

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		DOCUMENT NO. : PE-ID-417-145-I902		
			VOLUME II B		
			SECTION D		
			REV. NO. 00	DATE:15/05/2019	
			SHEET 2	OF	4
Data Sheet A & B					
DATA SHEET-A (TO BE FILLED BY PURCHASER)				DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
	@ WINDING TEMP PROTECTION	☒ THERMOSTAT (3 Nos.,1 IN EACH PHASE) ☐ -----			
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED (THERMISTOR PTC)			
INTEGRAL STARTER	INTEGRAL STARTER	☒ REQUIRED ☐ NOT REQUIRED			
	TYPE OF SWITCHING DEVICE	☐ CONTACTORS ☐ THYRISTORS			
	TYPE	☐ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)			
	IF SMART (REFER BELOW POINT a – h)				
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED			
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐			
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC			
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED			
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐			
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED			
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP			
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED			
	STEP DOWN CONT. TRANSFORMER	☒ REQUIRED			
	OPEN / CLOSE PB	☒ REQUIRED ☐ NOT REQUIRED			
	STOP PB	☒ REQUIRED ☐ NOT REQUIRED			
	INDICATING LAMPS	☒ REQUIRED ☐ NOT REQUIRED			
	LOCAL REMOTE S/S	☒ REQUIRED ☐ NOT REQUIRED			
	STATUS CONTACTS FOR MONITORING	☒ REQUIRED ☐ NOT REQUIRED			
	INTEGRAL STARTER DISTURBED SIGNAL(Refer Note 14)	REQUIRED (O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY,)			
	ACTION ON LOSS OF EXTERNAL ELECTRIC POWER	☐ STAYPUT ☐ FAIL SAFE			
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter) DATASHEET & WIRING DIAGRAM OF ISOLATION DEVICE TO BE PROVIDED	TYPE OF ISOLATING DEVICE	☒ INTERPOSING RELAY ☐ OPTO COUPLER TO BE DECIDED DURING DETAILED ENGINEERING			
	QUANTITY	☐ 2 NOS. ☐ 3 NOS.			
	DRIVING VOLTAGE	☒ 20.5 – 24V DC ☐ _____ V DC			
	DRIVING CURRENT	☒ 125mA MAX ☐ _____ mA MAX			
	LOAD RESISTANCE	☒ > 192 ohms - <25 k ohms ☐ > _____ ohms - < _____ ohms			
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY			
	OPEN / CLOSE	☒ 1 No. ☐ 2Nos. / ☒ 1 No. ☐ 2Nos			
	CONTACT TYPE	2 NO + 2 NC			
	RATING	5A 240V AC AND 0.5A 220V DC			
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE			
	ACCURACY	+3% OF SET VALUE			
LIMIT SWITCH (Not Applicable for Smart)	MFR & MODEL NO.	BIDDER TO SPECIFY			
	OPEN : INT : CLOSE	☐ 1 No. ☒ 2 Nos.	2 Nos. (ADJ.)	☐ 1 No. ☒ 2Nos.	

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Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
Actuator) (\$ Refer Notes)	CONTACT TYPE	2 NO + 2 NC		
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC		
	ACCURACY	2% OF SET VALUE		
POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	☒ REQUIRED ☐ NOT REQUIRED		
	MFR & MODEL NO.	BIDDER TO SPECIFY		
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ☒ ELECTRONIC (2 WIRE) CONTACTLESS		
	SUPPLY	☒ 24V DC ☐		
	OUTPUT	☒ 4-20mA		
	ACCURACY	± 1% FS		
SPACE HEATER	@SPACE HEATER	REQUIRED		
	@ POWER SUPPLY (NON INTEGRAL)	230V AC,1 PH.,50 Hz		
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY		
	@ RATING			
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED		
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ ☐ IP 68 @ ☐		
	@ EARTHING TERMINAL	REQUIRED		
	PLUG & SOCKET	☐ REQUIRED ☐ NOT REQUIRED		
	NO. OF PINS REQUIRED(TO BE CHECKED AS PER SIGNALS IN DRIVE CONTROL PHILOSOPHY)			
	NOS. OF PLUG & SOCKET	☐ 1 Nos. for ON/OFF ☐ 2 NOS.(for inching duty) ☐ OTHER (TO BE SPECIFIED INLINE WITH DRIVE CONTROL PHILOSOPHY)		
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:-----		
	@ SPACE HEATER CABLE GLAND	SIZE:-----		
	CONTROL CABLE GLANDS-1	INSTRUMENT CABLE SIZE FOR ON/OFF DUTY VALVES SHALL BE 8PX0.5 SQMM. ONE CABLE GLAND OF OD SIZE 20 MM. INSTRUMENT CABLE SIZE FOR INCHING DUTY TYPE VALVES SHALL HAVE TWO NO. CABLES (ONE NO. 8PX0.5 SQMM AND 2ND 2PX0.5 SQMM) - TWO NO. GLANDS OF OD SIZES 20 MM & 15 MM.		
	CONTROL CABLE GLANDS-2			
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY		_____ Kg.

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Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		

NOTES:

- SCOPE:** DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
 - CODES & STANDARDS:** DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691, IS-4722, IEC 60947-5-1 AND EN 15714-3 :2010 OR LATEST VERSION.
 - TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
 - CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
 - THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION.THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
 - THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.
 - THE MOTOR SHALL BE CAPABLE OF STARTING AT 85 PERCENT OF RATED VOLTAGE 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.
 - IN ADDITION TO ABOVE REQUIREMENTS FOR LIMIT/TORQUE SWITCH, **MECHANICAL END STOP** WITH ACCURACY OF 2% SHALL BE SUPPLIED.
 - IT SHOULD BE POSSIBLE TO OPERATE THE ACTUATOR LOCALLY. LOCKABLE LOCAL/REMOTE SELECTION SHALL BE PROVIDED ON THE ACTUATOR.
 - LOCAL POSITION INDICATOR SHALL BE PROVIDED FOR 0 TO 100 % TRAVEL.
 - CONTROL WIRING SHALL BE SUITABLE VOLTAGE GRADE COPPER WIRE 1.5 SQ. MM.
 - ENDURANCE: RATED TORQUE RANGE SHOULD BE BASED ON ISO 5211, ISO5210.
 - TAG PLATE SHALL BE CONFIRMING TO STANDARD BS-15714.
 - INTEGRAL STARTER/ACTUATOR DISTURBED SIGNAL SHALL BE CHECKED AND INCLUDE AS PER DRIVE CONTROL PHILOSOPHY.
 - ** VALVES WITH 10 DEGREE/20DEGREE FEEDBACK REQUIREMENT FOR APPLICATIONS SUCH AS CW/ACW/PLANT WATER SYSTEM ETC SHALL BE CONSIDERED AS INCHING DUTY VALVES. ACCORDINGLY, POSITION FEED BACK TRANSMITTER, PLUG & SOCKET REQUIREMENT SHALL BE CONSIDERED.**
- \$\$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.**
- ## EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.**

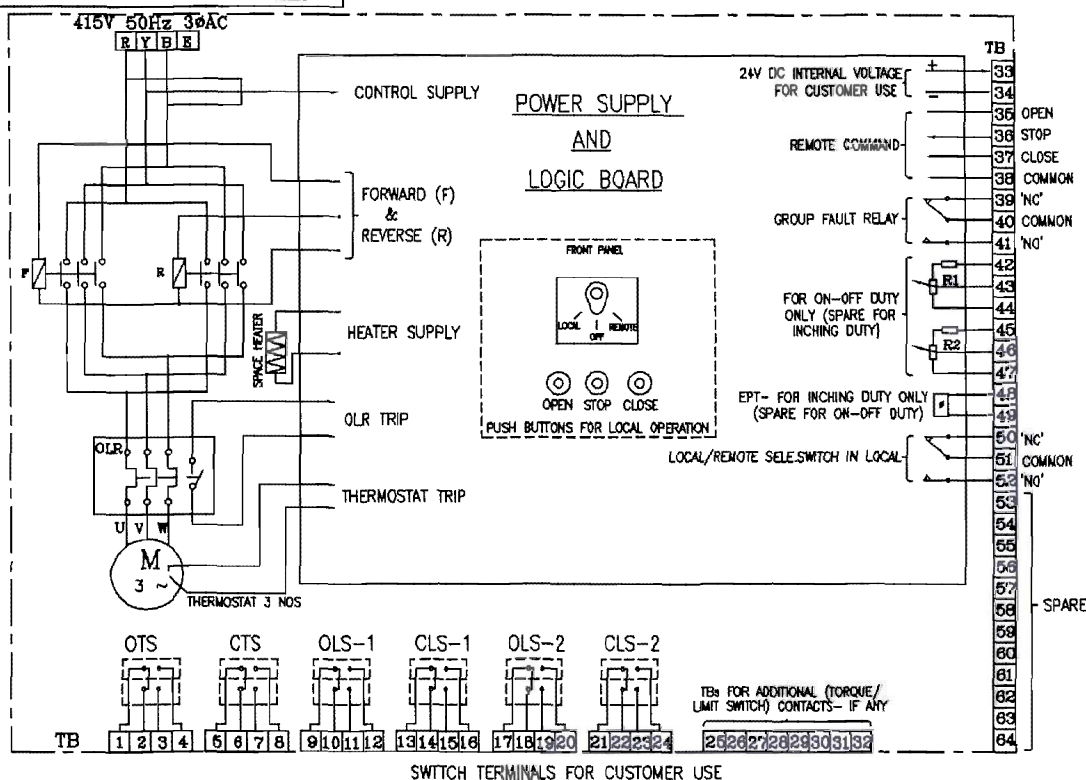
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
	RINKY	RAVINDER K RAINA	SHIVRAJ SINGH BANSALA	NAME
				SIGNATURE
	15.05.2019	15.05.2019	15.05.2019	DATE

NOTES* = TO BE FILLED BY MPL (LEAD AGENCY).

@ BE FILLED BY ES

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

DRAWING NO. 3-V-MISC-24227



CONTACT DEVELOPMENT DIAGRAM

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

CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company.

TYPE OF PRODUCT ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS
OR NAME OF
CUSTOMER/PROJECT

 365-121	BHARAT HEAVY ELECTRICALS LTD., UNIT: HIGH PRESSURE BOILER PLANT, TRUCKERIPALLI-550014.			NAME N.P.ESWAR	SIGN N.P	DATE 07.10.04	NO.OF VAR.	
	DEN				D.DINAKARAN	O.D	07.10.04	
	CHD				K.ARUNACHALAM	K.A	07.10.04	
	APPD							
DEPT VL		SCALE	WEIGHT (KG)	REFERENCE INFORMATION			NO. OF THIN	
CODE								
TITLE WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER			CARD CODE U 01	DRAWING NO. 3-V-MISC-24227			REV 0	

Size A3

FORM NO. PEM-6868-0

	Technical specification for CONTROL & INSTRUMENTATION 5x800 MW YADADRI TPS, NALGONDA	SPEC NO.: PE-TS-417-145-I	
		VOLUME	
		SECTION	
		REV. NO. 00	DATE : 03.04.2018
		SHEET	OF
INSTRUMENTATION DATA SHEET			

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VOLUME : VI
SECTION-VII
SUB SECTION - B
CONTROL VALVES

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1.00.00 GENERAL

1.01.00 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

1.02.00 Where high stroking speed , high actuation forces and accurate positioning is critical for the operation of the plant, as in case of HP or LP bypass valves, Separator Drain Valves , hydraulic actuators with electro-hydraulic interface shall be offered.

2.00.00 GENERAL TECHNICAL REQUIREMENTS

2.01.00 Bidder shall exercise caution in selecting severe service control valves like BFP recirculation, HP & LP bypass, superheater & reheater attemperator, PRDS for Boiler & Turbine, Feed control station ,Soot blower steam pressure, Fuel oil heating and pressurizing ,minimum economizer flow control ,DM make up (emergency / normal), control valves whose down stream are connected to vacuum such as HP/LP heater emergency level control, condenser make up water, separator level control , CEP minimum flow control etc. For such critical applications, Bidder shall offer valves which are proven for similar application. Above valves shall have leakage class equal or better than class-VI with metal-to-metal seating.

2.02.00 Valve with ANSI leakage class-V shall be provided for all applications except for the control valves indicated above.

2.03.00 Bidder shall provide redundant control valves for some services such as 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.

2.04.00 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 motorized isolating valve, inching duty motorized bypass valve and manual drain valves. Each redundant control valve shall have its upstream motorized and down-stream motorised 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.

2.05.00 Wherever, steam conditioning calls for , Pressure reducing & desuperheating, combined PRDS type valves shall be offered.

2.06.00 Control Valve shall be furnished with IBR certification wherever required .

2.07.00 Valve Body / End Connections

2.07.01 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.

2.07.02 Control valves of 40 mm. size and above with line pressure up to 50 Kg / Sq. cm may have flanged or welded end connections.

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- 2.07.03 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.
- 2.07.04 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.
- 2.07.05 Bonnet joints for all control valves shall be of flanged and bolted type.
- 2.07.06 Flanged valve shall be rated at no less than class 300 lbs
- 2.07.07 The direction of flow shall be clearly engraved on the body . Valve tag no, , description or purpose, stroke time shall be painted on all control valve body with black letters on white background in Bold letters.
- 2.07.08 Valve Body Materialial shall match the process conditionrequirement as per ANSI. . General guideline shall be as follows

SR. No.	SERVICE	MATERIAL
1.	Non corrosive, non-flashing and non cavitating service for fluid temperature up to 275°C	Cast carbon steel ASTM A216 Gr. WCB , Trim material - 316 SS stellited faced GUIDe posts and bushings.
2.	Non corrosive, non-flashing and non cavitating service for fluid temperature above 275°C	Cast alloy steel ASTM A217 Gr. WC9 Trim material - 316 SS stellited faced GUIDe posts and bushings.
3.	Severe flashing / cavitating services	Alloy steel ASTM A217 Gr. WC9 , Trim material - 440C
4.	Low flashing / cavitating services	Alloy steel ASTM A217 Gr. WC6 ,Trim material - 17-4 PH SS
5.	DM water application (condenser hotwell normal, emergency make up etc.)	316 stainless steel

- 2.07.09 Bidder may supply valves with body and trim materials with superior quality than specified material and in such cases Bidder shall furnish the comparison of offered material properties ,such as cavitation resistance , , hardness , tensile strength , strain energy , corrosion and erosion resistance etc. , with specified material for Owner's approval.

2.08.00 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 characterised valves and between 70 to 80 percent opening for equal percentage characterised valves.

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- 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 exit outlet velocity as defined in ISA handbook does not exceed 8 m / sec for liquid services , 150 m/sec for steam services and 50% of sonic velocity for flashing services The sizing procedure followed shall be as per latest edition of ANSI/ISA or equivalent standard.
- 2.09.00 Valve Top work
- 2.09.01 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.
- 2.09.02 Extended bonnet/ bonnet when maximum temperature fluid is greater than 280⁰ C shall be provided and high temperature packing shall also be used for high temperature application.
- 2.09.03 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 graphited asbestos glands are to be provided. For vacuum services,. All valves connected to vacuum on downstream side shall be provided with packing suitable for vacuum applications eg. double vee type chevron packing.
- 2.10.00 Valve Trim
- 2.10.01 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.
- 2.10.02 Balanced trim valves shall be offered for high shut-off pressure or high pressure drop condition to reduce the size of the actuators.
- 2.10.03 For flashing services and two stage mixtures, the trim material shall be 17-4 PH SS or equivalent.
- 2.10.04 If cavitating condition is foreseen, Bidder shall offer multistage or labyrinth trims 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.
- 2.10.05 Quick replacement type trim shall be considered for easy maintenance.
- 2.10.06 Plug shall be one-piece construction cast , forged or machined from solid bar stock .Plug shall be screwed or pinned to valve stems or shall be integral with the valve stems.

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- 2.11.00 Noise Level
- 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 dBA. The noise abatement shall be achieved by valve body & trim design and not by use of silencers. Valve Actuators
- 2.12.00 Actuator
- 2.12.01 Spring-diaphragm type actuators shall generally be used. Piston type actuators shall be offered in case of high shut-off pressure & quick response requirement. Hydraulic actuation system shall be provided for Critical valves as described elsewhere in the specification.
- 2.12.02 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.
- 2.12.03 Diaphragms shall be designed for 200% maximum operating pressure.
- 2.12.04 Nylon reinforced neoprene is preferred as diaphragm material.
- 2.12.05 Valve actuators shall be capable of operating at 80⁰ C ambient, continuously.
- 2.12.06 Entire actuator assembly shall be painted with corrosion inhibiting paint.
- 2.12.07 Air connection size shall be 1/4" NPT (F) unless otherwise dictated by process response time. Integral tubing shall be stainless steel.
- 2.12.08 Bidder shall indicate the stroking time of the valve assemblies with positioned and ensure that the stroke time shall meet the process and equipment dynamics and shall be better than 10 seconds.
- 2.12.09 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.
- 2.12.10 Hydraulic actuation system
- The system shall consist of , but not limited to , Hydraulic cylinder , proportional valve with blocking unit , SMART positioner with position transmitter , SOVs , safety bypass unit , safety control unit , Hydraulic supply unit and local controller cubicle with controller unit
- 2.13.00 Valve Positioners
- 2.13.01 All regulating service valves shall be offered with HART protocol based Smart Electro Pneumatic Positioners to ensure accuracy and repeatability of response.
- 2.13.02 Positioners shall have integral non contact type position transmitter, input and output gauges, local keypad & display and 4-20 mA DC output to DDCMIS in CCR.
- 2.13.03 Positioners shall be capable of functioning under hot, humid and vibrating conditions.
- 2.13.04 Positioner casings shall be dust tight, corrosion resistant and weatherproof to IP 65 .and explosion proof in hazardous areas.

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- 2.13.05 In general, positioner shall operate at signal range 4 – 20 mA DC for the full travel of the valve. Split range operation in few cases may be required.
- 2.13.06 Remote calibration from control room shall be possible through HART management station.
- 2.14.00 Performance
- 2.14.01 Performance of the complete assembly of the control valves shall be better than +/- 1% of FS for linearity , +/- 0.5 % of FS for hysteresis , 1% for accuracy.
- 2.15.00 Valve Accessories
- 2.15.01 Accessories shall include side mounted hand wheels, open & close , intermediate (as applicable) limit switches for both regulating and On off valves ,, junction boxes with 20 % spare terminals , Air filter regulators , airlock relays , volume chambers etc. Solenoid valve (SOV) wherever required shall be furnished. Each limit switch shall have not less than 2 NO & 2 NC contacts with contact rating 5A , 240 V AC / 0.5 A , 220 V DC . SOV shall have SS bar stock body , SS316 Trim , SS coil enclosure , Class H insulation Air filter regulator shall have sintered bronze filter element with maximum 5 microns filter size & 2 inch dial size pressure gauges. .Protection class of all Limit switches , junction boxes , SOV etc. shall have protection class IP 65 and explosion proof for hazardous areas.
- 2.15.02 Air distribution line to all final control elements like control valves, pneumatic dampers (both regulating / on-off type) , SOV operated valves shall be through SS manifolds and SS isolating valves only. These valves shall be properly tagged also with KKS tag no. and description of final control element / instrument for which they are intended.
- 2.16.00 Test and Examination
- All valves shall be tested in accordance with the Quality Assurance programme agreed between the Owner and Bidder , which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specification . The test shall include but not be limited to Non destructive test , Hydrostatic shell test prior to seat leakage test , Seat leakage test , Valve closure test , Functional test of fully assembled valves including actuators and accessories. CV test etc. For all control valves Cv test shall be witnessed by Owner.

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1.00.00 SPECIFICATION FOR ELECTRONIC TRANSMITTERS

1.01.00 PRESSURE TRANSMITTER

1. Working Principle : Smart (HART Compatible)
2. Type : Microprocessor based, 2 – Wire
3. Output Signal : 4-20 mA DC along with superimposed digital signal
4. Measuring Element : Capsule / Diaphragm
5. Element material : SS-316 (Stainless Steel) or better
6. Static Pressure : 150 % of maximum span continuously, without affecting the calibration
7. Turn-down ratio : 100: 1
8. Span and Zero : Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
9. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
10. Output Indicator : LCD (Integral indicator of 5 digit display)
11. Nameplate : Tag number, service engraved in SS tag plate
12. Body : SS
13. Operating Voltage : 24V DC
14. Load : 600 Ohms (min.) at 24 Volts D.C.
15. Ambient Temperature : 0 - 50 °C
16. Performance: :
 - i. Accuracy : $\pm 0.075\%$ of Span or better

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-
- | | | |
|-----|--|--|
| ii. | Repeatability | ± 0.05% of Span or better |
| 17. | Sealing/Isolation | : Extended diaphragm (Silicon oil/ Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications |
| 18. | Accessories | : <ul style="list-style-type: none"> 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 e. Companion flange with nuts, bolts and gaskets f. ½" NPT cable gland g. Handheld calibrator |
| 19. | Adjustment/Calibration/
Maintenance | : From handheld calibrator/ HART management system |

Notes: For primary air/ secondary air/ flue gas applications, DP type transmitters shall be provided for pressure measurement.
LVDT type is not acceptable.

1.02.00 DIFFERENTIAL PRESSURE TRANSMITTER / FLOW TRANSMITTER

- | | | |
|----|-------------------|---|
| 1. | Working Principle | : Smart (HART Compatible) |
| 2. | Type | : Microprocessor based, 2 – Wire |
| 3. | Output Signal | : 4-20 mA DC along with superimposed digital signal |
| 4. | Measuring Element | : Capsule / Diaphragm |

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- | | | | |
|-----|---------------------|---|---|
| 5. | Element material | : | SS-316 (Stainless Steel) or better |
| 6. | Static Pressure | : | 150 % of maximum span continuously, without affecting the calibration |
| 7. | Turn-down ratio | : | 100: 1 |
| 8. | Span and Zero | : | Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span |
| 9. | Enclosure Class | : | IP-65 (Explosion proof for NEC Class-1, Division 1 area) |
| 10. | Output Indicator | : | LCD (Integral indicator of 5 digit display) |
| 11. | Nameplate | : | Tag number, service engraved in SS tag plate |
| 12. | Body | : | SS |
| 13. | Operating Voltage | : | 24V DC |
| 14. | Load | : | 600 Ohms (min.) at 24 Volts D.C. |
| 15. | Ambient Temperature | : | 0 - 50 °C |
| 16. | Performance: | | |
| | i. Accuracy | : | ± 0.075% of Span or better |
| | ii. Repeatability | : | ± 0.05% of Span or better |
| 17. | Sealing/Isolation | : | Extended diaphragm (Silicon oil/ Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications |
| 18. | Accessories | : | a. Universal mounting bracket suitable for 2" pipe mounting

b. High tensile carbon steel U-bolts |

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- c. Siphon for steam and hot water services
- d. ½" NPT 5-valve stainless steel manifold, constructed from SS316 bar stock
- e. Companion flange with nuts, bolts and gaskets
- f. ½" NPT cable gland
- g. Handheld calibrator

19. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system

1.03.00 Displacer Type Level Transmitters

- 1. Type : Smart (HART Compatible)
- 2. Stages of operation : Continuous
- 3. Material :
- 4. i. Displacer SS-316
- 5. ii. Suspension wire SS-316
- 6. iii. Torque tube housing SS
- 7. iv. Torque tube Inconel
- 8. v. Displacer chamber SS
- 9. vi. Transmitter Housing SS
- 10. Operating Voltage : 24 V DC
- 11. Transmission : Microprocessor based, 2-wire
- 12. Output Signal : 4-20 mA DC along with superimposed digital signal
- 13. Static / overload : Maximum static pressure without

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	pressure		permanent deformation or loss of accuracy
14.	Turn-down ratio	:	10 : 1 or better
15.	Zero & Span	:	Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
16.	Enclosure Class	:	IP-65
17.	Output Indicator	:	LCD type (Integral indicator of 5 digit display)
18.	Nameplate	:	Tag number and Service engraved in stainless steel tag plate
19.	Ambient Temperature	:	0 - 50 °C
20.	Load Impedance	:	600 Ohms at 24 Volts (minimum)
21.	Process Connection	:	2" Flanged
22.	Performance - Accuracy	:	± 0.075 % of span or better
23.	Accessories	:	a) Counter Flange, nuts, bolts, gaskets etc b) Weights for 5 point calibration of instruments c) Vent and drain plugs d) ½" NPT Glands e) Handheld calibrator
24.	Preferred Features	:	a) Test plug connection and cutout terminals physically separated from other electronics b) Electronic Damping facility (adjustable)
25.	Adjustment/Calibration/ Maintenance	:	From handheld calibrator/ HART management system

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|---------|----------------------------|---|--|
| | 26. Applications | : | During detail engineering on Owner's approval |
| 1.04.00 | MASS FLOW METER | | |
| 1.04.01 | SENSOR | | |
| | 1. Measuring Principle | : | Coriolis Mass flow |
| | 2. Primary Element | : | Flow Tube of 316SS or better |
| | 3. Heating Arrangement | : | Integral |
| | 4. Temperature Control | : | For heavy fuel oil application |
| | 5. Process Connection | : | Flanged of rating as per process requirement |
| | 6. Drain | : | Self-draining facility |
| | 7. Enclosure | : | Stainless steel |
| | 8. Accessories | : | Counter flanges, Mounting nuts, bolts, gaskets etc. |
| 1.04.02 | TRANSMITTER | | |
| | 1. Measured quantities | : | Mass Flow rate, Total Mass Flow, Density |
| | 2. Input Signal Processing | : | Smart (HART compatible) |
| | 3. Display | : | LCD |
| | 4. Output | : | 2 nos. isolated output of 4-20mA DC selectable from four measured quantities |
| | 5. Load | : | < 750 ohms |
| | 6. Power supply | : | 240V AC, 50 Hz |

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|-----|---|---|---|
| 7. | Turn Down | : | 100:1 |
| 8. | Accuracy | : | ± 0.2 % of measured value |
| 9. | Housing | : | IP 65 (Explosion proof) |
| 10. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |
| 11. | Accessories | : | a) Handheld calibrator
b) Mounting U-bolts, nuts, bolts, prefab cable etc
c) $\frac{1}{2}$ "NPT cable gland |
| 12. | Adjustment/Calibration/
/Maintenance | : | From handheld calibrator/ HART management system |
| 13. | Applications | : | Fuel Oil service |

1.05.00 RADAR TYPE LEVEL MEASUREMENT

- | | | | |
|----|---------------------------|---|---|
| 1. | Type | : | Smart (HART Compatible) |
| 2. | Antenna | : | Co axial / guided wave radar /Overspill protection |
| 3. | Principle | : | TDR (Time Domain Reflectometry) |
| 4. | Communication | : | Two wire 4-20mA DC with HART |
| 5. | Environmental temperature | : | 0 – 50 °C |
| 6. | Enclosure | : | IP-65 (Explosion proof for NEC Class-1, Division 1 area) |
| 7. | Calibration | : | a) Self calibration with internal reference
b) Zero & Span calibration |
| 8. | Process Connection | : | External cage mounting
Flanged /screwed |
| 9. | Electronic Housing | : | Epoxy painted Die-Cast aluminium |

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	alloy	
10. Antenna / Flange assembly	:	316 SS or Hest alloy (as required)
11. Power supply	:	24 V DC
12. Output Indicator	:	LCD
13. Accuracy	:	5 mm or 0.1% of probe length
14. Accessories	:	a) Handheld calibrator
	:	b) Counter Flange, nuts, bolts, gaskets etc
	:	c) ½"NPT cable gland
	:	d) SS Nameplate
15. Adjustment/Calibration/ Maintenance	:	From handheld calibrator/ HART management system
16. Applications	:	Vessels under vacuum or low pressure applications, solid levels
1.06.00	ULTRASONIC LEVEL TRANSMITTER	
1. Type	:	Microprocessor based, 2-wire, Smart (HART Compatible)
2. Operating Principle	:	Detection of reflected ultrasonic pulse
3. Output Signal	:	4-20 mA DC along with superimposed digital signal
4. Operating frequency	:	10 KHz to 50 KHz (typical)
5. Display	:	LCD
6. Temperature Compensation	:	Built in –Programmable
7. Power supply	:	24 V DC
8. Enclosure	:	SS, IP-65 (Explosion proof for NEC Class-1, Division 1 area)

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|---|---|---|
| 9. Zero & Span | : | Continuous, tamper proof, remote as well locally adjustable. It shall be possible to calibrate the instrument without any level in the sump/ tank |
| 10. Accuracy & Repeatability | : | 0.15 % of span or better |
| 11. Resolution | : | 0.1 % of span |
| 12. Operating temp. | : | Transmitter- 500 C and Sensor - 800 C |
| 13. MOC Sensor | : | SS-316/Body- PVC and Face – Polyurethane |
| 14. Mounting | : | 4" Flanged/ 2" NPT for sensor and Transmitter on panel |
| 15. Accessories | : | <div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;">a)</div> <div>Handheld calibrator</div> </div> <div style="margin-top: 10px;"> <div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;">b)</div> <div>Weather canopy for protection from direct sunlight and direct rain</div> </div> <div style="margin-top: 10px;"> <div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;">c)</div> <div>½"NPT cable gland</div> </div> <div style="margin-top: 10px;"> <div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;">d)</div> <div>All mounting hardware (SS-316), Prefab cable</div> </div> <div style="margin-top: 10px;"> <div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;">e)</div> <div>SS Nameplate</div> </div> </div> </div> </div></div> |
| 16. Diagnosis | : | On-line |
| 17. Status Indication | : | Power On, HI, HI-HI, Lo, LO-LO, Fault |
| 18. Output Contacts | : | 2 SPDT, 230V, 5A |
| 19. Adjustment/Calibration/ Maintenance | : | From handheld calibrator/ HART management system |
| 20. Applications | : | Coal Bunker, Water Service etc. |

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1.07.00 ULTRASONIC FLOW TRANSMITTER

- | | | |
|---|---|---|
| 1. Type | : | Ultrasonic – Clamp On |
| 2. Accuracy | : | +/- 1 % of reading |
| 3. Repeatability | : | +/- 0.3 % of reading |
| 4. Rangeability | : | 400 : 1 |
| 5. Output Signal | : | 4-20 mA DC with HART |
| 6. Measured Parameter | : | Volumetric flow, Totalized flow and flow Velocity |
| 7. Display | : | LCD with internal Key Pad (Flow rate & Totalization) |
| 8. Power Supply | : | 24 V DC (2 Wire) |
| 9. Enclosure | : | SS (IP- 68 – Submersible) |
| 10. Mounting | : | SS Chain or Strap |
| 11. Accessories | | <ol style="list-style-type: none"> 1. Handheld calibrator 2. ½"NPT cable gland 3. Transducer cable 4. All mounting hardware (SS-316) 5. SS Nameplate |
| 12. Adjustment/Calibration/ Maintenance | : | From handheld calibrator/ HART management system |
| 13. Applications | : | Plant water service |

Note: Multi-path insertion type (minimum 4 path) Ultrasonic Flow meter shall be provided for Raw water/ Cooling Water flow measurements.

2.00.00 **HART HAND HELD CALIBRATOR**

Hand held calibrators (5 nos. for each type) shall be provided for adjustment/ calibration/maintenance of the HART compatible

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transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided.

3.00.00 **PROCESS ACTUATED SWITCHES**

3.01.00 PRESSURE SWITCH

1. Type :
 - i. Piston for high pressure application
 - ii. Bellow / Diaphragm for low pressure application
2. Sensing element : SS-316.
material All other wetted part SS316
3. Case Material : SS
4. Setter Scale : Black graduation on white linear scale.
Graduation 0-100% with red pointer for set points
5. Over range : 150 % of maximum pressure
6. Adjustments :
 - a) Internal Set Point
 - b) Differential adjustment
7. End Connection : 1/2" NPT bottom connected
8. Switch configuration : Two SPDT (240V, 5A AC/220V, 0.5A DC)
9. Switch Type : Snap acting, shock & vibration proof
10. Terminal Block : Suitable for full ring lugs
11. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
12. Performance :
 - a) Repeat accuracy $\pm 1.0\%$
 - b) Accuracy of Setting Indication of $\pm 1.5\%$
13. Ambient temperature : 0 – 50 Deg.C

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-
14. Nameplate : Tag number, service engraved in SS tag plate
15. Accessories : a) Silicon oil/ Fluorolub filled Remote diaphragm seal with SS-316 capillary for corrosive/ viscous/ solid bearing or slurry type fluid applications
b) Snubbers for pulsating fluid applications
c) Siphons for steam and hot water services
d) Retention ring and screws for surface mounting
e) 1/2" NPT 2 Valve SS-316 barstock manifold
f) 1/2" NPT cable gland
16. Applications : During Detail Engineering on Owner's approval

3.02.00 DIFFERENTIAL PRESSURE SWITCH

1. Type : i. Piston for high pressure application
ii. Bellow / Diaphragm for low pressure application
2. Sensing element : SS-316.
material All other wetted part SS316
3. Case Material : SS
4. Setter Scale : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
5. Over range : 150 % of maximum pressure

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- | | | | |
|-----|----------------------|---|---|
| 6. | Adjustments | : | a) Internal Set Point |
| | | : | b) Differential adjustment |
| 7. | End Connection | : | 1/2" NPT bottom/ back connected |
| 8. | Switch configuration | : | Two SPDT (240V, 5A AC/220V, 0.5A DC) |
| 9. | Switch Type | : | Snap acting, shock & vibration proof |
| 10. | Terminal Block | : | Suitable for full ring lugs |
| 11. | Enclosure Class | : | IP-65 (Explosion proof for NEC Class-1, Division 1 area) |
| 12. | Performance | : | a) Repeat accuracy $\pm 1.0\%$
b) Accuracy of Setting Indication of $\pm 1.5\%$ |
| 13. | Ambient temperature | : | 0 – 50 Deg.C |
| 14. | Nameplate | : | Tag number, service engraved in SS tag plate |
| 15. | Accessories | : | a) Silicon oil/ Fluorolub filled Remote diaphragm seal with SS-316 capillary Diaphragm seals for corrosive/ viscous/ solid bearing or slurry type fluid applications
b) Snubbers for pulsating fluid applications
c) Siphons for steam and hot water services
d) Retention ring and screws for surface mounting
e) 1/2" NPT 5 Valve SS-316 barstock manifold
f) 1/2" NPT cable gland |
| 16. | Applications | : | During Detail Engineering on Owner's |

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3.03.00 LEVEL SWITCH

3.03.01 FLOAT OPERATED

1. Float material : SS-316
2. Wetted parts : SS-316
3. Float chamber : Stainless steel/Carbon steel,
construction welded
4. Float chamber : Side mounted
mounting
5. Fluid connection : Side – Side
6. Fluid connection size : 1" ANSI RF Flange (rubber line, if
required)
7. Drain : ½ inch NPT with Plug
8. Pressure rating of
chamber : Minimum 1.5 times of design pressure
9. Repeatability : +/- 1.5 mm or better
10. Switch housing : Stainless Steel
11. Switch housing type : IP- 65
12. Type of switch : Snap acting magnetically operated
hermetically sealed
13. Switch configuration : 2 SPDT (5A, 240 V AC, 0.5A, 220V DC)
14. Accessories : a) Counter flange, nuts
& bolts, suitable
gasket etc.
b) Steel globe type
drain valve
c) ½"NPT cable gland

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d) Stainless steel nameplate with alpha-numeric engraved for service and tag

15. Application : During Detail Engineering on Owner's approval

3.04.00 FLOW SWITCH

1. Type : Paddle /Piston/Disk
2. Wetted part material : Stainless steel or Hastelloy for acidic application
3. End connection :
 - a) Threaded upto 1" line size with integral Tee
 - b) Flanged for line size > 1 ½"
4. Enclosure material : Stainless Steel
5. Enclosure class : IP 65
6. Switch configuration : 2 SPDT (5A, 240 V AC, 0.5A, 220V DC)
7. Repeatability : 2%
8. Cable connection : ½"NPTF
9. Accessories :
 - a) Tee, Counter flange, nuts & bolts, suitable gasket etc
 - b) ½"NPT cable gland
 - c) Stainless steel nameplate with alpha-numeric engraved for service and tag

3.05.00 RF LEVEL SWITCH

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- | | | |
|-----------------------------|---|--|
| 1. Type | : | RADIO FREQUENCY |
| Sensing probe | | |
| 2. Material | : | SS-316 |
| 3. Mounting | : | Threaded |
| 4. Application | : | 250°C (Max.) |
| Temperature | | |
| Electronic Controller | | |
| 5. Input Supply Voltage | : | 240V AC ±10%, 50 Hz. |
| 6. Relay Output | : | 2 SPDT (240V AC, 5A) |
| 7. Ambient Temperature | : | 50 °C |
| 8. Enclosure Protection | : | IP-66 |
| 9. Enclosure Housing | : | SS |
| | | Normal Level |
| | | Power On |
| 10. Local LED Indication | : | Alarm Level |
| | | Probe Healthy |
| 11. Switching Repeatability | : | ±0.5% |
| | | Co-axial cable for probe connection to |
| | | controller |
| 12. Accessories | : | SS Tag plate |
| | | ½" NPT Cable Glands |
| 13. Application | : | Solid level |

3.06.00 CONDUCTIVITY TYPE LEVEL SWITCH

- | | | |
|------------------|---|-----------------------------|
| 1. Type | : | Conductivity discrimination |
| 2. Probe MOC | : | SS-316 |
| 3. Mounting | : | Flanged on external cage |
| 4. Application | : | 250°C (Max.) |
| Temperature | | |
| 5. Test Pressure | : | Two times rated pressure |

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6. Input Supply Voltage	:	240V AC $\pm$ 10%, 50 Hz. Four independent channel with
7. Input	:	selectable switching threshold for water conductivity
8. Relay Output	:	2 SPDT (240V AC, 5A)
9. Ambient Temperature	:	50 °C
10. Enclosure Protection	:	IP-65 (Explosion proof for NEC Class-1, Division-1 area)
11. Enclosure Housing	:	SS HI,LO, HIGH-HIGH, LOW-LOW
12. Local LED Indication	:	Power Fault
13. Accessories	:	a) Interconnecting cable from probe to electronics b) Mounting accessories c) External cage d) Washer & Gasket e) ½" NPT Cable Glands f) SS Tag Plate
14. Application	:	During Detail Engineering on Owner's approval
3.07.00	TEMPERATURE SWITCH	
1. Type	:	Bimetallic or gas filled
2. Sensing Element	:	SS-316 Material
3. Bulb Material	:	SS-316
4. Capillary	:	Stainless Steel armored

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|-----|-----------------------|---|--|
| 5. | Movement Material | : | Stainless Steel |
| 6. | Case material | : | Stainless Steel with neoprene gasket and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area). |
| 7.. | Scale | : | Black graduation on white linear scale. Graduation 0-100% with red pointer for set points |
| 8. | Over range Protection | : | 120 % |
| 9. | Instrument connection | : | Bottom |
| 10. | Switch configuration | : | Two SPDT (240V, 5A AC/220V, 0.5A DC) |
| 11. | Switch type | : | Snap acting, shock and vibration-proof |
| 12. | Adjustability | : | Internal Set point adjustable over span range |
| 13. | Compensation | : | a) Capillary compensation with invar wire throughout the capillary length
b) Case compensation |
| 14. | 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 |
| 15. | Capillary length | : | 5 meters (minimum) for local mounting/15 meters for local panel mounting |
| 16. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |
| 17. | Accessories | : | Mounting accessories, 1/2" NPT cable gland |
| 18. | Applications | : | During Detail Engineering on Owner's |

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4.00.00 LOCAL INSTRUMENTS

4.01.00 PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE

- | | | |
|--------------------------|---|--|
| 1. Type | : | Bourdon/Bellows/Diaphragm |
| 2. Sensing & Socket | : | SS-316 |
| 3. Movement Material | : | SS-316 |
| 4. Case Material | : | Stainless steel. IP-65 (Explosion proof for NEC Class-1, Division 1 area) |
| 5. Dial Size | : | Generally 150 mm |
| 6. Scale | : | Black lettering on white in 270 O arc. |
| 7. Window | : | Shatterproof glass |
| 8. Range Selection | : | Normal process pressure: 50~70 % of range |
| 9. Over-range Protection | : | 125% of maximum range by internal stop. External stop at zero
For Zero adjustment (Micrometer screw external) |
| 10. Adjustment | : | For Range adjustment (Micrometer screw internal). |
| 11. Element Connection | : | Argon welding |
| 12. Process Connection | : | 1/2" NPT (M) Bottom for local, back for panel mounting |
| 13. Performance | : | Accuracy of ± 1.0 % of span or better |
| 14. Operating ambient | : | 0 - 50 °C |
| 15. Safety Feature | : | Blow out disc /diaphragm at the back |
| 16. Accessories | : | a) Snubbers for pulsating fluid application.discharge
b) Stainless steel Diaphragm seals |

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- for corrosive/ viscous/ solid bearing or slurry type fluid applications
- c) 3-Way SS316 Gauge cock for pressure gauges
- 5-valve SS316 manifold from
- d) barstock for differential pressure gauge
- e) Siphons for steam and hot water services
17. Nameplate : Tag number, service engraved in stainless steel tag plate

4.02.00 LEVEL INDICATOR (FLOAT & BOARD TYPE)

1. Type : Float and Board
2. Float Material : SS-316
3. Float Cable : SS-316
4. Indicator Assembly : Epoxy painted Aluminium
5. Guide wire spring assembly : SS-316 (2 Nos.)
6. Guide Wire Anchor : SS-316
Anodized Aluminium with engraved marking (Minimum graduation 10mm),
7. Scale Board :
mounting brackets and suitable hardware required as per tank height
8. Elbow Assembly : Anodized Aluminium
9. Flanges : RF , ANSI 150 , SS (3 Nos.)
10. Accuracy : ± 10 mm or better
11. Accessories : All mounting accessories including counter flange, nuts & bolts, suitable

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gasket etc. as applicable, SS Tag plate

4.03.00 GAUGE GLASS

1. Type : Reflex /Transparent
2. Material : Toughened borosilicate resistant to thermal shock
- Body Material : ~~Carbon Steel~~ Stainless Steel
- Enclosure : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
3. Integral cocks & valves/Fittings : i. SS 316
4. : ii. Rubber lined corrosion resistant stainless steel (for DM/RO service)
5. Vessel Connection : ANSI Flanged SS316
6. Accessories : i. Integral cocks
ii. Drain Valves
iii. Companion Flanges, Bolts, nuts, gaskets, SS Tag plate
iv. Illuminating lamps, Mica shield as required
v. Calibrated scale
7. Pressure rating : Twice the maximum working pressure
8. Temperature : 300 °C
9. Other details : For larger lengths (greater than 1200mm), additional gauge glasses shall be provided with minimum of 50 mm overlap.

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- 4.04.00 SLIGHT GLASS
1. Type : Flap-type.
 2. End connection : Screwed / Flanged
 3. Material
 - a) Body : SS- 304
 - b) Cover plate : SS- 304
 - c) Indicator : SS- 316
 4. Sight Glass : Toughened Borosilicate
 5. Gasket : Neoprene
 6. Bolts & Nuts : High tensile steel.
 7. Hydraulic Test Pressure : 1.5 times maximum working pressure
 8. Accessories : Companion Flanges, Bolts, nuts, gaskets as required, SS Tag plate.
- 4.05.00 ROTAMETER
1. Type : ON-LINE for line upto and including 50 mm NB.
: Borosilicate BY-PASS for line size above 50 NB
 2. Metering tube : Toughened Borosilicate
 3. Float : SS-316
 4. End fittings : SS-316
 5. Packing material : Teflon / PTFE
 6. Casing : Stainless Steel
 7. Gland Rings : Stainless Steel
/Followers/ Other wetted parts
 8. Orifice Plate : Stainless Steel (for bypass type)
 9. Operating Temperature : 0-50 Deg. c

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|------------------------|---|--|
| 10. Test Pressure | : | 200% of maximum operating pressure |
| 11. Scale | : | 250 mm nominal length |
| 12. Graduation | : | Direct reading |
| 13. Process Connection | : | Flanged (RF) to line size as per ANSI standards (150#) |
| 14. Tapping | : | D & D/2 |
| 15. Accuracy | : | +/- 2% of full scale reading |
| 16. Reproducibility | : | Within 0.5% of instantaneous reading |
| 17. Accessories | : | SS Tag Plate, orifice plate |

5.00.00 TEMPERATURE ELEMENTS & ACCESSORIES

5.01.00 RESISTANCE TEMPERATURE DETECTOR

- | | | |
|----------------------------------|---|--|
| 1. Type | : | Platinum (Duplex), Ungrounded |
| 2. Platinum (Duplex), Ungrounded | : | 100 ohm at 0 °C |
| 3. Base | : | Wound on ceramic (anti-inductive) |
| 4. Wiring | : | 3 Wire |
| 5. Protecting Tube | | |
| a) O.D. | : | 6 mm |
| b) Material | : | SS-316, Seamless |
| c) Filling | : | Magnesium oxide (Purity above 99.4%). |
| 6. Response time | : | a) 15 sec. (bare).
b) 30 sec. (with thermowell) |
| 7. Calibration | : | DIN 43760 |
| 8. Accuracy | : | ± 0.5% |
| 9. Head | | |
| a) Type | : | IP-65 universal screwed type |

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-
- b) Material : Stainless Steel
- 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.
- Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).
- Adjustable nipple-union-nipple
10. Accessories : a) [1/2" Sch 80 X ½" NPT] with thermowell connection
- b) Compression fittings/unions
- Flanges etc. (for flanged
- c) connections only)
- Thermowell (As specified
- d) below)
11. Thermowell connection : ½" NPT (M) or 150 RF Flanged
- Tag number, service engraved in
12. Nameplate : stainless steel tag plate

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Note: The specifications for RTDs of winding/ bearing of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However, the type of RTD shall be Pt-100.

5.02.00 THERMOCOUPLES

1. Type :
 - a) 16 SWG wire of Chromel Alumel) (Type-K)
 - b) Duplex
 - c) Ungrounded
2. Protecting Tube
 - a) O.D. : 6 mm
 - b) Material : SS-316, Seamless
 - c) Filling : Magnesium oxide (Purity above 99.4%).
3. Response time :
 - a) < 20 seconds for measurement
 - b) < 10 seconds for control
4. Accuracy : $\pm 1.1^{\circ}\text{C}$ up to 300°C & 0.4% of measured temperature range above 300°C
5. Head
 - a) Type : IP-65 universal screwed type
 - b) Material : Stainless Steel
 - c) Terminal blocks : Nickel plated Brass-screw type / silver plated
 - d) Cable connection : $\frac{1}{2}$ " NPT gland and grommet
6.
 - e) Others : Terminal head cover with SS chain and suitable gasket.

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Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).

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|----|-----------------------|---|---|
| 7. | Accessories | : | a) Adjustable nipple-union-nipple [1/2" Sch 80 X 1/2" NPT] with thermowell connection
b) Compression fittings/unions
c) Flanges etc. (for flanged connections only)
d) Thermowell (As specified below) |
| 8. | Thermowell connection | : | 1/2" NPT (M) or 150 RF Flanged |
| 9. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |

5.03.00 TEMPERATURE GAUGE

- | | | | |
|----|-----------------------------|---|--|
| 1. | Type | : | Expansion type (Liquid filled system) |
| 2. | Sensing Element Material | : | Bourdon – SS-316 |
| 3. | Bulb and Capillary Material | : | SS-316 |
| 4. | Capillary Tubing | : | Inner sheath - solid drawn Material
copper tube
Outer sheath - PVC tube |
| 5. | Movement Materials | : | Stainless Steel / Direct Bourdon tip connection to pointer spindle |
| 6. | Case Material | : | Stainless Steel stove enameled, black finish, threaded bezel ring, clear glass |

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		cover conforming to IP 65.
7. Dial size	:	150 mm
8. Scale	:	Black lettering on white background in 270 Deg.C arc
9. Over range protection	:	125 percent of FSD
10. Capillary Glanding	:	1/2" NPT(M) x compression fitting (SS) to suit capillary
11. Instrument Connection	:	Bottom connection for local mounting, back connection for panel mounting
12. Process Connection	:	1/2" NPT (M) or 150 RF Flanged
13. Extension Neck Length	:	50 mm
14. Compensation	:	a) Capillary compensation
15.	:	b) Case compensation
16. Performance	:	a) Accuracy : + /- 1.0 percent of full scale Deflection
	:	b) Repeatability : Less than 0.5 percent of full range
	:	c) Response time: 15 seconds (max.).
17. Capillary length	:	3.0 meters (local) / 15.0 metres (local panel)
18. Other features	:	Shatter proof glass
19. Nameplate	:	Tag number, service engraved in stainless steel tag plate
20. Accessories	:	SS316 Thermowell

5.04.00 THERMOWELL

1. Material	:	SS-316
2. Manufacture	:	Drilled from bar stock, Hex Head, Tapered design (As per ASME PTC 19.3)

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|-----|------------------------|---|---|
| 3. | Process connection | : | M33x2 |
| 4. | Certification | : | Not applicable |
| 5. | Bore concentricity | : | +5% of wall thickness |
| 6. | Identification mark | : | Tag number punched on head |
| 7. | Surface treatment | : | Polish after machining |
| 8. | Element connection | : | ½" NPT (M) or 150 RF Flanged |
| 9. | Head | : | Hex |
| 10. | Length of the hex head | : | 31.75 mm (min.) |
| 11. | Accessories | : | SS Plug and chain for test thermo wells
SS Nameplate, Flange with companion
flange & all required accessories for
flanged connections. |

Note: Wake frequency calculations shall be furnished for all thermowells for approval.

Thermowells shall be designed such that the resonant frequency is above the exciting frequencies generated by vortex shedding in the process fluid.

5.05.00 METAL TEMPERATURE THERMOCOUPLE

- | | | | |
|----|----------------------------|---|---|
| 1. | Measuring medium | : | Metal temperature |
| 2. | Type | : | Chromel Alumel (Type-K)
Duplex, Ungrounded |
| 3. | Insulation | : | Mineral Insulation Magnesium Oxide |
| 4. | Wire gauge | : | 16 AWG |
| 5. | Protective sheath | : | SS |
| 6. | Protective sheath diameter | : | 8 mm O.D. |
| 7. | Characteristics | : | Special limits of error as in ANSI thermocouple MC 96.01 |
| 8. | Accessories | : | ½" BSP SS sliding end connector, weld pad, clamps of heat resistant steel |

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|----|----------------|---|-----------------------------|
| 1. | Type | : | Hydrometer Type |
| 2. | Mounting | : | On line |
| 3. | Accuracy | : | +/- 2% of range |
| 4. | Scale | : | Black letter on white scale |
| 5. | End connection | : | PVC flange |

9.06.00 DENSITY/ CONCENTRATION METER

- | | | | |
|----|--------------------|---|---|
| 1. | Wetted Part | | Stainless Steel |
| 2. | Enclosure | | Stainless Steel (IP-65) |
| 3. | Power Supply | | 24 V DC |
| 4. | Output signal | : | 4-20 mA DC (isolated) into 600 ohms |
| 5. | Accuracy | | ±0.001 g/cc |
| 6. | Indication | : | LCD display |
| 7. | Temp. Compensation | : | Integral |
| 8. | Accessories | | Mounting hardware, integral amplifier
(if required), cable glands, tag plate
etc. |

10.00.00 SOLENOID VALVES

- | | | | |
|----|---------------------|---|--------------------------------------|
| 1. | Operating Principle | : | Electromagnetic (noiseless) |
| 2. | Coil voltage rating | : | 240 V AC /24 V DC (as required) |
| 3. | Ways | : | 2/3/4 way |
| 4. | Port size | : | 1/4" NPT all ports |
| 5. | Body | : | SS bar stock |
| | Trim | : | SS-316 |
| 6. | Duty | : | Suitable for continuous energization |
| 7. | Sealing | : | Airtight and leak proof |
| 8. | Ambient Temperature | : | 0 - 50 ° C |

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|-----|-------------------|---|--|
| 9. | Fluid Temperature | : | 0-150 ° C (approx.) |
| 10. | Coil Enclosure | : | Stainless Steel |
| 11. | Insulation | : | Class-H |
| 12. | Coil Casing | : | IP-65 (Explosion proof for NEC Class-1, Division-1 area) |
| 13. | Mounting | : | On pipe or on panel |
| 14. | Cable Connection | : | ½" NPT |
| 15. | Accessories | : | Cable glands, SS Tag plate |

Note : Solenoid valves shall be kept in pneumatic junction boxes only. Air distribution for SOV's shall be through SS manifold with SS isolation valves and auto drain traps and SS tubing from SOV to valves shall not be more than 6 meters.

ERECTION HARDWARES

1.00.00 GENERAL TECHNICAL REQUIREMENTS

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.

However, any item required for erection of Bidder supplied system but not categorically indicated in this section, shall be supplied by the Bidder and all these items shall conform to International / National standards / codes.

1.01.00 Electrical Accessories

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

- a) Rigid Steel Conduit
 - i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm.
 - ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.
 - iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with IS:9537 Part-I (1980) and Part-II(1981).. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel lacker or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.
 - iv) All rigid conduit fittings shall conform to requirements of IS:2667,1976. Galvanised steel fittings shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fitting shall be compatible with the flexible conduit supplied.
- 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.

- 1.02.00 Electrical Junction Box:
Please refer to Section VII , Subsection – D of this volume of the Specification.
- 1.03.00 Cable Gland
1. Type : Double compression
 2. Entry Thread : NPT / ET
 3. Material : Brass
 4. Finish : Cadmium Plated.
 5. Protection : IP 54 or better
 6. Accessories : Neoprene gasket, locknuts, reducers etc
- 1.04.00 Cable Tray
1. Material : Mild steel, slotted
 2. Thickness : not less than 2.0 mm
 3. Finish : Hot dip galvanized
 4. Perforation : As per MFR standard
 5. Cover : Suitable for tray
- 1.05.00 Process Hook Up Accessories & specification
Material and rating of the hook up items shall suit the piping and fluid condition. Hook up materials shall be IBR certified for applicable cases. Bidder shall furnish hook up drawings and the drawings for open racks & closed racks for owner's approval.
- 1.05.01 Seamless Stainless Steel Pipe
1. Reference : ASTM A-312 TP 316
 2. Material Grade : TP 316
 3. Type : Seamless /Plain end
 4. Size : As applicable (e.g. 1/2" NB etc)
 5. Schedule : 40
 6. Standard Length : 5 meter
- 1.05.02 Stainless Steel Pipe Fittings

1. Reference : ASTM A-182 F 316 / ANSI B16.11
2. Type : Forged
3. Rating : 3000 lbs / 6000 lbs / 9000 lbs
4. Size : To suit related SS pipe.
5. End connection : Generally socket weld
6. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

1.05.03 Seamless Stainless Steel Tube

1. Reference : ASTM A-213 , ASTM A-249 or ASTM A-269
2. Material Grade : TP 316
3. Size : As applicable (e.g. ½" OD X 0.083" wall thickness / ¼" OD X 0.049" wall thickness etc.)
4. Type : Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
5. Properties : The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
6. Test Pressure : 400 Kg/Sq. cm (minimum)
7. Tolerance : ± 0.13 mm for outside diameter
: ± 15 % for wall thickness
8. Standard Length : 5 meter
9. Test : Flare, Hardness, Ball and Bubble Test

1.05.04 Stainless Steel Tube Fittings

1. Reference : ASTM-A-182
2. Type : Double ferrule double compression
3. Material : 316 Stainless steel forged
4. Ferrule : 316 Stainless Steel

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| | 5. | Type of Fittings | : Male / female connector, elbow, cross /equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation. |
| | 6. | Size | : To suit SS tubing and NPT end connection |
| 1.05.05 | | C.S. Pipe | |
| | 1. | Reference | : ASTM-A 106 Gr. C |
| | 2. | Material | : Cold drawn seamless black C.S. |
| | 3. | Type | : Seamless / Plain ends |
| | 4. | Size | : As applicable (e.g. ½" NB etc) |
| | 5. | Schedule | : 80, 160, XXS as required |
| | 6. | Standard Length | : 5 meter |
| 1.05.06 | | C.S. Pipe Fittings | |
| | 1. | Reference | : ASTM-A 105 / ANSI B16.11 |
| | 2. | Type | : Forged |
| | 3. | Rating | : 3000 lbs / 6000 lbs / 9000 lbs |
| | 4. | Size | : Suitable to related C.S.Pipe |
| | 5. | End connection | : Generally socket weld |
| | 6. | Type of Fittings | : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc. |
| 1.05.07 | | A.S. Pipe | |
| | 1. | Reference | : ASTM-A 335 P22 AS PER ANSI B 36.10 |
| | 2. | Material | : Cold drawn seamless A.S. |
| | 3. | Type | : Seamless / Plain ends |
| | 4. | Size | : As applicable (e.g. ½" NB etc) |
| | 5. | Schedule | : XXS |
| | 6. | Standard Length | : 5 meter |
| 1.05.08 | | A.S. Pipe Fittings | |

- | | | | |
|--|----|------------------|--|
| | 1. | Reference | : ASTM-A 182 F22 AS PER ANSI B 16.11 |
| | 2. | Type | : Forged |
| | 3. | Rating | : 9000 lbs |
| | 4. | Size | : Suitable to related A.S.Pipe |
| | 5. | End connection | : Generally socket weld |
| | 6. | Type of Fittings | : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc. |
- 1.05.09 G.I.Pipe
- | | | | |
|--|----|-----------|---|
| | 1. | Reference | : IS-1239, Part-I |
| | 2. | Type | : Medium grade, threaded at both ends protected with end caps |
| | 3. | Material | : Continuous ERW galvanized MS pipe |
| | 4. | General | : Pipe shall be galvanized both inside and outside |
| | 5. | Size | : As applicable (e.g 1/2"/3/4"/1" etc.) |
- 1.05.10 G.I.Pipe Fittings
- | | | | |
|--|----|------------------|--|
| | 1. | Reference | : IS-1239, Part-II for material, dimension, thread etc. |
| | 2. | Style | : Threaded |
| | 3. | Type of Fittings | : Equal tee, three piece union, unequal tee, straight socket, 90 Deg. elbow, reducing socket cap. etc. to suit installation. |
| | 4. | Size | : Suitable to related G.I.Pipe |
- 1.05.11 Carbon Steel Globe Valve
- | | | | |
|--|----|----------------|--|
| | 1. | Reference | : ASTM A-105 |
| | 2. | Type | : Globe |
| | 3. | Construction | : Forged Body Cadmium Plated |
| | 4. | End Connection | : As applicable (eg. 1/2" Socket Weld etc.) |
| | 5. | Rating | : Cl. 800 / CL. 2500 |

- | | | |
|-----|-----------------|---|
| 6. | Material | : Body - Carbon steel
: Stem - Hardened Steel
: Plug - AISI 316 SS
: Seat- Stainless steel stellited |
| 7. | Packing | : Teflon / Grafoil as required |
| 8. | Yoke | : ASTM A105 |
| 9. | Hand wheel | : Carbon steel |
| 10. | Design standard | : As per ANSI B 16.34 |

1.05.12 Stainless Steel Globe Valve

- | | | |
|-----|-----------------|--|
| 1. | Reference | : ASTM A-182 F316 |
| 2. | Type | : Globe |
| 3. | Construction | : Forged Body |
| 4. | End Connection | : As applicable (eg. ½" Socket Weld etc.) |
| 5. | Proof Pressure | : 400 Kg/Cm2 |
| 6. | Material | : Body - Stainless steel
: Stem - Hardened Steel
: Plug - AISI 316 SS
: Seat- Stainless steel stellited |
| 7. | Packing | : Teflon as required |
| 8. | Yoke | : ASTM A182 F316 |
| 9. | Handwheel | : Carbon steel |
| 10. | Design standard | : As per ANSI B 16.34 |

1.05.13 Alloy Steel Globe Valve

- | | | |
|----|--------------|------------------|
| 1. | Reference | : ASTM A-182 F22 |
| 2. | Type | : Globe |
| 3. | Construction | : Forged Body |

- | | | |
|-----|-----------------|--|
| 4. | End Connection | : As applicable (eg. ½" Socket Weld etc.) |
| 5. | Rating | : CL. 2500 |
| 6. | Material | : Body - Alloy steel |
| | | : Stem - Hardened Steel |
| | | : Plug - AISI 316 SS |
| | | : Seat- Stainless steel stellited |
| 7. | Packing | : Grafoil as required |
| 8. | Yoke | : ASTM A182 F22 |
| 9. | Handwheel | : Carbon steel |
| 10. | Design standard | : As per ANSI B 16.34 |

1.05.14 Structural Steel

Steel supports for JB's, trays; tubes and related equipments shall not be limited to the following:

- | | |
|----|---------------------------------------|
| a) | MS Angle |
| b) | MS Channel |
| c) | I-Beam |
| d) | Hexagonal head Bolt & Nut with washer |
| e) | Foundation Bolt & Nut |
| f) | Expansion Bolt |
| g) | Steel Plates / Flats |
| h) | CRCA sheet |
| i) | 50 NB Pipe |
| j) | Pipe clamps, U Bolts & Nuts |
| k) | Checker plate |

1.05.15 Condensate Pot

- | | | |
|----|----------------|--|
| 1. | Reference | : ASTM A182 F22 /ASTM A105 |
| 2. | Material | : Alloy steel / carbon steel as per application |
| 3. | Construction | : Drilled from barstock |
| 4. | End connection | : As applicable (e.g 3 nos. ½" socket weld end etc.) |

	5. Accessories	: Vent valves
1.05.16	Instrument Valve Manifold	
	1. Type	: Two valve manifold : Five valve manifold
	2. Mounting	: Remote 2" Pipe Mounting / Transmitter Rack mounting
	3. Construction	: Single block (bar stock)
	4. Material	: Forged body and bonnet AISI 316 stainless steel
	5. Ports	: Mfg std. (e.g 1/2 " NPT (F) etc.)
	6. Rating	: 420 Kg/Sq. cm at ambient
	7. Operating Temperature	: (-)30 to (+)170 Deg C
	8. Packing	: PTFE Wafer
	9. Seat & Stem	: AISI 316 SS
	10. Plug	: AISI 316 SS free to turn on stem / 17-4 PH
	11. Handle Bar	: AISI 316 SS
	12. Connection	: Straight
	13. Accessories	: Plugs for all ports, Mounting Bracket , bolts , nuts
1.06.00	Pneumatic Hook Up Accessories	
1.07.00	Air Header	

Technical Particulars	For Panel	For Field
Material of Construction	: Stainless steel	: Stainless steel
Inlet Connection	: 2" NPT (M)	: 1" NPT (M)
Header Take-off Material	: Stainless steel	: Stainless steel
Take off connection	: 1 / 2" NPT (M)	: 1/ 2" NPT (M)
Take-off Valves Material	: stainless steel	: stainless steel

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Tube Take-off	: Tube adapter on valve	: Tube adapter on valve
Drain	: SS drain valve at lowest point	: SS drain valves at lowest point

FORM NO. PEM-6868-0

	Technical specification for CONTROL & INSTRUMENTATION 5x800 MW YADADRI TPS, NALGONDA	SPEC NO.: PE-TS-417-145-I	
		VOLUME	
		SECTION	
		REV. NO. 00	DATE : 03.04.2018
		SHEET	OF
KKS PHILOSOPHY			

	DOCUMENT TITLE
	KKS NUMBERING PHILOSOPHY 1X800MW KOTHAGUDEM

KKS NUMBERING PHILOSOPHY

For identifying (tagging) an instrument / equipment in Power plant KKS numbering scheme is used. The purpose is to assign a unique number to every equipment in the power plant. For C&I equipment unique number are to be provided up to the signal level so that a unique number Input / Output exist in DCS for every signal.

Normally KKS number is a 10 digit alpha-numeric code and is typically split into the following:

X	X	X	AAY			YBBB		
---	---	---	-----	--	--	------	--	--

First three digits indicate the Sub-System. The Code for the major system are given as per **Annexure-1**.

Fourth and Fifth digits are the **Numerical Keys at System Code Level** and used to distinguish between main systems having same Alpha Codes.

Sixth and Seventh digits are the **Equipment / Apparatus / Measuring Circuit Code**. The code of various Equipment / Apparatus / Measuring Circuit is shown in **Annexure-2**

Eight, Nine and tenth digits are the **Numerical Keys at Equipment / Apparatus / Measuring Circuit Code** and used to distinguish between various instruments in the same sub-group. Numerical keys at System / Equipment / Apparatus / Measuring Circuit is shown in **Annexure-3**.

	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%; padding: 5px;">DOCUMENT TITLE</td> <td style="padding: 5px; text-align: center;">KKS NUMBERING PHILOSOPHY</td> </tr> <tr> <td colspan="2" style="padding: 5px; text-align: center;">1X800 MW KOTHAGUDEM</td> </tr> </table>	DOCUMENT TITLE	KKS NUMBERING PHILOSOPHY	1X800 MW KOTHAGUDEM	
DOCUMENT TITLE	KKS NUMBERING PHILOSOPHY				
1X800 MW KOTHAGUDEM					

ANNEXURE-1

List of System / Sub-System Codes used in Power Plant:

- 1) Compressed air system : QEA, QEC
- 2) Ventilation System : SAA TO SAZ
- 3) Fire Detection & Protection System + Fire Water pumps : SGM, SGN, SGO, SGP
- 4) Sewage Treatment : SJA TO SJZ
- 5) Pre-treatment Plant : GBI, GBM, GBV
- 6) RO DM Plant : GCI, GCM, GBV

ANNEXURE-2

Standard Equipment Codes:

AA	Valves including drives, also hand operated
AB	Seclusions, Lock, Gates, Doors
AC	Heat Exchanger
AE	Turning, Driving, Lifting equipment
AF	Continuous conveyors, Feeders
AG	Generator Units
AH	Heating and Cooling Units
AK	Pressing and Packaging equipment
AM	Mixer, Stirrer
AN	Blower, Air Pumps / Fans, Compressor Units
AP	Pump Units
AT	Purification, Drying, Filter
AV	Combustion Equipment e.g. grates

Standard Apparatus Codes:

BB	Vessels and Tank
BF	Foundation
BG	Boiler Heating Surfaces
BN	Injector, Ejector
BP	Flow and throughput limitation equipment (Orifice)
BQ	Holders, Carrying Equipment, Support
BR	Piping, Ducts, Chutes, Compensator
BS	Sound Absorber
BU	Insulations, Sheatings

	DOCUMENT TITLE KKS NUMBERING PHILOSOPHY 1X800 MW KOTHAGUDEM
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Standard Measuring Circuits Codes:

CD	Density
CE	Electrical Quantities
CF	Flow, throughput
CG	Distance, Length, Position
CK	Time
CL	Level
CM	Humidity
CQ	Analysis (SWAS)
CS	Speed, Velocity, Frequency
CT	Temperature
CY	Vibration, Expansion

ANNEXURE-3

Numerical Keys

A) Numerical Keys at System Code Level

- i) Use 10, 20, 30, To distinguish between main systems having same Alpha Codes. Examples:
 - a) Main Steam (Left) and Main Steam (Right)
 - b) BFP – A/B/C
 - c) ID Fan – A/B, FD Fan A/B, AH – A/B
- ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.
- iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.

B) Numerical keys at Equipment Code level:

There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.

- i) Valves and Dampers --- *Equipment Code – AA*

N1 N2 N3

	DOCUMENT TITLE KKS NUMBERING PHILOSOPHY 1X800 MW KOTHAGUDEM
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Motorised (<i>on/off duty</i>)	-	0	01 to 50
Motorised (<i>inching duty</i>)	-	0	51 to 99
Pneumatic (Control)	-	1	01 to 50
Motorised (<i>thyrestor Control</i>)	-	1	51 to 99
Sol. Operated	-	2	01 to 99
(Open / Close duty (Valves, NRVs, Gate)			
Hydraulic	-	3	01 to 99
NRV (Without actuation)	-	4	01 to 99
Manual	-	5	01 to 99
Manual	-	6	01 to 99
Relief & Safety Valves	-	7	01 to 99
Reserve	-	8	01 to 99
Reserve	-	9	01 to 99
ii) Field Instruments			
Field Transmitters & Analog Signals	-	0	01 to 99
Field Switches & Binary Signals	-	1	00 to 99
PG Test Point	-	4	00 to 99
Gauges	-	5	00 to 99
Automatic Turbine Tester (ATT)-HWR	-	2	00 to 99
(Reserved for protection Signals used by Hardwar)			

Example of Numerical Key Usage:

In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, Where system code is same.



Technical specification for
CONTROL & INSTRUMENTATION
 5x800 MW YADADRI TPS, NALGONDA

SPEC NO.: **PE-TS-417-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 03.04.2018

SHEET OF

LCP and JUNCTION BOXES SPECIFICATION

**Telangana State Power Generation Corporation Ltd.
1x800 MW Kothagudem TPS**

**EPC Bid Document
e-PCT/TS/K/02/2014-15**

- 1.00.00 **GENERAL REQUIREMENT**
- 1.01.00 ENCLOSURES FOR INSTRUMENTS AND OTHER EQUIPMENT
- 1.01.01 All panels, cabinets, distribution boxes, junction boxes, terminal boxes and all other field mounted equipment / enclosures shall have suitable environmental protection as detailed in Section-I of this volume of the specification.
- 1.02.00 SURFACE PREPARATION & PAINTING
- 1.02.01 All sheet metal panel/ desk exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below.
- 1.02.02 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 and all other residue due to the fabrication operation. Oil, grease and salts etc. shall be removed from the panels by one or more solvent cleaning methods prior to blasting.
- 1.02.03 Two spray coats of inhibitive epoxy primer surfacer shall be applied to all exterior and interior surfaces, each coat of primer surfacer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades:
- Exterior – Opaline green shade 275 of IS: 5 or equivalent international code..
 - Interior - Brilliant White.
- 1.02.04 Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections, shall not be acceptable.
- 1.03.00 WIRING
- 1.03.01 All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks. All intercommunications between sections of panels/desks shall be furnished.
- 1.03.02 Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized ink print shall be used with cross- identification.
- 1.03.03 All wire termination shall be made with insulated sleeve and crimping type lugs. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs will not be accepted. Wires shall not be looped around the terminal screws or studs.

DEVELOPMENT CONSULTANTS
(PCT-K-03-2013-14_V-VI_S VII_SS D.DOC)

V VI/S-VII/SS-D: 1

- 1.03.04 Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables. Internal wiring shall be grouped so that all outgoing wiring to each particular remote location is terminated on adjacent terminal blocks. Interior wiring and jumperings shall be arranged so that external connections can be made from internal side of terminal blocks. Common connections shall be limited to two (2) wires per terminal.
- 1.03.05 Wiring shall be arranged to ensure free access to all instrument or devices for maintenance. 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
- 1.03.06 Wires shall be dressed and run in trays or troughs with clamp-on type covers. Wirings may 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.
- 1.03.07 Shield wires shall be terminated on separate terminal blocks. Common connections shall be limited to two wires per terminal. Signal circuit shields shall be grounded at the power supply end only or as recommended by manufacturer.
- 1.03.08 All low level signal cables shall be separately bundled to from control cable and maintained at 300 mm minimum spacing from control bundles.
- 1.03.09 Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.
- 1.03.10 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. Shielded wires used in such cases for panel internal wiring shall be continuous and ungrounded with the shield terminated individually and separately in panel terminal block.
- 1.03.11 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 failure of the conductor.
- 1.03.12 Internal wiring in factory pre-wired electronic systems cabinets may be installed according to the Contractor's standard wire size, insulation, and method of termination on internal equipment. Insulation for all wiring, including circuit board wiring, back panel wiring, power supply wiring and interconnecting cables between devices shall pass the vertical flame test per IPCEAS-1981. Identification of conductors may be done by insulation color-coding identified on drawings or by printed wiring lists.

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- 1.04.00 TERMINAL BLOCKS
- 1.04.01 All terminal blocks shall be rail mounted/ post mounted type, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 Deg C. The terminal blocks in field mounted junction boxes, instrument enclosures racks etc. shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room termination/ marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by Bidder shall be subject to Owner.
- 1.04.02 All terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, small partitions, transparent covers, support brackets, distance sleeves, warning level, marking etc. For RTDs ring - tong type lugs shall be used at Junction Boxes.
- 1.04.03 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) Integrated self-loosening protection to avoid shifting of contact surface that may allow contamination of connection point.
 - iii) Inspection and maintenance free (resistant to thermal aging and vibration)
 - iv) Low and constant voltage drop
- 1.04.04 The insulation of the terminal blocks shall be of suitable thermoplastic material.
- 1.04.05 The spacing between Terminal blocks channels in panels and cubicles shall be adequate for routing the cable troughs and to allow adequate free workspace for termination and removal of wires. The terminal blocks shall be arranged with atleast 100 mm clearance between two sets of terminal blocks and junction box walls.
- 1.04.06 Signals of different voltage levels shall be clearly segregated by providing separate rows to each type of signal and by using terminal blocks of different color for each type of signal and by providing barrier strips between them.
- 1.04.07 Terminal blocks shall be provided with white marking strips / self-adhesive marker cards and where permitted by the safety codes and standards, shall be without covers. Power terminals and high voltage (above 48 volts) terminals shall have protection covers. All terminals shall be provided with permanent terminal identification numbers on both sides.
- 1.04.08 At least 20% spare unused terminals shall be provided on each terminal block for circuit modifications and for termination of all conductors in a multi-conductor control cable.

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- 1.04.09 The bottom of the terminal block shall be at least 200 mm above the cable gland for bottom entry type panels.
- 1.04.10 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.
- 1.04.11 Other requirements of the terminal blocks are as follows:
- i) The last terminal 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 above test plug socket to connect adjacent terminals. Adequate number of short circuit jumper plugs shall be provided for the purpose.
 - v) Where more than one connection to a terminal block is required, two tier terminals shall be used.
- 1.05.00 GROUNDING
- 1.05.01 Separate Protective and Electronic system ground as required shall be provided.
- 1.05.02 All panels, desks, cabinets shall be provided with a continuous bare copper ground bus (Frame ground), bolted to the panel structure at bottom on both sides and effectively ground the entire structure. The bolts shall face inside of panels.
- 1.05.03 For electronic system cabinets the electronic system ground bus (Electronic ground) shall be similar but insulated from the cabinet and shall be separately connected to the system ground. The same ground may be used to earth the shield of shielded signal cables, otherwise a separate ground bus shall be provided for connecting the signal cable shields. Cable shields shall be grounded at the panel end only and shall never be left open. The electronic ground between panels of a shipping section shall be firmly looped.

~~2.00.00 CONTROL DESKS & PANELS~~

~~2.01.00 GENERAL~~

- ~~2.01.01 All control desk, panels etc. shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, utility receptacles, grounding, ventilation, space heating, anti-vibration pads, internal piping &~~

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- clearly brought out by the Contractor in his offer, alongwith all relevant details/basis.
- 3.03.00 Any other requirement for proper LVS mounting & functioning & viewing shall also be specifically brought out by the Contractor in his offer, along with all relevant details.
- 4.00.00 **LOCAL INSTRUMENT RACK (LIR) & LOCAL INSTRUMENT ENCLOSURE (LIE)**
- 4.01.00 GENERAL
- 4.01.01 Devices (Transmitters/ Switches) located in the field shall be suitably grouped together to the extent possible and installed in the LIE (Closed Rack) and LIR (Open Rack) in Boiler/TG Building and Off-site plant areas.
- 4.01.02 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.
- 4.01.03 No more than six instruments shall be grouped in a single rack / enclosure.
- 4.01.04 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.
- 4.01.05 Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.
- 4.01.06 Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging
- 4.01.07 Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.
- 4.01.08 Earth stud shall be furnished at rack for safety grounding.
- 4.02.00 **LOCAL INSTRUMENT ENCLOSURE (LIE)**
- 4.02.01 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.
- 4.02.02 Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.
- 4.02.03 2" NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any

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- member, which would reduce access, shall be avoided.
- 4.02.04 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.
- 4.02.05 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. All enclosures shall have access doors on front side.
- 4.02.06 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.
- 4.02.07 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings within transmitter racks both open and closed type, is admissible.
- 4.02.08 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. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..
- 4.02.09 Each rack shall be provided with one receptacle, light fixtures with wire guard and one lighting switch each at instrument & Junction box compartments with wire guard. Lighting switches may be door actuated & mounted inside the panel. Outlet box, switch box and device covers shall be of galvanized stamped steel. Light switches and receptacles shall be installed inside the enclosure on the wall near the latch side of the enclosure door. Light fixtures shall be installed on the ceilings of the enclosures.
- 4.02.10 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.
- 4.02.11 Vibration dampeners shall be installed for supporting each enclosure. The loading at each corner of the enclosure shall be determined by actual test weighting when construction is complete to determine the correct length of each dampener for proper loading of the dampener in accordance with manufacturer's recommendations
- 4.03.00 LOCAL INSTRUMENT RACK (LIR)
- 4.03.01 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

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falling objects and shall be epoxy painted. Canopy shall be of CRCA steel sheet of at least 3 mm thickness.

4.03.02 Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable fenders grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project to protect instrument from accidental contact during personnel movement. Center posts or any member, which would reduce access, shall be avoided.

4.03.03 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments.

4.03.04 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible.

4.03.05 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. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..

Each rack shall be provided with one receptacle, one light fixture with wire guard and one lighting switch. Outlet box, switch box and device covers shall be galvanized stamped steel. Light fixtures shall be installed on the canopy of the rack

4.03.06 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.

4.04.00 JUNCTION BOX

- | | | |
|----------------------|---|--|
| 1. Type of Enclosure | : | Dust tight & weatherproof conforming to IP 65 |
| 2. Material | : | 3 mm sheet steel / fiberglass reinforced polyester(UV stabilized) |
| 3. Type of Cover | : | Solid unhinged with retention chain / Screwed at all four corners |
| 4. Paint | : | i) Exterior : Opaline green shade 275 of IS: 5
ii) Interior - Brilliant Glossy White. |

- Surface / Two (2) inch Pipe stanchion
5. Mounting : (At a dry compartment at one side of the enclosure / rack with front opening type door)
6. Cable Entry : 3 mm (min) Bottom / side Gland plate
7. Gasket : Neoprene
8. Grounding : Brass earth lug with green screw head
External-2 nos , Internal-1no. (M6)
9. Number of Drain Holes : Two at bottom capped
10. Identification : Label for JB and Tags for cable
11. Accessories :
- a) Rail mounted cage clamp type screwless terminals (suitable for conductor size up to 2.5sq.mm of suitable voltage grade) with markers and 20% spare terminals
 - b) Cable gland (Brass) & raceways
 - c) Ferrules & lugs (Brass)
 - d) Aluminum back panel
 - e) Canopy at top
 - f) Mounting brackets
 - g) bolts and nuts made of brass etc.

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	Technical specification for CONTROL & INSTRUMENTATION 5x800 MW YADADRI TPS, NALGONDA	SPEC NO.: PE-TS-417-145-I	
		VOLUME	
		SECTION	
		REV. NO. 00	DATE : 03.04.2018
		SHEET	OF

Instrumentation Quality Plan



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

CHECK LIST FOR PRESSURE SWITCH

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

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

Note :

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



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

CHECK LIST FOR TRANSMITTER

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

Legend :

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

Note :

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



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

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION			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

[illegible]

Legend :

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

Note :

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

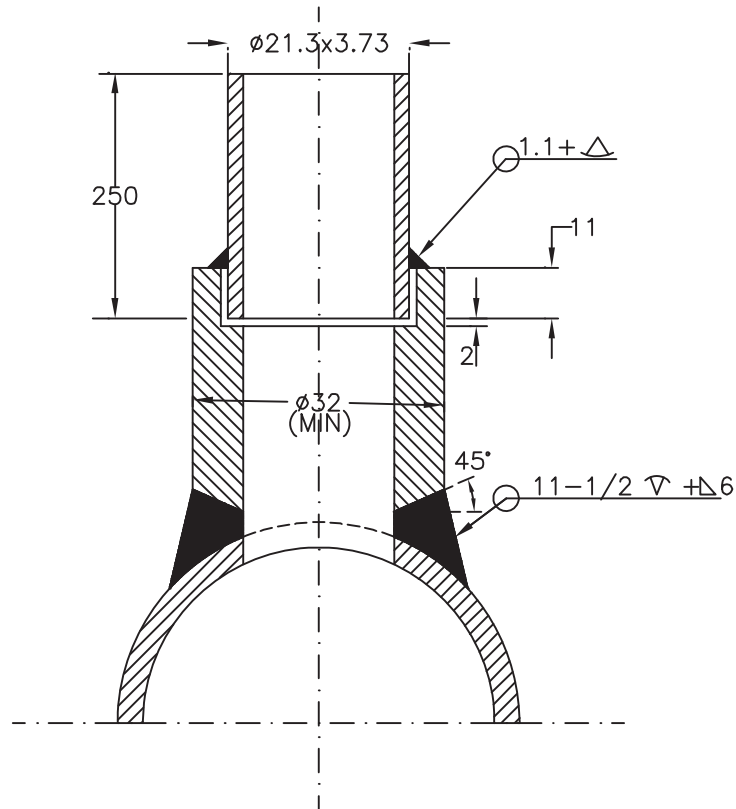
FORM NO. PEM-6868-0

	Technical specification for CONTROL & INSTRUMENTATION 5x800 MW YADADRI TPS, NALGONDA	SPEC NO.: PE-TS-417-145-I	
		VOLUME	
		SECTION	
		REV. NO. 00	DATE : 03.04.2018
		SHEET	OF
CABLE BOQ			

CABLE SIZES FOR 5X800 MW YADADRI TPS	
Sl no.	Cable Type
	G-TYPE
1	2P X 0.5 sqmm
2	4P X 0.5 sq mm
3	8P X 0.5 sqmm
4	12P X 0.5 sqmm
5	2P X 1.5 sqmm
	F-TYPE
1	4P X 0.5 sqmm
2	8P X 0.5 sqmm
3	12P X 0.5 sqmm
4	20P X 0.5 sqmm
	CONTROL CABLE
1	3C X 2.5 sqmm
2	5C x 2.5 sq mm
3	12C x 2.5 sqmm

INSTRUMENT STUB DETAILS

										CUSTOMER:  TELANGANA STATE POWER GENERATION CORPORATION LTD TELANGANA, INDIA 5 x 800 MW YADADRI TPS, UNIT # 1 TO 5									
										CONSULTANT:  TATA CONSULTING ENGINEERS LIMITED BANGALORE, INDIA									
JOB NO.417										BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA									
										COPY RIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED it must not be used directly or indirectly in any way detrimental to the interest of the company.		DEPT CODE I		NAME AKS		SIGN		DATE 20.01.18	
												DRN DESN		AKS		20.01.18			
												CHD RKR		20.01.18					
												APPD SSB		20.01.18					
										TITLE INSTRUMENT STUB DETAILS									
										DEPT. SIGN		SCALE 		DRAWING NO. PE-DG-417-145-1101					
												SHEET 1 OF 6		REV. 00					

**NOTE :**

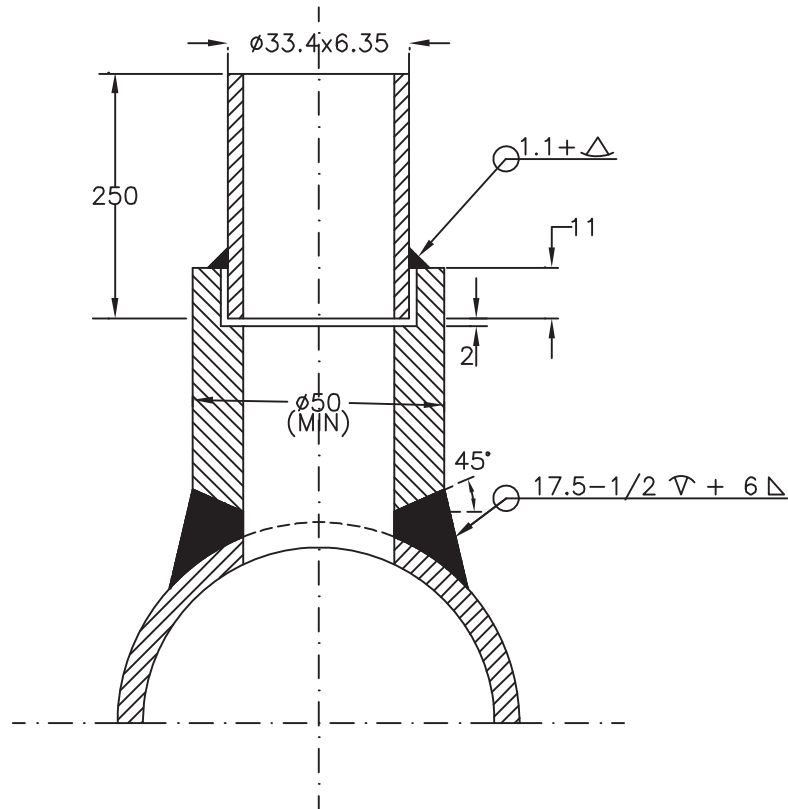
1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. THE OTHER END OF THE NIPPLE SHALL BE SOCKET WELDED WITH 1/2" GLOBE VALVE OF MATERIAL AS PER ANSI B 31.1.
4. TWO ISOLATION VALVES ARE TO BE USED FOR PRESSURE EXCEEDING 40 Kg/Cm2.
5. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
6. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY(1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES.



TITLE : 5 x 800 MW YADADRI TPS
 STD INSTRUMENT STUB
 DETAILS
 PRESSURE STUB

SYSTEM PRESS < 60Kg/Cm2 & SYSTEM TEMP < 425 Deg C, Nb15 , CL3000

DRG. NO.
 PE-DG-417-145-I101
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 SH. 02 OF 06

**NOTE :**

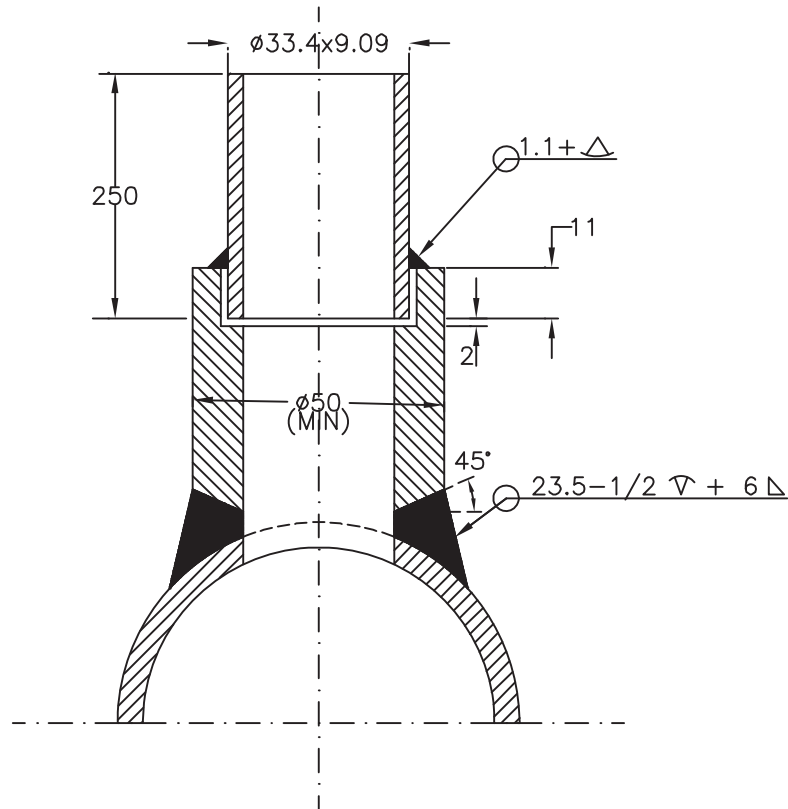
1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. THE OTHER END OF THE NIPPLE SHALL BE SOCKET WELDED WITH 1" GLOBE VALVE OF MATERIAL AS PER ANSI B 31.1.
4. TWO ISOLATED VALVES ARE TO BE USED.
5. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
6. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY(1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES.



TITLE : 5 x 800 MW YADADRI TPS
 STD INSTRUMENT STUB
 DETAILS
 PRESSURE STUB

DRG. NO.
 PE-DG-417-145-1101
 REV. 00
 SH. 03 OF 06

SYSTEM PRESS > 60Kg/Cm² & 425 Deg C < SYSTEM TEMP <= 500 Deg C , Nb25 , CL3000/6000

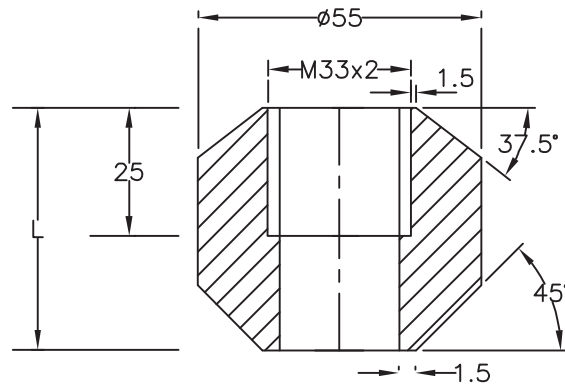
**NOTE :**

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. THE OTHER END OF THE NIPPLE SHALL BE SOCKET WELDED WITH 1" GLOBE VALVE OF MATERIAL AS PER ANSI B 31.1.
4. TWO ISOLATED VALVES ARE TO BE USED.
5. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
6. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY(1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES.

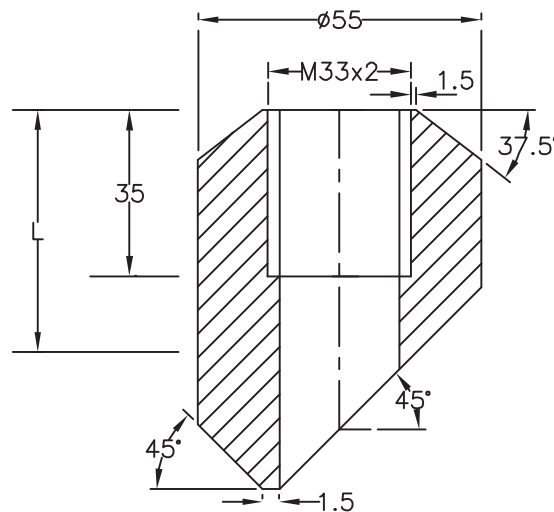


TITLE : 5 x 800 MW YADADRI TPS
 STD INSTRUMENT STUB
 DETAILS
 PRESSURE STUB
 SYSTEM TEMP > 500 Deg C , Nb25 , CL9000

DRG. NO.
 PE-DG-417-145-I101
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 SH. 04 OF 06



TEMPERATURE STUB FOR STRAIGHT IMMERSION



TEMPERATURE STUB FOR SLANT IMMERSION

NOTE :

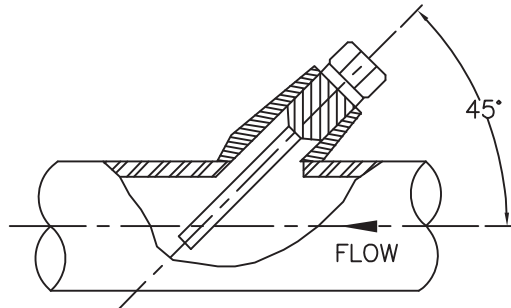
1. MATERIAL OF THE BOSS SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED.
2. LENGTH OF THE STUB (L) SHALL BE 64/45 mm DEPENDING UPON PIPE SIZE, AS PER CORPORATE STD. AA 7326102.(FOR PIPE OD 88.9 mm TO 159 mm STUB HEIGHT SHALL BE=64mm & FOR PIPE OD ≥ 219.1 mm STUB HEIGHT SHALL BE=45mm)
3. STRAIGHT IMMERSION STUBS SHALL BE USED FOR PIPE OD'S 168.3 mm & ABOVE. THE STUB HEIGHT FOR PIPE OD 168.3 mm TO <219.1 mm SHALL BE 64 mm.
4. SLANT IMMERSION STUBS SHALL BE USED FOR PIPE OD'S 88.9 mm TO 159 mm.
5. FOR MAIN PIPE OD'S 88.9 mm & BELOW SUITABLE EXPANDER SHALL BE USED.
6. PLEASE REFER SHEET-6 FOR THERMOWELL INSTALLATION.



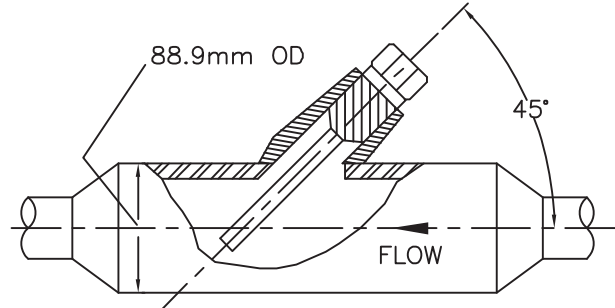
TITLE : 5 x 800 MW YADADRI TPS
STD INSTRUMENT STUB
DETAILS

TEMPERATURE STUB

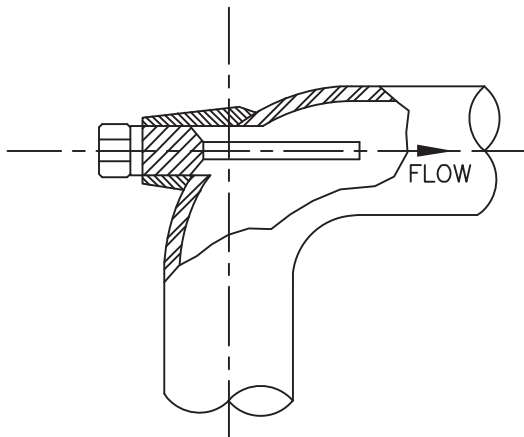
DRG. NO.
PE-DG-417-145-I101
REV. 00
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**INSTALLATION TYPE-1**

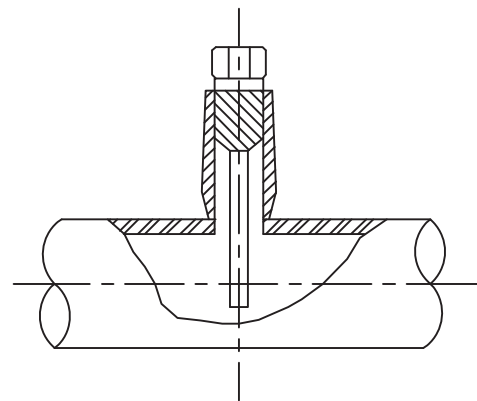
FOR MAIN PIPE OD 88.9mm to 159mm

**INSTALLATION TYPE-2**

FOR MAIN PIPE OD BELOW 88.9mm

**INSTALLATION TYPE-3**

FOR MAIN PIPE OD 88.9mm & BELOW

**INSTALLATION TYPE-4**

FOR MAIN PIPE OD 168.3mm & ABOVE



TITLE : 5 x 800 MW YADADRI TPS

STD INSTRUMENT STUB
DETAILS

THERMOWELL INSTALLATION

DRG. NO.
PE-DG-417-145-I101
REV. 00
SH. 06 OF 06

5 X 800MW YADADRI TPS

TECHNICAL SPECIFICATION
FOR
FUEL OIL UNLOADING & STORAGE SYSTEM

SECTION - II

STANDARD TECHNICAL SPECIFICATIONS



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT PPEI,
NOIDA-INDIA



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORGAE SYSTEM
5 X 800MW YADADRI TPS**

SPECIFICATION NO. PE-TS-417-166-A001

SECTION I

REV – 00

DATE - 26.04.2018

5 X 800MW YADADRI TPS

**TECHNICAL SPECIFICATION
FOR
FUEL OIL UNLOADING & STORAGE SYSTEM**

SECTION - IIA

STANDARD TECHNICAL SPECIFICATIONS-MECHANICAL



**BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT PPEI,
NOIDA-INDIA**



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
5 X 800MW YADADRI TPS
(STANDARD TECHNICAL SPECIFICATIONS)**

SPECIFICATION NO. PE-TS-417-166-A001

SECTION-IIA

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EQUIPMENT SELECTION & DESIGN CRITERIA/ DATA SHEET

A. LDO/HFO Storage Tank

- 1) LDO/HFO storage tank shall be constructed as per technical specification clause no. 6.02.00, Vol. IIB, Sec. 3B and GA drawing attached in Section-IA, Annexure-E.
 - a) Minimum dimensions of LDO Tank provided: 12.0m (dia.) and 11.0 (ht)
 - b) Minimum dimensions of HFO Tank provided: 20.0m (dia.) and 16.0 m (ht).
 - c) Minimum thickness of the tank shell and roof shall be as per GA Drawing (section1A)
 - d) Thickness of the tank bottom shall be per GA Drawing (section1A).
 - e) Width of the plate can be considered out of these 1250/1500/1800/2000. As per IS803, minimum course width is 1500mm unless agreed otherwise mutually. Due to non-availability of plates at the time of detail engineering, option of course width of 1250mm has been also kept.
 - f) Roof structure of tank shall be designed in Stadd. During detail engineering, mother format same to be submitted to BHEL for checking.
 - g) Tank low-low level shall be decided in a way that suction heater and floor coil heater is always submerged.
 - h) Additional height required to meet the effective capacity to be provided by the vendor without any commercial implication.
- 2) Drain oil tank:
 - a) Dimensions of Drain Oil Tank: 4.5m x 2.5m x 2.0 m.
 - b) Minimum thickness of the plate: 6.0mm including corrosion allowance
 - c) Design Code: IS 800 / standard hand book

B. FLOOR COIL HEATER AND SUCTION HEATER

Floor Coil Heater shall be constructed as per technical specification Annexure-I, Vol. IIB, Sec. 3B. Page no. 15.

C. UNLOADING PUMPS / SUMP PUMP & OIL RECOVERY PUMP

HFO / LDO Unloading pumps shall be constructed as per technical specification Annexure-III, Vol. IIB, Sec. 3B.

- a) HFO & LDO unloading pump will be designed for a viscosity of 50-500cst and 2-50cst respectively.
- b) Design capacity of pump shall be based on lowest viscosity plus 10%
- c) For selection of pump head and motor rating, the criteria shall be as follows:
 - Pump head will have 10% margin over the calculated pump head. Motor rating be arrived at by considering higher of the following.
 - 15% margin over BHP at duty point (duty point means specified discharge at 1.1 times the calculated head) @ highest viscosity
 - RV set pressure (10% or 1 kg/cm² higher than duty point pressure whichever is higher) BHP @ highest viscosity



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
5 X 800MW YADADRI TPS
(STANDARD TECHNICAL SPECIFICATIONS)**

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FOR SUMP PUMP AND OIL RECOVERY PUMP:

S.No	Characteristics	Drain oil pump / Recovery oil pumps	Sump Pump in Oil Unloading Area	Sump Pumps in pump house
1	Type of Pumps	Vertical Single Screw positive displacement.	Vertical single screw type	Vertical single screw type
2	No. &Capacity of Pumps	As per scope of supply		
3	Type of Duty	Intermittent	Intermittent	Intermittent
4	Type of Drive	Direct driven by Electric Motor		
5	Location	Indoor / Outdoor	Outdoor	Indoor
6	Nature of Fluid to be pumped	HFO/LDO	Water with traces of oil	Water with traces of oil
7	Design Viscosity range	2-500 cST	5-50cST	5-50cST
8	Sealing	Manufacturer Specific		
9	Design Code	Manufacturer specific.		
10	Bearings	Antifriction type	Manufacturer specific	
11	Material of Construction			
i)	Casing	Cast Iron to IS 210 Gr FG 260/ CS Fabricated		
ii)	Casing lining, if applicable	Manufacturer specific		
iii)	Rotor/ Impeller	13% chrome SS	Cast Iron to IS 210 Gr FG 260)	
iv)	Rotor housing, if applicable	CI AS PER IS 210 GR. 260	Manufacturer specific	
v)	Shaft	13% chrome SS	BS 970 EN-8 or equivalent	
vi)	Relief valve body	NA	NA	
vii)	Relief valve spring	NA	NA	
viii)	Base Plate	Fabricated from MS to IS 2062		
ix)	Coupling	Manufacturer specific		
x)	Hydrotest Pressure	1.5 Times maximum discharge pressure		
xi)	Hydrotest Duration	30 Minutes		

D. STRAINERS FOR LDO/HFO UNLOADING PUMPS

Strainers shall be provided as per following details.

S.No.	Characteristics	Value
01	Type	Simplex Type for unloading pumps & Drain oil pumps (Integral to pump)
02	Fluid	LDO/HFO
03	Flow Rate	To match pump flow rate
04	Operating Pressure, maximum kg/cm ² (g)	Bidder specific
05	Operating temperature, ° C	55
06	Design Pressure , kg/cm ² (g)	1.1 times the operating pressure , min.
07	Design Temperature, ° C	65
08	Fluid Viscosity	As per Fuel Oil Characteristics
09 a)	Pressure drop in clean condition	0.15 kg/cm ²
09 b)	Maximum permissible pressure drop under 50 % clogged condition	0.3 kg/cm ²
10	Screen basket data	
a)	Dia. of perforations	40 mesh
b)	Minimum thickness	Bidder specific



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
5 X 800MW YADADRI TPS
(STANDARD TECHNICAL SPECIFICATIONS)**

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SECTION-IIA

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11	Steam Jacket	Applicable for HFO unloading pump suction strainer.
12	Steam pressure for steam heating	4 kg/cm ² (a) or higher as decided during detail engineering
13	End Connection details	
a)	Inlet & outlet size	Shall match connected upstream and downstream pipe size
b)	Type	Flanged
c)	Details / Standard	IS: 6392 /ANSI B 16.5 /Equivalent.
14	Material of Construction	
a)	Body	Fabricated from IS 2062/ Seamless pipe to ASTM A 106
b)	Cover	Fabricated from IS 2062 PLATES
c)	Screen basket	SS 304
15	Hydrotest Pressure	1.5 Times Design Pressure
16	Hydrotest Duration	30 Minutes

E. PIPES, FITTINGS & FLANGES

- Oil Pipes shall be provided as per Volume IIB, Section-3A, Annexure-III
- Pipe in oil lines shall be API 5L Gr. B (ERW).
- Steam and Condensate line shall conform to ASTM 106 GR. B, Schedule 40.
- IA line shall be STAINLESS STEEL ERW TYPE AS PER ASTM-A312 GR.304. SCHEDULE 40S (MIN)
- Additional details of the above specified item / other items are also covered below:

Minimum Pipe Thickness shall be as follow:

Pipe Size	Thickness (mm)	Pipe Size	Thickness(mm)
15 NB	2.77	100 / 80 / 65 NB	3.96
20 NB	2.87	150 NB	4.78
25 NB	3.38	200/250 NB	5.56
40 NB	3.68	300/350 NB	6.35
50 NB	3.91	400 NB NB	6.35

Pipe of size 400 NB and above shall be fabricated from IS2062 plate. Thickness of plate fabricated pipe shall be 8.0mm.

Fittings / flange / gasket details

<u>SR.</u>	SIZE	MATERIAL STANDARD/ OTHER DETAILS	DIMENSION STANDARD
<u>1</u>	FITTINGS & FLANGES		
<u>A.</u>	FUEL OIL		
a.	Fittings (Elbow, Tees and Reducers)	Material Standard	Dimension Standard
	50 NB and below	Forged carbon steel to ASTM A 105	SW ends to ANSI B 16.11 (3000#)
	65 NB and above	Fabricated from parent pipe / Carbon Steel to ASTM A 234,Gr.WPB	BW ends to ANSI B 16.9, Sch.40
b.	Slip on Flanges / Blind Flanges	Material Standard	Dimension Standard



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
5 X 800MW YADADRI TPS
(STANDARD TECHNICAL SPECIFICATIONS)**

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	All sizes	Fabricated from IS2062 plate	As per ANSI B16.5, Class 150,/BS 4504/ IS 6392 ; class 150 lb/ equivalent to relevant standard.
B.	STEAM AND CONDENSATE SERVICE		
a.	Fittings (Elbow, Tees and Reducers)	Material Standard	Dimension Standard
	50 NB and below	Forged carbon steel to ASTM A 105	SW ends to ANSI B 16.11 (3000#)
	65 NB and above	Carbon Steel to ASTM A 234, Gr. WPB	BW ends to ANSI B 16.9, Sch.40
b.	Slip on Flanges/Blind Flanges	Material Standard	Dimension Standard
	All sizes	Forged carbon steel to ASTM A 105	ANSI B16.5/ BS 4504/ IS 6392, class suitable for intended service.
C.	AIR LINE		
a.	Fittings (Elbow, Tees and Reducers)	Material Standard	Dimension Standard
	25 NB and below	Stainless steel as per ASTM A-182 F304	
2	GASKETS		
A.	STEAM	Spiral wound SS316	
B.	FUEL OIL	Teflon	
C.	AIR LINE & BILGE WATER LINE	Grafoil	
3	Bolts / Studs / Anchor Bolt	ASTM A 193 Gr. B7	
4	Nuts	ASTM A 194 Gr 2H	

F. STEAM TRAPS

S.No.	Characteristics	Value
1	Design Features	
	Type	IB Type Traps for Floor Coil Heater & TD type or any other type as per trap vendor recommendation for other services
2.	Strainer	Integral
3.	End connection	Socket welded / Manufacturer standard.
3a	Design criteria	2 times the actual condensate load
4.	Material of construction	
a.	Body	Carbon steel/ SA105/ As per manufacture standard practice
b.	Trims	SS conforming to AISI-316/304/ Manufacturer's standard practice
c.	Strainer	SS conforming to AISI-316/304/ Manufacturer's standard practice

G. VALVES

Valves shall be provided as per Technical Specification, Volume IIB, Section 3A, Annexure-III, Clause no. 4. e,f,g,h,i.



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
5 X 800MW YADADRI TPS
(STANDARD TECHNICAL SPECIFICATIONS)**

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The valves shall be provided in the oil lines as per the following: -

- a) Size up to 200 NB: Ball valves
- b) Size 250 NB and up to 350 NB: Plug valve
- c) Size above 350 NB: Gate valve

H. HOSES

S.No.	Characteristics	Value
1	Type	Flexible rubber hose with steel / GI impregnated confirming to BS 1435/ IS 10733
2	Size	80NB x 8 m long for HFO & LDO
3	Quantity	As indicated in scope of supply
4	Temperature of fluid handled, °C	Capable of handling oil Up to 85 °C temperature
5	Type of end connection	To match railway wagon unloading nozzle (details to be checked and confirmed by customer)

I. DATA SHEET FOR STEAM/CONDENSATE HOSES

S. No.	Characteristics	Value
1.	Type	Metallic Flexible Hose, Electro zinc plated, Carbon /Stainless Steel double interlocked, non- asbestos/ galvanised wire inserted hose.
2	Size	50 NBx8.0 m long for steam service 25 NB x8.0 m long for condensate service. Any other fitting required to match the Road tanker steam & condensate nozzle shall also be provided by the bidder.
3.	Quantity	As per scope of supply
4.	Location	outdoor
5.	Temperature of fluid handled, °C	210°C
6.	Design temperature	By bidder
7.	Working Pressure, kg/cm ²	Corresponding to aux. steam pressure downstream of Pressure reducing station (PRS)
8.	Design Pressure, kg/cm ²	1.5 times the pressure downstream of PRS
9.	Test pressure, kg/cm ² (g) & duration	21, 15 mins minimum
10.	Testing standard	Bidder to indicate
11.	Type of end connection	To Match railway wagon Steam & Condensate Nozzle

Note:

Above details of steam / condensate hoses are only indicative. Successful bidder shall furnish manufacturer's complete datasheet / drawing for customer's approval

J. PRESSURE REDUCING STATION AND DESUPERHEATER

S.No.	Characteristics	Value
1	Type	PID controlled type
2	Steam pressure at inlet	16 kg/ cm ² (a)
3	Steam Pressure at outlet	4 kg/ cm ² (a) or more as required by FO System vendor.
4	Leakage class	Class- IV
5	Material of Construction	



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
5 X 800MW YADADRI TPS
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a)	Body	Cast Steel
b)	Trim	SS
6	De-superheater- MOC	
a)	Spray nozzle with assembly	SS 316 (Spray Nozzle design pressure shall be equal to Design Spray Water Pressure)
b)	Body	A216 WCB
c)	Pipe	SA 106GRB
7	PRDS Design Criteria	
	PRDS shall be designed considering steam requirement in following area: 1. One no. HFO Tank under initial heating condition. 2. One no. HFO Tank at maintenance temperature. 3. Two nos. suction heater under operation. 4. Equipment (pumps and strainers) and Line Tracing 5. Road Tanker with heating arrangement under simultaneous unloading Plus 10% margin on above.	

K. CONTROL VALVE FOR SUCTION AND FLOOR COIL HEATER

S. No.	Characteristics	Value
1	Type	Pneumatically operated control valve 1. Modulating with SMART positioner for Floor Coil heater 2. Modulating with SMART positioner for Suction Heater 3. On-off type of Drain oil tank
2	Steam pressure at inlet	4kg/cm2(a)
3	Controlling	Pneumatically controlled
4	Material of Construction	
a)	Body	Cast Steel
b)	Trim	SS 316
5	Leakage class	Class V

CONDENSATE FLASH TANK

1	Storage Medium	Condensate
2	Number Of Tank	One (1) no.
3	Type of Construction	Vertical /Cylindrical with dished ends.
4	Tank Capacity(m3)	Two (2)
5	Dimensions	Dia & ht for 2 m3 flash tank to be decided by bidder
6	Design Code	IS 2825 Class-II
7	Material Of Construction	PLATES : IS 2002 GR.2A
8	Worst Operating Pressure	Four(4.0) Kg/cm2
9	Design Pressure	10% Margin On Worst Operating Condition
10	Temperature	250 degC
11	Corrosion allowance	1.8mm
12	Joint efficiency	85%
13	Insulation & cladding	As required as per approved calculation.
14	Radiography	Shall be conducted on 10% of the total longitudinal and circumferential joints and 100% of total weld joints of dished ends.
15	Testing requirements	a. As per IS 2825

7337/2020/PS-PEM-MAX



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
5 X 800MW YADADRI TPS
(STANDARD TECHNICAL SPECIFICATIONS)**

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		b. DPT shall be carried out on welds c. Hydraulic test at 1.5 times the design pressure shall be carried out.
16	Vent	Free vent pipe of 250mm size and 2.5m length.



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS TANKS
(STANDARD TANK SPECIFICATION)**

SPECIFICATION NO. PE-TS-417-166-A001

SECTION IIA

REVISION 00

DATE: 20.04.2020

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1.0 SCOPE

This specification covers design, engineering, supply of material, fabrication, assembly, inspection and testing at shop as well as at site, erection and commissioning, painting and functional demonstration testing at site.

2.0 CODES & STANDARDS

The design, fabrication & assembly, erection & performance of steel tanks shall comply with all latest statutory regulations and safety codes applicable in the locality where the tanks are to be installed. Tanks shall conform to the latest applicable Indian / British / USA standards. The vendor shall not be construed to be relieved of his responsibility by virtue of this specification. The tank in general shall conform to the latest editions, as applicable, out of the following standards.

1. IS-800 Code of practice for use of steel in general building construction
2. IS-803 Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tank.
3. IS-804 Specification for rectangular pressed steel tanks
4. IS-805 Code of practice for use of steel in gravity water tank.
5. IS-816 Code of practice for metal arc welding for general construction in MS.
6. IS-817 Code of practice for training and testing for metal arc welder
7. IS-2825 Code of practice for unfired pressure vessel
8. BS-2594 Specification for carbon steel welded horizontal cylindrical storage tank
9. BS-2654 Specification for vertical steel welded storage tanks with butt welded shells for the petroleum industry
12. Indian Factories Act
13. American code for oil tanks API 650
14. Material Specification as per relevant IS / or approved equal
15. American water works association standards (AWWA D100)



**TECHNICAL SPECIFICATION FOR
MISCELLANEOUS TANKS
(STANDARD TANK SPECIFICATION)**

SPECIFICATION NO. PE-TS-417-166-A001

SECTION IIA

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3.0 DESIGN REQUIREMENT**3.1 General Requirement**

3.1.1 All tanks will be mild steel tanks. The tanks will be of welded construction and will be designed to withstand satisfactorily the internal forces due to the liquid which these tanks have to hold as specified and external forces due to wind and seismic forces without deformation or undue strain. The plates will be cold rolled through plate bending machines by several no. of passes to the curvature.

3.1.2 Tank thickness shall be calculated as per IS803 latest edition. Intermediary wind girder design, Wind Design, Seismic design, anchor bolt design / selection etc. shall be done as per API 650 latest edition, latest addendum available at the time of detail engineering.

3.1.3 All tanks will be designed for the capacities, dimensions and working conditions as specified in **GA DRAWING OF FO TANKS**. These tanks will be provided with all necessary connections as specified. The design of tanks will be such as to allow easy inspection, cleaning and repair. Due consideration will be given to wind loading and adequate stiffening will be provided to prevent failure of tank due to buckling when it is empty. A 2.0 mm corrosion allowance for shells, bottom and roofs above and beyond the required thickness / calculated thickness / nominal thickness as specified in the design code shall be provided.

3.1.4 Vessel seams shall be so positioned that they do not pass through nozzle connections on vessel. For vessels consisting of more than two sections, longitudinal seams shall be offset.

3.1.5 The inside seam should be ground smooth, suitable for application of corrosion resistant primer. If the stiffening of shell, bottom and / or roof is necessary, tanks will be stiffened from outside.

3.1.6 Flange faces of all nozzles shall be machined and squared with the vessel center line.

3.1.7 All roofs and supporting structures shall be designed to support dead load plus a uniform live load of not less than 150 kg/m² of projected area.

3.1.8 The tanks shall be designed to have all courses truly vertical. Adequate distance between vertical joints in adjacent courses shall be taken so that the distortion is reduced to minimum.

3.1.9 When removing temporary attachments from shell plates, care should be taken that parent plate is not damaged. Holes in plate work to assist in fabrication / erection should be avoided as far as possible. The location of holes and method of filling shall be indicated in the fabrication drawing. Any projection of metal shall be chipped and ground flush with the plate surface. The plate shall not be gouged or torn in process of removing lugs.

3.1.10 In the construction of shell, very care shall be taken to minimize distortion or lack of circularity due to welding or for any other reason.

3.1.11 Material of construction of all tanks shall be mild steel conforms to IS – 2062 grade – B unless otherwise specified in the **GA DRAWING OF FO TANKS**.

3.1.10 Alignment



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- 3.1.10.1 Plates to be joined by butt-welding shall be matched accurately. Misalignment in completed vertical joints shall not exceed 10% of the plate thickness or 1.5 mm for plates of 20 mm thick and under, whichever is larger.
- 3.1.10.2 In completed horizontal butt joints, the upper plate shall not project beyond the face of the lower plate at any point by more than 20% of the upper plate thickness with a maximum of 3 mm for plate thickness exceeding 8 mm except that for plate thickness 8 mm and under, the maximum shall be 1.5 mm.
- 3.1.10.3 Each tank shall be properly constructed ensuring perfect vertical alignment with 5 mm or as specified in the relevant code / standard and tank circularity within 5 mm on diameter or as specified in the relevant code / standard. Local bulging and / or depressions at any location of tank particularly shell shall not be permitted.
- 3.1.11 **WELDING**
- 3.1.11.1 Tanks and other attachments shall be welded as per IS-816.
- 3.1.11.2 Welding sequence shall be so adopted that distortion due to welding shrinkage shall be minimum. Welding procedure specification shall be submitted for approval of BHEL giving details of material, welding position, sequence, type of electrode used, pre-heat & post weld requirement etc as per the code of construction. Brand name of electrodes to be used with proper classification (e.g. E 6013) shall be as per BHEL's approval.
- 3.1.11.3 Welding shall not be carried out when the surface is wet and during periods of rain and high winds unless the welder and the work are properly shielded which should meet the approval of the purchaser.
- 3.1.11.4 Inspection of all welds shall be carried out in accordance with the governing code of construction. All material used by the purchaser such as electrodes, gaskets, bolts, nuts etc shall be conforming to relevant standards of repute and approved by the purchaser prior to use.
- 3.1.12 Each tank shall be complete with access staircase, ladder and safety cage and fittings like drain connection, overflow connection, tank inlet and outlet covers, level gauge glass, fittings with isolation cocks and protection covers, tank vent connection etc all complete with needed accessories for the completeness of the tanks and as specified in **GA DRAWING OF FO TANKS**.
- 3.1.13 All openings in tank plate shall be well reinforced in approved manner by adding pad plates of adequate size and / or structural sections.
- 3.1.14 **STAIRCASE / ACCESS LADDER AND HAND RAILING**
- 3.1.14.1 All cylindrical vertical tanks shall be provided with spiral staircase and shall conform to the requirements specified in design codes / standards unless specified otherwise. All stair treads shall be 32 mm steel fabricated gratings or 8mm thk. chequered plate which will be decided during detail engineering stage. Each tread, if needed, shall be housed in individual steel fabricated frame which shall be adequately supported from the tank outer periphery. The staircase shall have minimum 800 mm clear width.



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- 3.1.14.2 Access ladder, one (1) for each horizontal cylindrical / rectangular tank shall be provided for access to the tank roof. It shall be steel fabricated having minimum 450 mm width. Ladder stringers shall be heavy steel flats or angle section. All rungs shall be minimum 20 mm diameter rods spaced at not more than 30 mm center to center. All ladders shall have steel fabricated safety cage to the approved construction. Safety cage shall be provided about 2.5 m clear height of the ladder. Access ladder's stringers shall be widely spaced at top for free access to the tank roof.
- 3.1.14.3 All staircase and roofs of vertical cylindrical tanks shall be provided with pipe hand railings of effective height as indicated in the relevant code / standard throughout. Handrails shall be constructed out of 32 mm medium class galvanized steel pipe conforming to IS- 1239: 1968. Handrail posts shall be arranged at spacing not greater than 1850 mm. Two (2) sets of pipes horizontal runners all along the length shall be provided. All welds joints in the handrails shall be ground flush to protect any person getting injured. Steel toe plates of 100 mm flats shall be used. Hand railing shall be fabricated and installed in an approved manner as directed by purchaser in accordance with approved drawings.
- 3.1.15 Unless otherwise specified, for all flanged connections, vendor shall furnish suitable counter flanges and necessary nuts, bolts and gaskets materials.
- 3.1.16 Unless otherwise specified, bolts and nuts shall be hexagonal head conforming to bolts and nuts shall be SA 193 & 194 respectively.
- 3.1.17 Gaskets shall be 3 mm thick full-face rubber or CAF. On completion of hydraulic test / water fill test, contractor shall replace the gaskets used during testing at his own cost.
- 3.1.18 Float level indicators other than float and arrow type level indicator, gauge glass shall be provided.
- 3.1.19 During erection of tank, shell plates shall be suitably supported both for outside and inside to avoid buckling / collapsing of tank due to high-speed wind, gust or severe storm, if any, occurring during erection.
- 3.2 **VERTICAL CYLINDRICAL STORAGE TANKS**
- 3.2.1 The vertical cylindrical storage (non- pressure) tanks shall be of mild steel welded construction and shall be designed in accordance with codes and standards as specified in the **GA DRAWING OF FO TANKS**. The vertical cylindrical storage tanks shall have slightly sloping bottom towards an adequately sized sump inside the tank to enable complete draining of the tank. The tank shall be designed for a wind pressure and seismic coefficient as specified.
- 3.2.2 Conical roof shall be either self-supported or supporting. The roof shall have a slope as specified in the relevant design code to ensure drainage of rainwater. Needed roof rafters and purlins adequately designed shall be provided.
- 3.2.3 All plates to be used for fabrication of tank shall be checked and all sides trimmed to make them square.



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- 3.2.4 All bottom plates shall have lap weld joints on all sides with overlap not less than five times the plate thickness.
- 3.2.5 All shell course plates shall be taken during bending to prevent plate skewing. For butt weld joints, edges shall be prepared which shall be uniform and smooth throughout. To maintain needed root penetration gap at any butt weld joint, sufficient numbers of erection cleats shall be provided on all sides of outer periphery of each shell plate. Plates for tanks shall be straightened by pressing or by other non-injurious methods.
- 3.2.6 Each shell course shall be of uniform width throughout longitudinal weld in plates. Make up for the course width shall not be permitted. Shell plates in each course width shall be so arranged that all vertical joints be staggered having a minimum of 600 mm stagger. Shell thickness could be reduced in upper courses depending on design requirements but in no case the plate thickness shall be less than 8 mm.
- 3.2.7 The tank height shall be completed by the provision of top curb/ angle which shall be butt-welded to the adjacent tank plate courses. The outstanding leg of the curb angle shall be kept outside the tank periphery. All butt weld joints shall be full strength welds but for design of shell plate thickness adequate weld efficiency as recommended by applicable code(s) shall be used.
- 3.2.8 Tank roof shall be either self-supported or supported over rafters / steel fabricated central column(s). Adequately sized and spaced rafters and purlins shall be provided. All rafters shall have sliding bolted connections at one end and preferably on the tank periphery side. The roof-supporting frame shall have needed tie rods or bracing sets.
- 3.2.9 Roof plates shall have lap joints with lap not less than 25 mm and lap weld over the top surface only. Roof plates shall have continuous fillet welds around the tank curb angle. No joint of roof plate over the supporting frame shall be made.
- 3.2.10 Openings needed for mounting various specified accessories shall be well reinforced in accordance with application codes and as approved. Manhole shall be bolted and hinged covers unless otherwise specified.
- 3.2.11 All inlet pipe nozzles located at the top of tanks shall be provided with internal piping up to 500 mm high above the tank's bottom inside with suitable weir plate at bottom. The inside piping shall be adequately supported and shall be provided with adequately sized vent connection at pipe top.
- 3.3.0 **RECTANGULAR TANKS**
- 3.3.1 Rectangular tanks shall be fabricated in steel material and shall be designed to withstand internal hydrostatic pressure. In addition, these shall be checked for a wind pressure and seismic coefficient as specified wherever applicable. While worst of these two shall be considered, the permissible stress shall be increased as per good engineering practice when their effect considered with tank load.
- 3.3.2 Tank bottom and / or side plates shall be of minimum 8 mm thick plate. Corrosion margin of at least 2 mm shall be provided over the design thickness of bottom and / or side plates.



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- 3.3.3 To support tank plates and to maintain required unsupported plate length, adequately sized and spaced steel structural closed frame shall be provided inside the tank. Longitudinal and / or vertical structural members to connect and adequately support these frames shall be provided at corners. Horizontal diagonal members / sway bracings at corner shall also be provided.
- 3.3.4 Tank plates cut to size shall be welded on these frames. Plate butt weld joints at other locations shall be eliminated to avoid warping of the plates at free joints. Adequate openings in the structural frames, particularly at the bottom shall be provided to ensure complete unrestricted drainage of tank at one point. Suitable sized drain valve of size minimum 25 NB unless otherwise specified in the **GA DRAWING OF FO TANKS** shall be provided below the tank bottom for proper draining of the tank.
- 3.3.5 Complete assembled tank shall have at its bottom longitudinal steel fabricated bearer beams welded to it. The tank with bearer will rest over number of concrete blocks to be provided by purchaser. The tank shall be adequately bolted / welded to the concrete blocks. Needed inserts / anchor bolts shall be furnished by the bidders. Grouting of tank over concrete blocks in approved manner shall be included in bidder's scope of work, if erection is also awarded to the bidder.
- 3.3.6 Where rectangular tanks are flushed in dual compartments the inside partition plate shall be well reinforced to withstand hydrostatic test pressure completely on one side throughout the full height.
- 3.3.7 The rectangular tank shall be designed as per good engineering practice and reference shall be taken from the book named "Theory of plates and shells" by Timoshenko. Design calculation shall be done in accordance with the above mentioned book.
- 3.3.8 Suitable steel structural e.g. channels shall be provided below the bottom plate so that tank can rest on the foundation / slabs through the structural supports.
- 3.4 **HORIZONTAL CYLINDRICAL TANK**
- 3.4.1 The horizontal cylindrical tank with dished ends shall be of mild steel welded construction and shall be designed in accordance with BS – 2594 / IS – 2825 / ASME as specified in the **GA DRAWING OF FO TANKS**. The tank shall be designed for a wind pressure and seismic coefficient as specified. While worst of these two shall be considered, the permissible stress shall be increased as per relevant code / standard.
- 3.4.2 The shell and dished end plate thickness shall be chosen as per design requirement but in no case the dished end and shell plate thickness shall be less than 8 mm.
- 3.4.3 All seams, longitudinal as well as circumferential, shall be butt-welded. Longitudinal seams should not be situated in the lower third of a tank or on the top center line.
- 3.4.4 All tank shall be supplied with integral saddle support and shall be designed in accordance with BS- 2594 / IS – 2825 / ASME as specified in the **GA DRAWING OF FO TANKS**.
- 4.0 **TESTING AND INSPECTION AT MANUFACTURERER'S WORKS**



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4.1 General

4.1.1 The supplier shall provide inspection to establish and maintain quality of workmanship in his works and that of his subcontractors to ensure the mechanical accuracy of components, compliance with drawings identity and acceptability of all materials, parts and equipment. He shall conduct all tests required to ensure that the equipment and material furnished shall conform to requirements of the acceptable codes. All tests and test procedure proposed by manufacturer shall be submitted to the purchaser for their prior approval.

4.1.2 All materials used for manufacture of the equipment under this specification shall be of tested quality. Relevant test certificates shall be made available to the purchaser before the final shop inspection. In case the relevant correlating test certificates are not available, the supplier shall arrange to carry out the necessary tests required by codes at his own cost.

4.1.3 Alloy cast iron and cast steel components shall be tested for both physical and chemical properties in absence of purchaser's representatives. Test bears shall be either integral or taken from the same ladle of material as the casting they represent.

4.1.4 All materials including valves, instruments, pipings, flanges, counter flanges etc. shall be procured from BHEL approved manufacturer's only. Dealers are not acceptable.

4.2 TESTING AND INSPECTION FOR TANKS

4.2.1 The scope of testing and inspection for pressure vessel covered in this specification shall generally comprise of the following:

- i) Examination and approval of fabrication drawings to ensure that design, materials and fabrication details meet requirement of code and specifications. Purchaser will review these drawings for interface problems and conformity with the general arrangement drawings and accord their approval.
- ii) Examination of materials of construction and identification with material test certificates.
- iii) All the plates of thickness 50 mm or more shall be ultrasonically tested to ensure freedom from laminations.
- iv) Ensuring the relevant weld procedure and welder qualification tests are in accordance with stipulated code requirements.
- v) Inspection of dished end flanges and alloy steel bolting where required.
- vi) Inspection during fabrication at appropriate stages including fit ups.
- vii) For all butt welds, the root run and final run shall be subjected to dye-penetrant or magnetic particle inspection. For all fillet welds the final run shall be subjected to dye-penetrant / magnetic particle examination.
- viii) Examination of radiographs including radiographic techniques, supervision of other non - destructive tests and heat treatment procedure as required by codes and specifications.



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- ix) Examination of internal cleanliness before final closure.
- x) Dimensional examination of completed vessel including axis marking, proof marking, match marking etc.
- xi) Witnessing of hydrostatic, pneumatic or vacuum tests or special tests as required by the code and specification. In case of hydrostatic tests, the test pressure must be kept for a minimum of two hours.
- xii) Witnessing cleanliness, preservation, packing and marking.
- xiii) Stamping of vessel and issue of certificates.
- xiv) All tanks under this specification shall be tested as per the relevant design and testing code / standard. Supplier shall submit the detailed testing procedure for the tanks during detail engineering stage for BHEL / customer / consultant's approval and approved document shall be adhered by them and testing shall be done accordingly without any commercial implication.

4.2.2 **NON - PRESSURE TANKS**

The scope of testing and inspection for non-pressure tanks covered in this specification will comprise of the following:

- i) Identification of materials to manufacturer's test certificates.
- ii) Inspection of plate edges after edge preparation and checking curvature against templates if shell plates sent after rolling.
- iii) Checking of dimension and match marking.
- iv) Bottom testing
 - a. After the bottom and bottom course of shell plates have been welded, the bottom shall be tested by pumping air beneath the bottom plates to a pressure just sufficient to lift them off the foundation and in any case not less than 100 mm water gauge. The pressure shall be held by construction of a temporary dam of clay or other suitable material around the tank periphery. Soap suds or other suitable material shall be applied to all joints for detection of leaks.
 - b. Fuel oil may be used instead of air and soap suds to test for leaks, subject to prior agreement and approval of purchaser.
 - c. Alternatively, the bottom seams may be tested by vacuum box method subject to prior agreement and approval of the purchaser. The vacuum box used shall comply with IS- 803, 1976 (figure-24)
- v) Shell testing



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The shell of fixed roof non - pressure tanks shall be tested after completion of roof. Testing shall be done by filling the tank with water to the level of the top leg of the top curb angle and noting any leaks.

vi) Roof testing

The roof of the tank shall be tested by pumping air under the roof plates while the tank is still full of water. In the non - pressure tank, the roof shall be tested to a pressure of 75 mm of water gauge and in case of pressure roof tanks, to a pressure of one and a quarter times the pressure at which the pressure sides of the pressure / vacuum relief valve is designed to open. Soap suds or other suitable material shall be applied to all joints for detection of leaks.

vii) All field-testing shall be performed prior to any painting or coating application.

4.3 REPAIR OF LEAKS

4.3.1 All leaks detected during testing shall be repaired to the satisfaction of the purchaser and on completion retested for leakage as per approved procedure.

4.3.2 In the joints between roof plates only, pin hole leaks may be repaired by mechanical caulking. However, where there is any indication of considerable porosity, the leaks shall be sealed by laying down an additional layer of weld over the porous sections.

4.3.3 In all other joints, whether between shell plates or bottom plates or both, leak shall be repaired only welding and if necessary, after first cutting out the defective part.

4.3.4 When the tank is filled with water for testing, defects in the shell joints shall be repaired with the water level at least 300 mm below the joint being repaired.

4.3.5 No welding shall be done on any tank unless all lines connecting thereto have been completely blanked off. No repairs shall be attempted on tanks while filled with oil, nor any tanks which have contained oil until the tanks have been emptied, cleaned and freed from gas in a safe manner. No repair shall be attempted on a tank which has contained oil except in a manner approved in writing by the purchaser, and in absence of the purchaser's inspector.

5 X 800MW YADADRI TPS

TECHNICAL SPECIFICATION
FOR
FUEL OIL UNLOADING & STORAGE SYSTEM

SECTION-IIB
(FORMAT FOR O& M MANUAL)



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA

Format for Operation & Maintenance Manual

Project name :

Project number :

Package Name :

PO reference :

Document number :

Revision number :

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

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				
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				