sheet thickness, uniformity of coating.	
5.1.3	Check for dimensions & mass as per latest IS-277.	
5.1.4	Check for defect, twists, ungalvanised spots as per IS-2629.	
5.1.5	Bend test & wrapping test as per IS-277.	
5.1.6	Zinc coating test on samples as per IS-6745.	
5.2	INSPECTION & TESTING AT SITE.	
5.2.1	The duct branches, elbows etc. shall be inspected and the joints and connections etc, are to be checked before they are assembled in position.	
5.2.2	After completion, all duct systems shall be checked and tested for air leakage, tightness, velocity, pressure drop, vibration and noise etc.	
6.	<u>BALANCING</u>	
6.1.1	The entire air distribution system shall be balanced by vendor to supply the air quantities as required in various rooms so as to maintain the requisite temperature and air flow in the conditioned spaces. The final balance of air quantities through each grill/diffuser etc. shall be recorded and submitted to purchaser for approval. Proper steps shall be taken to have a uniform temperature in all enclosures, with utmost care for noise level to be within tolerance limit	
6.1.2	All instruments required for testing/balancing etc. of the air distribution system shall be provided by vendor.	

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7.

DATA TO BE FURNISHED BY VENDOR AFTER THE AWARD OF CONTRACT

7.1

Fabrication drawings of ducts and grilles, louvers, dampers, etc, including typical details of grilles dampers etc.

7.2

Test certificates in line with scope of inspection.

7.3

Other dimensional drawings & documents as may be required by purchaser for better understanding of the system & for preparation of operation, maintenance & instruction manual.



LOW PRESSURE AIR DISTRIBUTION SYSTEM
DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

SHEET 1 OF 2

Description

Data

- | | |
|--|---|
| 1. General (List of areas) | : As per Specification/Tender drawing. |
| 2. GSS Duct Work | |
| a) Type | : GSS as per IS: 277
(Zinc coating as per Section-C of Specific Technical Requirements.) |
| b) Size | : As per Section-C of Specific Technical Requirements and bill of quantity. |
| 3. Acoustic lining | : Up to 5m length from AHU Outlet. |
| 4. Special painting | : Galvanised. |
| 5. Thermal Insulation | : Required in supply air duct in AC entire length. |
| 6. Diffusers (Circular/Square) | |
| 300 mm size | |
| 350 mm size | |
| 450 mm size | |
| 550 mm size | |
| 600 mm size | |
| Any other size | |
| <div style="display: flex; align-items: center;"> <div style="font-size: 4em; margin-right: 10px;">}</div> <div> : Bidder to estimate as per drawings./specification.
 All grille frame and louvers shall be manufactured of at least 16 SWG Aluminium </div> </div> | |
| 7. SA grilles (for each size) | : To suit air flow as per System requirements / Tender Drawings. |
| 8. RA grilles (for each size) | : -do- |

NOTE:

1. Duct sheet thickness shall be as per IS-655
2. Opposed blade type volume control damper shall be provided at each supply air diffusers/grilles.
3. Bidder to provide suitable gasketing at each duct flange.
4. Fire damper shall be motor operated type, when otherwise specified under Section-C.
5. Access door in ducting system shall be provided as required.
6. MS Angle (painted) shall be used for duct supports etc.
7. Velocity thru duct shall normally not exceed 9.0 M/sec for Air conditioning system. Maximum velocity (outlet) for supply air diffuser shall not exceed 2.5 m/sec.



LOW PRESSURE AIR DISTRIBUTION SYSTEM
DATA SHEET - A

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8. All Grilles & diffusers shall be supported with frame. Frame etc. shall be supplied by bidder.

	TECHNICAL SPECIFICATION CENTRIFUGAL PUMPS	SPECIFICATION NO.PES-553-04
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STANDARD TECHNICAL SPECIFICATION
FOR
CENTRIFUGAL PUMPS

	TECHNICAL SPECIFICATION CENTRIFUGAL PUMPS	SPECIFICATION NO.PES-553-04
		VOLUME II B
		SECTION D
		SHEET 2 OF 10
1. GENERAL 1.1 This specification covers the design, material, constructional features, manufacture, assembly, inspection and testing at manufacturer’s or his subcontractor’s works, suitable painting requirements of centrifugal pumps and drives complete with all accessories as specified hereinafter. 2. CODES AND STANDARDS 2.1 The design, manufacture, inspection, testing & performance of the pumps as specified hereinafter, shall comply with the requirements of the latest revision of the following standards as indicated below (as applicable): 2.1.1 IS-1520 : Horizontal centrifugal pumps for clear, cold and fresh water. 2.1.2 IS-5120 : Technical requirements - Rotodynamic special purpose pump. 2.1.3 IS-1710 : Vertical turbine pumps for clear, cold and fresh water. 2.1.4 BS - 599 : Method of testing Pumps. 2.1.5 PTC - ‘6’ : Centrifugal Pumps Power test code 2.1.6 API - 610 2.1.7 Hydraulic Institute Standards of USA Wherever standards for certain aspects materials etc., not mentioned, the same shall be as per the applicable Indian or International standards. 2.2 In case of any conflict between the above codes/standards and this specification, the later shall prevail and in case of any further conflict in this matter, the decision of Purchaser’s engineering shall be final and binding.		

	TECHNICAL SPECIFICATION CENTRIFUGAL PUMPS	SPECIFICATION NO.PES-553-04
		VOLUME II B
		SECTION D
		SHEET 3 OF 10
3. <u>DESIGN REQUIREMENTS</u>		
3.1	The pumps shall be of heavy duty suitable for long periods of uninterrupted service and shall be standard product of the manufacturer thoroughly proven for satisfactory performance and reliability.	
3.2	The materials of construction of various components shall be as indicated under Data Sheet-A and where not specified to the applicable Indian/British/American standards..	
3.3	All pressure containing components including the pump casing, nozzles and stuffing box housing shall be designed, fabricated and tested in accordance with applicable Indian standards if not specified otherwise.	
3.4	The pump shall be suitable for handling the fluid as specified in Data Sheet-A.	
4. <u>CONSTRUCTION FEATURES:</u>		
4.1 PUMP CASING		
4.1.1	Pump casing may be axially or radially split or barrel type construction as specified in the pump data specification sheet. The casing shall be designed to withstand 1.5 times the maximum pressure developed by the pump at the pumping temperature.	
4.1.2	Pump casing shall be provided with adequate number of vent and priming connections with valves, unless the pump is made self venting & priming. Casing drain, as required, shall be provided complete with drain valves or plugged with threaded plugs as required.	
4.1.3	Pump shall preferably be of such construction that it is possible to service the internals of the pump without disturbing suction and discharge piping connections.	
4.1.4	Under certain conditions, the pump casing nozzles will be subjected to reactions from external piping. Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610	
4.2 IMPELLER		
4.2.1	Unless specifically indicated under Data Sheet-A enclosed, the pump impellers shall be of closed vane type. The impellers shall be secured to the shaft and shall be retained against circumferential movement by keying, pinning or lock rings. Impellers shall be checked for eccentricity and statically and dynamically balanced individually. The assembled rotor shall be dynamically balanced and checked for eccentricity. Supplier shall ensure during balancing that wall thickness of impeller vane, shroud etc is maintained above the minimum thickness requirement as per design.	
4.3 WEARING RING		
4.3.1	Renewable wearing rings for the casing and/or the impellers and renewable shaft sleeves, shall be provided for all pumps. Length of the shaft sleeves must extend	

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	beyond the outer faces of gland packing or seal and plate so as to distinguish between the leakage between shaft & shaft sleeve and that past the seals/gland.	
4.4	SHAFT	
4.4.1	Shaft size selected shall take into consideration the critical speed which shall be away from the operating speed as recommended in applicable Code/Standard. The critical speed shall also be at least 10% away from runaway speed.	
4.5	BEARING	
4.5.1	Bearings and hydraulic devices, of approved make, (if provided for balancing axial thrust) of adequate design shall be furnished for taking the entire pump load arising from all probable conditions of continuous operation throughout its Range of Operation and also at the shut off condition. The bearing shall be designed on the basis of 20,000 working hrs minimum for the load corresponding to the duty point. Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid being pumped. Where there is a possibility of liquid entering the bearing, suitable arrangement in the form of deflectors or otherwise shall be provided ahead of bearing assembly. Bearings shall be easily accessible without disturbing the pump assembly.	
4.6	STUFFING BOX	
4.6.1	Packed type stuffing boxes of adequate depth with lantern rings shall be provided to minimize the leakage. In all cases where the pump suction is below atmospheric pressure, the shaft packing shall be sealed by the liquid pumped by tapping off from the pump discharge itself and all pipes, valves, fittings etc., required for this shall be furnished by the manufacturer. Tubings used for connections shall be flexible metallic type preferably SS-304/316. PVC/ rubber tubings are not acceptable.	
4.7	SHAFT COUPLING	
4.7.1	The pumps shall be directly coupled to their drives through heavy-duty flexible coupling. Suitable sturdy coupling guards of min. 1.5 mm MS sheet/ Aluminium sheet shall be provided along with the coupling. The pump and its drive motor shall be mounted on a common base plate.	
4.8	BASE PLATE AND SOLE PLATE	
4.8.1	Unless otherwise stated the data specification sheet, a common base plate mounting both for the pump and drive shall be furnished. The base plate shall be of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the pumping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, hydraulic piping thrust, etc. Suitable drain taps and drip lip shall be provided. The external corners of the base plate shall be rounded to avoid sharp corners. Drilled holes shall have sufficient space around for proper seating of washer with nut. If required in the data specification sheet, steel sole plates shall be provided, below the base plate.	

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4.9	PRIME MOVER	
4.9.1	The drive motor selected shall conform to the requirements of the enclosed motor specifications.	
4.10	LIFTING ARRANGEMENT	
4.10.1	Each pump and motor shall incorporate suitable lifting attachments e.g. lifting lugs or eye bolts etc., to facilitate erection and maintenance..	
5.	<u>PERFORMANCE REQUIREMENTS</u>	
5.1	The pump shall be designed to have best efficiency at the specified duty point. The pump set shall be suitable for continuous operation at any point within the Range of Operation as stipulated in the data specification sheets.	
5.2	Pump shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum being at shut off. Power capacity characteristic will be non-overloading type i.e. 110% of the design flow the power required to drive the pump will be practically the same as that at the design flow.	
5.3	Wherever specified in data sheet, pumps of each category shall be suitable for parallel operation. The head vs capacity, input power vs. capacity characteristics, etc., shall match to ensure equal load sharing and trouble free operation throughout the range.	
5.4	The pump motor set shall be designed in such a way that there is no damage due to the reverse flow through the pump which may occur due to any malfunction of the system.	
6.	<u>DRIVE RATING</u>	
6.1	The power rating of the drive shall be selected such that a minimum margin of 15% is available over the pump input power required at the rated duty point. However, the drive rating shall not be less than the maximum power requirement at any point within the 'Range of Operation' specified.	
6.2	In cases where parallel operation of the pumps are specified the actual drive rating is to be selected by the bidder considering overloading of the pumps in the event of tripping of one of the operating pumps.	
6.3	The bidder under this specification shall assume full responsibility in the operation of the pump and the drive as one unit.	
7.	<u>SCOPE OF INSPECTION AND TESTING</u>	
7.1	CASTING	
7.1.1	The Witnessing pouring and thereafter physical testing of castings of 'Critical' nature such as casings, impellers, diffusers. Castings shall have 'as cast' heat numbers	

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		SHEET 6 OF 10
	unless they require overall machining. For partially machined components manufacturer shall ensure availability of as cast heat nos. on unmachined area.	
7.1.2	Identification and correlation with test reports for all tests as per the relevant material specifications for castings of 'Major' nature such as suction bell, discharge elbow, stuffing box, gland, wearing rings, shaft sleeves etc.	
7.1.3	Foundry's conformity certificate for castings of 'Minor' nature such as base plates, covers etc.	
7.1.4	Verification of Heat treatment charts (as applicable)	
7.1.5	Castings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.	
7.1.6	Surface finish of Steel castings shall meet MSS SP-55.	
7.2	FORGING	
7.2.1	Identification and correlation with mill test certificates for all tests as per the relevant specifications for important forgings like casings, stage bodies, diffusers, shaft material.	
7.2.2	Verification of heat treatment charts (time temperature) (as applicable).	
7.2.3	Forgings may be required to meet NDT requirements such as Radiography, Magnetic Particle Testing or Dye-penetrant testing prior to Hydro-test as per requirements specified in Quality Plan.	
7.3	FABRICATED ITEMS	
7.3.1	Identification and correlation with mill test certificates for material of items such as discharge bellows, column pipes etc.	
7.3.2	Approval of welding procedure specifications and qualifications of weld procedures and personnel as per ASME Sec IX.	
7.3.3	Dye penetrant tests of weldment as per ASTM E-165 and acceptance norm as per ASME Sec.VIII, Div.1, Appendix 8	
7.3.4	Verification of heat treatment charts (time temperature), (as applicable)	
7.3.5	Note: For para 7.1.2, 7.2.1 and 7.3.1 above; in case correlating original test certificates are not available, material shall be identified by Main Vendor and test conducted at NABL approved Laboratory.	
7.4	IN PROCESS INSPECTION AND TESTING	
7.4.1	Identification Dye penetrant testing after machining for impellers including vanes, pump shaft, diffusers as per applicable code; in absence of which, as per ASTM E - 165. Permissible defects and acceptance norms need to be specified. On static parts acceptance norms are as per ASME Sec.III NB 2546.	
7.4.2	Ultrasonic testing of dynamic duty component, i.e. pump shafts (50mm dia and above) and static duty forgings i.e. Barrel, casting (15mm and above wall thickness)	

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7.4.3	as per applicable code, in absence of which as per ASTM E388 and acceptance norms as stipulated hereunder. Probe shall be of min. 2 MHz frequency. Acceptance norms for UT for dynamic duty components. the following defects are unacceptable a) Cracks, flakes, seams and laps b) Defects giving indications longer than that from a 4mm equivalent flaw. c) Group of defects with maximum indications less than that from a 4mm equivalent flaw, which cannot be separated at testing sensitivity, if the back echo is reduced to less than 50%. d) Defects giving indications of 2 to 4mm dia. equivalent flaw separated by distance less than four times the size of the larger of the adjacent flaw.	
7.4.4	For static duty components - as per NB 2542.2 of ASME Sec. III	
7.4.5	Hydro tests of all pressure parts such as casings, column pipes, discharge elbows etc., at two times duty point pressure or 1.5 time shut off pressure, whichever is higher for 30 min., without any leakage. Note : In case the pump is required to boost certain pressure, the inlet pressure head shall also be taken into consideration to compute test pressures	
7.4.6	Static and dynamic balancing of individual impellers and also assembled rotors as per V.D.I. 2060 Q 6.3 or ISO 1940 G 6.3.	
7.5	PERFORMANCE TEST	
7.5.1	Pump testing with unit supply motor as per specifications and acceptance norms cited elsewhere, in absence of which as per IS 5120 latest edition. Performance shall be checked for minimum of 7 points (including shut off head and over load) following characteristics shall be checked. a) Capacity V/s Head b) Capacity V/s Power absorbed by pump c) Capacity V/s pump efficiency Note : For pump of fire protection system, performance test shall be conducted up to 150% of rated capacity.	
7.5.2	NPSH test in case specifically mentioned elsewhere.	
7.5.3	Vibration, noise level and temperature rise measurement. Noise level shall be within 85dB(A) at 1 metre distance. Vibration within satisfactory zone of VDI 2056 Group G machines. Temperature shall not exceed ambient + 40 deg. C.	
7.5.4	Overall dimensions as per GA drawings. One pump/type/size assembly with job motor shall be mounted on base plate, provided the components are ordered on the same manufacturer.	
7.5.5	Examination after selective opening up after running for pumps operating at speed over 1800 rpm and capacity exceeding 68M3/hr.	
7.5.6	Painting and packing as per technical specification.	

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7.6	TEST AT SITE	
7.6.1	The pumps will be tested at site by the purchaser to verify their performance. If the pumps fail to operate smoothly or within the required performance all such deficiencies shall be rectified by the manufacturer by making suitable alternatives in the pump set and additional tests required to show the effect of such alterations shall be performed by him.	
7.7	PERFORMANCE GUARANTEE	
7.7.1	The vendor shall guarantee the material and workmanship of all components as well as the operation of the pump as per requirement of this specification. The vendor shall also guarantee for each pump the total dynamic head at the specified rated capacity and also corresponding efficiency, brake horse power and shut off head	
8.	<u>CLEANING, PROTECTION , PAINTING & PACKING</u>	
8.1	Before shipment of the equipment to be supplied under this specification the necessary cleaning, flushing etc., as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere shall be done to remove all dirt, scales etc. Shop coats of rust inhibiting paints, lacquers etc., shall be applied to various parts as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere. Flanges, inlet and outlet pipe, etc shall be protected. Packing shall be done as per manufacturers standard/ as specified for the contract in Data Sheet A/ elsewhere.	

	TECHNICAL SPECIFICATION CENTRIFUGAL PUMPS	SPECIFICATION NO.PES-553-04
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9.	<u>DRAWINGS, TECHNICAL DOCUMENTS AND OTHER INFORMATION REQUIRED WITH THE PROPOSAL</u>	
9.1	Fully dimensioned outline GA drawings of the pump motor assembly unit for each type and size offered. This drawing should include: a) Foundation base plate and sole plate details as applicable b) Civil foundation and anchor bolts details and loading data c) Minimum submergence required for the pump (if applicable)	
9.2	Cross sectional drawing of the equipment showing the details of assembly of components and their material of construction and/ make with standard applicable codes.	
9.3	Performance characteristics (Discharge capacity vs head, BHP and efficiency of the pumps.	
9.4	Motor speed torque curve superimposed on pump speed torque curve. Required NPSH of pump.	
9.5	Experience list about the supply and successful operation of similar pumps for similar application.	
9.6	A comprehensive write up or brochure on the details of manufacturing and testing facilities in the shop of the manufacturer.	
9.7	Quality plan for the equipment being offered, in BHEL format as practiced in the manufacturer's works and Field Quality Plan for receipt, storage erection, commissioning & testing at site.	
9.8	Data sheet-B with all the particulars filled in.	
10.	<u>MANUFACTURERS NAME AND TAG. PLATES</u>	
10.1	Each pump shall have a permanently attached brass/ Stainless steel tag on the body indicating the following information both in Hindi and English: a) Manufacturer's name and trade mark. b) Design Capacity and Head. c) Design. d) Purchaser's tag no. as furnished during the contract. The purchaser's tag no. will be indicated by the Purchaser on the drawing submitted for approval by the vendor.	

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CENTRIFUGAL PUMPS
DATA SHEET - A

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SECTION D

REV 00

SHEET 1 OF 2

DESCRIPTION

DATA

- | | |
|------------------------------------|---|
| 1. Designation | : Condenser water and Chilled Water pumps for AC plant. |
| 2. Type | : Horizontal, Centrifugal pump or vertical split type casing pump . |
| 3. Quantity | : Refer to section-C of Specific Technical Requirements |
| 4. Installation | : On floating type foundation. |
| 5. Fluid to be handled | : Water |
| 6. Temperature of fluid | : To suit. |
| 7. Capacity M3/hr and TDH at rated | : To suit system requirements but head shall not be less than 25 MWC. |
| 8. Duty | : Continuous (24 hours / day) |
| 9. Suction condition | : Flooded |
| 10. Type of drive | : Direct |
| 11. Prime Mover | : LV AC motor |
| 12. Maximum speed | : 1500 RPM |
| 13. Type of lubrication | : Grease Lubrication |
| 14. Material | |
| a) Impeller | : Bronze to Grade IS: 318 Grade 2 |
| b) Pump shaft | : EN - 8 / Equivalent (Approved). |
| c) Casing | : CAST IRON TO IS: 210 Grade - 260. |
| d) Wearing ring | : Bronze to Grade IS:318 GR-2, Renewable type. |
| e) Shaft Sleeve | : -do- |
| f) Base plate | : Cast Iron to Grade FG-200 IS-210/M.S. fabricated. |
| g) Bolt and nuts. | : MS |
| h) Stuffing Box gland/bush case. | : Deep Bronze packing to be renewable with case. |



CENTRIFUGAL PUMPS
DATA SHEET - A

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SECTION D

REV 00

SHEET 2 OF 2

i) Stuffing box Packing. : Flexible Graphite or PTFE (Asbestos shall not be used)

j) Pump motor coupling. : Flexible.

15. ACCESSORIES REQUIRED:-

The following accessories shall be provided by the bidder for each pump:

a) Suction & Discharge pressure gauges. : Yes.

b) Vent connection : Yes.

c) Drain piping up to common drain point
in plant room. : Yes

d) Companion flanges. : Yes

e) Common base plate. : Yes.

f) Suction strainer. : Yes

g) Isolating valve : Yes

h) NRV at pump outlet at inlet/outlet : Yes

i) Any special requirements : The Chilled Water pumps shall be suitably insulated as per spec.

j) Inspection & Testing : As per specification enclosed elsewhere.



**TECHNICAL SPECIFICATION
FOR
PACKAGE CONDITIONING UNIT**

SPECIFICATION NO.PES-553-05

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SECTION D

SHEET 1 OF 6

**STANDARD TECHNICAL SPECIFICATION
FOR
PACKAGE CONDITIONING UNIT**

	TECHNICAL SPECIFICATION FOR PACKAGE CONDITIONING UNIT	SPECIFICATION NO.PES-553-05
		VOLUME II B
		SECTION D
		SHEET 2 OF 6
1	<u>GENERAL</u>	
1.1	This specification covers the design, manufacture, inspection and testing at the manufacturer's works and suitable packing delivery and testing of the packaged air conditioning unit.	
2	<u>CODES AND STANDARDS</u>	
2.1	The design, manufacture, inspection, testing and performance of the packaged type air conditioning unit shall comply with all statutes, regulations and safety codes currently applicable in the locality where the equipment will be installed. The equipment shall also conform to the latest editions of the codes and standards specified herein under. Nothing in this specification shall be construed to relieve the vendor of this responsibility.	
	In particular, the packaged air conditioning Unit (max 7.5 TR capacity, ductable or non ductable type) or cassette type (up to 5 TR) shall conform to the latest editions of the following standards:	
2.1.1	I.S.660	: Safety code for Mechanical Refrigeration.
2.1.2	I.S.5111	: Code of practice for measurement, and testing of refrigerant compressor.
2.1.3	I.S.659	: Safety code for air conditioning.
2.1.4	I.S.2494	: V Belt for industrial purpose.
2.1.5	I.S.3142	: V grooved pulleys for V Belts.
2.1.6	I.S.4503	: Shell and tube type heat exchanger.
2.1.7	ARI 210	: Standard for/unitary air conditioning equipment
2.1.8	ARI 270	: Standard for application installation and servicing of unitary equipment.
2.1.9	ASHRAE-37	: Standard methods of testing for rating unitary air conditioning and heat pump / equipment.
2.1.10	ANSI-B9-1	: Safety code for mechanical refrigeration.
3	<u>DESIGN AND CONSTRUCTIONAL REQUIREMENTS</u>	
3.1	Compressor The compressor shall be hermetic or semi-hermetic or screw rotary type or scroll type. The same shall be suitable for R410A/R407C/R134A refrigerant. The compressor shall be mounted on anti-vibration spring/rubber pads and shall be positioned in such a way that it is freely accessible with sufficient space all around for easy maintenance. Safety controls like High and Low pressure cut-out overload and single phasing protection for the motors shall be provided. A crankcase heater shall also be provided, if considered necessary by the vendor.	
3.2	CONDENSING UNIT Shell and tube type water cooled condenser or air cooled condenser with adequate area shall be provided as specified in Data Sheet-A. The condensing unit shall be complete with	

	TECHNICAL SPECIFICATION FOR PACKAGE CONDITIONING UNIT	SPECIFICATION NO.PES-553-05
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	multipass heads and shall be fitted with the following:	
3.2.1	Hot gas inlet and liquid outlet connection with shut off valve for liquid.	
3.2.2	Drain plug, air vent and test valve.	
3.2.3	Water inlet and outlet connection with thermowell and suitable cocks respectively.	
3.2.4	Relief valve and air purge valve (Fusible plug in place of relief valve not acceptable)	
3.2.5	Any other accessory as recommended by the manufacturer for proper functioning of the equipment.	
3.3	AIR HANDLING FAN The air handling fan shall be of the centrifugal type and with forward curved blades. This shall be driven by means of a three phase induction motor through V belt drive. The fan static pressure shall be selected for passing air through high efficiency absolute filters, if specified in Data Sheet-A.	
3.4	FILTERS Filters shall be of dry panel type and shall be cleanable. The velocity of air across the filters shall not exceed 1.75m/sec (350FPM).	
3.5	COOLING COIL The cooling coil shall be of direct expansion type and shall be made of heavy gauge copper with aluminium fins. The fins shall be bonded to the copper tubes under hydraulic pressure. A distributor shall be provided for feeding the refrigerant to different sections of the coil. Rows shall be staggered in the directions of airflow. The velocity of air across coil shall not exceed 2.5M/Sec. (500 FPM).	
3.6	CONTROLS All necessary controls and accessories like thermostatic expansion valve, refrigerant solenoid valve, distributor, filter drier in the liquid lines, shut off valves, HP/LP cut out for compressor, thermostat with adjustable settings, overload and single phasing preventer for motor etc. are to be provided. The microprocessor based control panel shall be provided outside the packaged unit on one side. The control panel shall generally be in line with the specification for control panels given elsewhere. The control shall be so interlocked that the fan shall be started independently first, and then only the compressor. Tripping of the compressor by the thermostat or compressor cut outs shall not trip the fan. The thermostat setting shall be adjustable	
3.7	REFRIGERANT PIPING The refrigerant piping shall be either heavy gauge copper as furnished in Data Sheet-A. The piping shall be completely factory assembled, pressure tested, dehydrated and initially charged with FREON gas and compressor oil. The line accessories shall include liquid line shutoff valve dehydrator, strainer, flow indicator and distributor etc.	
3.8	CABINET All the equipments, except control panel, mentioned above shall be provided within a heavy gauge sheet metal cabinet, of floor/ wall mounted type. This shall be given two coats of anti-corrosive and rust proof paint, finished with two coats of final paint . Painting shall be as per manufacturers std unless specified otherwise in data sheet 'A'. The interior of the cabinet shall be provided with thermal and acoustic insulation of minimum 25mm thick. The insulating material shall be fire proof.	

	TECHNICAL SPECIFICATION FOR PACKAGE CONDITIONING UNIT	SPECIFICATION NO.PES-553-05
		VOLUME II B
		SECTION D
		SHEET 4 OF 6
	The front and back side of the cabinets shall be easily removable providing maintenance to all the interior parts. All the electric wires within the cabinet shall run in flexible conduits and carry identification tags. The bottom side of the panel shall be specially ribbed to take care of the transportation. 3.9 OTHER ACCESSORIES Each packaged air conditioner shall be provided with required number of neoprene rubber isolating pads. 4 CONTROL AND INTERLOCK REQUIREMENTS The compressor shall have all protective devices like HP/LP cutouts, overload protection for the motor, single phasing preventor for motor etc. The interlocking requirement shall be as indicated below: 4.1 The compressor shall not start, unless condenser water flow is achieved for water cooled condenser. The condenser flow shall be sensed by means of a flow switch. 4.2 The compressor shall not start unless the evaporator fan is started. 4.3 The tripping of compressor on HP/LP, overload or on thermostat shall not trip the fan. 4.4 Strip heater (if provided in the ducting system) shall not be switched on, unless the evaporator fan is started and airflow is established. For this purpose, an air stat on flow switch shall be used. The heater shall be separately controlled by humidistat/thermostat 4.5 A humidifying package, if specified in data sheet A, shall be controlled by humidistat. 5 TEST AND INPSECTION 5.1 Inspection and Testing at Manufacturer's Works 5.1.1 static and dynamic test for fans 5.1.2 Hydrostatic static test on condenser and cooling coil. 5.1.3 vacuum/pressure test for the complete refrigeration circuit. 5.1.4 Visual and Free running test of the packaged unit on test bed. 5.1.5 Free running test on compressor. 5.1.6 AIR CAPACITY WITH ANEMOMETER. 5.1.7 NOISE LEVEL- <=85 dB(A). 5.1.8 Other tests as per approved qualities plan/scope of inspection. 5.2 Inspection and Testing at Site 5.2.1 Performance testing of the packaged unit for 72 hours in summer / monsoon & 24-hours in winter- Up-to 3 TR (individual M/c capacity) inside room temperature (Dry & wet bulb) will be checked with all machines in the room operating. The actual days of testing shall be mutually agreed. During the above testing, the following readings shall be taken to compare the same with guaranteed performance data. 5.2.1.1 Condenser inlet and outlet pressure and temperature 5.2.1.2 Entering and leaving air temperature of the cooling coil air filters.	

	TECHNICAL SPECIFICATION FOR PACKAGE CONDITIONING UNIT	SPECIFICATION NO.PES-553-05
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5.2.1.3	Motor current for the compressor and blower.	
5.2.1.4	Air quantity delivered by the fan. This shall be computed by adding air quantity leaving all the grilles entering the air filters. Room temperature (Dry & wet bulb)	
5.2.1.5	Test to ensure all controls and safety instruments are working properly. During the above testing, noise level also will be checked to ensure that the same are within acceptable limits. Any undue vibration detected physically will be corrected. All tools and instruments required for the above testing will be provided by the vendor.	
6	<u>PAINTING:</u> The packaged unit shall be given two coats of primer paint finished with two coats of finish paint as per Manufacturers std. unless specified otherwise elsewhere/ Data sheet 'A'. The colour of finish paint will be as specified in Data Sheet-A.	
7	<u>GUARANTEES</u> The package unit shall be guaranteed for performance measured in terms of the inside temperature maintained. The packaged unit shall also be free from any manufacturing defects and shall be guaranteed as per contract after the first test as per 5.0 is successfully carried out, and the plant taken over by the purchaser.	
8	<u>NAME PLATES</u> Suitable Name plate as per Data Sheet 'A', depicting the equipment number as designated in Data Sheet A shall be provided for each packaged unit and screwed to a prominent position on the packaged unit.	



**TECHNICAL SPECIFICATION
FOR
PACKAGE CONDITIONING UNIT**

SPECIFICATION NO.PES-553-05

VOLUME II B

SECTION D

SHEET 6 OF 6

9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT

- 9.1 Final technical data as per Data Sheet-B
- 9.2 G.A. and interior view of packaged unit
- 9.3 Electrical wiring diagram
- 9.4 Catalogues for all controls
- 9.5 O & M Manual
- 9.6 Erection Manual



PACKAGE-CONDITIONING UNIT
DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

SHEET 1 OF 1

DESCRIPTION

DATA

- | | |
|---|--|
| 1) Capacity of the unit at operating conditions. | : As specified |
| 2) Numbers required | : Refer to Section-C of Specific Technical Requirements |
| 3) Designation of the unit | : Package AC Unit |
| 4) Whether air cooled/water cooled | : Refer to Section-C of Specific Technical Requirements |
| 5) The plant shall be suitable for maximum-
- ambient temp. | : Refer outdoor design condition as specified. |
| 6) Whether a plenum Chamber required | : Units shall be connected to fresh air ducts. |
| OR | |
| Whether to be connected duct system. | : Yes. |
| 7) Whether Humidifier required for humidity-
-control. | : Refer to Section-C of Specific Technical Requirements |
| 8) Whether strip heaters required for winter
heating. | : Refer to Section-C of Specific Technical Requirements |
| 9) Whether strip heater required for Humidity
control. | : Refer to Section-C of Specific Technical Requirements |
| 10) Final painting colour shade
stage. | : Subject to approval / during detail engineering |
| 11) Whether fan static pressure is to be
designed for filters arrangement shown. | : Yes. |
| 12) Installation supporting structure/
drain piping, insulation. | : Required. Drain piping with insulation up to the
nearest drain point. |
| 13) Controls & Instruments | : Yes (Lot) |
| 14) Isolation Switch | : Yes |



**STANDARD TECHNICAL SPECIFICATION
FOR
AIR FILTER**

SPECIFICATION NO.PES-553-06

VOLUME II B

SECTION D

SHEET 1 OF 4

**STANDARD TECHNICAL SPECIFICATION
FOR
AIR FILTER**

	STANDARD TECHNICAL SPECIFICATION FOR AIR FILTER	SPECIFICATION NO.PES-553-06
		VOLUME II B
		SECTION D
		SHEET 2 OF 4

1.

GENERAL

This specification covers the design, manufacture, inspection and testing at manufacturer’s work or his sub-contractor’s works of Air filters to be used for air-conditioning and ventilation system.

2.

CODES AND STANDARDS

This design, manufacture and performance of AIR FILTERS shall comply with all currently applicable statutes, regulation and safety codes in the locality where the equipment will be installed. The equipment shall also conform to latest applicable Indian/British/USA standards. Nothing in this specification shall be construed to relieve the vendor of this responsibility. The following standards, in particular, shall be applicable for certified ratings of filters and for conducting performance test, if required.

a) BS EN - 779 -Methods of test for air filters used in air conditioning and general ventilation.

3.

GENERAL

The enclosed Data sheet A gives the type and other particulars of filters required.

3.1

POLY FIBRE AIR FILTERS

Filtering media shall consist of a suitable fibrous material (e.g. polyethylene extruded sections coir etc.) packed into a 20 gauges GSS framework, complete with handles etc. The filter element shall be supported by galvanised steel wire mesh of 10mm. sq. on either side, Velocity across the filters shall not exceed 2.5 M/sec. Average efficiency Em (%) shall be ≥ 80 as per BS EN - 779.

3.2

DRY FABRIC AIR FILTERS

Filter element shall be pressed felt filter fabric or suitable material recommended by the manufacturer, stitched on to galvanised wire gauge support and crimped to form deep folds. Suitable aluminium spacers shall be provided to ensure uniform distribution of air flow through filters. Filter casing shall be provided with neoprene sponge rubber sealing, The filter shall have Average efficiency Em (%) of ≥ 95 as per BS EN - 779.

3.3

PANEL TYPE METALLIC FILTERS (DRY/VISCOUS)

Filter shall consist of V-fold galvanised wire mesh interspaced with flat layers of galvanised wire mesh. The density of media shall increase in the direction of air flow. Edges of wire mesh shall be suitably hemmed to prevent abrasion during handling. The media shall be supported on either side by galvanised expanded metal casing. The framework shall be at least 18 gauge GSS. Filter shall be either dry or wetted type as per data sheet=A. The oil shall be mineral oil of approved quality and make. As a the filter frame made of Aluminium alloy conforming to IS:737 can be considered unless use of aluminium is prohibited otherwise due to site conditions being saline/corrosive.

All filters shall be capable of being cleaned of their accumulated dust by tap water flushing. The dry metallic filter shall have Average arrestance Am (%) shall be ≥ 90 .

	STANDARD TECHNICAL SPECIFICATION FOR AIR FILTER	SPECIFICATION NO.PES-553-06
		VOLUME II B
		SECTION D
		SHEET 3 OF 4
However oil wetted air filters shall have Average Efficiency E_m (%) ≥ 90 as per BS EN - 779..		
3.4	AUTOMATIC CLEANING FILTERS This shall consist of a filter mat and drop eliminator, driven by a suitably rated geared motor unit being supported on a steel framework. The filter mat shall consist of an endless steel wire mat insets of steel mesh held between an upper & a lower shall drop eliminator shall consist of an endless steel wire without insets of steel mesh. The unit shall include a suitable oil pump, gladge raking mechanism and sludge container and tensioning device. Pressure drop shall be limited to 0.5 / mm WG when clean & 10 mm when dirty. Air velocity across filter shall not exceed 3 M/sec.	
3.5	ABSOLUTE FILTERS Filters shall be constructed by pleating a continuous sheet of filter medium into closely spaced pleats separated by heavy corrugated aluminium spacers. They shall be individually tested and certified to have an efficiency of not less than 99.97% when tested with 0.3 micron dioctyphalate smoke as per IS:2831. The clean filter initial static pressure drop shall not be greater than 25mm WC at rated capacity. A neoprene sponge rubber sealing shall be provided on either face of filter frame.	
3.6	WATER REPELLANT NYLON FILTERS This shall be constructed of water repellent nylon fabric with continuous water spraying on it from a header for keeping it clean. Efficiency of this filter shall be 85% down to 10 microns. This filter shall be used for unitary air filtration system only.	
4.	<u>INSPECTION & TESTING</u> The scope of inspection for air filters shall be as below:	
4.1	Dimensional inspection of frame & filter media.	
4.2	Witnessing of type tests on one per type per size air filters for the following properties. a) Gravimetric efficiency. b) Pressure drop in clean & dirty (choked - %age to be specified) condition. c) Efficiency as per BS EN - 779.	
4.3	Verification of type test certificates for similar type & size of filters for sodium flame test as per BS-3928 (if applicable- refer data sheet).	

	STANDARD TECHNICAL SPECIFICATION FOR AIR FILTER	SPECIFICATION NO.PES-553-06
		VOLUME II B
		SECTION D
		SHEET 4 OF 4
5. DATA TO BE FURNISHED BY VENDOR AFTER AWARD OF CONTRACT 5.1 GA Drawing. 5.2 Drawing showing material/construction detail 5.3 Installation and\service manual 5.4 Rating curves/charts 5.5 Test certificates 5.6 Elect. diagrams (when automatic cleaning type)		



AIR FILTER
DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

SHEET 1 OF 1

DESCRIPTION

DATA

1) General

- | | |
|------------------------------|--|
| 1.1 Service | : Air Conditioning. |
| 1.2 Location | : Central Air conditioning plant, & package AC plant, fresh air fan system. Also for split AC. |
| 1.3 Nos. | : Refer Section 'C' of Specification. |
| 1.4 Total air flow/type | : Refer Section 'C' of Specification. |
| 1.5 Temperature | : As per project information. |
| 1.6 Relative Humidity | : 100% |
| 1.7 Gas Composition | : Atmospheric Air (Dusty) as prevalent in power Station. |
| 1.8 Filter Media | : Synthetic non-woven |
| 1.9 Efficiency | : Average arrestance efficiency of 65-80 % for Dry Panel filter (pre-filters) and average arrestance Efficiency of 80-90 % for fine filters. |
| 1.10 Allowable pressure drop | : 2.5 mm & 6.5 mm in clean and dirty condition respectively for dry panel filters(prefilters).
12 mm in clean condition for fine filters. |
| 1.11 Frame Work | : 18 G, GSS. |
| 1.12 Mounting | : Ladder Type M.S Angles (galvanised) |
| 1.13 Size | : 600 x 600 mm |

Note:-

- 1) Face velocity of air across the filters shall not exceed 2.5 m/sec.

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-553-08
		VOLUME II B
		SECTION D
		SHEET 1 OF 6

STANDARD TECHNICAL SPECIFICATION FOR THERMAL INSULATION FOR COLD SURFACES

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-553-08
		VOLUME II B
		SECTION D
		SHEET 2 OF 6

1.

SCOPE

This specification covers design, manufacture, testing at manufacturers works, supply, application & finishing of insulation for cold piping, air conditioning ducting & equipment for low temperature service.

2.

CODES & STANDARDS

The design, manufacture and performance of materials covered under this specification shall comply with all currently applicable statues, regulations & safety codes in the locality where the equipment/material are to be installed. The material shall also conform to the latest applicable Indian/British/American codes & standards. Nothing in this specification shall be construed to relieve the vendor of his responsibility. In particular, the material shall conform to the latest editions of the following standards :-

IS:3069: GLOSSARY OF TERMS & SYMBOLS & UNITS RELATING TO THERMAL INSULATION

materials.

2.1

IS:4671: Expanded polystyrene for thermal insulation purposes.

2.2

IS:3677: Mineral wool for thermal insulation.

2.3

IS:8183: Resin bonded mineral wool.

3.

DESIGN REQUIREMENTS

3.1

The insulating material as well as protective covering shall be new & unused, non-corrosive, vermin/rodent proof and shall be guaranteed to withstand continuously & without deterioration the maximum/minimum temperatures to which they may be subjected to, under specified site conditions.

3.2

The insulation material must be light weight, strong, free from shots & coarse fibre & shall provide high insulation efficiency at low weight & coat. It should be non-hygroscopic & should not rot. It shall not settle or shake down even when subjected to prolonged vibrations.

3.3

The insulation material, density and thickness etc. Shall be as specified in DATA SHEET A.

4.

APPLICATION DETAILS

4.1

The surface to be insulated shall be thoroughly cleaned and allowed to dry. Pressure/hydrostatic tests, if any, shall be carried out before application of insulation.

4.2

A layer of solvent free, anticorrosive paint shall be applied & allowed to dry.

4.3

Hot industrial bitumen of grade 85/40 or 85/25 conforming to latest IS:702 shall be uniformly applied @ 1.5 kg/sq.m on the surface to be insulated. A similar layer shall also be applied on the inside surface & edges of the insulation. A suitable cold adhesive compound may also be used in place of bitumen.

4.4

Insulation in the form of pipe sections/rolls slabs of specified density & thickness shall be stuck to the coated surface with joints staggered & well butted & secured. The adjoining sections shall be tightly pressed together. All the joints shall be sealed with

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-553-08
		VOLUME II B
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		SHEET 3 OF 6
	bitumen/equivalent adhesive. Voids if any shall be packed with suitably cut pieces of insulation material.	
4.5	In case of double layer application both circumferential & longitudinal joints shall be suitably staggered.	
5.	<u>VAPOR SEALING & INSULATION FINISH</u> The insulation shall be treated for vapor sealing & weather proofing & finished as specified in DATA SHEET A The acceptable types of finishes are outlined below:-	
5.1	FINISHING SYSTEM I: EXTERNAL INSULATION WITH PLASTER FINISH	
5.1.1	A thick vapor seal of hot bitumen @ 2.5 kg/Sqm shall be applied on the outer surface of insulation & allowed to dry.	
5.1.2	The surface shall then be wrapped with 20mm (3/4" _ hexagonal mesh of 24 SWG GI wire, butting all the joints & laced down with 22 SWG GI lacing wire.	
5.1.3	12.5mm (1/2 inch) thick sand cement plaster in the ratio of (1:1) shall be applied in two layers, the second layer being brought to a smooth finish. A water proofing compound shall be added to the cement before its application.	
5.2	FINISH SYSTEM II: EXTERNAL INSULATION WITH PLASTER FINISH OVER POLYTHENE.	
5.2.1	The insulation shall be covered with 500 g polythene/polythene bonded Hessians (PBH) with 50mm overlap on longitudinal & circumferential joints. Overlaps shall be sealed with synthetic adhesive in case o-f polythene & liberal coat of bitumen in case of PBH:	
5.2.2	The surface shall then be wrapped with 20mm (3/4") mesh of 24 SWG GI wire butting all the joints & laced down with 22 SWG GI lacing wire.	
5.2.3	12.5mm thick (1/2 inch) sand cement plaster in ratio of(4:1) shall be applied in two layers, the second layer being brought to a smooth & even finish similarly as described above.	
5.3	FINISH III:EXTERNAL INSULATION WITH SHEET METAL FINISH	
5.3.1	The insulation shall be covered with 500g polythene with 50mm overlaps at joints which shall be sealed with synthetic adhesive or equivalent compound.	
5.3.2	The polythene shall be covered with 24 gauge GI/aluminum sheet	
5.3.3	25mm wide x 22 SWG GI/aluminum peripheral straps shall be fixed over the GI/aluminum sheet at 300mm centres to secure.	
5.4	FINISH IV: EXTERNAL INSULATION WITH PLASTER & WATER PROOFING COMPOUND For ducts & piping exposed to atmosphere, the finish shall be as follows:	
5.4.1	A thick vapor seal of hot bitumen at 2.05 kg/sq.m shall be applied on the outer surface of insulation & allowed to dry.	
5.4.2	The surface shall then be wrapped with 20mm (3/4") hexagonal mesh of 24 SWG GI Wire butting all the joints & laced down with 22 SWG GI lacing wire.	
5.4.3	12.5mm thick (1/2 inch) sand cement plaster in ratio of (4:1) shall be applied in two layers, the second layer being brought to a smooth finish with water proofing compound added to the cement.	

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-553-08
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5.4.4	3 mm (1/8") thick coat of water proofing compound shall be applied & wrapped with fibre glass RP tissue. A final coat of 3mm thick water proofing compound shall then be applied over the fiberglass RP tissue & allowed to dry. Alternatively, in place of water proofing as desired above, tar felt type 3 grade 1 of IS 1322 with joints overlapped by 75mm shall be fixed & sealed with bitumen & over this 24 SWG. 25mm hexagonal GI mesh shall be fixed with 22 swig. GI lacing wire & finally bitumen paint shall be applied over wire netting.	

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-553-08
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6.

INSULATION OF PUMPS & VALVES

6.1

For all inspection covers & hatches on equipment, pump casing & valve bodies, flanges etc. the insulation shall be applied such as to facilitate removal with minimum damage to the insulation. This shall be achieved by encasing the insulation in 22 gauge aluminum sheet metal boxes, which shall be bolted together around the equipment to permit easy removal & replacement. Proper care shall be taken to maintain continuity of vapor seal between the static & removable partitions of the insulation.

6.2

The tenderer may offer thickness of insulation & finishes other than that specified in DATA SHEET A. However, calculations/reasons in support of alternative proposal shall be furnished for purchaser's approval.

7.

INSPECTION & TESTING (REFER SPEC. NO - PES-553.00)

7.1

All necessary tests, as required to ensure that the material supplied conform to the requirements of applicable codes & standards, shall be carried out at manufacturer's works & test certificates including these for material/accessories shall be furnished for purchasers approval.

8.

PAINTING

8.1

Pipe work having insulation & cladding shall be provided with color identification for the fluids handled and for indicating direction of flow.

8.2

Equipment surfaces having insulation and cladding shall also have identification numbers and any other relevant data provided on the insulated surface.

8.3

All painting for insulated surfaces shall conform to the requirement specified elsewhere.

	TECHNICAL SPECIFICATION THERMAL INSULATION FOR COLD SURFACES	SPECIFICATION NO.PES-553-08
		VOLUME II B
		SECTION D
		SHEET 6 OF 6
9. DATA TO BE FURNISHED AFTER AWARD OF CONTRACT		
9.1	Final version of data sheet 'B' incorporating changes if any along with design data.	
9.2	Test certificates/reports giving result of insulation to ensure conformance to applicable codes & standards & in particular the following:- a) Thermal conductivity test. b) Sound absorption coefficient test. c) Corrosion test. d) Sulphur content, moisture content, shot content, moisture absorption etc. e) Compressive strength & cross breaking strength test.	
9.3	Sketches/technical literature/sectional drgs. indicating insulation materials finish and method of application etc.	
9.4	Manual dealing with safety aspects & instructions for combating fire arising out of insulation work.	
9.5	Instructions on maintenance of insulation work.	



THERMAL INSULATION
FOR COLD SURFACE
DATA SHEET - A

VOLUME II-B

SECTION D

REV 00

SHEET 1 OF 1

Insulation Material

Insulation	Code	Thermal Conductivity MW/cm °C	Density Kg/m ³
Resin bonded mineral wool / glass wool	IS:8183	0.49 at 50 °C	At least 24 for duct insulation and 48 for acoustic lining.
Mineral Wool Pipe Section (min. Gr.2)	IS:9842	0.43 at 50 °C	At least 81
Expanded Polystyrene	IS:4671	0.37 at 10 °C	At least 15

Type of Insulation

S.No.	Surface	Insulation Material	Insulation Form	Thickness (mm)
i)	Supply & Return air duct for air-conditioning system	Resin bonded roll Mineral Wool (IS:8183)		25
ii)	Refrigerant Piping	a) Expanded Polystyrene or b) Mineral Wool	Pipe Section Pipe Section	75 75
iii)	AHU drain pipe	a) Expanded Polystyrene or b) Mineral Wool	Pipe Section Pipe Section	25 25
iv)	AHU drain pan coil section and fan section	a) Expanded Polystyrene or b) Mineral Wool	Slabs Slabs	25 25
v)	Chilled water piping, valves & specialties	a) Expanded Polystyrene or b) Mineral Wool	Pipe Section Pipe Section	75 75
vi)	Chiller	a) Expanded Polystyrene or b) Mineral Wool	Slabs Slabs	100 100
vii)	Chilled Water Pumps	a) Expanded Polystyrene or b) Mineral Wool	Slabs Slabs	50 50
viii)	Expansion tank with pipe	a) Expanded Polystyrene or b) Mineral Wool	Slabs/Pipe Section Slabs/Pipe Section	50 50



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM
LIST OF MAKES OF SUB-VENDOR ITEMS**

SPECIFICATION NO. PE-TS-415-553-A001

SECTION : I

SUB-SECTION : E

REV 00

ANNEXURE-I

LIST OF MAKES OF SUB-VENDOR ITEMS



AIR CONDITIONING SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

SECTION-I SUB SECTION -E

LIST OF MAKES OF SUB-VENDOR ITEMS



AIR CONDITIONING SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

Sl. NO.	ITEM / EQUIPMENT	SUB SUPPLIER
1	SCREW CHILLER	YORK / TRANE / CARRIER / KIRLOSKAR / DUNHAM BUSH / MCQUAY (DAIKIN) / BLUE STAR / VOLTAS
2	VAPOUR ABSORPTION MACHINE	VOLTAS / THERMAX / KIRLOSKAR
3	PRECISION PACKAGE UNITS	STULZ / UNIFLAIR / EMERSON / BLUEBOX / CLIMADENTA
4	PACKAGE UNIT	VOLTAS / BLUE STAR / CARRIER
5	SPLIT AIR CONDITIONER	VOLTAS / BLUE STAR / CARRIER / HITACHI / LG
6	AIR HANDLING UNITS	VOLTAS / BLUE STAR / ZECO / CARRIAIRE (FLAKT) / EDGETECH / ETHOS / SYSTEM AIR / WAVES AIRCON
7	AHU FAN (CENTRIFUGAL FAN)	CB.DOCTOR / FLAKT / KRUGER / NICOTRA / COMEFRI / MARATHON / PATEL AIR
8	CHILLED & CONDENSER WATER PUMP	BEST & CROMPTON / JYOTI / SAM TURBO / KBL / KSB / M&P / VOLTAS / BEACON-WEIR / WORTHINGTON / FLOWMORE / SULZER / BHARAT PUMPS & COMPRESSORS LTD / FLOWSERVE INDIA CONTROL PVT LTD / V-FLOW PUMPS & SYSTEMS CO
9	COOLING TOWER	PAHARPUR / MIHIR / PCT / FLOWTECH / BELL
10	INDUCTION MOTORS (LT)	As per Electrical spec.
11	AIR FILTER	PUROLATOR / FMI / ANFILCO / TENACITY / JOHN FOWLER / SPECTRUM / AIR TECH / PUROMATIC
12	AXIAL FANS / F.A. FANS	FLAKT / KHAITAN / PATEL / NICOTRA / SARLA / KRUGER / MARATHON / C DOCTOR
13	INSULATION MATERIAL	BEARDSHELL / K-FLEX / PARAMONT/ ARMAFLEX / SUPREME / LLOYDS / UP TWIGA / AEROCELL
14	BALANCING VALVE	ADVANCE
15	BUTTERFLY VALVE	AUDCO / FOURESS / INTER VALVE / BDK / WEIR BDK / TYCO / CRANE PROCESS / KEYSTONE
16	NON RETURN VALVE	LEADER / H.SARKAR / FLUID LINE / HI -TECH / CRESENT / A V VALVES / BANKIM & COMPANY / SHIVADURGA
17	GATE/GLOBE VALVES	CRESENT / BDK / AUDCO / FOURESS / KIRLOSKAR / SANT / BOMBAY METAL & ALLOYS / BANKIM / LEADER / H SARKAR / AV VALVES / VENUS PUMPS AND ENG/SAMSON CONTROLS PVT. LTD/INSTRUMENTATION LTD./ Koso India Private Limited,



AIR CONDITIONING SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

18	3 WAY MIXING VALVE WITH ACTUATING MOTOR	SIEMENS BUILDING TECHNOLOGY /JOHNSON / BELIMO / HONEYWELL / RAPID CONTROL / ALC
19	MOTORIZED BUTTERFLY VALVE	ANERGY / ADVANCE / BELIMO / JOHNSON / HONEYWELL / SIEMENS
20	Y / POT STRAINER	MULTITEX / GREAVES COTTON / JAYPEE / SANT / OTOKLIN / GRAND PRIX / GUJARAT OTOLIFT / DS ENGG / SAROJINI ENTERPRISE / BHATIA ENGINEERING / FILTERATION ENGINEERS INDIA PVT LTD / SUNGOV ENGINEERING
21	PIPING - ERW	SURYA ROSHNI / TISCO / DADU PIPES / INDUS TUBE / WELSPUN / TATA / BST / JINDAL / SAIL
22	PIPING - CS SEAMLESS (ASTM A 106)	ISMT / MAHARASHTRA SEAMLESS
23	GI SHEETS FOR DUCTING	TISCO / INDIAN IRON & STEEL CO LTD. / RASHITRYA ISPAT NIGAM LTD. / ESSAR/ ISPAT INDUSTRIES / JSW STEEL / LLOYDS STEEL / BHUSHAN / TATA / SAIL / JINDAL
24	FIRE DAMPER	TSC / CARRYAIRE / RAVISTAR (SYSTEM AIR)
25	GRILL/DIFFUSER/VOLUME CONTROL DAMPER	AIR FLOW/ TSC /AIR MASTER/ CARYAIRE/RAVI STAR (SYSTEM AIR)
26	STRIP HEATER	ESCORTS / RACOLD / DASPASS/ ALCO/ HEATCO / HOTSET
27	PAN HUMIDIFIER	RAPID COOL/ HOTSET /ALCO
28	RELIEF / PURGE VALVE	BRASSOMATIC
29	THERMOSTATS	HONEYWELL / RANCO / PENN / DANFOSS / INDFOSS / JHONSON CONTROL /RANUTROL
30	HUMID STAT	JHONSON CONTROL / HONEYWELL / PENN
31	ANTI FREEZE THERMOSTAT	RANCO / HONEYWELL / PENN / DANFOSS / INDFOSS
32	FLOW SWITCH	As per C&I spec
33	FLOW METER	As per C&I spec
34	RH SENSOR/TEMP SENSOR	As per C&I spec
35	PLC BASED PANEL	NA
36	OWS / PC	As per C&I spec
37	PRINTER	As per C&I spec
38	UPS	As per C&I spec
39	FIBRE OPTIC CABLE	As per C&I spec
40	ANNUNCIATOR FOR PANEL	As per C&I spec
41	LT ADAPTER BOX FOR AL TO CU CABLE CONVERTOR	As per C&I spec
42	METERING PUMP	SHAPO TOOLS / VK PUMPS
43	WATER SOFTENING PLANT	THERMAX / ION EXCHANGE / DOSI ION
44	PRESSURE TRANSMITTER	As per C&I spec
45	TEMPERATURE TRANSMITTER	As per C&I spec



AIR CONDITIONING SYSTEM

LIST OF MAKES OF SUB-VENDOR ITEMS

46	ROTAMETER	As per C&I spec
47	BATTERY CHARGER	As per C&I spec
48	BATTERY (NI -Cd)	As per C&I spec
NOTE		
NOTES: 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. 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. 3. PLEASE ALSO REFER RESPECTIVE SUB-SECTION C-3, C-4 & C-5 FOR ELECTRICAL, C&I AND HANDLING RELATED EQUIPMENT LIST OF MAKE.		



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM
MANDATORY SPARE LIST**

SPECIFICATION NO. PE-TS-415-553-A001

SECTION : I

SUB-SECTION : E

REV 00

SHEET 1 OF 1

ANNEXURE-II

MANDATORY SPARE LIST

(REFER SUGGESTIVE PRICE FORMAT)



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM
PAINTING & COLOUR SCHEME**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : I

SUB-SECTION : E

REV 00

SHEET 1 OF 1

SECTION-I

SUB SECTION E

ANNEXURE-III

**PAINTING & COLOUR SCHEME
(PLEASE REFER SECTION C2-C)**



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM
LIST OF TOOLS & TACKLES**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : I

SUB-SECTION : E

REV 00

SHEET 1 OF 1

ANNEXURE-IV

LIST OF TOOLS & TACKLES

(REFER SUGGESTIVE PRICE FORMAT)



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM
DRAWINGS / DOCUMENTS SUBMISSION
PROCEDURE**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : I

SUB-SECTION : E

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SHEET 1 OF 1

SECTION-I

SUB-SECTION-E

ANNEXURE-V

**DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE
(COVERED UNDER SUB-SECTION C2-B)**



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM
MASTER DRAWING LIST WITH SCHEDULE
OF SUBMISSION**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : I

SUB-SECTION : E

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SECTION-I

SUB-SECTION-E

ANNEXURE-VI

**MASTER DRAWING LIST WITH SCHEDULE OF
SUBMISSION**



**1x660MW BHUSAVAL TPS
AIR CONDITIONING SYSTEM
MASTER DRAWING LIST WITH SCHEDULE
OF SUBMISSION**

SPECIFICATION No: PE-TS-415-553-A001
SECTION : I
SUB-SECTION : E
REV 00
SHEET 2 OF 4

S. NO.	DRAWING NO	DRG./ DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
1	PE-V0-415-553-A001	INSPECTION CATEGORISATION PLAN FOR AIR CONDITIONING SYSTEM	4
2	PE-V0-415-553-A006	QAP OF AIR HANDLING UNIT	15
3	PE-V0-415-553-A008	QAP OF COOLING TOWER FOR AIR CONDITIONING SYSTEM	15
4	PE-V0-415-553-A007	QAP OF PUMPS FOR AIR CONDITIONING SYSTEM	15
5	PE-V0-415-553-A002	QAP OF CHILLER PACKAGE	14
6	PE-V0-415-553-A009	QAP OF MOTORS FOR AIR CONDITIONING SYSTEM	15
7	PE-V0-415-553-A011	HEAT LOAD CALCULATION FOR MAIN PLANT, ESP / VFD CONTROL ROOMS AND SERVICE BUILDING ETC FOR AIR CONDITIONING SYSTEM	4
8	PE-V0-415-553-A013	PRESSURE DROP CALCULATIONS FOR CHILLED AND CONDENSER WATER PIPING FOR AIR CONDITIONING SYSTEM	10
9	PE-V0-415-553-A037	PID FOR MAIN PLANT, SERVICE BUILDING & ESP CONTROL ROOM FOR AIR CONDITIONING SYSTEM	8
10	PE-V0-415-553-A012	OPERATION & CONTROL PHILOSOPHY FOR AIR CONDITIONING SYSTEM	12
11	PE-V0-415-553-A045	CHD & COND WATER PIPING LAYOUT WITHIN PLANT ROOM & UPTO VARIOUS AHU ROOMS, & COOLING TOWER AREA FOR POWER HOUSE	15
12	PE-V0-415-553-A042	AC DUCT LAYOUT DRAWING FOR SERVICE BUILDING WITH AHU ROOM LAYOUT AND FOUNDATION DETAILS	18
13	PE-V0-415-553-A039	AC DUCT & AHU RMLAYOUT WITH FOUNDATION DETAIL FOR UPS BATTERY CHARGER RM AT 8.5M	16
14	PE-V0-415-553-A047	CHD & COND WATER PIPING LAYOUT WITHIN PLANT ROOM & UPTO VARIOUS AHU ROOMS, & COOLING TOWER AREA FOR SERVICE BUILDING	15
15	PE-V0-415-553-A046	AC PLANT ROOM LAYOUT & COOLING TOWER AREA LAYOUT WITH COMPLETE FOUNDATION DETAIL OF ALL EQUIPMENT FOR POWER HOUSE	15
16	PE-V0-415-553-A048	AC PLANT ROOM LAYOUT & COOLING TOWER AREA LAYOUT WITH COMPLETE FOUNDATION DETAIL OF ALL EQUIPMENT FOR SERVICE	15



**1x660MW BHUSAVAL TPS
AIR CONDITIONING SYSTEM
MASTER DRAWING LIST WITH SCHEDULE
OF SUBMISSION**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : I

SUB-SECTION : E

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SHEET 3 OF 4

S. NO.	DRAWING NO	DRG./ DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
		BUILDING	
17	PE-V0-415-553-A040	AC DUCT LAYOUT DRAWING FOR CONTROL RM ARES AT 17M ALONG WITH AHU RM LAYOUT WITH FOUNDATION DETAILS	16
18	PE-V0-415-553-A041	AC DUCT LAYOUT DRAWING FOR ESPWITH PU RM LAYOUT WITH FOUNDATION DETAILS	18
19	PE-V0-415-553-A038	TYPICAL Details DUCT FABRICATION/ SUPPORT / ERECT. FOR AIR CONDITIONING SYSTEM INSUL-DUCT/ PIPG & EQP CHD & COND WATR PIPE ERECT	7
20	PE-V0-415-553-A036	TDS FOR INSTRUMENTS (GAUGES-TEM, PR, LVL, PRES: SWITCH-TEMP,LVL, DP: SENSORS-TEMP, HUM ETC) FOR AIR CONDITIONING SYSTEM	12
21	PE-V0-415-553-A018	TDS AND GA OF COOLING TOWER FOR AIR CONDITIONING SYSTEM	15
22	PE-V0-415-553-A026	TDS AND GA OF PRECISION AC UNITS ALONG WITH FOUNDATION DETAILS FOR AIR CONDITIONING SYSTEM	12
23	PE-V0-415-553-A019	TDS AND GA OF AIR HANDLING UNITS FOR AIR CONDITIONING SYSTEM	14
24	PE-V0-415-553-A031	TDS AND GA OF SUPPLY / RETURN AIR DIFFUSER/GRILL FOR AIR CONDITIONING SYSTEM	8
25	PE-V0-415-553-A035	TDS AND GA OF FILTERS FOR AIR CONDITIONING SYSTEM	10
26	PE-V0-415-553-A020	TDS AND GA OF CONDENSER AND CHILLEDWATER PUMPS ALONG WITH FOUNDATION DETAILS FOR AIR CONDITIONING SYSTEM	15
27	PE-V0-415-553-A028	TDS AND GA OF HEATERS AND HUMIDIFIER FOR AIR CONDITIONING SYSTEM	7
28	PE-V0-415-553-A030	TDS AND GA OF VALVEES (BALANCING VALVE, GATE VALVE, CHECK VALVE , Y ATRAINER) FOR AIR CONDITIONING SYSTEM	9
29	PE-V0-415-553-A033	TDS OF PIPES FOR AIR CONDITIONING SYSTEM	5
30	PE-V0-415-553-A023	TDS OF INSULATION MATERIAL (DUCT INSULATION, DUCT LINING, PIPE INSULATION) FOR AIR CONDITIONING SYSTEM	12



**1x660MW BHUSAVAL TPS
AIR CONDITIONING SYSTEM
MASTER DRAWING LIST WITH SCHEDULE
OF SUBMISSION**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : I

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SHEET 4 OF 4

S. NO.	DRAWING NO	DRG./ DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
31	PE-V0-415-553-A032	TDS OF GI SHEET FOR AIR CONDITIONING SYSTEM	5
32	PE-V0-415-553-A025	TDS AND GA OF WATER SOFTENING PLANT ALONG WITH FOUNDATION DETAILS FOR AIR CONDITIONING SYSTEM	16
33	PE-V0-415-553-A024	TDS AND GA OF FRESH AIR FANS FOR AIR CONDITIONING SYSTEM	12
34	PE-V0-415-553-A027	TDS AND GA OF FOR 3-WAY MIXING VALVE FOR AIR CONDITIONING SYSTEM	8
35	PE-V0-415-553-A029	TDS AND GA OF FIRE DAMPER WITH ACTUATOR FOR AIR CONDITIONING SYSTEM	10
36	PE-V0-415-553-A034	TDS AND GA OF EXPANSION TANK, MAKEUP WATER TANK AND SOFT WATER TANK FOR AIR CONDITIONING SYSTEM	5
37	PE-V0-415-553-A022	TDS AND GA OF MOTOR (PUMP, COOLING TOWER, AHU)	15
38	PE-V0-415-553-A021	TDS AND GA OF PAC / SPLIT AIR CONDITIONER	12
39	PE-V0-415-553-A014	TDS AND GA OF SCREW CHILLER ALONG WITH FOUNDATION DETAILS FOR AIR CONDITIONING SYSTEM	16
40	PE-V0-415-553-A052	SPLIT AC SCHEDULE FOR AUXILIARY BUILDING	22
41	PE-V0-415-553-A057	PG/ DEMONSTRATION TEST PROCEDURE FOR AIR CONDITIONING SYSTEM	12
42	PE-V0-415-553-A058	O&M MANUAL FOR AIR CONDITIONING SYSTEM	25
43	PE-V0-415-553-A101	GA DRAWING FOR ELECTRIC HOIST, DSL ARRANGEMENT AND PAINTING DETAILS	15
44	PE-V0-415-553-A102	SCHEMATIC CIRCUIT DIAGRAM FOR ELECTRICAL HOIST	15
45	PE-V0-415-553-A103	MECHANISM SIZING CALCULATION FOR ELECTRICAL HOIST	15
46	PE-V0-415-553-A100	MQP OF ELECTRICAL HOIST	15
47	PE-V0-415-553-A200	MANUFACTURING QUALITY PLAN	15
48	PE-V0-415-553-A201	GA DRAWING FOR CHAIN PULLEY BLOCK WITH DETAIL BOM WITH PAINTING DETAILS	15
49	PE-V9-415-553-I902	INSTRUMENT SCHEDULE	15
50	PE-V9-415-553-I903	INSTRUMENT INSTALLATION/ HOOK UP DRAWINGS	15
51	PE-V9-415-553-I904	INSTRUMENT QP/CHECK LIST	15
52	PE-V9-415-553-I906	CONTROL SCHEMES/LOGIC DIAGRAM (TO BE IMPLEMENTED IN DCS)	15
53	PE-V9-415-553-I907	FIELD JB TERMINATIONS /GROUPING DOCUMENT	15
54	PE-V9-415-553-I908	DCS INPUT / OUTPUT LIST (ANALOG & BINARY)	15



**1x660MW BHUSAVAL TPS
AIR CONDITIONING SYSTEM
MASTER DRAWING LIST WITH SCHEDULE
OF SUBMISSION**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : I

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S. NO.	DRAWING NO	DRG./ DOC. TITLE	SCH. WEEK (FROM DATE OF LOI)
55	PE-V9-415-553-I909	ANNUNCIATION & SOE LIST	15
56	PE-V9-415-553-I910	PROCESS GRAPHIC MANUSCRIPTS FOR DDCMIS	15
57	PE-V9-415-553-I911	CABLE SCHEDULE & INTERCONNECTION	15
58	PE-V9-415-553-I912	BILL OF MATERIAL	15
59	PE-V9-415-553-I913	LOCAL CONTROL PANEL DATA SHEET & WIRING DIAGRAM	15
60	PE-V9-415-553-I914	PANEL LAYOUT & EXTERNAL/INTERNAL GA DRAWING (INCLUDING FOUNDATION DETAILS & FLOOR CUT-OUT)	15
61	PE-V9-415-553-I915	LIST OF SIGNAL EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE)	15
62	PE-V9-415-553-I916	LCP QUALITY PLAN	15

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
4. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.: -
 - a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.
 - b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.
 - c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.
 - d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
 - e) Drawings/ documents to be submitted for purchaser's review/ approval shall be under Revision A, B, C... etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 etc.
 - f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM
MASTER DRAWING LIST WITH SCHEDULE
OF SUBMISSION**

SPECIFICATION No: PE-TS-415-553-A001

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SHEET 6 OF 4

- g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.
- h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.
- i) 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.
- j) Bidder to follow the following the drawing submission schedule:
- k) 1st submission of drawings from date of LOI as per the submission schedule.
- l) Every revised submission incorporating comments – within 7 days.
- m) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM
FORMAT FOR OPERATION AND
MAINTENANCE MANUAL**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : I

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**SECTION-I
SUB-SECTION-E
ANNEXURE-VII
FORMAT FOR OPERATION AND MAINTENANCE
MANUAL**



**1x660MW BHUSAVAL TPS
AIR CONDITIONING SYSTEM
FORMAT FOR OPERATION AND
MAINTENANCE MANUAL**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : I

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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 &				



**1x660MW BHUSAVAL TPS
AIR CONDITIONING SYSTEM
FORMAT FOR OPERATION AND
MAINTENANCE MANUAL**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : I

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Sl.no. & Sections	Description	Tick (v)if included in Manual			Remarks
		Yes	No	Not Applicable	
	bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				
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 equipments 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 equipments.				
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				



**1x660MW BHUSAVAL TPS
AIR CONDITIONING SYSTEM
FORMAT FOR OPERATION AND
MAINTENANCE MANUAL**

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Sl.no. & Sections	Description	Tick (v)if included in Manual			Remarks
		Yes	No	Not Applicable	
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.				
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				



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM
SITE STORAGE AND PRESERVATION**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : I

SUB-SECTION : E

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**SECTION-I
SUB-SECTION-E
ANNEXURE-VIII
SITE STORAGE AND PRESERVATION**

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)



PROJECT ENGINEERING MANAGEMENT, POWER SECTOR
BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

- 1 SCOPE OF THE DOCUMENT
- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
 - a) GENERAL STORAGE REQUIREMENTS
 - b) GENERAL PRESERVATION REQUIREMENTS
 - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
 - a. Rust preventive fluid (RPF)
 - b. Rust protective paints
 - c. Tarpaulin covers, in case of outdoor storage
 - d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
 - Ingress of moisture and corrosion damages.
 - Damage to protective coating.
 - Open ends in pipes, vessels and equipment -
 - In case any open ends are noticed, same shall be capped.
2. Any damages to equipment / materials.
 - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
 - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere. (C)**

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



ii **Semi-closed storage. (S)**

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.



The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

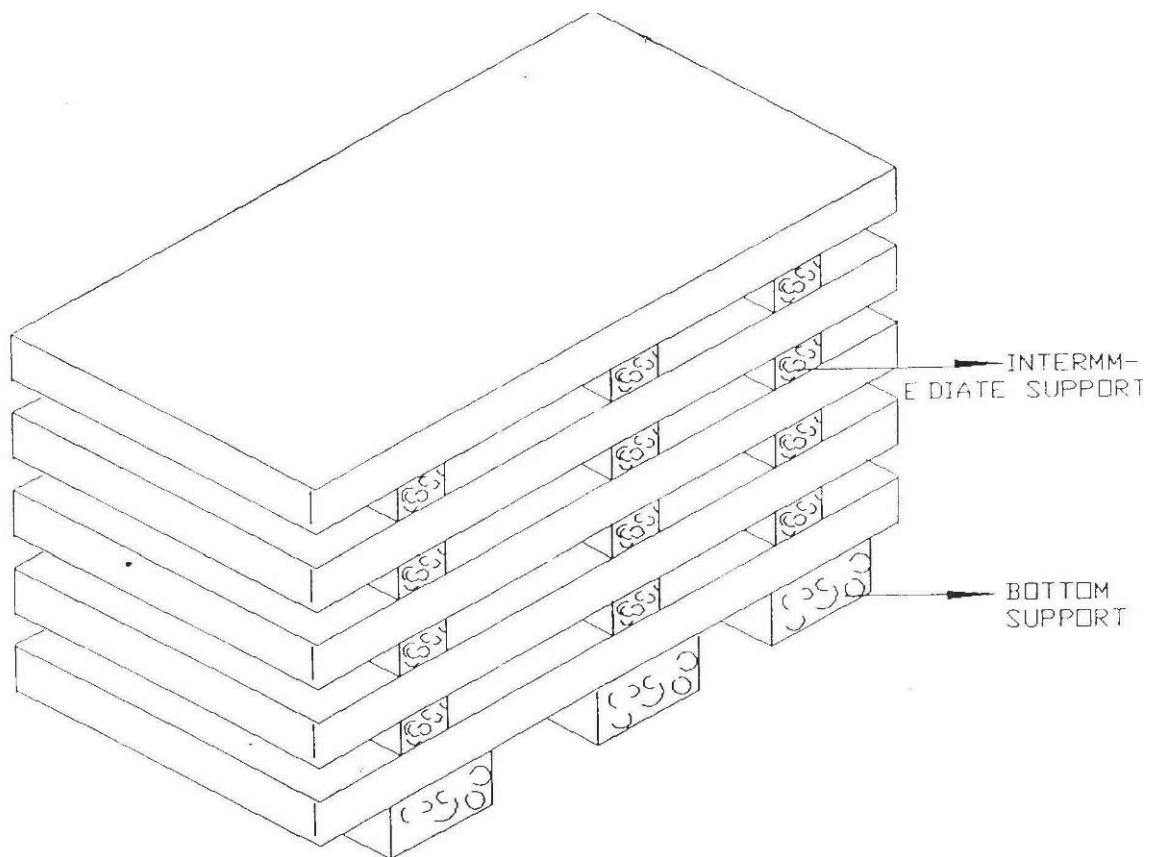


Figure – 1 – PLATE STACKING ARRANGEMENT

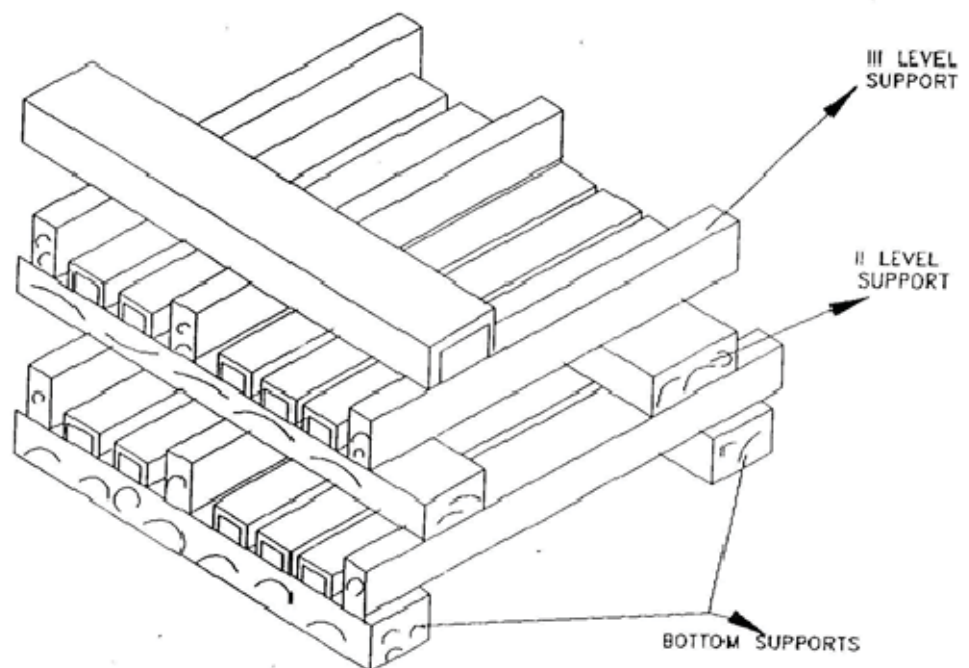


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : I

SUB-SECTION : E

REV 00

SHEET 1 OF 1

SECTION-I
SUB-SECTION-E
ANNEXURE-IX
PACKING PROCEDURE
(REFER SUB-SECTION C2-B)



**1x660MW BHUSAVAL TPS
AIR CONDITIONING SYSTEM**

SPECIFICATION No: PE-TS-415-553-A001

SECTION: II

REV. 00

SECTION II



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM
INSPECTION AND TESTING**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : II

SUB-SECTION : 1

REV 00

SHEET 1 OF 4

SECTION-II

SUB-SECTION-1

INSPECTION AND TESTING

	1x660MW BHUSAWAL TPS AIR CONDITIONING SYSTEM INSPECTION AND TESTING	SPECIFICATION No: PE-TS-415-553-A001	
		SECTION : II	
		SUB-SECTION : 1	
		REV 00	
		SHEET 2 OF 4	
1.01.00	Inspection and Tests during Manufacture.		
1.01.01	The method and techniques to be used by the Bidder for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner.		
1.01.02	The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.		
1.01.03	Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.		
1.01.04	Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Bidder may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.		
	The owner's representative shall have at all reasonable times access to bidder's or his sub-vendor's premises and shall have power to inspect/ examine materials and workmanship or equipment under manufacture.		
	The Bidder shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Further nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere.		
	For electrical equipment, routine tests as per relevant IS spec are to be carried out on all equipment. Type tests are also to be carried out on selected equipment as detailed in the specs of concerned electrical equipment.		
1.01.05	Under no circumstances any repair or welding of castings be carried out without the consent of the Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer.		
1.01.06	All the individual and assembled rotating parts shall be statically and dynamically balanced in the works. Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to dispatch from place of manufacture.		
1.01.07	All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the		



**1x660MW BHUSAVAL TPS
AIR CONDITIONING SYSTEM
INSPECTION AND TESTING**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : II

SUB-SECTION : 1

REV 00

SHEET 3 OF 4

Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material. Equipment or parts coming under any statutory Regulations shall be certified by a Competent Authority under the regulations in the specified format.

1.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than one hour.

1.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

1.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnuflux and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major but welding joints shall be radiographed unless otherwise stipulated.

Statutory payments in respect of IBR approvals including inspection shall be made by the bidder. Bidder's scope shall include to preparation of all necessary documents, co-ordination and follow-up for above approval. Owner shall only forward assistance/endorsement of documents /design /drawings /reports/records to be submitted for approval as stipulated/ required by Statutory Authorities till registration of the unit and clearance for commercial operation.

1.02.00 Performance Tests at Site

1.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Bidder on site under normal operating conditions. The Bidder shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.

1.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.

1.02.03 The Bidder shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.

1.03.00 For details of specific tests required on individual equipment refer to respective section of this specification.

	MANUFACTURER'S NAME & ADDRESS:	<u>MANUFACTURING QUALITY PLAN</u> ITEM: Chain Pulley Block QP No.: REV.:0, Date.: , PAGE: 1 OF 4	PROJECT: 1X660 MW BHUSAWAL TPS UNIT-6 PACKAGE: CHAIN PULLEY BLOCK

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
					6.					10.			
1.	2.	3.	4.	5.			7.	8.	9.				11.

1	<u>RAW MATERIAL & B/OUT ITEMS:</u>												
1.1	HOOKS	CHEMICAL & MECH MARK & IDENTIFICATION INTERNAL DEFECTS PROOF LOAD TEST NDT AFTER PROOF LOAD TEST	MA MA MA MA MA	LAB ANALYSIS VISUAL UT REVIEW DPT	ONE SAMPLE PER HEAT 100% 100% 100% 100%	MATERIAL SPECIFICATION AS PER APPROVED DRAWINGS. HOOK TC FROM COMPETENT AUTHORITY ASTM A-388 (REFER NOTE D) IS 15560 ASTM E-165		MTC. TC IR TC TC	✓ ✓ ✓ ✓ ✓	P P P P P	V V V V V	V V V V V	ON SHANK PORTION
1.2	LOAD CHAIN	- DIMENSIONS - BREAKING STR & % ELONGATION - PROOF LOAD -HEAT TREATMENT -GRADE	MA MA MA MA MA	MEASUREMENT -TENSILE TEST -TENSILE TEST REVIEW REVIEW	100% 1/LOT 100% 100% 1/BATCH	APPD. DRGS -DO- -DO- -DO- -DO-	APPD. DRGS. -DO- -DO- -DO- -DO-	IR MTC MTC HT CHRT MTC	✓ ✓ ✓ ✓ ✓ ✓	P P P P P P	V V V V V V	V V V V V V	

MANUFACTURER / CONTRACTOR	LEGEND: ** M : MANUFACTURER / SUB-SUPPLIER C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION	FOR CUSTOMER USE	
SUB-CONTRACTOR		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL
SIGNATURE			

	MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN ITEM: Chain Pulley Block QP No.: REV.:0, Date.: , PAGE: 2 OF 4	PROJECT: 1X660 MW BHUSAWAL TPS UNIT-6 PACKAGE: CHAIN PULLEY BLOCK

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
					6.					10.			
1.	2.	3.	4.	5.			7.	8.	9.				11.

1.3	RAW MATL. (BAR /FORGING) FOR GEAR BLANKS/SHAFTS/ PINIONS/AXLE/ RATCHET PAWL / RATCHET WHEEL & PLATES FOR FABRICATION ETC	CHEMICAL COMPOSITION MECHANICAL INTERNAL DEFECTS NDT AFTER MACHINING	MA MA MA MA	Review Review UT DPT	ONE SAMPLE PER HEAT 100% 100%	Material specification as per approved drawings. ASTM A-388 REFER NOTE 1 ASTM E-165 NO RELEVANT INDICATION		MFR' S TC IR TC	✓ ✓ ✓ ✓	P P P P	V V V V	V V V V	TC or inspection report for components shall be given. For rounds ≥50mm and plates ≥25 mm.
1.4.	LOAD CHAIN WHEELS	- CHEMICAL & MECHANICAL PROPERTIES	MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	APPD. DRG.	APPD. DRG.	MTC	✓	P	V	V	
1.5	BEARINGS	MAKE, TYPE, CATALOUGE NO.	MA	VISUAL	RANDOM	APP DRG / MFR"S CATALOGUE	APP DRG / MFR"S CATALOGUE	IR	✓	P	V	V	
1.6	HAND CHAIN WHEEL	CHEMICAL MECHANICAL PROPERTIES	MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	AS PER DRAWING	AS PER DRAWING	MTC	✓	P	V	V	
1.7	HAND CHAIN	GRADE/ DIMENSION	MA	GRADE DIMENSION	100%	AS PER DRAWING	AS PER DRAWING	MTC	✓	P	V	V	

	LEGEND:	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR	** M : MANUFACTURER / SUB-SUPPLIER C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION		
SUB-CONTRACTOR		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL
SIGNATURE			

	MANUFACTURER'S NAME & ADDRESS:	<u>MANUFACTURING QUALITY PLAN</u> ITEM: Chain Pulley Block QP No.: REV.:0, Date.: , PAGE: 3 OF 4	PROJECT: 1X660 MW BHUSAWAL TPS UNIT-6 PACKAGE: CHAIN PULLEY BLOCK

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
					6.					10.			
1.	2.	3.	4.	5.			7.	8.	9.				11.

1.8	TROLLEY GEARS, PINION, WHEELS, AXLE	CHEMICAL & MECHANICAL	MA	LAB ANALYSIS,	100%	APPVD DRGS	APPVD DRGS	IR/TC	✓	P	V	V	
2	<u>IN PROCESS</u>												
2.1	RATCHET PAWL / RATCHET WHEEL	-HARDNESS -SURFACE CRACK	MA MA	HARDNESS DPT	100% 100 %	IS:3832/ APPD DRG. ASTM E165	IS:3832/ APPD. DRG. NO DEFECT	IR IR	✓ ✓	P P	V V	V V	
2.2	COMPONENTS AFTER HARDFACING & MACHINING	HEAT TREATMENT SURFACE HARDNESS SURFACE CRACK DIMENSION	MA MA MA MA	HT CHART HARDNESS DPT FOR SURFACE CRACK MEASURE	100% 10% 100% 10%	IS 1875/IS 4367/IS 3832 --DO-- ASTM E 165	NO DEFECT	IR IR IR IR	✓ ✓ ✓ ✓	P P P P	V V V V	V V V V	
3.0	<u>FINAL INSPECTION</u>												
3.1	COMPLETE ASSEMBLY	OVERALL DIMENSION ENDURANCE TYPE TEST OPERATIONAL PROOF LOAD & LIGHT LOAD TEST, EFFORT. HEIGHT OF LIFT	CR MA CR MA	MEASUREMENT TYPE TEST LOAD TEST VISUAL	100 % 1 PER SIZE 100% 100 %	IS:3832 /APPD DRG IS 3832 -DO- -DO-	IS:3832 /APPD DRG IS 3832 -DO- -DO-	IR TC IR IR	✓ ✓ ✓ ✓	P P P P	W V W W	V V V V	

MANUFACTURER / CONTRACTOR	LEGEND:	FOR CUSTOMER USE
SUB-CONTRACTOR	** M : MANUFACTURER / SUB-SUPPLIER C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER/ NOMINATED INSPECTION AGENCY. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION	REVIEWED BY
SIGNATURE		NAME & SIGN OF APPROVING AUTHORITY & SEAL

	MANUFACTURER'S NAME & ADDRESS:	MANUFACTURING QUALITY PLAN ITEM: Chain Pulley Block QP No.: REV.:0, Date.: , PAGE: 4 OF 4	PROJECT: 1X660 MW BHUSAWAL TPS UNIT-6 PACKAGE: CHAIN PULLEY BLOCK

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
					M	C/N				M	C	N	
					6.					10.			
1.	2.	3.	4.	5.			7.	8.	9.				11.

		SWIVELING OF HOOK	MA	VISUAL	100%	APPROVED DRG	APPROVED DRG	IR	✓	P	W	V	
		EFFORT	MA	PULL ON CHAIN	100%	-DO-	-DO-	IR	✓	P	W	V	
3.2	PAINTING	-CLEANING - SHADE & DFT OF PAINT	MA MI	VISUAL VISUAL	AT RANDOM AT RANDOM	APPROVED DRAWING/ SPECIFICATION	APPROVED DRAWING/ SPECIFICATION	IR IR		P p	--- W	--- ---	
3.3	NAME PLATE	VERIFICATION	MA	VISUAL	100%			IR		P	V	---	
3.4	PACKING	-VERIFICATION	MI	VISUAL	100%	SPECS.	SPECS.	IR		P	---	---	
3.5	REVIEW OF QA DOCUMENTATION	VERIFICATION	MA	VISUAL	100%	APPD. QP	APPD. QP		✓	V	V	V	
CR – CRITICAL, MA – MAJOR , MI – MINOR													

NOTE 1: WHEN BACK WALL ECHO (BWE) IS SET AT 100% OF FULL SCREEN HEIGHT (FSH) IN DEFECT FREE AREA THEN

(A) DEFECT ECHO SHALL NOT EXCEED 20% OF FSH &

(B) BWE SHOULD BE MINIMUM 80% OF FSH IN ANY AREA.

NOTE 2: RECORDS IDENTIFIED WITH TICK SHALL BE ESSENTIALLY INCLUDED IN QA DOCUMENTATION.

	LEGEND:	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR	** M : MANUFACTURER / SUB-SUPPLIER		
SUB-CONTRACTOR	C : BHEL / NOMINATED INSPECTION AGENCY.		
SIGNATURE	N : CUSTOMER/ NOMINATED INSPECTION AGENCY.	REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL
	INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION		

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		1X660 MW BHUSAWAL TPS UNIT-6				
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE		ELECTRIC WIRE ROPE HOIST				
						REV	0	CONTRACT No						
						DATE		CONTRACTOR		BHEL-PEM				
						PAGE	1 of 4							
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY				REMARKS
									D*	M	C	N		
1	2	3	4	5	6	7	8	9		**	10		11	
1.0	RAW-MATERIALS													
1.1	a) STRUCTURAL MATERIAL b) RAW MATERIAL FOR HOIST AND GEAR BOX HOUSING, TROLLEY PLATE, ROPE DRUM IF FABRICATED ETC	CHEM & MECH PROPS	MA	Lab analysis	1 SAMPLE PER LOT%	IS 2062 /APPD. DRG./ DATA SHEET		MTC/IR	√	P/V	V	V	Test shall be carried out in absence of mill TC or non-correlation of TC with material.BHEL to identify Samples for testing. Test to be carried out at NABL accredited Lab. Reports to be submitted for verification during inspection.	
		NDT	MA	UT	100%	ASTM A388-2004	NOTE 1	IR	√	P	V	V	For dia / plate thickness above 25 mm	
1.1 A	SEAMLESS PIPE FOR ROPE DRUM	CHEMICAL , MECHANICAL	MA	Lab analysis	1 SAMPLE /pipe	Approved drg/ASTM A 106 Grade A or B		MTC/IR	√	P/V	V	V	Test shall be carried out in absence of mill TC or non-correlation of TC with material.BHEL to identify Samples for testing. Test to be carried out at NABL accredited Lab. Reports to be submitted for verification during inspection	
		Flattening & Acid Etching test	MA	PHYSICAL & METALLOGRAPHY	1 SAMPLE /pipe	No cracks, pitting, rusting , damage etc		IR	√	P	V	V		
		SURFACE DEFECTS	MA	Visual	100%									
1.2	FORGINGS FOR GEARS BLANKS ,PINIONS, SHAFT/AXLES, WHEELS , STEEL CASTINGS	MECH , CHEM. PROPS	MA	Lab analysis	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET / IS:3938	LAB. REPORT / MANUFACTURER'S TEST CERTIFICATE	√	P	V	V		
		NDT	CR	UT	100%	ASTM A 388	NOTE 1	INSPN. REPORT	√	P	V	V	IF DIA or THK > 50mm	
		Hardness , surface defects after hardfacing and machining/grinding	MA	DPT/MPI	100%	ASTM E -165 /E-709, No linear indication		MTC	√	P	V	V		
1.3	WIRE ROPE	Dimensional, type, constrction ,	MI	measurement	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	MFRS' TEST CERT.	√	P	V	V		
		EXAMINATION OF REPORT OF BREAKING LOAD CAPACITY	CR	Review of TC	100%	IS: 2266		MFRS' TEST CERT.	√	P	V	V		
1.4	HOOKS	MECH. , CHEM. PROPS.	MA	Lab analysis	100%	APPROVED DRG/DATA SHEET IS:15560		MFRS' TEST CERT.	√	P	V	V		
		U.T IF SHANK DIA > 50mm	CR	NDT	100%	ASTM A 388	NOTE 1	INSPN. REPORT	√	P	V/W	V	SHANK PORTION ONLY	
		Dimension & PROOF LOAD TESTING	CR	Measurment , PROOF LOAD TEST	100%	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560		QCR	√	P	V/W	V	IF REQUIRED BY END CUSTOMER.	
		DPT AFTER PROOF LOAD	CR	NDT	100%	ASTM E-165	NO CRACKS	INSPN. REPORT	√	P	V/W	V		
1.5	SHEAVES	MECH	MA	Tensile & hardness	1/lot	Approved drgs		MTC/IR	√	P	V	V		

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		1X660 MW BHUSAWAL TPS UNIT-6			
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE		ELECTRIC WIRE ROPE HOIST			
						REV	0	CONTRACT No					
						DATE		CONTRACTOR		BHEL-PEM			
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
									D*	M	C	N	
1	2	3	4	5	6	7	8	9					11
1.6	CASTING FOR BEARING PLATED, ROPE GUIDES, PULLEYS ETC	CHEMICAL & MECHANICAL	MAJOR	LAB ANALYSIS	1/LOT	APPROVED DRG/MFG STANDARD	APPROVED DRG/MFG STANDARD	LAB REPORT	√	P	V	V	
2.0	IN-PROCESS												
2.1	Welding process capability and welder skill	WPS,PQR & WPQ	MA	Welding procedure approval and Welder performance qualification in accordance with ASME Section IX	100%	ASME Section IX		WPS,PQR & WPQ		P	V	V	In case approved WPS/PQR/WPQ from BHEL/NTPC/EIL/LLOYDS/TPL available, then documents/records to be submitted for verification during inspection, else, Vendor shall get the approval of Welding Procedure / Welder from the identified agency prior to carrying out welding at the
2.2	Welding of trolley, rope drum etc	Fillet weld	MA	DPT	10%	ASTM E165 or Eq/ No cracks or linear indication		INSPN. REPORT	√	P	V	V	
		Butt welds	MA	RT, DPT	100%	ASME SEC VIII, DIV 1, UW 51/52		RT FILM & REPORT	√	P	V	V	100% RT for butt weld in tension and 10 % in compression. 100% RT on butt weld of rope drum
		DPT AFTER STRESS RELIEVING OF ROPE DRUM	MA	NDT	100%	ASTM E-165	NO CRACKS	INSPN. REPORT	√	P	V	V	
2.3	NDT OF LOAD BEARING BUTT WELDS (IF ANY)	WELD QUALITY OF BUTT WELDS IN TENSION	CR	PT & RT	100%	ASME SEC. VIII DIV. I	ASME SEC. VIII DIV. 4 . CLUW-51 FOR RT APPENDIX -8 FOR PT	INSPN. REPORT ND FILM	√	P	W	V/ W	FILMS TO BE REVIEWED BY BHEL & END CUSTOMER/THIRD PARTY. DPT SHALL BE CHP .
2.4	GEAR BOXES												
	COMPLETE ASSEMBLY	OVERALL DIMENSIONS. LEAK TEST, REDUCTION RATIO, BACK LASH AND CONTACT PATTERN,	MA	MEAS./VISUAL	100%	MFG. DRG./KERSON E TEST	MFG. DRG./NO LEAKAGE WHEN FILLED	INSPN. REPORT	√	P	V		
	NO LOAD RUN TEST FOR 4 HRS	CHECK FOR OIL LEAKAGE, VIBRATION, NOISE ,TEMP. RISE. REDUCTION RATIO, BACKLASH , CONTACT PATTERN	MA	PERFORMANCE	100%	APPROVED DRGS /No leakage,Noise 85dba maxat 1 mtrs, vibration 75 microns max, oil temp rise 20 deg above ambient max		- DO -	√	P	V	V	
3.0	ELECTRICALS												
1	MOTORS & CABLES	Make, type , rating	MA	Visual /measurment	100%	Apprvd drg	IS 325 / IS:3938	IR, MTC	√	P	V	V	For motor refer Note: 2
		ROUTINE TESTS											
3	LIMIT SWITCHES,SFU, ISOLATOR/ O/L RELAY, MCB, FUSES,PUSH BUTTONS,CONTACTOR, INDICATING LAMPS etc	Make , type , rating, functional, Continuity	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V	
4	BRAKES	Make , type , rating, HV/IR, Functional test	MA	Review of TC	100%	Approved drgs		IR, MTC	√	P	V	V	
5	DSL	Make , type , rating, dimension	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V	
6	Control transformer	Make , type , rating, input/output	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V	
	CONTROL PANEL, PENDANT SWITCH	* FIXING OF COMPONENTS WIRING MARKING CONTINUITY * FUNCTIONAL TEST * IR & H.V. TEST * IP - PROTECTION TEST * PAINT SHADE, THICKNESS, SHEET THICKNESS, ADHESION TEST * DIMENSION	MA	VISUAL/MEASUR	100%	APPD.DRG. WIRING DIAGRAM,	APPD. DRG. WIRING DIAGRAM,	IR	√	P	V	V	
8	VVVF DRIVES (IF APPLICABLE)	MAKE , TYPE , RATING , ROUTINE TESTS	MA	VISUAL/ VERIFY	100%	APPROVED DRAWINGS	APPROVED DRAWINGS	MTC	√	P	V	V	
4.0	FINAL INSPECTION												

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		1X660 MW BHUSAWAL TPS UNIT-6			
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE	ELECTRIC WIRE ROPE HOIST				
						REV	0	CONTRACT No					
						DATE		CONTRACTOR	BHEL-PEM				
						PAGE	1 of 4						
SI.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
									D*	M	C	N	
1	2	3	4	5	6	7	8	9		**	10		11
4.1	COMPLETELY ASSEMBLED HOIST	1. COMPLETENESS, CORRECTNESS, WELD QUALITY, OVERALL DIMENSIONS.	MA	VISUAL, MEAS	100%	APPD. DRG.	APPD. DRG.	MNFRS' TEST CERT.	√	P	W	V	CHP
4.2	ASSEMBLED HOIST PERFORMANCE WITH ACTUAL CONTROL PANEL, AND PENDENT PUSH BUTTON	1. LOAD TEST	CR	LOAD TEST at SWL	100%	IS:6547 / IS:39	IS:6547 / IS:3938	MNFRS' TEST CERT.	√	P	W	V	CHP
		2. HOISTING & LOWERING SPEED, PERFORMANCE OF CONTROLLERS SWITCHES CONTACTORS, RELAYS AND OTHER CONTROL DEVICES CORRELATIONS OF CIRCUITS AND INTERLOCKS AND SEQUENCES OF OPERATION , CURRENT MEASUREMENT, LIMIT SWITCH OPERATION.	CR	MEAS & VISUAL	100%	IS:3938, TECH SPEC.	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	CHP
		3. OPERATION OF ALL PROTECTIVE DEVICES	CR	VISUAL	100%	TECH SPEC	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	CHP
4.3	OVER LOAD TEST	OVER LOAD TEST INCLUDING HOLDING CAPACITY OF BRAKES, LIFTING LOAD FROM MID AIR, SOUNDNESS OF WELD AFTER OVERLOAD	CR	TEST AT 125 % OF-SWL	100%	IS:3938	IS:3938	INSPN. REPORT	√	P	W	V	CHP
5	PAINING												
5.1	PRIMER & FINISHING AND SHADE	Examination - Shade , DOP by paper insertion method	MI	visual	100%	DRG. & DATA SHEET & RELV. IS SPEC.		MNFRS' TEST CERT.		P	V		
		DFT	MA	measurement	Sample					P	V		
6	PACKING	STURDINESS, PROTECTION MARKING	MA	VISUAL	100%	MFG STD	MFG STD			P			
	NOTE:												
1	When back wall echo is set to 100% in sound area then a) defect echo shall not exceed 20% b) Back echo shall be minimum 80% in any area.												
2	Less than 30 KW. Acceptance of motor less than 30 KW is based on COC of the manufacturer & the contractor confirming as follows : It is hereby confirmed that the above mentioned motor/motors was/were manufactured taking care of specific requirement regarding ambient temp, voltage & frequency variation, hot start, pull out torque, starting KVA/KW, temp rise, distance between center of stud and gland plate and tested in accordance with approved drawing/data sheet.												
LEGND													
	* RECORDS IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY MANUFACTURER IN QA DOCUMENTATION.												
	** M: MANUFACTURER/SUBCONTRACTOR												
	C: BHEL/BHEL NOMINATED THIRD PARTY INSPECTION AGENCY												
MANUFACTURER/ SUB CONTRACTOR		N: CUSTOMER/CUSTOMER'S CONSULTANT/CUSTOMER'S APPOINTED THIRD PARTY					REVIEWED BY		NAME & SIGN OF APPROVING AUTHORITY & SEAL				
SIGNATURE		'P'- PERFORM", W"- WITNESS AND "V"- VERIFICATION " CHP" CUSTOMER HOLD POINT											

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		1X660 MW BHUSAWAL TPS UNIT-6			
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE		ELECTRIC WIRE ROPE HOIST			
						REV	0	CONTRACT No					
						DATE		CONTRACTOR		BHEL-PEM			
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
									D*	M	C	N	
1	2	3	4	5	6	7	8	9		**	10		11
1.0	RAW-MATERIALS												
1.1	a) STRUCTURAL MATERIAL b) RAW MATERIAL FOR HOIST AND GEAR BOX HOUSING, TROLLEY PLATE, ROPE DRUM IF FABRICATED ETC	CHEM & MECH PROPS	MA	Lab analysis	1 SAMPLE PER LOT%	IS 2062 /APPD. DRG./ DATA SHEET		MTC/IR	√	P/V	V	V	Test shall be carried out in absense of mill TC or non-correlation of TC with material.BHEL to identify Samples for testing. Test to be carried out at NABL accredited Lab. Reports to be submitted for verification during inspection.
		NDT	MA	UT	100%	ASTM A388-2004	NOTE 1	IR	√	P	V	V	For dia / plate thickness above 25 mm
1.1 A	SEAMLESS PIPE FOR ROPE DRUM	CHEMICAL , MECHANICAL	MA	Lab analysis	1 SAMPLE /pipe	Approved drg/ASTM A 106 Grade A or B		MTC/IR	√	P/V	V	V	Test shall be carried out in absense of mill TC or non-correlation of TC with material.BHEL to identify Samples for testing. Test to be carried out at NABL accredited Lab. Reports to be submitted for verification during inspection
		Flattening & Acid Etching test	MA	PHYSICAL & METALLOGRAPHY	1 SAMPLE /pipe	No cracks, pitting, rusting , damage etc		IR	√	P	V	V	
		SURFACE DEFECTS	MA	Visual	100%								
1.2	FORGINGS FOR GEARS BLANKS ,PINIONS, SHAFT/AXLES, WHEELS , STEEL CASTINGS	MECH , CHEM. PROPS	MA	Lab analysis	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET / IS:3938	LAB. REPORT / MANUFACTURER'S TEST CERTIFICATE	√	P	V	V	
		NDT	CR	UT	100%	ASTM A 388	NOTE 1	INSPN. REPORT	√	P	V	V	IF DIA or THK > 50mm
		Hardness , surface defects after hardfacing and machining/grinding	MA	DPT/MPI	100%	ASTM E -165 /E-709, No linear indication		MTC	√	P	V	V	
1.3	WIRE ROPE	Dimensional, type, constrction ,	MI	measurement	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	MFRS' TEST CERT.	√	P	V	V	
		EXAMINATION OF REPORT OF BREAKING LOAD CAPACITY	CR	Review of TC	100%	IS: 2266		MFRS' TEST CERT.	√	P	V	V	
1.4	HOOKS	MECH. , CHEM. PROPS.	MA	Lab analysis	100%	APPROVED DRG/DATA SHEET IS:15560		MFRS' TEST CERT.	√	P	V	V	
		U.T IF SHANK DIA > 50mm	CR	NDT	100%	ASTM A 388	NOTE 1	INSPN. REPORT	√	P	V/W	V	SHANK PORTION ONLY
		Dimension & PROOF LOAD TESTING	CR	Measurment , PROOF LOAD TEST	100%	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560		QCR	√	P	V/W	V	IF REQUIRED BY END CUSTOMER.
		DPT AFTER PROOF LOAD	CR	NDT	100%	ASTM E-165	NO CRACKS	INSPN. REPORT	√	P	V/W	V	
1.5	SHEAVES	MECH	MA	Tensile & hardness	1/lot	Approved drgs		MTC/IR	√	P	V	V	

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		1X660 MW BHUSAWAL TPS UNIT-6			
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE	ELECTRIC WIRE ROPE HOIST				
						REV	0	CONTRACT No					
						DATE		CONTRACTOR		BHEL-PEM			
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
									D*	M	C	N	
1	2	3	4	5	6	7	8	9					11
1.6	CASTING FOR BEARING PLATED, ROPE GUIDES, PULLEYS ETC	CHEMICAL & MECHANICAL	MAJOR	LAB ANALYSIS	1/LOT	APPROVED DRG/MFG STANDARD	APPROVED DRG/MFG STANDARD	LAB REPORT	√	P	V	V	
2.0	IN-PROCESS												
2.1	Welding process capability and welder skill	WPS,PQR & WPQ	MA	Welding procedure approval and Welder performance qualification in accordance with ASME Section IX	100%	ASME Section IX		WPS,PQR & WPQ		P	V	V	In case approved WPS/PQR/WPQ from BHEL/NTPC/EIL/LLOYDS/TPL available, then documents/records to be submitted for verification during inspection, else, Vendor shall get the approval of Welding Procedure / Welder from the identified agency prior to carrying out welding at the
2.2	Welding of trolley, rope drum etc	Fillet weld	MA	DPT	10%	ASTM E165 or Eq/ No cracks or linear indication		INSPN. REPORT	√	P	V	V	
		Butt welds	MA	RT, DPT	100%	ASME SEC VIII, DIV 1, UW 51/52		RT FILM & REPORT	√	P	V	V	100% RT for butt weld in tension and 10 % in compression. 100% RT on butt weld of rope drum
		DPT AFTER STRESS RELIEVING OF ROPE DRUM	MA	NDT	100%	ASTM E-165	NO CRACKS	INSPN. REPORT	√	P	V	V	
2.3	NDT OF LOAD BEARING BUTT WELDS (IF ANY)	WELD QUALITY OF BUTT WELDS IN TENSION	CR	PT & RT	100%	ASME SEC. VIII DIV. I	ASME SEC. VIII DIV. 4 . CLUW-51 FOR RT APPENDIX -8 FOR PT	INSPN. REPORT ND FILM	√	P	W	V/ W	FILMS TO BE REVIEWED BY BHEL & END CUSTOMER/THIRD PARTY. DPT SHALL BE CHP .
2.4	GEAR BOXES												
	COMPLETE ASSEMBLY	OVERALL DIMENSIONS. LEAK TEST, REDUCTION RATIO, BACK LASH AND CONTACT PATTERN,	MA	MEAS./VISUAL	100%	MFG. DRG./KERSON E TEST	MFG. DRG./NO LEAKAGE WHEN FILLED	INSPN. REPORT	√	P	V		
	NO LOAD RUN TEST FOR 4 HRS	CHECK FOR OIL LEAKAGE, VIBRATION, NOISE ,TEMP. RISE. REDUCTION RATIO, BACKLASH , CONTACT PATTERN	MA	PERFORMANCE	100%	APPROVED DRGS /No leakage,Noise 85dbA maxat 1 mtrs, vibration 75 microns max, oil temp rise 20 deg above ambient max		- DO -	√	P	V	V	
3.0	ELECTRICALS												
1	MOTORS & CABLES	Make, type , rating	MA	Visual /measurment	100%	Apprvd drg	IS 325 / IS:3938	IR, MTC	√	P	V	V	For motor refer Note: 2
		ROUTINE TESTS											
3	LIMIT SWITCHES,SFU, ISOLATOR/ O/L RELAY, MCB, FUSES,PUSH BUTTONS,CONTACTOR, INDICATING LAMPS etc	Make , type , rating, functional, Continuity	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V	
4	BRAKES	Make , type , rating, HV/IR, Functional test	MA	Review of TC	100%	Approved drgs		IR, MTC	√	P	V	V	
5	DSL	Make , type , rating, dimension	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V	
6	Control transformer	Make , type , rating, input/output	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V	
	CONTROL PANEL, PENDANT SWITCH	* FIXING OF COMPONENTS WIRING MARKING CONTINUITY * FUNCTIONAL TEST * IR & H.V. TEST * IP - PROTECTION TEST * PAINT SHADE, THICKNESS, SHEET THICKNESS, ADHESION TEST * DIMENSION	MA	VISUAL/MEASUR	100%	APPD.DRG. WIRING DIAGRAM,	APPD. DRG. WIRING DIAGRAM,	IR	√	P	V	V	
8	VVVF DRIVES (IF APPLICABLE)	MAKE , TYPE , RATING , ROUTINE TESTS	MA	VISUAL/ VERIFY	100%	APPROVED DRAWINGS	APPROVED DRAWINGS	MTC	√	P	V	V	
4.0	FINAL INSPECTION												

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		1X660 MW BHUSAWAL TPS UNIT-6			
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE	ELECTRIC WIRE ROPE HOIST				
						REV	0	CONTRACT No					
						DATE		CONTRACTOR	BHEL-PEM				
						PAGE	1 of 4						
SI.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
									D*	M	C	N	
1	2	3	4	5	6	7	8	9		**	10		11
4.1	COMPLETELY ASSEMBLED HOIST	1. COMPLETENESS, CORRECTNESS, WELD QUALITY, OVERALL DIMENSIONS.	MA	VISUAL, MEAS	100%	APPD. DRG.	APPD. DRG.	MNFRS' TEST CERT.	√	P	W	V	CHP
4.2	ASSEMBLED HOIST PERFORMANCE WITH ACTUAL CONTROL PANEL, AND PENDENT PUSH BUTTON	1. LOAD TEST	CR	LOAD TEST at SWL	100%	IS:6547 / IS:39	IS:6547 / IS:3938	MNFRS' TEST CERT.	√	P	W	V	CHP
		2. HOISTING & LOWERING SPEED, PERFORMANCE OF CONTROLLERS SWITCHES CONTACTORS, RELAYS AND OTHER CONTROL DEVICES CORRELATIONS OF CIRCUITS AND INTERLOCKS AND SEQUENCES OF OPERATION , CURRENT MEASUREMENT, LIMIT SWITCH OPERATION.	CR	MEAS & VISUAL	100%	IS:3938, TECH SPEC.	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	CHP
		3. OPERATION OF ALL PROTECTIVE DEVICES	CR	VISUAL	100%	TECH SPEC	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	CHP
4.3	OVER LOAD TEST	OVER LOAD TEST INCLUDING HOLDING CAPACITY OF BRAKES, LIFTING LOAD FROM MID AIR, SOUNDNESS OF WELD AFTER OVERLOAD	CR	TEST AT 125 % OF-SWL	100%	IS:3938	IS:3938	INSPN. REPORT	√	P	W	V	CHP
5	PAINING												
5.1	PRIMER & FINISHING AND SHADE	Examination - Shade , DOP by paper insertion method	MI	visual	100%	DRG. & DATA SHEET & RELV. IS SPEC.		MNFRS' TEST CERT.		P	V		
		DFT	MA	measurement	Sample					P	V		
6	PACKING	STURDINESS, PROTECTION MARKING	MA	VISUAL	100%	MFG STD	MFG STD			P			
	NOTE:												
1	When back wall echo is set to 100% in sound area then a) defect echo shall not exceed 20% b) Back echo shall be minimum 80% in any area.												
2	Less than 30 KW. Acceptance of motor less than 30 KW is based on COC of the manufacturer & the contractor confirming as follows : It is hereby confirmed that the above mentioned motor/motors was/were manufactured taking care of specific requirement regarding ambient temp, voltage & frequency variation, hot start, pull out torque, starting KVA/KW, temp rise, distance between center of stud and gland plate and tested in accordance with approved drawing/data sheet.												
		LEGND											
		* RECORDS IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY MANUFACTURER IN QA DOCUMENTATION.											
		** M: MANUFACTURER/SUBCONTRACTOR											
		C: BHEL/BHEL NOMINATED THIRD PARTY INSPECTION AGENCY											
MANUFACTURER/ SUB CONTRACTOR		N: CUSTOMER/CUSTOMER'S CONSULTANT/CUSTOMER'S APPOINTED THIRD PARTY											
		"P"- PERFORM", "W"- WITNESS AND "V"- VERIFICATION											
SIGNATURE		" CHP" CUSTOMER HOLD POINT					REVIEWED BY		NAME & SIGN OF APPROVING AUTHORITY & SEAL				



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM
LIST OF DOCUMENTS TO BE SUBMITTED WITH
BID**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : II

SUB-SECTION : 2

REV: 00

SHEET 1 OF 1

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

1. Compliance cum confirmation certificate
2. Guaranteed power consumption
3. Un priced format
4. Deviation schedule /No deviation certificate in attached format 'Deviation sheet (Cost of withdrawal)'.
5. Pre bid clarification schedule (as applicable)



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM
COMPLIANCE CUM CONFIRMATION
CERTIFICATE**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : II

SUB-SECTION : 3

REV. NO. 00

SHEET: 1 OF 2

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 and those resolved as per 'Schedule of Deviations', 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 is within the contracted price without any extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.
- 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 even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM
COMPLIANCE CUM CONFIRMATION
CERTIFICATE**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : II

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REV. NO. 00

SHEET: 2 OF 2

commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account

- 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.
- 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.
- m) Successful bidder shall furnish detailed erection manual for each of the equipment supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.
- n) Document approval by customer 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 for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- o) 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.



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM
PRE-BID CLARIFICATION SCHEDULE**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : II

SUB-SECTION : 4

REV. NO. 00

SHEET: 1 OF 1

PRE-BID CLARIFICATION SCHEDULE

S. NO.	SECTION/CLAUSE/PAGE NO.	STATEMENT OF THE REFERRED CLAUSE	CLARIFICATION REQUIRED

The bidder hereby clarifies that above mentioned are the only clarifications required on the technical specification for the subject package.

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM
DEVIATION SHEET (COST OF
WITHDRAWAL)**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : II

SUB-SECTION : 5

REV: 00

DEVIATION SHEET (COST OF WITHDRAWAL)
(Refer GCC and unpriced schedule for cost of withdrawal
format)



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM
GUARANTEED POWER CONSUMPTION**

SPECIFICATION No: PE-TS-415-553-A001

SECTION : II

SUB-SECTION : 6

REV: 00

GUARANTEED POWER CONSUMPTION

Guaranteed Power Consumption For Air Conditioning System (ANNEXURE I)						
NAME OF PROJECT:		1X660 MW BHUSAWAL TPS				
NAME OF PACKAGE:		AIR CONDITIONING SYSTEM				
TECHNICAL SPECIFICATION No:		PE-TS-415-553-A001_Rev 00				
S.NO.	DESCRIPTION OF EQUIPMENT	NO OF EQUIPMENT		TOTAL GUARANTEED POWER CONSUMPTION FOR EACH EQUIPMENT AT MOTOR INPUT TERMINAL AND CONTROL PANEL (IN KW)	DUTY FACTOR	TOTAL KW
		WORKING	STANDBY			
		3A	3B	4	5	6=3Ax4x5
A	AC PLANT FOR MAIN CONTROL ROOM AREAS-					
1	Water cooled Screw chiller	1	1		1	
2	AHU for main control room	2	2		1	
3	Fresh air fan for main control room	1	1		1	
4	Smoke exhaust fan for main control room	1	0		1	
5	AHU for UPS room	1	1		1	
6	FCU for SWAS room of 3TR capacity	2	2		1	
7	Fresh air fan for UPS room	1	1		1	
8	Chilled water pumps	1	1		1	
9	Condenser water pumps	1	1		1	
10	Cooling tower fan for above AC plant	1	1		1	
11	pumps for water softening plant	1	1		1	
B	AC PLANT FOR SERVICE BUILDING					
1	Water cooled Screw chiller	1	1		1	
2	AHU for AC area	4	4		1	
3	Chilled water pumps	1	1		1	
4	Fresh air fan	1	1		1	
5	Smoke exhaust fan	1	0		1	
C	AC PLANT-3 (ESP Control room)					
1	Precision AC for ESP control room	2	2		1	
2	Fresh air fans for above PAC room.	1	1		1	
3	Smoke exhaust fans for above AHU rooms.	1	0		1	
C	AC PLANT-4 (FGD Control room)					
1	Split AC each of 2 TR for FGD Control Room	10	10		1	
				TOTAL (KW)		
Note:	Estimated power consumption (EPC) figure for the system (for working drives only) has been considered as 571 KW. So long bidder's quoted guaranteed power consumption (GPC) above remains within this EPC, there will be no technical loading of bid on power consumption for evaluation. However, if bidder's quoted GPC exceeds EPC, there shall be technical loading of bid for evaluation @ Rs 4,50,000/- per KW of additional power over EPC. Bidder's guaranteed power consumption at motor input terminals (not shaft power) as furnished in relevant schedule shall be demonstrated by the successful bidder during performance testing at works/ site. In case power consumption is noted higher than EPC / bidder's quoted GPC whichever is higher, during inspection/ PG test, penalty @ Rs 4,50,000/- per KW shall be levied on vendor.					
Particulars of bidder / authorised representative						
Name	Designation	Signature	DATE	Company Seal		

Guaranteed Power Consumption For Air Conditioning System (ANNEXURE II)						
NAME OF PROJECT:		1X660 MW BHUSAWAL TPS				
NAME OF PACKAGE:		AIR CONDITIONING SYSTEM				
TECHNICAL SPECIFICATION No:		PE-TS-415-553-A001_Rev 00				
S.NO.	DESCRIPTION OF EQUIPMENT	NO OF EQUIPMENT		TOTAL GUARANTEED POWER CONSUMPTION FOR EACH EQUIPMENT AT MOTOR INPUT TERMINAL AND CONTROL PANEL (IN KW)	DUTY FACTOR	TOTAL KW
		WORKING	STANDBY			
		3A	3B	4	5	6=3Ax4x5
A	VENTILATION SYSTEM FOR AUXILIARY BUILDING AC AREA					
1	Split AC each of 2 TR for Static Excitation Room @ 17M EI of power house	7	7		1	
2	Split AC each of 2 TR for Dining room of canteen building	6	3		1	
3	Split AC each of 2 TR for Fuel oil transfer pump house control room	2	2		1	
4	Split AC each of 1.5 TR for Officer room and officer staff of gate office	2	0		1	
5	Split AC each of 1.5 TR for Time and security office - visitors waiting area and pass section	2	0		1	
6	Split AC each of 1.5 TR for Time and security office - record room, staff room, server room	6	0		1	
7	Split AC each of 1.5 TR for Time and security office - deputy officer room and deputy commandant room	4	0		1	
8	Split AC each of 1.5 TR for chemical lab UV-v room	2	1		1	
9	Split AC each of 1.5 TR for chemical lab boom calorimeter room	2	1		1	
10	Split AC each of 1.5 TR for chemical lab balance chemist room	2	1		1	
11	Split AC each of 2 TR for Compressor house control room	4	2		1	
12	Split AC each of 2 TR for CW ACW pump house control room	4	2		1	
13	Split AC each of 2 TR for Fuel oil pressurising and heating pump house	2	1		1	
14	Split AC each of 1.5 TR for AC plant control room	2	1		1	
15	Split AC each of 2 TR for CPU regeneration control room	4	2		1	
16	Split AC each of 1.5 TR for CPU service vessel	1	1		1	
17	Split AC each of 2 TR for Raw water pump house control room	4	2		1	
18	Split AC each of 2 TR for Abandoned pump house control room	4	2		1	
19	Split AC each of 2 TR for Aux boiler control room	2	1		1	
20	Split AC each of 1.5 TR for DM plant control room	3	1		1	
21	Split AC each of 1.5 TR for PT plant control room	3	1		1	
22	Split AC each of 1.5 TR for ETP plant control room	3	1		1	
23	Split AC each of 1.5 TR for STP plant control room	3	1		1	
24	Split AC each of 1.5 TR for Ozonisation control room	3	1		1	
				TOTAL (KW)		
Note:	Estimated power consumption (EPC) figure for the system (for working drives only) has been considered as 124 KW. So long bidder's quoted guaranteed power consumption (GPC) above remains within this EPC, there will be no technical loading of bid on power consumption for evaluation. However, if bidder's quoted GPC exceeds EPC, there shall be technical loading of bid for evaluation @ Rs 4,50,000/- per KW of additional power over EPC. Bidder's guaranteed power consumption at motor input terminals (not shaft power) as furnished in relevant schedule shall be demonstrated by the successful bidder during performance testing at works/ site. In case power consumption is noted higher than EPC / bidder's quoted GPC whichever is higher, during inspection/ PG test, penalty @ Rs 4,50,000/- per KW shall be levied on vendor.					
Particulars of bidder / authorised representative						
Name	Designation	Signature	DATE	Company Seal		



**1x660MW BHUSAWAL TPS
AIR CONDITIONING SYSTEM
DRAWINGS**

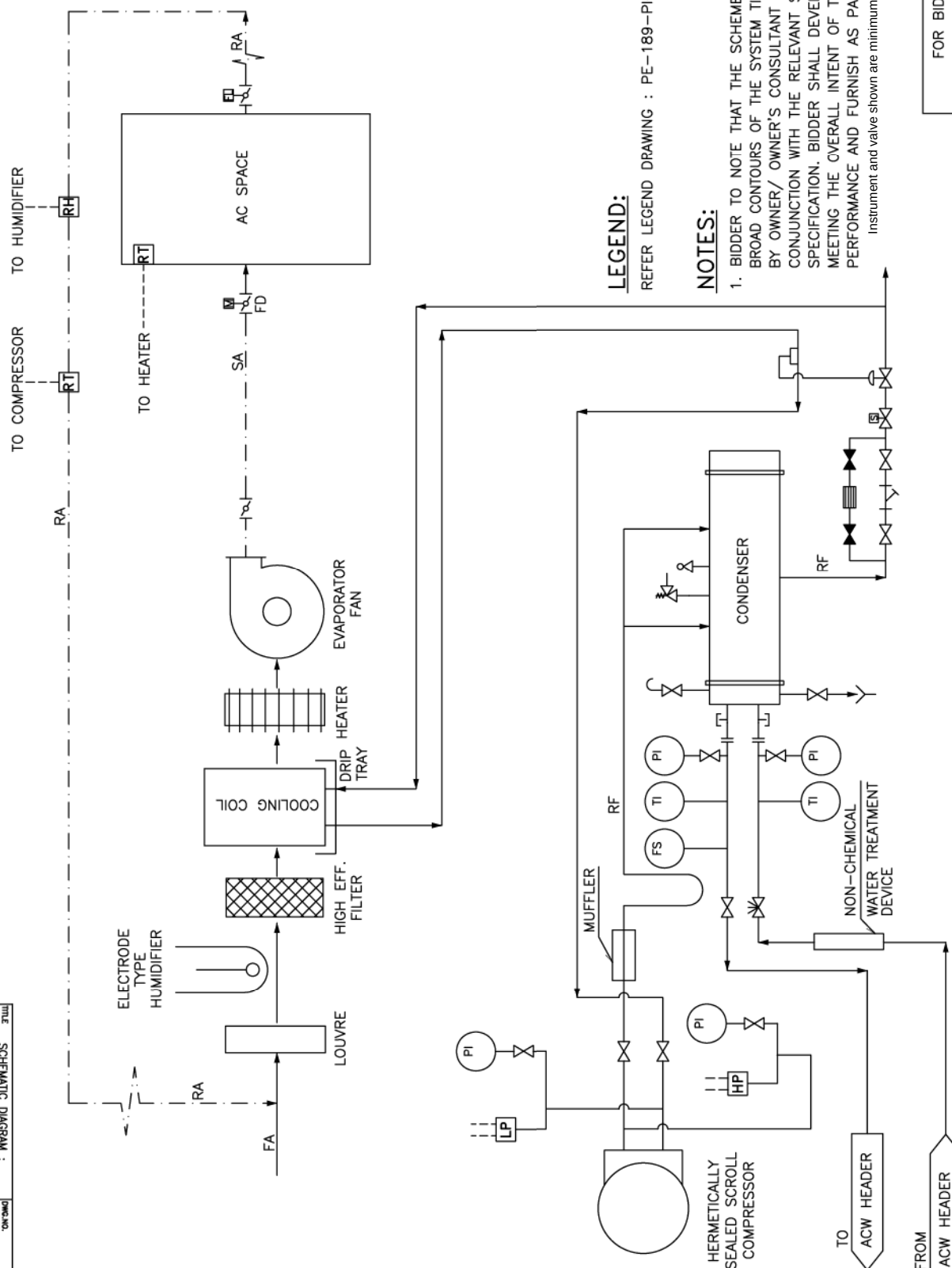
SPECIFICATION No: PE-TS-415-553-A001

SECTION : II

SUB-SECTION : 7

REV: 00

DRAWINGS



LEGEND:

REFER LEGEND DRAWING : PE-189-PI-200

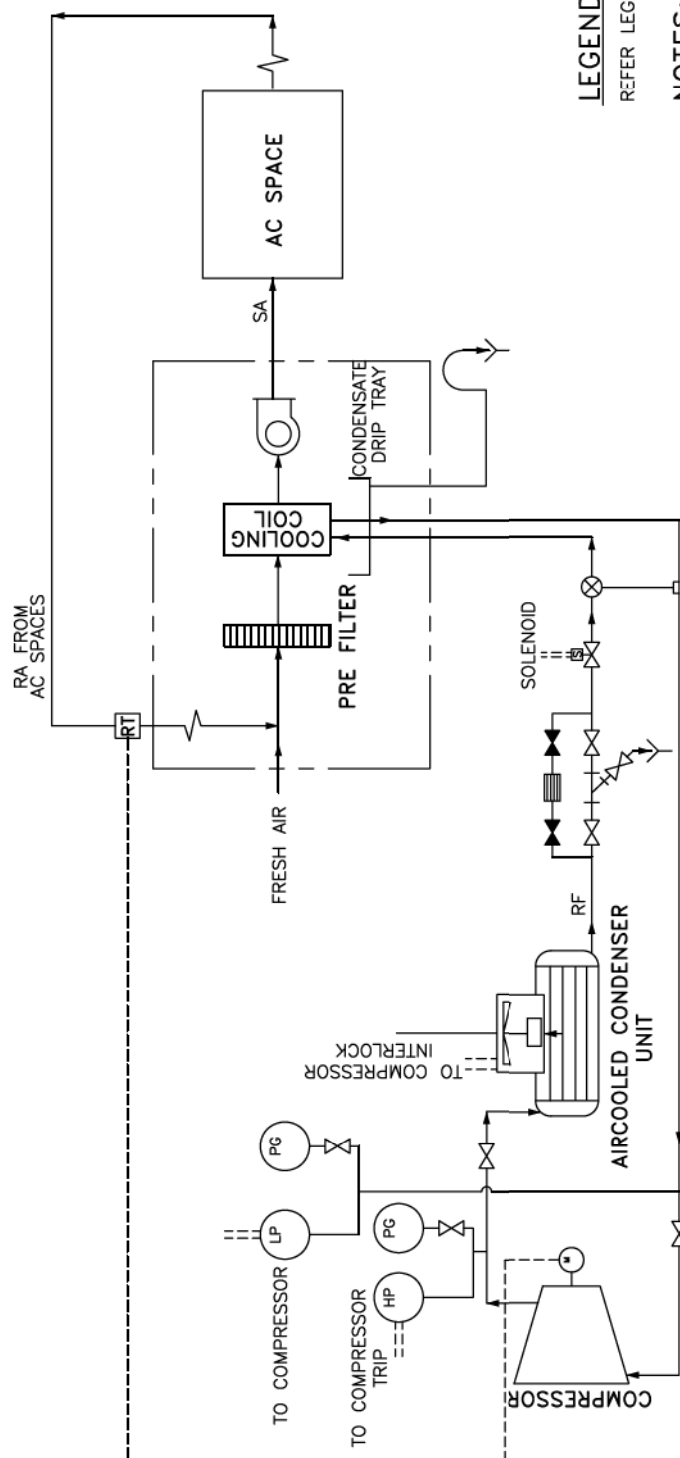
NOTES:

1. BIDDER TO NOTE THAT THE SCHEME SHOWN CAPTURES THE BROAD CONTOURS OF THE SYSTEM TITLED HERE AS CONCEIVED BY OWNER/ OWNER'S CONSULTANT AND SHALL BE READ IN CONJUNCTION WITH THE RELEVANT SECTION OF THE SPECIFICATION. BIDDER SHALL DEVELOP DETAILED P&IDS MEETING THE OVERALL INTENT OF THE SCOPE AND PERFORMANCE AND FURNISH AS PART OF THE PROPOSAL. Instrument and valve shown are minimum requirement

Instrument and valve shown are minimum requirement

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LEGEND:

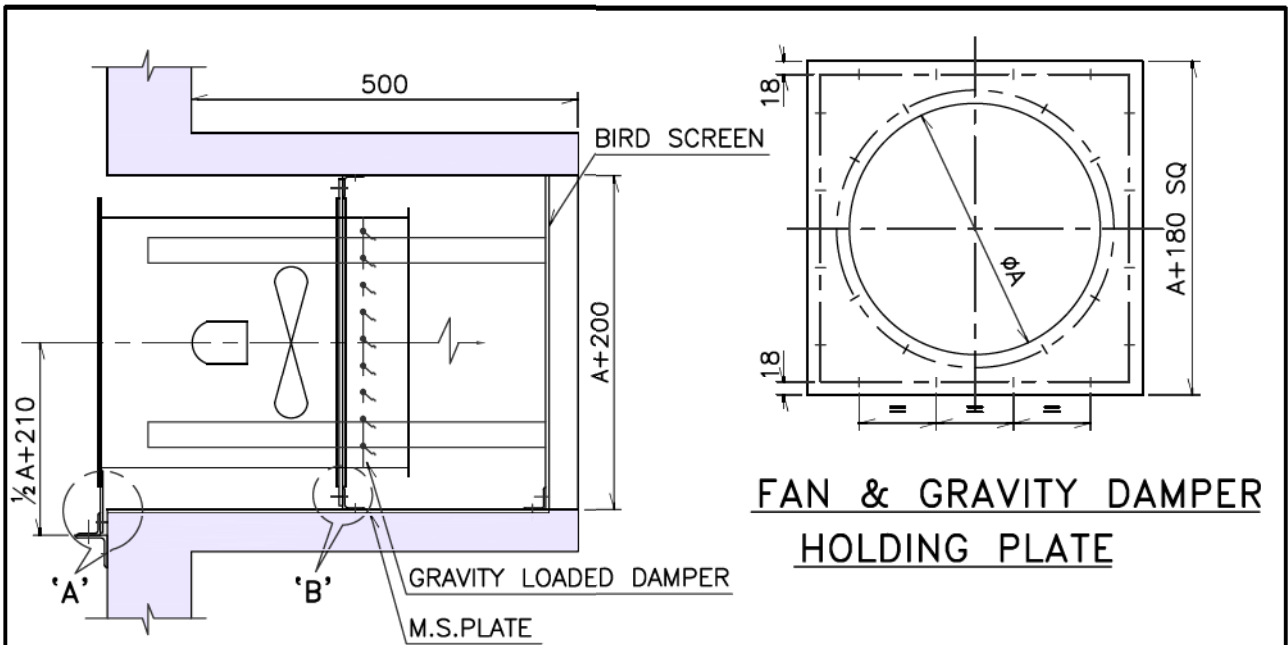
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NOTES:

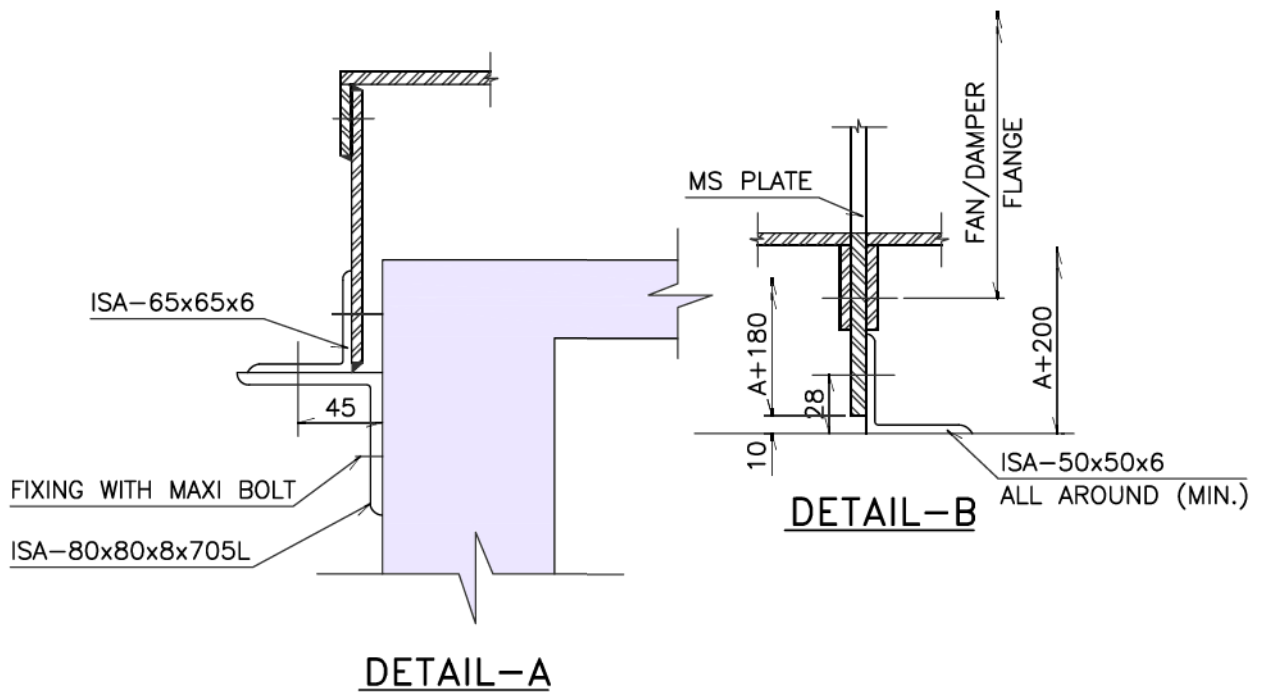
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FOR BID PURPOSE ONLY

ISSUE	REVISIONS										DO NOT SCALE																																														
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SECT. ELEVATION



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DATE : 05-09-2011

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TYPICAL ARRANGEMENT OF FAN FIXING DETAIL

SCALE ~

APPROVED

A.K.S.

DIV. MECH.

DR. P.N.Z.

CH. S.N.S.

DWG.NO.

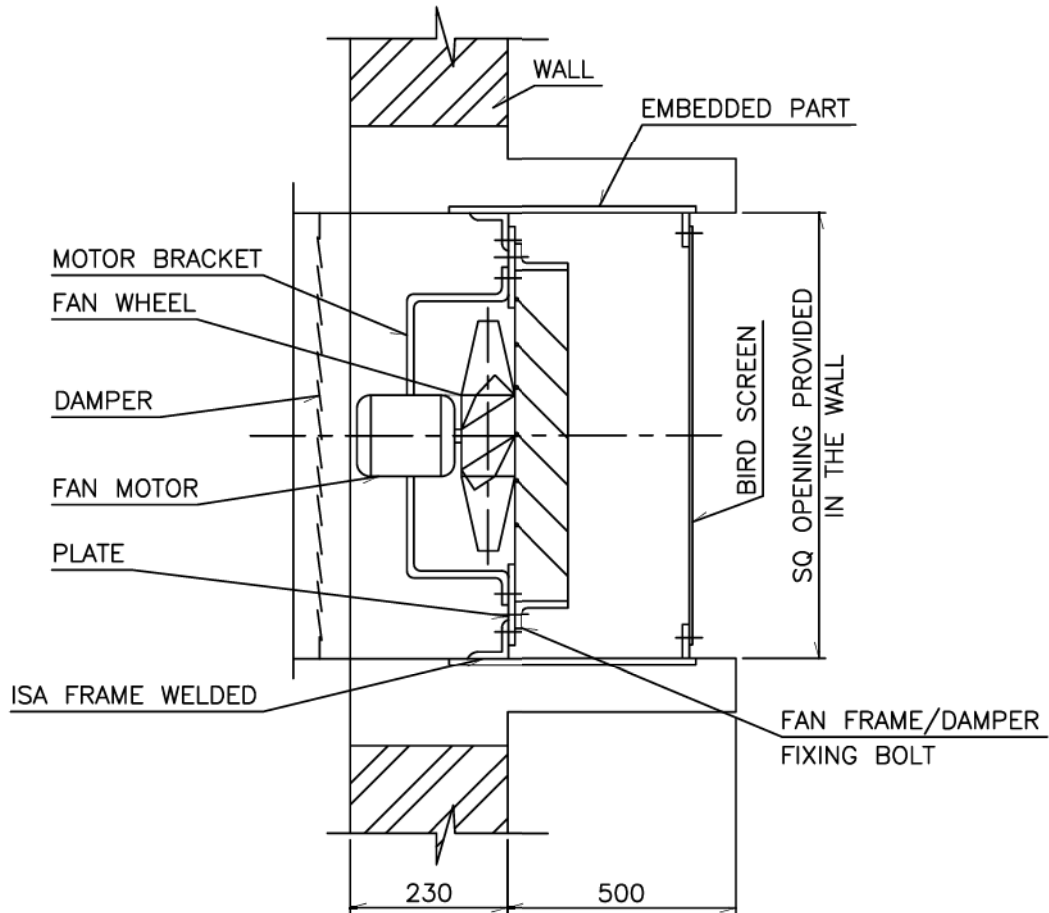
PE-189-ME-SK-1032

S.N.S.

ISSUE PO

CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

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



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DATE : 05-09-2011

ISSUE	BY	CH	DATE

TYPICAL ARRANGEMENT OF SMOKE EXHAUST FAN

SCALE ~

DIV. MECH.

DR. P.N.Z.

CH. S.N.S.

APPROVED

A.K.S.

DWG.NO.

PE-189-ME-SK-1031

S.N.S.

ISSUE PO

CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

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