

For pipes up to and including 100 NB, provided the pipe does not exceed 12.7 mm in thickness, gas welded butt joints will be accepted without backing rings.

Welded joints in pipe work shall be pre-heated to a temperature as required by the agreed standard or code or to the approval of the Engineer. The temperature shall be maintained during the welding operation and a record of metal temperature shall be obtained by means of a recording thermometer throughout the welding operation.

All welds shall be built-up by the application of multiple layers or passes. The thickness of metal applied for each layer or pass shall not exceed 3 mm. Each layer shall be cleaned and lightly peeled before the next layer is applied. Before being assigned to welding work, each operator shall have passed a qualification test as prescribed in the applicable Code/ Regulations. Each approved welder shall have an identification number which shall be indicated on all welds.

Welded joints shall be stress relieved as per ANSI B31.1/IBR. Stress relieving temperature shall be measured by thermocouple pyrometers or other suitable equipment. Readings of temperature against time shall be recorded.

33.6.13

#### **BENDS AND ELBOWS**

- (a) Elbows shall be generally of long radius type.
- (b) Bends for piping 65mm NB and above shall be made hot and for piping 50mm NB and smaller may be made cold.
- (c) Bends shall be made in accordance with PFI-ES-24. Bends shall be supplied with the minimum tangents except where the piping layout necessitates shorter lengths in which case the tangents shall be suitably reduced after the bending operation to suit the requirements of the piping layout.
- (d) Heat treatment of bends shall be done as per material specification.
- (e) Where examinations of bends indicates that wall thinning has resulted in thickness less than the minimum specified, repair by weld deposition shall be allowed only where the length of the affected area is 150mm or less as measured along the outside arc of the bend. Repairs in excess of this amount shall not be allowed. All repairs shall be carried out only after approval of the employer.
- (f) Circumferential butt weld shall not be used in the area of the bend. Longitudinal welds, where bends are formed from welded pipe shall be located on the bend's neutral axis.
- (g) Bend thinning allowance on straight pipe prior to bending shall be applied as per ANSI B 31.1. For bends of 5D or higher radius, the difference between maximum and minimum diameters shall not exceed 8 percent of average measured outside diameter of the pipe before bending.
- (h) All bends in 50 NB and larger piping shall be made hot. Bends in 40 NB and smaller piping may be made cold only when commercially available bending

shoes are used. Finished bends shall be smooth in contour and free from buckles and distortion.

- (i) Pipe bends may be fabricated by the incremental induction heating process. Circumferential butt welds or longitudinal welds (where seamless piping has been specified) shall not be used in the arc of the pipe bends, without Engineer's permission. After bending, such welds, where permitted, shall be re-examined and re-inspected.
- (j) All piping bends are subject to heat treatment as required by the original material specification unless otherwise approved by the Engineer.
- (k) All pipe bends in 50 NB and larger piping shall be examined ultrasonically after fabrication for wall thickness conformance. Measurements shall be taken in accordance with PFI Standard ES-20 using the "Pulse Echo" method. Data reports containing information as recommended in PFI Standard ES-20 shall be forwarded to the Engineer for record purposes.
- (l) Where examination of pipe bends indicates that wall thinning has resulted in less than code required minimum wall thickness repair by weld deposit shall be allowed only where the affected area is 150 mm or less as measured along the outside arc and with Engineer's approval. Repairs in excess of this amount shall not be permitted.

#### 33.6.14

#### **End Preparation, Cutting etc.**

- (a) For steel pipes, end preparation for butt-welding shall be done by machining/flame cutting.
- (b) Socket weld end preparation shall be saw/machine cut
- (c) For tees, laterals and other irregularities details, cutting template shall be used for accurate cutting and cutting shall follow the outline of the template.

#### Alignment Considerations

- The pipes joined by welding shall be aligned correctly within the existing tolerances on diameter, wall thickness and out of roundness, which shall be preserved during welding.
- All flange facings shall be true and perpendicular to the axis of the pipe with boltholes being off centre.

#### 33.6.14.1

Branch connections shall conform to the requirements of ASME B 31.1. All branch connection welds shall be full penetration welds, except as permitted by ASME B 31.1/IBR. The branch connections shall generally conform to the following :

- Socket welding and threaded connections on pipelines shall be made by forged outlet fittings. The holes in pipe headers made for these connections shall be drilled to the same size as the fitting inside diameter. All burrs shall be removed and threaded fitting shall be repeated after welding.

- For branch connection, additional reinforcements shall be provided wherever necessary by the applicable codes including supply of necessary material by the contractor at his own cost.
- The design and fabrication details for the instrument stub connection are included in Tenderer's scope. Materials for instrument connection shall be the same as that of the pipe to which it is attached. Fittings ratings shall be in accordance with those specified for the main process pipe.

33.6.14.2 All materials that are bent, forged or informed shall be subjected to heat treatment after the forming operations as required by the original material specification. For ally steel materials the preferred heat treatment process is full annealing.

### **33.6.15 SPECIFIC REQUIREMENTS: WELDING**

In addition to the requirements spelt out elsewhere, the followings shall be taken into consideration:

#### **33.6.15.1 Welding Process**

- (a) Welding under this specification shall be done by one of the following processes :
  - (i) Manual oxy-acetylene welding process
  - (ii) Manual shielded metal arc process (SMAW)
  - (iii) Manual inert gas tungsten arc process (TIG)
- (b) Automatic or semi-automatic welding shall be done only with the specific approval of the Owner/Consultant.
- (c) Socket weld joint shall be done with low hydrogen type covered electrodes with manual shielded metal arc process.
- (d) Welding at any joint should be completed uninterrupted. If this procedure cannot be followed for some reason, the weld shall be insulated for slow and uniform cooling.
- (e) As far as possible welding shall be carried out in flat position. If not possible, welding shall be done in a position as close to flat position as possible.
- (f) As a rule no backing ring shall be used for circumferential butt welds.

#### **33.6.15.2 Alignment and Spacing**

- (a) Components to be welded shall be aligned and spaced. Root opening shall be as under :

- (i) For wall thickness 2.5 mm or under and for all thickness in oxy-acetylene welding 1.0 mm - 2.0 mm
- (ii) For wall thickness over 2.4 mm 2.0 mm - 3.0 mm

Special care shall be taken for fitting and alignment in case of inert gas tungsten arc welding. Flame heating for adjustment of ends is not permitted without the approval of the Owner/Consultant.

- (b) A wire spacer of proper diameter may be used for the weld root opening but must be removed after tack welding and before application in root pass.
- (c) Tack welding for the alignment of pipe joints shall be executed carefully and shall be free from defects since tack welds form a part of final welding. Defective welds shall be removed prior to the welding of joints. Electrode size for tack welding shall be selected depending upon the root opening.
- (d) Tacks should be equally spaced as follows:
  - (i) For 65 NB pipe and smaller 2 tacks
  - (ii) For 80 NB to 300 NB pipe 4 tacks
  - (iii) For 350 NB and larger pipes 6 tacks

### 33.6.15.3 Welding Technique

- (a) Root pass shall be made with respective electrodes/filler wires. The size of the electrodes shall not be greater than 3.25 mm (10 SWG). Welding shall be done with direct current values recommended by the electrode manufacturers.
- (b) Upward technique shall be adopted for welding pipes in horizontally fixed position. For pipes with wall thickness less than 3 mm, oxy-acetylene welding is recommended.

### 33.6.17 **CLEANING AND PROTECTION**

- (a) All fabricated piping shall be cleaned as per relevant SSPC cleaning technique/practice such that both inside and outside surface of the piping are free of sand, loosely adhering scale, dirt and other foreign matters.
- (b) After cleaning outside surface shall be coated with enamel or other protective paint, the weld end preparation shall be coated with deoxyaluminate paint and protected adequately. Use of grease or oil. Other than light grade mineral oil is not allowed.

- (c) After desiccating and preservation, the fabricated sections shall be covered, boxed, capped, or others shielded from further contamination or corrosion.

### 33.6.18 **MARKING**

- 33.6.18.1 All piping shall be marked clearly and legibly at the shop with its identifying pipeline description and piece no. as per the appropriate component or spool piece fabrication drawing.
- 33.6.18.2 Marking shall be by any method which does not produce sharp discontinuities and the marking does not get erased until the piping is erected. Piping 6 mm and thicker may be marked by stamping using round nose or dot interrupted die stamps with minimum nose radius of 0.8mm.
- 33.6.18.3 Item too small to be marked shall have metal tags securely attached to each bundle or container of such items such that it does not get erased until the item has been erected.

### 33. 6.19 **SPECIFIC REQUIREMENTS- ERECTION**

- 33.6.19.1 Where control valves, flow nozzles, orifices and other piping appurtenances are to be installed, they shall be installed only after steam blowing and chemical cleaning operation. After the completion of the steam blowing / chemical cleaning the contractor shall cut spool pieces of required length and install the components.
- 33.6.19.2 Field run piping shall be erected only after completion of the erection of all other piping system structures and equipment unless otherwise approved/directed by the employer.
- 33.6.19.3 when C clamps are tack welded to the pipe for the purpose for the alignments of a joint, preheating for the lack welding shall be performed if the main joint adjacent to it to be preheated as per the requirement of this specification, otherwise preheating for the tack weld may be omitted after the joint is completed, all tack weld shall be removes, flushed with the adjacent of pipe by chipping and /or grinding. The areas where C clamps were attached shall be subjects to stress reliving as required.
- 33.6.19.4 The hydrostatic testing of the piping system shall be done after proper installation of all permanent hangers/supports. Springs hangers shall be locked during hydrostatic test. Prior to steam blowing all hangers which had been locked for the hydrostatic testing shall be unlocked.
- 33.6.19.5 The setting and logging of all supports, restraints/limit stop, spring hangers, etc, is the responsibility of the contractor. The initial setting on all hangers and supports and clearance on restrains and limit stops shall correspond to the design cold values. The contractor shall check all readings after completion of erection of piping system and application of insulation and carry out readjustment as necessary to be in line with the design cold values. After satisfactory setting of all hangers/restraints. Hangers reading / clearance shall be logged by the contractor in proper format and a joint protocol be made.
- 33.6.19.6 The contractor shall monitor the behavior of all hangers, supports, restrains etc. during the initial stage of plant operation. When the piping system(s) have attained their rated temperature the contractor shall log, hanger reading, snubber deflection, restrains/limits stop clearances as specified elsewhere.

33.6.19.7 **All gaskets shall be asbestos free material and suitable for the service application.**

33.6.20 **SPECIFICATION FOR POWER CYCLE PIPING & FITTINGS**

S. No.	Description	Alloy Steel	Carbon Steel
A	<b>PIPES</b>		
	Material	X20 Cr Mo V 121 to DIN 17175 or ASTM A335 Gr P91 (For all temp above 510 deg C)  ASTM A 335 Gr P22	ASTM A 106 Gr B/ ASTM 106 Gr C (A 106 Gr C for BFD design parameters, CRH design parameters & above) ASTM A 672 Gr B 60 CLASS-12/ 22
	Construction	Seamless	Seamless
B	<b>FITTINGS</b>		
	Material for 65 NB & Above	X20 Cr Mo V 121 to DIN 17175 or ASTM A 234 Gr WP91 (for temp above 510 Deg C) ASTM A 234 Gr WP 22	ASTM A 234 Gr WPB with A 106 gr B piping
	Material for 50 NB & Below	ASTM A 182 Gr F 91 (For all temp above 510 deg C) ASTM A 182 Gr F 22	ASTM A 105
	Construction	Seamless (forged for 50 NB & below)	Seamless (forged for 50 NB & below)
	Basic Standards	ANSI B 16.9 ANSI B 16.11 ANSI B 16.25 ANSI B 16.28	ANSI B 16.9 ANSI B 16.11 ANSI B 16.25 ANSI B 16.28
	Rating/wall/thickness	To match with that of pipe	To match with that of pipe
C	<b>WELDING</b>		
	Backing rings	Not permitted	Not permitted
D	<b>MATERIAL ANALYSIS</b>		
	MANDATORY REQUIRMENTS	All tests, as given in respective material code (other than supplementary requirements). Shall be carried out as minimum. This includes the tests wherein it is specified in the respective material code that "the test is to carried out when specified by the purchaser" or any such indication, in the code.	

**E. HYDROSTATIC TEST PRESSURE**

~~(1) Piping system under IBR purview:~~

~~At shop~~

~~All piping including fabricated piping shall be hydro tested at 1.5 times the design pressure subjected to regulation 374 of IBR. However, non-destructive testing in lieu of hydro test is also acceptable subject to regulation 343 (3) of IBR~~

~~After erection~~

~~All piping system shall be hydro tested at 1.5 times the design pressure subjected to regulation 374 of IBR. However for such systems where it is practically not possible to do hydro tests. The test as called for in ANSI B 31.1 & IBR in lieu of hydro test~~

shall also be acceptable.

~~**Hydro test of boiler feed piping:** since isolating valve is not provided at economizer inlet, contractor to make all necessary arrangement of hydro testing of BFD piping beyond HP heater downstream heating isolating valve upto TP either by blanking or providing a temporary valve. NDT as per the provision of IBR & ASME B 31.1 can be carried out for the joint at TP between SG & TG contractor.~~

(2) Non- IBR piping system:-

At shop	All piping including fabricated piping shall be hydro tested at 1.5 times the design pressure subjected to regulation 374 of IBR. However, non-destructive testing in lieu of hydro test is also acceptable subject to regulation 343 (3) of IBR
After erection	All piping system shall be hydro tested at 1.5 times the design pressure subjected to regulation 374 of IBR. However for such systems where it is practically not possible to do hydro tests. The test as called for in ANSI B 31.1 & IBR in lieu of hydro test shall also be acceptable.

Note:

1. EFW pipes as per A 672 are acceptable if the design pressure and design temperature are such that it calls for ASME 300 class & below piping and size is 550NB and above. The fitting shall correspond to ASTM A 234 with grade corresponding to the pipe. Material. Welded construction fitting are also acceptable with A672 piping. However all requirements as per ASME B31.1 including the requirements given in mandatory appendix-D, IBR & respective material code shall be fully complied with, in respect of welded firings
2. In case the design temperature is above 545 deg C, then P91 material only shall be applicable for both pipes as well as fittings.

Materials for fittings, specialties and valves shall be corresponding to piping material.

### 33.6.21 SPECIFICATION FOR POWER CYCLE VALVES

#### 33.6.21.1 General Requirements

33.6.21.1.1 All the control station configuration shall be as follows.

(a) For Continuous Service requirement:

- (i) One (1) pneumatically/hydraulically operated control valve.
- (ii) One (1) motor operated isolation valve at the upstream side of control valve.
- (iii) One (1) manual operated isolation valve at the downstream side of the control valve.

- (iv) One (1) pneumatically/hydraulically operated bypass control valve.
  - (v) One (1) motor operated isolation valve at the upstream side of the bypass control valve.
  - (vi) One (1) manual operated isolation valve at the downstream side of the bypass control valve.
  - (vii) Non return valve in the common downstream line, for spray piping.
  - (viii) Drain valves at upstream and downstream of the control valves.
- (b) For Intermittent Service requirement:
- (i) One (1) pneumatically/hydraulically operated control valve.
  - (ii) One (1) motor operated isolation valve at the upstream side of control valve.
  - (iii) One (1) manual operated isolation valve at the downstream side of the control valve.
  - (iv) One (1) motor operated inching type regulating bypass valve.
  - (v) One (1) motor operated isolation valve at the upstream side of the bypass valve.
  - (vi) One (1) manual operated isolation valve at the downstream side of the bypass valve.
  - (vii) Non return valve in the common downstream line, for spray piping.
  - (viii) Drain valves at upstream and downstream of the control valves.

All valves shall have cast/forged steel bodies with covers and glands of approved construction. The valves shall be provided with electric motors/solenoids and actuators as required.

Locating the valves on vertical runs shall be avoided as far as possible

All valves shall, unless otherwise approved, have ends prepared for butt-welding and the internal diameter shall be the same as the internal diameter of the pipes to be joined.



All valves shall receive tests at Manufacturer's or Contractor's works in accordance with the specific requirements of the approved Codes of Practice so that the same is acceptable to IBR where applicable. Valves shall be rising stem or otherwise as approved by the Owner.

All valves shall function smoothly without sticking, rubbing or vibration on opening or closing.

Material, design, manufacture, testing etc. for all valves and specialties along with the accessories shall conform to the codes as specified or approved equivalent and acceptable to IBR.

By-pass valves shall be provided for high pressure and larger size valves (including control valves) as per standards followed and as felt necessary for smooth and easy operation, even though not specifically mentioned in the specification.

Valves subjected to vacuum shall have sufficient long deep-seated packing. Valves in general shall preferably be of such design as to permit repacking while in service by providing back seating arrangement duly tested during manufacture.

All valves shall have outside screwed spindles and screwed thread of spindle shall not pass through or into the stuffing box. Where valves are exposed to the weather, protective covers shall be provided for the spindles, which shall be subject to approval.

Valves requiring sealing water shall be adequately deep and shall be equipped with lantern ring to admit pressurised water for gland-sealing. Gland sealing water shall be tapped from one tapping point on the condensate extraction pumps discharge header and shall be reduced in pressure as per the requirement.

The stops which limit the travel of any valve in the "Open" or "Shut" position shall be arranged exterior to the valve body.

All regulating valves shall be designed to prevent erosion of the valve plugs and seats when the valves are operated partially opened. The valves shall have contoured plug.

Approved access arrangements shall be provided for all valves and particular attention shall be given to those valves fitted with gearing, which require lubrication of the valve itself.

Valves which cannot be operated from the floor or walkways shall be provided with suitable extension rods and linkages. If such a valve is provided with integral bypass then similar arrangement shall be done for the bypass valve also. The extension shall be such that the hand wheel is at a height of approximately one metre above the level of the floor or platform from which the valve is to be operated. Where required, valves shall be provided with head-stocks and pedestals of rigid construction and where gears or level wheels are used, these shall be of cast steel or suitable quality cast iron with

machine cut teeth. Where extension spindles are fitted, all thrust when opening or closing the valves shall be taken directly on the valve body. The extension linkage shall be so designed to take care of the thermal movements of the valve body with the pipe on which the valve is installed. The connection of the extension spindle to the valve stem shall be through a flexible coupling.

The extension spindle shall be of the same material as that of the valve stem. The floor stands shall have column, not less than Group-B of ASTM-126. Necessary nuts and bolts for mounting the floor stands on foundation shall have to be provided. Adequate means of easy lubrication shall have to be provided for valves and operating extension components.

Stems shall preferably be arranged vertically with gland at the top, however, in no circumstances must the stem be inclined downward from horizontal or gland be at the bottom. Globe valves shall be installed with the pressure under the disc. Valves shall not be fitted in inverted position.

Where necessary, for accessibility, grease nipples shall be fitted at the end of extension piping and where possible these shall be grouped together and mounted on a common panel situated at a convenient position. A separate nipple shall be provided to lubricate each point. The Contractor shall supply the first fill of oil or grease for these parts. The Contractor shall supply a suitable manually operated grease gun for the standard type of nipple provided.

The spindles for all valves for use outside the building shall have weatherproof protection covers of approved construction.

All valves shall be fitted with indicators so that it may be readily seen whether the valves are open or shut. In the case of those valves fitted with extended spindles, indicators shall be fitted both to the extended spindles and to the valve spindles.

Plastic or bakelite valve hand wheels are not permitted.

All valves shall be closed by rotating the hand wheel in a clockwise direction when looking at the faces of the hand wheel. The face of each hand wheel shall be clearly marked with the words 'Open' and 'Shut' with arrows adjacent to indicate the direction of rotation to which each refers.

Each valve hand wheel shall be fitted with a circular nameplate of approved material indicating the valve tag number, duty or service intended and the function of the valve. The nameplates shall incorporate the colour code corresponding to the service of the piping.

Wherever practicable, heavy valves of total weight including actuator, drive motor, integral by-pass etc equal to or greater than 500 kg shall be provided with suitable lugs to permit direct suspension by hanger rods or direct resting on bottom support, as applicable.

Special attention shall be given to the operating mechanism for large size valves in order that quick and easy operation is obtained and maintenance is kept to a minimum.

Eyebolts shall be provided where necessary to facilitate handling heavy valves or parts of valves.

The Bidder shall supply during the course of the Contract, comprehensive drawings showing the design of valves, test pressure and working pressure /temperatures. They should include a parts list referring to the various materials used in the valve construction.

Gate valves below 100 NB shall be solid wedge/Flexible wedge type. Valves of 150/300 and size 100 NB and above shall be flexible wedge type. However, for sizes 100 NB and above for temperature 300oC above, parallel slide gate valves shall be used.

All sampling and root valves shall be of integral body bonnet type.

For butterfly valves, Contractor shall guarantee that in the closed position and with a disc differential pressure as specified, the valves shall be water tight.

Contractor shall guarantee that the operating mechanism shall open and close the valve under the specified maximum differential pressure within the time specified.

**A. CAST STEEL VALVES (GATE/ GLOBE/ CHECK 65 NB & Above)**

S. No.	Description	Alloy Steel		Carbon Steel		Stainless Steel
		600 lbs & below	600 lbs & above	600 lbs & below	600 lbs & above	400 lbs & below
1.0	Basic Standard	ANSI B 16.34				
2.0	Construction					
a	Bonnet/ cover	Bolted Type	Pressure Type	Bolted Type	Pressure Type	Bolted Type
b	Disc					
	Globe Valves	Throttling Type Plug				
	Check Valves	Twilting/ swing type				
	Gate Valves	Solid/ flexible wedge below 100 NB				
		Flexible Wedge for 100 NB & above				
c	Seat	Integral Type				
3.0	Material					
a	Body, Bonnet & Cover	ASTM 216 Gr WCB	ASTM 216 Gr WCC	ASTM A 217 WC9 ASTM A 217 Gr C 12A		ASTM A 351 CF 8
b	Stem	13% Chrome Steel ASTM A 182 Gr F6A				ASTM 182 F316/ F 304
c	Hinge Pin (for check valves)	13% Chrome Steel ASTM A 182 Gr F6A				ASTM 182 F316/ F 304
d	Disc & Seat ring (heat treated & hardened)	ASTM A 216 Gr WCB minimum	ASTM A 216 Gr WCC	ASTM A 217 Gr WC9 ASTM A 217 Gr C12A		ASTM 182 F316/ F 304
		Hardness 250 BHN	Seating surface hard faced with satellite 350 BHN			
e	Back seat/ stem guide bushing	ASTM A 182 gr F6a 13% Cr SS with stellite hard facing				ASTM 182 F316/ F 304

**B. FORGED STEEL VALVES (GATE/ GLOBE/ CHECK 50 NB & Below)**

S. No.	Description	Carbon Steel	Alloy Steel	Stainless Steel
1.0	Basic Standard	ANSI B 16.34		
2.0	Construction			
a	Bonnet/ cover	Bolted Type for 600/ 800 lbs Seal welded for 900 lbs & above		Seal Welded/ Bolted Type for 600/ 800 lbs Seal welded for above 800 lbs
b	Disc			
	Gate Valves	Solid Wedge Type		
	Globe Valves	As per mfg std		
	Check Valves	Piston Lift		
c	Seat	Integral Type		
3.0	Material			
a	Body, Bonnet & Cover	ASTM A 105	ASTM A 182 Gr F22 ASTM A 182 Gr F91	ASTM 182 F316/ 304
b	Stem	13% Chrome Steel ASTM A 182 Gr F6A		ASTM 182 F316/ F 304
c	Hinge Pin (for check valves)	13% Chrome Steel ASTM A 182 Gr F6A		ASTM 182 F316/ F 304
d	Disc & Seat ring	ASTM A 105 with stellite minimum Hardness 350 BHN	ASTM A 182 Gr F22/ F 91 hard faced with satellite minimum hardness 350 BHN	ASTM 182 F316/ F 304 hard faced with satellite minimum hardness 350 BHN

**C. ANGLE GLOBE VALVE**

S. No.	Description	Alloy Steel	Carbon Steel
1.0	Design Standard	ASME B 16.34	
2.0	Material		
a	Body & Bonnet	A 182 Gr F22/ F 91 or better	A 105 or better
b	Spindle/ disc	Stellited	
c	Body Seat & Back Seat	Stellited	
d.	Gland Packing	Graphite	
3.0	Construction		
a	Valve Type	Outside Screw & yoke Type	
b	Body & Bonnet	Forged body with integral/ welded bonnet connection	
c	Disc type	Taper plug or parabolic type to suit system requirement	
d	End connection	Socket weld (ANSI B 16.11) for sizes 50 Nb & below Butt weld (ANSI B 16.25) for sizes 65 NB & above	
e	Pressure rating	To suit the service condition. However minimum pressure rating shall be corresponding to ANSI Class 1500	

**D OTHER VALVES (65 Nb & Above)**

S. No	Description	Safety Valve		Relief Valve	BF Valve
		Alloy Steel	Carbon Steel		
1.0	Design Standard	ASME B 16.34			AWWA C 504
2.0	Pressure Class	400 lbs & below			75 B & above
3.0	Accumulation	10% (max)			
4.0	Blowdown	5% (max)		10% to 15%	
5.0	Construction				
a	General	Spring loaded with weld end inlet, pop up type		Spring loaded with flanged inlet & outlet	Long body butt welded
b	Bonnet	Bolted type			
c	Seat bushing	Renewable type screwed on and held in position type			
d	Shaft seat				O ring type
6.0	Material				
a	Body & Bonnet cover	ASTM A 217 WC 9/ C 12A	ASTM A 216 Gr WCB/ WCC		ASTM A 216 Gr WCB
b	Spindle/ Shaft	Stainless Steel			ASTM A 182 Gr 304
c	Disc, nozzle, seat ring	ASTM A 182 F 316			ASTM A 216 Gr WCB  Seal & O Ring : EOT/ BUNA – N/ Neoprene for water service EOPT/ EPDM for steam service
d	Spindle Guide	17% Chrome steel or monel, heat treated and hardened to minimum hardness 250 BHN			
e	Spring	Stainless Steel or Tungsten Steel	Carbon Steel		
f	Retainer Rings and Internal Bolts				SS 304
g	Bearing				Sleeve type self lubricated

Note the material of body, bonnet/ cover & disc shall be corresponding to that of pipe material on which valve is installed.

**33.6.22 SPECIFIC REQUIREMENTS**

1. Valve of size 65 NB and above shall have butt welded ends as per ANSI B16.25 and valves 50 NB and below shall have socket weld ends as per ANSI B16.11
2. Locking arrangement, wherever specified shall be of non-detachable type.
3. Valve shall be tested in accordance to ANSI B 16.34, however, for butterfly valves; the requirements of AWWA C-504 shall also be met.

4. All gates and globe valves shall be without side screw and yoke with rising stem.
5. Gate valve below 100 NB shall be solid wedge/flexible wedge type, valve of size 100 NB and above shall be of flexible wedge type. However, for sized 100mm NB and above for temperature above 300 °C, parallel slide valves are also acceptable.
6. Specification for valve shall be as indicated in C&I subsection.
7. Stem for all valves shall be heat treated and hardened- minimum, hardness 200HB and surface finish of 16 RMS or better in area of stem packing.
8. Gland packing for gate and globe valves shall be alloy steel/SS wire reinforced graphite with stem corrosion inhibitor.
9. All bolts and nuts shall be ASTM A-193 Gr. B 7 and ASTM A-194 Gr. 2H respectively.
10. Hand wheel for valves shall be of malleable iron / carbon steel.
11. Minimum differential hardness between seat and other disc material shall be 50 HB in case of 13 % chrome hardened with heat treatment of steel.
12. Valves closure test shall be as per supplied complete with discharge elbow and drip pan along with drain.
13. For valve of size 65 NB and above in vacuum service, water gland-sealing arrangement shall be provided. For valve of size 50 NB and below, deep gland packing shall be provided. Butterfly valves, subjected to vacuum, shall be tested for vacuum as per relevant code.

33.6.23

**SPECIFICATION FOR HANGERS/SUPPORTS**

Design and manufacture of hangers/supports shall conform to ANSI B 31.1 MSS-SP-58, MSS-SP-89

Where hangers rod angularity exceed 4 degree from cold to hot position (at rated parameters), the hanger and structural attachments shall be offset in the cold position in such a manner that the hanger rod is vertical in hot position unless otherwise specified.

The contractor shall furnish, detailed arrangement sketches for each support, restrains, anchor, etc. the sketches shall include the key plan identification no. bill of quantities, design load , operating load, spring stiffness, amount of precompression, centre line elevation of pipe, spring box position/orientation, etc.

Hangers support tag no. shall be marked on all pipe hangers/support, restraints and anchor assemblies, the design loads, hot and /or cold loads shall be stamped on respective constant and variable springs.

33.6.24

**TECHNICAL REQUIREMENTS**

- (a) Each threaded connection and adjustable rod shall be provided with lock nuts.
- (b) Each rod of a double rod hanger support shall be designed for the full hydro test load coming on the double rod hanger assembly.

- (c) Hanger support rods of less than 10mm diameter for supporting pipes of 50 NB and smaller and less than 12mm diameter for supporting pipes of 65 mm NB and larger, shall not be used.
- (d) Parts of the hanger or support which move relative to the pipes during operation shall be connected to the pipe attachments in such a manner that they lie entirely outside the pipe thermal insulation.
- (e) Attachment to piping shall be as far as possible by clamps.
- (f) Where axial movement is to be restricted or riser clamps are used, suitable lug stops to prevent pipe movement shall be designed for welding on to pipe.
- (g) Bolted pipe clamps shall have a minimum thickness of 5mm for weather protected locations and 6 mm for locations exposed to weather.
- (h) Beam clamps shall be forged steel equipment with a rod to fix a nut.
- (i) All sliding surface of supports and restrains shall have Teflon lining on one surface coming in contact with stainless steel lining on the other surface.
- (j) All piping hangers and supports shall be designed to carry the weight of the piping fitting, thermal insulation, self weight of the hanger assembly and medium transported or test medium whichever is heavier. In addition all rigid rod hangers and variable spring shall be designed to carry the operation load in hot condition.
- (k) All design and fabrication including loading and allowable stresses shall be in accordance with ANSI B31.1. Note shall be taken of the requirements against earthquake at site. Hangers and supports for systems shall be completely engineered and prefabricated for all piping 50 NB and above. Sufficient random materials shall be furnished for field support of all lines of smaller diameter.
- (l) For pipes of design temperature 1000C and more, bottom supports shall be avoided as far as possible and hanger type supports shall only be used. However, where bottom support cannot be avoided, the same shall be provided with suitable shoes along with balls/rollers/rockers (if movement is more than 50 mm) and SS/Graphite is to be used (if the movement is more than 20 mm) to minimise frictional resistance against thermal movements. The material of shoe as well as the ball/rockers/rollers shall be suitable for the design temperature of the supported pipe and shall be of sufficient hardness so as to permit a reasonably long life keeping its roundness and maintaining a low friction factor. Where a constant load type support is required, the bottom support shall also be of constant load type.
- (m) Provision shall be made for support of piping which may be disconnected during maintenance work.
- (n) Support steel shall be of structural quality. Perforated strap, wire or chain shall not be used. Support components shall be connected to support steel by welding, by bolting or by beam clamps. Bolt holes shall be drilled, not burned. Support components may be bolted to concrete using approved concrete anchors.
- (o) Double nuts or lock-nuts shall be used on hanger rods and bolts in all cases.
- (p) Variable springs shall be furnished with travel stops. The travel stops shall be factory installed at the "cold" position.



- (q) Spring hangers should not be loaded more than 80% of the spring travel range.
- (r) Both constant load and variable spring support/hanger shall be provided with outside indicators for deflection and load. Provision for the site adjustment of load at least  $\pm 10\%$  shall be incorporated. Also spring locking arrangement and turnbuckles of load/position adjustment shall be provided for all hangers.
- (s) Constant load type spring support/hangers shall be so selected as to permit, for the specific load, an over-travel of at least 25 mm or 20% (whichever is greater) of the specified range of vertical travel. The initial setting of the hangers/supports shall be such that half of the "over-travel" is allowed in either direction. Constant support hangers shall have a support variation of not more than 6% throughout the total travel range.
- (t) Rigid hangers & restraints shall be judiciously selected, without exceeding the stipulated limits of terminal forces & moments & stress level. Struts shall be considered where compressive load is expected.
- (u) Where the piping system is subject to shock loads, such as thrust imposed by the actuation of safety valves (SV), hanger design shall include provision for shock absorbing devices of approved design.
- (v) Vertical restraints near safety valves shall be preferred for taking SV discharge thrust, provided equipment terminal reactions remains within allowable limit.
- (w) Attempts shall be made to avoid use of shock absorbers, dampers etc as far as possible to take care of occasional loading like seismic effect etc by proper engineering of the piping design and effective use of restraints. However, shock absorbers, VISCO- dampers, wherever felt necessary are to be supplied and erected by the bidder.
- (x) Layout of piping shall be properly designed to avoid excessive vibration by effective use of restraints. However, wherever felt necessary, shock absorbers, VISCO- dampers may be employed.
- (y) Hanger rods (except rigid hangers where both tension and compression may occur) shall be subjected to tensile loading only. At hanger locations where lateral movement is anticipated, suitable linkage and rocking washers shall be provided to permit swing.
- (z) For all hangers, the length of suspension shall be so selected that the hanger rod may never make an angle of more than 40 with vertical due to horizontal pipe movements. If this cannot be avoided by erecting the hanger vertically for cold condition, it shall be suitably off set so that the above requirement is fulfilled in cold as well as hot conditions. Hangers shall be designed so that they cannot become disengaged by movements of the supported pipe.
- (aa) Hanger support rods of less than 10 mm diameter for supporting pipes 40 NB and smaller and less than 13 mm diameter for supporting pipes of 50 NB and larger, shall not be used.
- (bb) Supports, guides and anchors shall be so designed that excess heat will not be transmitted to the building steel.
- (cc) Tie rods/struts shall preferably be used for restraints to achieve low friction restraining.

- (dd) The Tie-rods/struts shall have proper arrangement and adequate length, so that, thermal movements in other directions, which are intended to be free are not constrained and there is no appreciable shift in centreline of pipe or the elevation of the supporting point on pipe due to sway. The design shall have provisions for adjusting the length to take up any slack and securely locking in position permanently once adjustment is done.
- (ee) Snubbers & dampers shall be designed to take seismic/dynamic loads, thrust due to safety valve discharge. Effort shall be made to limit its use by judicious placement of rigid hangers.
- (ff) Bottom support spring hangers to be avoided as far as possible.

## 33.6.25

**SPRING HANGERS**

Constant load hangers shall generally be used when vertical displacement exceeds 40 mm or where the supporting effort variation of available variable spring exceeds 25%.

Constant load hanger shall be of moment coil spring counter balanced design or cam & spring type. Variable spring hangers shall be of helical spring design. Spring hanger/ assembly shall be constructed such that complete release of piping load is impossible in case of spring miss alignment or failure.

Constant load hangers shall have a minimum field adjustment range of 15% of the load. The total travel for constant speed load hangers shall be design travel plus 20% but in no case shall be difference between total travel and design travel be less than 15 mm. The supporting effort variation throughout the travel range of constant load hangers shall not exceed 6%.

Variable spring hangers shall have supporting effort variation of not more than 25% throughout the total travel range.

All springs shall remain under compression throughout their operating regime and never under tension.

Spring hangers shall have provision of rlocking the hangers in any position of the travel.

Spring hangers shall be adjusted to the cold position before shipment and locked in that position. The cold and hot position shall be clearly marked on the travel indicator scales.

All spring hangers shall be locked before performing the hydro test. The locking shall be removed before the line is placed under operation.

## 33.6.26

**SNUBBERS**

Snubbers shall be designed to allow normal movement of pipe due to thermal expansion and shall require minimum maintenance.

Snubbers shall be of hydraulic type of Lisega/ ITT Girnell, Germany or owner approved eqvt

Axes of anubbers/ restraints shall be parallel to the direction of the expected reaction force in operating condition.

### 33.6.27 **RESTRAINTS & ANCHORS**

All anchors shall be designed for direct rigid fastening to the structural steel member.

Anchors, guides and restraints shall be capable of withstanding the forces and moments due to thermal expansion and dynamic effects.

### 33.6.28 ~~**STEAM STRAPS & STRAINERS**~~

Steam traps shall be of inverted bucket/ thermostatic type with integral or separate Y type strainers.

Traps shall have stainless steel internals.

All Y type strainers shall have stainless steel screen of not more than 20 mesh size. Screen open area shall be at least four (4) times the pipe cross sectional area.

Strainer shall have screwed blow off connection with removable plug.

Y type strainers shall be provided along with each steam trap in case the strainer does not form an integral part of the trap.

### 33.6.29 **SPECIFICATION FOR THERMAL INSULATION**

Insulation materials, cladding and accessories

- (a) The insulating material and cladding material shall be as per the tables of material given in the subsequent clauses.
- (b) All insulating materials, accessories and protective covering shall be non-sulphurous, incombustible, low chloride content, chemically rot proof, non-hygroscopic and shall be guaranteed to withstand continuous use and without deterioration the maximum temperature to which they will be subjected under the specification conditions.
- (c) The use of insulation of finishing materials containing asbestos in any form is not permitted.
- (d) Insulation mattress/section shall be supplied in thickness of 25,40,50 and 75 mm. insulation of higher thickness shall be made up in multiple layer using mattress/slabs of thickness specified above. However; if the required thickness is not achieved, the mattress/slabs in increment of 5mm shall be acceptable. The min. & the innermost layer shall be thickest.

### 33.6.30 **INSULATION MATERIALS**

- (a) Rock/glass insulation mattress shall be of long fibered rock or glass processed into fibrous form bonded with a binder. No kind of slag wool inclusion is acceptable.
- (b) Calcium silicate pipe insulation shall be composed principally of hydrous calcium silicate reinforced with mineral fibre. It should be asbestos free.

- (c) All insulation shall conform to the quality requirements laid down below and test certificates on samples from the lot to be supplied shall be furnished to employer for approval.

33.6.31

**OTHER ACCESSORIES**

The contractor shall also provide other accessories such as ceramic boards. Sealants and washers as required.

33.6.32

**INSTALLATION**

- (a) All surface to be installed shall be cleaned of all foreign materials such as dirt, grease, rust etc, and shall be dry before the application of insulation.
- (b) Before applying the insulation the contractor shall check that all instrument tappings, clamps, lugs and other connections on the surface to be insulated have been properly installed as per the relevant erection drawing.
- (c) All flanged joints shall be insulated only after the final tightening and testing.
- (d) The insulation shall be applied to all surfaces when they are at ambient temp. ample provision shall be made for the maximum possible thermal movement and the insulation shall be applied so as to avoid breaking/ telescoping due to alternate periods of expansion and contraction
- (e) All cracks voids and depressions shall be filled with finishing cement suitable for the equipment operating temp. so as to form a smooth base for the application of cladding.

33.6.33

**INSULATION MATERIALS**

	Type#1	Type#2	Type#3	Type#4	Type#5	Type#6
Type	Lightly resin bonded mineral (rock) wool	Lightly resin bonded mineral (rock) wool	Bonded glass wool	Resin bonded mineral (rock) wool performed pipe section	Resin bonded glass mineral wool performed pipe section	Calcium silicate performed block type
Apparent density	120-150 Kg/m <sup>3</sup>	100 Kg/m <sup>3</sup>	64Kg/m <sup>3</sup>	140-150Kg/m <sup>3</sup>	60-80 Kg/m <sup>3</sup>	20-25 Kg/m <sup>3</sup>
Mtl. standards	IS: 8183	IS: 8183	IS: 8183	IS: 9842	IS: 9842	IS: 8154
Applicable service	Piping system & equipment with operating temp. above 400°C	Piping system & equipment with operating temp. in range of 60- 400°C	Piping system & equipment with operating temp. in range of 60- 400°C	Piping system of 350 NB and below with operating temp. in range of 60- 650°C	Piping system of 350 NB and below with operating temp. in range of 60- 400°C	Piping system & equipment with operating temp. in range of 400- 600°C

Testing requirement	As per IS:8183	8183	8183	8183	IS:9842	IS:8154
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33.6.34

**CLADDING MATERIAL & ACCESSORIES SHALL BE AS SPECIFIED HERE UNDER:**

Sl. No.	Item	Basic specification	Description
1.	cladding	Aluminium ASTM B-209-1060 temper H14 or IS:737 Gr.19000/H2	Thickness of sheathing (a) 18SWG (1.219) for diameter for insulated surface 450mm and above and for flat surfaces. (b) 20 SWG (0.91mm) for diameter of insulated surface 150mm and above upto 450mm. (c) 22 SWG (0.71mm) for diameter of insulated surface 150mm and below.
2.	Binding & lacing wire	Galvanized steel wire to IS: 280 for temp. below 400°C and stainless to IS:6528 for temp above 400°C	20 SAWG for all insulation interface temperature.
3.	Straps & brands	(i) Aluminium where interface temperature are below 400°C (ii) Stainless steel where temperature are above 400°C	Band shall be 20 mm wide & 0.6 mm for securing aluminium sheathing anodized aluminium bends shall be used.
4.	screws	Stainless steel	Self tapping, cheese headed
5.	Hexagonal wire mesh	(i) Galvanized wire to IS :280 mesh for interface temperature upto 400°C (ii) Stainless steel wire for temperature above 400°C	Wire mesh netting shall be 10 to 13mm aperture at least 0.56 mm diameter wire

33.6.35

**INSTALLATION ON PIPING**

- (a) All vertical pipes shall be provided with the suitable insulation supports to prevent collapsing/ crushing of insulation due to its self weight. Support rings shall be provided on all vertical piping with a difference in elevation of 4 meter or above, and there shall not be more than 3 meter straight length between support ring.
- (b) Longitudinal joints of insulation mattresses section of horizontal piping shall be on the bottom or at the sides of the pipe.
- (c) When more than one layer of insulation mattress/section is required on piping the circumferential joints on adjacent layer shall be staggered by atleast 150mm and longitudinal joints shall be fitted on pipe using binding wires.

- (d) The mattress type insulation shall be formed to fit the pipe and applied with the mattress edges drawn together at the longitudinal joints and secured by lacing wire pipe section insulation shall be fitted on pipe using binding wires.
- (e) The mattress type insulation is applied in two or more layers each layer of mattress shall be backed with hexagonal wire mesh. For the first layer of insulation and in case of single layer insulation, hexagonal wire mesh shall be provided on both the surface of the mattress. For pipe sections, the sections shall be held in place by binding wires without any wire mesh.
- (f) The ends of all wire loops shall be firmly twisted together with pliers, bent over and carefully pressed into the surface of insulation. Any gap in the insulation shall be filled with loose mineral wool or finishing cement.
- (g) Insulation mattress/section ends shall be terminated at a sufficient distance from the flanges to facilitate removal of bolts.
- (h) The insulation shall be held in place by fastening over with binding wire for insulation surface with diameter upto and including 550mm and with metal bends for insulation surfaces with diameter over 550mm. the fastening shall be done at intervals of 250mm except where specified otherwise. The ends of the binding wire shall be hooked and embedded in the insulation the straps shall be mechanically starched and fastened with metallic clamping seals of the same materials as the strap.
- (i) Insulation for the application on bends and elbows shall be cut into mitred segments, sufficiently short to form a reasonably smooth internal surface. after the application of insulation material in place, insulating cement shall be applied as required to obtain a smooth surface.
- (j) Weather hoods shall be provided for insulated piping passing through floors/walls.
- (k) All pipe attachments coming on horizontal pipes, included pipes and bends shall be insulated along with pipe such that there will be no insulation applied to hanger rod and the component connecting hanger rod to pipe attachment. All pipe attachments exposed to weather shall be provided with weather proof.
- (l) Upstream of all drain lines and the lines connected to steam traps, shall be insulated upto and including first isolating valve for heat conservation. Rest of such lines such as downstream of the drain valves, traps etc. and other lines such as safety valve discharges, vents, etc. shall be insulated for personal protection.

33.6.36

**INSTALLATION ON VALVES AND FITTINGS**

- (a) All valves fittings and specialties shall be insulated with the same type and thickness of insulation as specified for the connected piping with the special provision and or exceptions as given below.
- (b) All valves and flanges shall be provided with removable box type of insulation covered with box fabricated from aluminum sheets of thickness same as the connected pipe cladding. Adjoining pipe insulation shall be believed back to permit removal bolts and nuts or bends. The portion of the valve which can not be covered by box type insulation shall be filled by loose insulating material of packing density at least equal to that of the insulating material of adjoining pipe. The insulation for valve/flanges shall be applied after the finishing has been applied over the connected piping. The cladding shall be applied in such a

manner that the bonnet flange can be exposed easily without disturbing the complete insulation and cladding.

- (c) Expansion joints, metallic or rubber shall not be insulated unless otherwise specifically indicated.

33.6.37

#### INSULATION ON EQUIPMENT

a	The insulation applied to the equipment shall be reinforced with hexagonal wire mesh. One layer of wire mesh shall be provided on the equipment surface prior to application of insulation.
b	Installation on horizontal cylindrical vessel/tanks (including heaters, deaerator, heat exchanger etc.)
c	All the surface of insulation layer, applied on horizontal cylindrical vessel shall be securely fastened by bands upto vessel/tanks outer diameter of 1500mm and below. Where vessel/tank outer diameter exceeds 1500mm, binding wire passing through insulation clip provided both longitudinally and circumferentially at 500 centers shall be used. Gaps in the insulation shall be filled with insulation mineral wool and finished with finishing cement so as to obtain a smooth surface for the application of cladding. The contractor shall provide a support ribs/lugs on the surface of the vessel/tank as necessary. The contractor shall obtain the approval of the employer and the equipment supplier's field engineering representative before performing any welding on equipment. Any heat treatment equipment as per recommendation of equipment supplier shall be performed by the contractor.
d	Installation on vertical cylindrical vessel/tanks (including flash tanks etc.)
e	All vertical vessels/tanks shall be provided with support rings/ribs with other necessary frame work to take up the weight of the insulation prior to HT. the contractor shall obtain the approval of the employer and the equipment supplier's field engineering representative before performing any welding on equipment. Any heat treatment of vessel/equipment that is required after welding of rings/ribs on the vessel/equipment shall be as per recommendation of equipment supplier and shall be as per recommendation of equipment supplier and shall be performed by the contractor.
f	The mattresses shall be held in position by means of 9 SWG steel wire nails, the nails being 25 mm longer than the thickness of insulation to be applied. After the mattresses have been placed over the nails, the nails shall be bent and embedded in the insulation. Alternative, wire loops may be tack welded at 250mm centers to hold the insulation in place.

33.6.38

#### INSTALLATION OF CLADDING

- (a) All insulation shall be protected by means of an outer covering of aluminium sheathing. All insulation/cladding joints shall be sealed and made effectively weather and waterproof. All flat surfaces shall be given suitable slope to prevent collection of pools of water on the cladding surface. All sheathing shall be protected internally by the application of two coats of bitumenastic paint.
- (b) All longitudinal joints shall have a minimum overlap of 50mm and shall be located at 45° or more below the horizontal for horizontal equipment joints shall be made with cheese headed self tapping galvanized steel screws at 150mm centers.



- (c) All circumferential joints shall have a minimum overlap of 100mm and shall be held in position by stainless steel or anodized aluminium bands, stretched and clamped.
- (d) Removable box type cladding for valves and flanges shall be fitted on the connected pipe cladding, with bands.
- (e) Aluminium cladding shall not come directly into contact with either the equipment surface or with the supporting arrangement on the equipment surface. To this end, adequate layers of 3 mm thick ceramic board shall be provided between the cladding and any supporting arrangement equipment surface, and fitted with self tapping screws/metal bands, as applicable.
- (f) For bends, fittings etc. the cladding shall be provided in segments as to ensure a smooth finish of the cladding.
- (g) For cladding on vertical pipes/equipment, provision for load take up shall be made at every 2 to 4 meters along pipe/equipment axis.
- (h) All joints shall be sealed with acrylic emulsion weather barrier.
- (i) Galvanic corrosion shall be prevented by carefully avoiding permanent contact of aluminium cladding with copper, copper alloys, tin, lead, nickel or nickel alloys including monal metal.

33.6.39

**TESTING AND GUARANTEE**

- (a) All tests, as per the applicable material standards and as specified shall be carried out in accordance with the methods prescribed. Employer shall have the right to witness any or all of the tests conducted by the contractor at the shop or laboratory.
- (b) The contractor shall guarantee that if on actual measurement the specified maximum insulation surface temperatures are exceeded, the contractor shall either replace the insulation with a superior material or provide additional insulation thickness at no extra cost.

33.6.40

**SPECIFICATION FOR HYDROSTATIC TEST OF PIPING SYSTEM**

33.6.40.1

on completion of insulation/erection of the piping systems a hydraulic test in accordance with the requirements of the Indian boiler regulations, shall be performed by the contractor, the procedure adopted for hydraulic test shall have the prior approval of the employer, the detailed schemes and procedure for carrying out hydraulic testing shall be prepared and furnished by the contractor and it shall be discussed and finalized during detailed engineering stage.

33.6.40.2

Cutting /welding/edge preparation and re-welding required for blanking, temporary piping connection and /or for replacements by spool pieces including reinstallation of components after hydraulic testing shall be the responsibility of contractor.

33.6.40.3

The water for the hydraulic test shall be made alkaline by addition of suitable chemicals. After the test, the steam generator and high pressure external piping shall be suitably drained and preserved.

33.6.40.4

all the valves, high pressure piping and interconnected pipes connecting the pressure parts, shall be subjected to hydraulic test along with the pressure parts, all blank flanges, removable plugs, temporary valves, piping and fittings, spools other



accessories and services required for carrying out hydraulic testing of piping shall be furnished by the contractor, the the pressurization equipment including water piping from the supply, needed for the above test shall also be furnished b the contractor, any defect noticed during the testing shall be rectified and the unit shall be retested by the contractor.

33.6.40.5 The hydraulic test shall be considered successful only on certification to that effect by the concerned inspecting authority as per the provision of the IBR and the project manager.

33.6.41 **SPECIFICATION FOR CHEMICAL CLEANING OF PIPING SYSTEM AND EQUIPMENTS**

33.6.41.1 It is indented to chemically clean the following piping system

- (a) boiler feed piping
- (b) heater drains piping
- (c) main condensate piping
- (d) extraction steam piping
- (e) The following equipment which form a part of the above system shall also be included in the cleaning operation.
  - i. H.P. heater
  - ii. L.P. heater
  - iii. Deaerator
  - iv. Gland steam cooler
  - v. Drain cooler

33.6.41.2 Before including chemicals, all the piping system and equipment listed above shall be water flushed, water flushing will be followed by alkaline cleaning acid cleaning and passivation.

33.6.41.3 How ever the bidder shall submit along with the offer his usual procedure and practices for chemical cleaning of the piping and equipment specified. The bidder shall submit all schematics, write-up, details of chemical to be used etc. and detailed procedures he intends to follow, these schematics and procedures shall be subjected to the approval of the employer.

33.6.42 **PRE-CLEANING PROCEDURE**

Prior to starting any phase of cleaning operation the following procedure shall be ensured.

- (a) Installation of all temporary piping valves, pumps and equipments as required for the flushing and chemical cleaning operations.
- (b) Temporary piping shall be routed at floor level as far as possible and secured in place to prevent movement /vibration beyond applicable limits.
- (c) Installation of the instruments as required to ensure satisfactory monitoring and control of the cleaning process. The contractor shall also determine and arrange location for sampling of the cleaning solution during cleaning.

- (d) Bypassing all regulation/control valves coming in the cleaning circuit or installation of temporary spool pieces.
- (e) Installation of special end covers and temporary suction strainers, for boiler feed pumps and condensate pumps. Pump internals shall not be installed.
- (f) Installation of the plastic seal in the condenser neck to protect the turbine from alkaline fumes.
- (g) Blocking and securing of all spring hangers in the steam lines which may be flooded during the cleaning operation.
- (h) Hand cleaning of the interiors of all vessels which are included in the cleaning operation.

33.6.43

**GENERAL CLEANING PROCEDURE**

- (a) Seal water lines to pump shall be broken and flushed.
- (b) Where pipe lines terminate in spray headers, these headers shall be inspected after each phase of the cleaning operation and cleaned if necessary.
- (c) All strainers shall be observed closely during the cleaning operation by reading differential pressure gauges, and shall be cleaned when the differential pressure exceeds a predetermined value.
- (d) All high points, vents shall be opened periodically to ensure full system flow.
- (e) Upon completion of each stage of cleaning, the waste products shall be drained and transferred to the waste treatment basins, the contractor shall then supply and add the necessary chemicals to the basin to neutralize all waste solutions and rinses generated by the cleaning process, and arrange for its disposal to an area to be indicated by the employer/engineer.
- (f) Strictest safety precautions shall be exercised at all times during the chemical cleaning and during storage and handling of the chemicals, the contractor shall ensure provision of all protective clothing, apparatus and equipment along with necessary first aid kits as required for handling the chemical and for carrying out the cleaning operation.

33.6.44

**SPECIFICATION FOR FLASH TANKS**

33.6.44.1

The flash tanks and accessories shall be designed, manufactured and tested in accordance with ASME boiler and pressure vessels (B&PV) codes (latest) and other applicable ANSI standards referenced in the above codes.

33.6.44.2

**NUMBER AND SIZING**

Flash tank shall be provided into which all recoverable drains from turbine casing extraction lines, valves, strainers, main steam, CRH and HRH line drains, cascaded drains from heaters etc. shall be led. Number of flash tanks shall be as per tender drg. Requirement/details of various flash tanks are given below.

- (a) High pressure HP flash tank for accommodating high pressure (above and including hot reheat design pressure) steam drain and HP heater emergency drains, as included in the tender drawing.
- (b) Low pressure LP flash tank for accommodating low pressure (below hot reheat design pressure) steam drain and LP heater emergency drains, as included in the tender drawing.
- (c) Atmospheric flash tank to accommodate alternate drains of steam lines, feed water safety valve discharge and aux. steam line drains, as indicated in the tender drawing.

33.6.44.3

**CONSTRUCTIONAL FEATURES**

- (a) Flash tanks shall be vertical cylindrical design and of welded construction with torispherical or hemi spherical heads.
- (b) Drains/hot water inlet nozzles shall be tangential to the vessel periphery. Suitable vortex breaker arrangement shall be made at the liquid outlet to the vessel. In the contractor finds better alternative arrangement, the same can be submitted for the employer acceptance & approval.
- (c) The drain & the vent of the flash tanks shall be adequately sized and lead to the condenser. There shall not be any valve on the drain and vent lines. Loop seal shall be provided on the drain if required.
- (d) A man hole shall be provided on the flash tanks for inspection purpose, it shall be diameter of 500mm minimum. The man hole shall be of davit type and shall be provided with grip.
- (e) The flash tanks shall be located on the ground/mezzanine floor of the power house. Necessary structural supports including anchor bolts shall be provided. Three (3) support lags at 120 degree spacing shall be provided on each flash tank. Necessary lugs for handling by the TG hall EOT crane shall be provided.
- (f) The flash tanks shall be provided with a full length level including gauge glass complete with protective rods. Isolation valves and drains. Temperature indicator and temperature switches shall be provided on the flash tanks.
- (g) The flash tanks shall be provided with access ladders. If required for the access to the instruments, valves, main holes etc.

33.6.45

**SCHEDULE OF MATERIAL**

Shell and head	ASTM A 285 Gr.C
Wear plate/baffle	ASTM A 285 Gr.C
Nozzle neck	ASTM A 106 Gr.B
Manhole nozzle flange and cover	ASTM A 285 Gr.C
Couplings	ASTM A 105
Bolts and studs	ASTM A 193 Gr.B7
Nuts	ASTM A 194 Gr.2 H
Gaskets	spiral wound SS 316 with graphite

However the material as per ASTM A 516 Gr. B shall be acceptable subject to the relevant codes / standards permitting so for the design parameters of various flash tanks.

33.6.46

**SPECIFICATION FOR METALLIC EXPANSION JOINTS**

33.6.46.1

The expansion joint shall be metallic multi-bellows construction shall be used to reduce the reactions (force and moments) at the connected equipment terminals due to thermal expansion / contraction and/or vibration of connected equipment and piping.

33.6.46.2

the design material, construction, manufacture, inspection testing and performance of the expansion joints shall comply with the currently applicable requirement of EJMA, boiler and pressure vessel code section III, ANSI B-31.1 and all statutes, regulations and safety codes.

33.6.47

**CONSTRUCTION DETAILS****(a) Bellows**

- i. The bellow shall be hydraulically or roll formed from perfect cylinders of single ply, 304 grade stainless steel.
- ii. The number of longitudinal weld seams shall be minimum and there shall be no circumferential weld seam.
- iii. Cold formed stainless steel bellows shall not be heat treated.
- iv. All bellow elements shall be pickled after forming.
- v. Equalizing rings, where required, shall be either from high quality casting or from fabrication metal.
- vi. Flanged expansion joints shall be provided with adequate pipe stubs.
- vii. Butt welded expansion joints shall have adequate length of pipe so that site welding does not impair or reduce the joints efficiency.

**(b) sleeves**

- i. Expansion joints will be furnished with internal sleeves of the same material as the bellows and installed with sufficient clearance to allow full rated deflection. The sleeves shall be welded on the flow inlet end of the joint only.
- ii. Bellow shall have external sleeves with an arrow indicating the direction of flow on the outside. The external steel covers provided to protect bellows from physical damages, shall be suitable for supporting insulation where necessary and shall be detachable.

**(c) Tie bars**

- i. Joints shall be shipped at neutral length. They shall be provided with suitable erection and knock-off type temporary tie bars to prevent damage and misalignment during transit and also with permanent tie bars along with necessary nuts, bolts, etc.
- ii. The rod on pressure balanced type expansion joints shall be adequately sized to prevent buckling in vacuum services or services either other external loads.

33.6.48

**TYPE TEST OF METALLIC EXPANSION JOINT**

Following tests (type tests) shall be carried out for metallic expansion joints as per the procedures given in EJMA.

- (a) Life cycle test
- (b) Meridional yields-rupture testing
- (c) Squirm testing

33.6.49

for the purpose of carrying out type tests: metallic bellows shall be grouped based on the parameters as give below. The bellows conforming to the same combination of these parameters shall constitute one group. Type test shall be carried out on one or specific above.

- i. Material of bellow: based on material of bellow, bellow shall be categorized in to three category namely carbon steel, stainless steel (Eg. SS304,316,321 etc.) & high alloy steel (Eg. inconal).
- ii. Profile of convolutions: each profile shall be considered as separate category (e.g. U profile, V profile & Lyra profile etc.)
- iii. Dimension of bellows: based on the size, the categories shall be as under:
  - Nominal diameter of metallic expansion joint up to and including 800mm NB.
  - Nominal diameter of metallic expansion joint greater than 800mm NB up to and including 1600mm NB.
  - Each size above 1600mm NB shall be a separate category.
- iv. Design pressure: based on the design pressure, bellows shall be categorized as under:
  - Deign pressure from full vacuum up to 5Kg/sq.cm(g).
  - Design pressure above 5Kg/sq.cm(g) and up to 10Kg/sq.cm(g) with or without vacuum.

33.6.50

**NUMBER OF CYCLES**

For the life cycle test, the number of test cycles shall be minimum 10,000 cycles.

Other tests for the metallic expansion joint shall be carried out as per the approval QP/QA section. Further, other terms and conditions for type test shall be as specified elsewhere in the specification.

33.6.51

**SPECIFICATION FOR SURFACE PREPARATION & PAINTING**

33.6.51.1

Surface preparation methods and paint/ primer materials shall be of the type specified herein. If the contractor desires to use any paint/primer materials other than that specified specific approval shall be obtained by the contractor in writing from the employer for using substitute material.

33.6.52.2

All paints shall be delivered to job site in manufactures sealed containers, each container shall be labeled by the manufacture with the manufacture's name type of paint , batch no. and color.

33.6.52.3 unless specified otherwise paint shall not be applied to surface of insulation, surface of stainless /nickel/copper/brass/monal/aluminum/hastelloy/lead/galvanized steel items, valve stem, pump rod, shaft gauges, bearing and contact surface, lined or clad surfaces.

33.6.52.4 All pipelines shall be colour coded for identification as per the colour-coding scheme indicated in Volume II and which will be furnished to the contractor during detailed engineering.

### 33.6.53 **SURFACE PREPARTION**

33.6.53.1 All surfaces to be paints shall be thoroughly cleaned of oil, grease and other foreign matter, surfaces shall be free of moisture and contamination from chemicals and solvents.

33.6.53.2 the following surfaces scheme are envisaged here, depending upon requirement any one or a combination of these may be used for surface preparation before application of primer.

SP1	solvent cleaning
SP2	application of rust converter (Ruskil or equivalent grade)
SP3	power tool cleaning
SP4	shot blasting (shot blasting shall be used as surface preparation method for hot worked pipes prior to application of primer)
SP4*	shot blast cloning /abrasive blast cleaning to SA 21/2 (near white metal) 35-50 microns
SP5	phosphating
SP6	Emery sheet cleaning/ manual wire brush cleaning.

### 33.6.54 **APPICATION OF PRIMER /PAINT**

33.6.54.1 The paint /primer manufacturer's instructions covering thinning, mixing, method of application, handling and drying time shall be strictly followed and considered as part of this specification. The dry film thickness (DFT) of primer / paint shall be as specification herein.

33.6.54.2 Surface prepared as per the surface preparation scheme indicated herein shall be applied with primer paint within 6 hours after preparation of surface

33.6.54.3 Where primer coat has been applied in the shop, the primer coat shall be carefully delaminated, cleaned and spot primed with one coat of the primer before applying intermediate and finish coats. When the primer coat has not been applied in the shop, primer coat shall be applied by brushing, rolling or spraying on the same day as the surface is prepared, primer coat shall be applied prior to intermediate and finish coats.

33.6.54.4 Steel surface that will be concealed by building walls shall be primed and finish painted before the floor is erected. Tops of structural steel members that will be covered by grating shall be premed and finish painted before the grating is permanently secured.

33.6.54.5 Following are the primer/painting schemes envisaged herein:

- |      |   |   |
|------|---|---|
| PS3  | - | zinc chrome primer (Alkyd base) by brush/Spray to IS104.  |
| PS3* | - | zinc chrome primer (Alkyd base) by dip coat.  |
| PS4  | - | synthetic Enamel (long oil alkyd) to IS2932.  |
| PS5  | - | red oxide zinc phosphate to IS-12744.   |
| PS9  | - | aluminum paint to IS 2339.  |
| PS9* | - | heat resistant aluminium paint to IS-13183 Gr.-I (for temperature 400 °C – 600 °C) , IS -13183 Gr.-II (for temperature 200°C -400°C) and IS-13183 Gr.-III (for temperature up to 200°C) |
| PS13 | - | rust preventive fluid by spray, dip or brush.   |
| PS14 | - | weldable primer-Deoxaluminat or equivalent.   |
| PS16 | - | high build Epoxy CDC mastic `15'.   |
| PS17 | - | aliphatic acrylic polyurethane CDE134, %V=40.0 (min.)   |
| PS18 | - | Epoxy based TiO2 pigmented coat.  |
| PS19 | - | Epoxy based zinc phosphate primer (92% zinc in dry film (min.)%VS=35.0 (min.)   |
| PS20 | - | Epoxy based finish paint.   |

33.6.54.6 All weld edge preparation for site welding shall be applied with one coat of weldable.

33.6.54.7 For internal protection of pipes/tubes, VCI pellets shall be used at both ends after sponge testing and ends capped. VCI pellets shall not be used for SS components and composite assemblies.

## 33.6.55 Primer/painting schedule

Sl. No	Description		Surface preparation	Primer coat			Intermediate coat			Finish coat			Total min. (microns)	Colour shade
				System	Coat	Min. DFT/coat (microns)								
1	All insulated piping's. Fittings/ componentes, pipe clamps, vessels/tanks, equipments etc.		SP3/SP4	PS 9*	1	20	-	-	-	PS9*	1	20	40	as per NTPC colour shade/ coding scheme
2	All insulated piping's. Fittings/ componentes, pipe clamps, vessels/tanks, equipments etc.	Design temperature <60 <sup>0</sup> C	SP3/SP4	PS 5	2	25	-	-	-	PS4	3\$	35\$	155\$	
		Design temperature 60 <sup>0</sup> C-200 <sup>0</sup> C	SP3/SP4	PS 9*	1	20	-	-	-	PS9*	1	20	40	
		Design temperature >200 <sup>0</sup> C	SP3/SP4	PS 9*	1	20	-	-	-	PS9*	1	20	40	
3	Constant load hanger (CLH). Variable load hanger (VLH) and other supports		SP4*	PS 19	1	40	-	-	-	PS17	1	30	70	
4	Valves													
	Cast/forged	Design temperature <95 <sup>0</sup> C	SP1/SP2/S P3	PS 9	1	20	-	-	-	PS9	1	20	40	
		Design temperature 95 <sup>0</sup> C-200 <sup>0</sup> C	SP1/SP2/S P3	PS 9*	1	20	-	-	-	PS9*	1	20	40	
		Design temperature >200 <sup>0</sup> C	SP1/SP2/S P3	PS 9*	1	20	-	-	-	PS9*	1	20	40	



Sl. No	Description		Surface preparation	Primer Coat			Intermediate coat			Finish coat			Total min. (microns )	Colour shade
				System	Coat									
5	All structural steel componants	outside TG building and in SG envelope	SP4*	Inorganic Ethyle Zinc Silicate	1	75	PS18	1	75	a)) epoxy coat b)) final coat of paint PS1	2	25	250	
											1	30		
		Within TG building	SP4*	---do---	1	35	PS18	1	35	a)) epoxy coat b)) final coat of paint PS1	2	25	150	
											1	30		
6	Weld edges		SP6(hand cleaning by wire brushing)	PS13 (wieldable primer)	1	25	-	-	-	-	-	-	-	
\$ The first 2 finished coats (total min. DFT of 70 microns) shall be done at shop and the 3 <sup>rd</sup> finish coat (min. DFT 35 microns) shall be applied at site.														

33.6.56

Testing requirements:

The detailed testing requirements for power cycle piping and its components are given in the subsection for quality Assurance (QA). The requirements pertaining to testing given in this subsection if in variance with that given in QA subsection, then the more stringent of the two shall be followed.

**ANNEXURE – 1****LIST OF POWER CYCLE PIPING**

The following list of power cycle piping is an indicative one and is provided for the guidance of the Bidder only. Items not mentioned but deemed necessary for making the system complete shall also be included.

<b>SR. NO.</b>	<b>NAME</b>		<b>DESCRIPTION</b>
1.0	Main Steam lines	:	From SH outlet to inlet of turbine
2.0	Main Steam Equalising line	:	Between RHS and LHS Main Steam lines
3.0	HP By-pass line	:	Between Main Steam line and CRH line
4.0	Cold Reheat line	:	Between HP turbine outlet and Reheater
5.0	Extraction line from CRH	:	Between CRH and Deaerator
6.0	Extraction line from CRH	:	Between CRH and H.P. heater
7.0	Extraction line from MS equalising line	:	From MS equalising line to auxiliary steam header
8.0	Steam supply to BFP Turbine	:	From the main and alternative source point to BFP Turbine Inlet
9.0	Extraction from BFP discharge	:	1. Between BFP discharge and H.P. By-pass 2. Between BFP discharge and PRDS
10.0	Warm up line for HP By-pass	:	Between MS line and H.P. By-pass line
11.0	Hot Reheat lines	:	Between Reheater and I.P. turbine
12.0	HRH equalising line	:	Between LHS and RHS Hot Reheat lines
13.0	LP By-pass line	:	Between HR line and condenser
14.0	Warm up line for LP By-pass	:	Between LP By-pass line and HR line
15.0	CEP Suction line	:	Between condenser hot well and CEP.
16.0	Main condensate line	:	Between CEP outlet and Deaerator through GSC, CPU, Drain Cooler, L.P. heaters.

SR. NO.	NAME		DESCRIPTION
17.0	CEP Minimum Recirculation line	:	Between main condensate line after CEP to condenser.
18.0	GSC Minimum Recirculation line	:	Between main condensate line after GSC to condenser.
19.0	Deaerator filling line	:	Between Condensate Transfer pump discharge and deaerator
20.0	Boiler filling line	:	Between Condensate Transfer pump discharge and Boiler bottom ring header /economiser inlet.
21.0	Fill up and Emergency	:	From Condensate Transfer pump discharge to make-up to condenser.
22.0	DMCW make-up tank	:	From Cycle make-up pump discharge to DMCW make-up tank.
23.0	Gravity Make-up to condenser	:	From condensate storage tank to condenser.
24.0	Condensate Dump Line	:	Between M.C. line after GSC and condensate storage tank.
25.0	Cycle make-up Pump Recirculation	:	Between Cycle make-up pump discharge header and Condensate Storage Tank.
26.0	Cycle make-up Pump Suction Line	:	From condensate storage tanks to Cycle make-up pump suction header.
27.0	By-pass line	:	For all control valves
28.0	By-pass lines for heaters (group bypass/individual bypass)	:	GSC, LP Heaters and HP Heaters.
29.0	CEP sealing line	:	Bidder's choice.
30.0	All extractions from main condensate line	:	For
			(a) Exhaust Hood spray
			(b) Turbine Flash Tank spray
			(c) L.P. By-pass spray

SR. NO.	NAME		DESCRIPTION
			(d) Water sealing of valves
			(e) Vacuum breaker line sealing
			(f) CEP sealing
			(g) Analytical measurements
			(h) Alkali flushing
			(i) Spray water to GSC desuperheater
			(j) Sampling
			(k) Instrument seal pot
			(l) Water sealing of valves & water washing of BFP Turbine
			(m) Spares
31.0	Turbine flash tank drain and vent line	:	From turbine Flash Tank drains to condenser hot well  From flash vessels vent to condenser steam space
32.0	BFP Suction lines	:	Between Deaerator and individual BFP suction
33.0	Main Feed Water Line	:	From BFP discharge through HP heaters, control station up to economiser inlet header
34.0	Steam turbine drive for BFP	:	Associated piping
35.0	Inlet line to attemperation water header	:	From main feed water line to attemperation water header
36.0	Extraction from BFP	:	From BFP suction to sample cooler suction, BFP warm-up & Balance Leak-off line.
37.0	All extraction from Main Feed Water line	:	(a) To Auxiliary Steam pressure reducing de-superheating station

SR. NO.	NAME		DESCRIPTION
			(b) Stub for alkali flushing
			(c) HP By-pass spray
			(d) Blind Stub
			(e) Minimum re-circulation lines
38.0	Extraction lines	:	From various stage of turbine/CRH to L.P. Heaters, H.P. heaters, Deaerator and BFP Turbines.
39.0	All vents of H.P and L.P. heaters	:	(a) L.P. Heater vents to Condenser
			(b) H.P. Heater vents to Condenser
40.0	All cascade drain connection between heaters		(a) From each HP Heater to next lower pressure HP Heater
			(b) From the lowest pressure H.P. heater to Dearator
			(c) From each L.P. Heater to next lower pressure L.P. heater
			(d) From lowest pressure L.P. heater to flash vessel through drain cooler.
41.0	All Drip connections to Flash Tanks	:	(a) From H.P. Heaters
			(b) From L.P. Heaters (except the lowest pressure L.P. heater)
			(c) From Gland Steam condenser
42.0	Air Steam mixture line from Turbine Glands	:	(a) To GSC
			(b) To Atmosphere
43.0	Vapour extraction line for GSC	:	From GSC through vapour extractors to atmosphere
44.0	By pass Line to GSC	:	Through desuperheater to atmosphere

SR. NO.	NAME		DESCRIPTION
45.0	Air steam mixture line from condenser	:	To vacuum pumps
46.0	Drip connections to Deaerator	:	From H.P. Heaters
47.0	Connections for air outlet from vacuum pump	:	From vacuum pumps to atmosphere
48.0	Steam connection to Auxiliary steam header	:	From final superheater outlet
49.0	High Temperature Auxiliary Steam Header	:	One with interconnection
50.0	Auxiliary Steam from High Temperature Header	:	(a) To Gland Sealing unit
			(b) For mill inerting (if required)
			(c) For soot blowing
51.0	Low Temperature Auxiliary Steam Header	:	One with interconnection
52.0	Auxiliary Steam from Low Temperature Header	:	(a) For Deaerator pegging
			(b) For atomizing
			(c) For F.O. Heating
53.0	Extraction line from CRH line	:	From CRH line to auxiliary steam header

## CHAPTER 10

### 10.0 MISCELLANEOUS PUMPSETS

#### 10.1 GENERAL INFORMATION

10.1.1 Sump pumps specified hereinafter shall be used to dewater various sump pits in various plant areas like BTG area, Plant Water System, Ash Handling plant etc. where gravity draining is not be envisaged and to ensure general housekeeping

10.1.2 Pumps under this specification have been divided into following three (3) groups according to different duty envisaged and location of sumps/pits.

##### 10.1.2.1 Group - A

The Group - A pumps shall be electric motor driven permanently installed vertical wet pit bottom suction volute type and shall handle drainage water, containing solid particles with sludges, polluted liquid, oils etc. from the area where they are installed. These pumps shall run intermittently by the use of high and low level switches in the sump. Particle size in the water shall not normally exceed 15 mm.

Group-A pumps shall also be provided to all indoor sumps of the plant and outdoor sumps of capacity 5 cu.m and above and underground cable vaults (if any) under the scope of this specification.

##### 10.1.2.2 Group - B

These pumps shall be horizontal centrifugal electric motor/diesel engine driven portable type. Each pump set along with control panel etc. shall be mounted on a trolley for ease of transportation. These pumps shall be suitable for dewatering of pipelines of large diameter, if required and alike jobs and handling of liquids containing hard solid particles, sludge, polluted liquid, significant amount of fuel oil/HSD etc. and particle size shall not normally exceed 20 mm. These types of pumps shall be used in different plant areas.

##### 10.1.2.3 Group - C

The Group - C pumps shall be vertical submersible portable type pump motor sets with suitable arrangement for carrying to any place and for lowering to and raising from various water reservoirs and pits. The pump motor set shall be suitable for handling water containing mud/sludge, solid particles, cotton waste, silica, ash particles, coal particles, polluted liquid etc. The particle size in water shall not exceed 20 mm. These pumps shall be utilised to dewater various deep sumps/pits (e.g. C.W pump house) in case of any eventuality.

#### 10.2 CODES AND STANDARDS

10.2.1 The design, manufacture and performance of the sump pumps and drives specified, hereinafter, shall comply with the requirements of all applicable codes, the latest applicable Indian/British/American/DIN Standards, in particular the following:

10.2.2 IS-1710 : Vertical Turbine Pumps for clear cold and fresh water.



- 10.2.3 IS-5120 : Technical Requirements – Roto-dynamic special purpose pumps.
- 10.2.4 IS-5600 : Sewage and drainage pumps.
- 10.2.5 Hydraulic Institute Standards of USA.
- 10.2.6 The materials of the various components shall conform to the applicable IS/BS/ASTM/DIN Standards.
- 10.3 GENERAL PERFORMANCE REQUIREMENT
- 10.3.1 The pumps shall be designed to have best efficiency at the specified duty point. The pump set shall be suitable for continuous operation at any point within the "Range of Operation" as stipulated by the manufacturer.
- 10.3.2 Pumps shall have a continuously rising head capacity characteristics from the specified duty point towards shut off point, the maximum head being at shut off.
- 10.3.3 Permanently installed vertical pumps shall be suitable for parallel operation. The head vs capacity, the bhp. vs capacity characteristics etc. shall match to ensure equal load sharing and trouble free operation throughout the range. Drive Motor shall not be overloaded when pump discharge is more than rated condition.
- 10.3.5 The static head requirement of portable submersible type sump pump may have a considerably wide range of variation depending upon the depth of pit being dewatered. While the pump shall have adequate capacity at the maximum head, the motor shall be sufficiently rated to cater for any overloading during the pump operation at its minimum possible head, i.e., maximum discharge.
- 10.3.6 Pump motor set shall run smooth without undue noise and vibration. Acceptable peak to peak vibration limits shall generally be guided by Hydraulic Institute Standards (latest edition).
- 10.4 SCOPE OF WORK
- 10.4.1 Pumps under groups A, B and C as listed in the Annexure- I along with drive units, couplings and other accessories mentioned below, as also those needed to make the pump-motor sets complete in all respect, for proper operation and maintenance. All motors in outdoor duty shall be provided with IP-55 enclosure and canopy. In addition to the accessories listed in Annexure-I, each pump set shall also include the following:
- 10.4.2 For the vertical Group - A sump pump motor sets
- Two (2) nos. redundant ultrasonic type level transmitter (2 Nos.) with limiter technique shall be provided for alarming, auto start & auto stop. along with necessary junction box, local control panel, control cables etc. to achieve automatic starting/stopping of the sump pumps, and also ON/OFF indication for sump pump shall be monitored at DDC system. The entire assembly being mounted on the same base frame as mentioned above (item "b"). The control panel shall also be equipped with start/stop push button for starting/stopping individual sump pumps manually. Local control panel and cable shall be as per requirements described else where in the specification.

## 10.4.3

For each of the trolley mounted horizontal Group-B sump pump motor sets/pump-Diesel Engine sets

- a) One (1) no. 7.5 meters long hose for the pump suction and one (1) no.30 meters long hose for the pump discharge, either ends of each hose being provided with female hose coupling.
- b) One (1) no. 500 mm long straight pipe piece, with both ends flanged, one end matching with the pump suction nozzle.
- c) Two (2) nos. male type hose couplings, one of which is suitable for coupling with the above mentioned 500 mm pipe piece on one side and the 7.5 meters long suction hose on the other side, whereas the other is suitable for coupling with the pump discharge nozzle on one side and the 30 metres long hose on the other side. The pump suction pipe-piece and discharge nozzle shall be of flanged type. As such each coupling end that is to match with the pipe/pump nozzle shall also be flanged and shall be equipped with necessary bolts, nuts & gaskets.
- d) A foot valve (of Bidder's recommended size) with suction strainer, necessary coupling and matching piece/reducer (if necessary) to couple with the 7.5 meter long suction hose end.
- e) A starter panel complete with incoming switch/contacter, fuse, overload relays, start-stop push button, O/L reset push button, cable gland, wiring terminals, red and green indication lamps (LED type), necessary control cables etc., and also 50 metres length of flexible power cable with power plug at one end and arrangement to connect the other end with the starter panel.
- f) The pump motor set with a baseframe along with the starter panel, power cable, suction & discharge hoses etc., as mentioned above, shall be mounted on a suitable trolley with swivelling front wheel and having adequate fixing arrangement for all equipment, for operation without any undue vibration and with facility for being handled by a single operator.

## 10.4.5

For each of the portable submersible Group-C sump pump motor sets.

- a) Two (2) nos. 30 metres long discharge hose, having female hose coupling at both ends.
- b) One (1) no. 500 mm long pipe piece with both ends flanged, one end connected by necessary bolts, nuts & gaskets with the flanged discharge nozzle of the sump pump.
- c) One (1) no. male type hose coupling, one end of which is suitable to couple with the discharge hose and the other end is flanged, matching with the above mentioned 500 mm long pipe end and connected therewith by necessary bolts, nuts & gaskets.
- d) Suitable attachment for temporary seat of the pump motor set on the floor at sump bottom.

- e) One (1) no. 25 metres long submersible type power cable having a power plug at one end and a hermetically sealed (waterproof) cable gland for connection with the pump drive- motor at the other end.
- f) Suitable lugs and other attachments on the pump motor assembly frame, for hoisting and lowering of the pump motor set from and to the sump.
- g) One starter panel, having a plug socket as receptacle of the above mentioned power plug (item "e"), a 25 metre long incoming power cable with switch/contactors and fuse, start- stop push buttons, red and green LED type indication lamps, over load relays, O/L reset push button, cable gland etc., and also a suitable arrangement for temporarily mounting the starter panel, near the sump, where the portable sump pump-motor set is to work. The incoming 25 metre long power cable shall also be provided with a suitable power plug at one end.

10.4.6 Lubrication of one (1) initial fill and one additional fill after commissioning.

10.4.7 Rust inhibitor paint at Manufacturer's works.

## **10.5 DESIGN AND CONSTRUCTION**

10.5.1 The design, construction testing and other details of the sump pumps and related accessories shall be in line with the stipulations and data in this chapter.

10.5.2 Each sump pump shall be equipped and coupled with a drive motor, with rating so selected as to have at least 15% margin over the maximum power required by the pump, throughout its range of operation. All other requirements of the drive motors shall be as stipulated in the Electrical Specification Vol IV.

The discharge rate of sump pump is uncontrolled. As such pump should be capable to operate even under a condition of as low as 25% of specified total head. Motors of group-B pumps should be designed to cater such eventuality.

10.5.3 All electrical items shall conform to the stipulations of Electrical Specification Vol IV as applicable.

10.5.4 All piping shall be as per IS-1239 of medium or heavy grade (as suited for the maximum operating pressure) and shall be either galvanised or painted with approved rust inhibiting paint. Pipe size shall be as per Appendix-II. Any matching piece/reducer required to match the pipe with pump nozzle, hose, etc. shall be provided.

10.5.5 All valves shall be steel body type as per applicable IS/BS/ANSI standard, with pressure class compatible with the maximum working pressure.

10.5.6 All hoses shall be of steel wire reinforced type. Pump suction hose shall be suitable for working under vacuum. Pump discharge hose shall be suitable to withstand the maximum pressure that it may be subjected to in all working conditions, including hydrostatic testing of the sump pump discharge line.

10.5.7 Pump suction strainer shall have openings large enough just to permit the entry of solids having maximum size as stipulated under clause no. 1.02.00.

## 10.6 Pumps

10.6.1 Pumps under Group-A shall be wet pit type, vertical shaft, centrifugal, vertical submerged suction, non-clog volute type complete with enclosed shaft, discharge pipe, head assembly thrust bearing and drive assembly, cover plates etc.

10.6.2 Pumps under Group-B shall be of horizontal shaft, single stage, end suction, radially split casing, centrifugal, non-clog design complete with common base plate, drive assembly etc. These pumps shall be trolley mounted portable type.

10.6.3 Pumps under Group-C shall be submersible pump-motor type, single stage and non-clog design and shall be portable type.

## 10.7 Casing

- a) Casing shall be so designed to allow free passage of specified maximum size of solid.
- b) Casing shall be designed to withstand the maximum shut-off pressure developed by the pump.
- c) The casings shall be cast, free from blowholes, sand holes, other detrimental defects. The casing shall be complete with suction and discharge connections.
- d) For pumps under Group-A adequate seal arrangement shall be made to keep leakage of liquid from casing to column assembly to minimum and adequate drain shall be provided in column assembly to permit escape of the leakage flow. The casing shall also include the bearing housing of the bottom pump shaft bearing.
- e) Casing of pumps under Group-B shall be provided with vent connections and drain connections with valves. These pumps shall be manually primed.

## 10.8 Impeller

- a) The impeller shall be open/semi-open non clog type, cast in one piece and specially designed to pass large solids or unscreened liquids. The clearance between stationary and moving parts should be such as to allow sustained performance without exclusive maintenance.
- b) Impellers of pumps under Group-A shall have provision for adjustment from an accessible location and for pumps under Group-C shall be capable of passing fibrous material like cotton waste, jutes, etc.

## 10.9 Pump Shaft

- a) Shaft size selected shall be such that critical speed is at least 20% away from the operating speed and the runaway speed.
- b) The shaft shall be ground and polished to final dimension and of ample size to withstand all stresses resulting from rotor weight, hydraulic loads and across the line starting. Shaft shall be provided with renewable sleeves particularly under stuffing boxes and other locations as recommended by pump manufacturers.

- c) The coupling between shafts shall be so designed that they become tight during pump operation.

#### 10.10 Column Pipe (for pumps under Group-A)

The discharge pipe shaft assembly shall be flanged or screwed as per manufacturer's standard and standard length of each piece of column pipe shall be in conformity to the shaft piece lengths from consideration of easy handling.

#### 10.11 Bearings

- a) Adequate nos. of properly designed bearings shall be furnished. Bearings for pumps shall be antifriction type and lubricated by grease. Line shaft bearings of vertical pumps shall also be grease lubricated. All necessary grease gun, grease cup and tubing shall be included.
- b) Thrust bearing of adequate design shall be furnished for taking the entire pump thrust arising from all probable conditions of continuous operation through out its "range of operation" and also the shut-off condition. The life of thrust bearing shall be 20,000 working hour minimum for the load corresponding to the duty point. The bearings shall be lubricated by grease from a location conveniently accessible. Design shall be such that the lubricant cannot contaminate the handling liquid.

#### 10.12 Wearing Ring/Liner Plate

Renewable wearing rings/liner plates shall be provided either on impeller or on the casing or on both impeller and casing.

#### 10.13 Stuffing Box

Stuffing Box of pumps under Group-A shall be of mechanical packing type. For pumps under Group-B and Group-C mechanical seal of reliable design shall be provided.

#### 10.14 Coupling

Pump and motor shall be connected with a suitable flexible coupling. Coupling shall be provided with coupling guard.

#### 10.15 Mounting Plate for Group-A Pumps and Base Plate for pumps under Group-B.

Each pump under Group-A shall be provided with a suitable mounting plate. The mounting plate shall be adequately sized to accommodate the level switches, discharge pipe, grease cups etc. if any. Pumps and motor under Group-B shall be mounted in one base plate. Base plate shall be of rigid construction properly ribbed as needed. Suitable drain with valve and drain funnel shall be furnished by the Bidder.

The necessary supporting plate, mounting frame, base plate etc. as required shall be supplied under this specification, along with anchor bolts, foundation bolts, pipe, sleeves etc. Lifting lug, eyebolts, etc. as required for the proper handling of each pump set shall be furnished.

#### 10.16 Suction Bell

The pumps under Group-A, C shall be complete with adequately dimensioned suction bell to guide and streamline intake fluid.

#### 10.17 Material of Construction

For material of construction of various parts of data specification sheet shall be referred to.

#### 10.18 **INSPECTION AND TESTING**

10.18.1 All pumps shall be tested at the shop for capacity, head, efficiency and brake horse power. These tests are to be done according to the requirements of "Hydraulic Institute Standard".

10.18.2 The pump integral accessories like thrust bearing, pump motor coupling etc. shall be subject to tests as per manufacturer's standard.

10.18.3 Test on motors, control panels, starter panels, cables shall be conducted as per the requirement of Vol.IV of this specification and as per Quality Assurance Plan to be approved by Owner during detail engineering.

10.18.4 After delivery/erection at site, pumps shall be operated to prove satisfactory and trouble free performance.

#### 10.19 **DRAWINGS, DATA, INFORMATION REQUIRED**

10.19.1 Location and dimension of all sumps which requires assisted evacuation, present in the areas covered under the scope of this specification.

10.19.2 List of location of Group-A .

10.19.3 Characteristic curves of pumps showing effective head, pump input power, efficiency, submergence and NPSH, against capacity ranging from shut-off condition to 125% or rated capacity for Group A, B pumps and to 150% of rated capacity for Group C pumps.


10.19.4 Speed vs. torque curve of the pump corresponding to recommended mode of pump starting, super-imposed on speed vs. torque of the motor, corresponding to 80% and 100% rated voltage.

10.19.5 Diagram showing the type of lubrication system etc.

**DATA SPECIFICATION SHEET**


<b>S. No.</b>	<b>Description</b>	<b>Group A</b>	<b>Group B</b>	<b>Group C</b>
<b>1</b>	<b>Pumps</b>			
1.1	Rated Capacity	Capacity of each pump should be so selected to empty sump pit in 10 to 15 minutes	Twenty (20)	Fifty (50)
1.2	Total Dynamic Head at rated Capacity (MLC)	To be calculated with 10% margin on frictional drop	15	20
1.3	Minimum suction lift	-	6	-
1.4	Nos. required	These pumps shall be provided in all indoor sumps and outdoor sumps of 5 cum & above and underground cable vaults and CW pumphouse. Pumps shall be of 2 x 100% capacity for each sump.	Four (4) (2 electric motor driven and 2 diesel engine)	Four (4)
1.5	Duty	Intermittent		
1.6	Pump design standard	IS 5120/ IS 1710/ HIS		
1.7	Parallel operation	Yes	No	Yes
1.8	Material of Construction			
a)	Base Plate/ Cover Plate	MS – IS 2062	MS – IS 2062	MS – IS 2062
b)	Column Pipe	MS – IS 2062	MS – IS 2062	MS – IS 2062
c)	Casing	2% NiCi	2% NiCi	2% NiCi
d)	Impeller	2% NiCi	2% NiCi	2% NiCi
e)	Pump/ Impeller Shaft	SS 410	SS 410	SS 410
f)	Shaft Sleeve	SS 410	SS 410	SS 410
g)	Shaft Coupling	SS 410	SS 410	SS 410
h)	Shaft Bearing	BUSH GM as per IS 306	BUSH GM as per IS 306	BUSH GM as per IS 306
i)	Gland	CI IS 210 FG 260	CI IS 210 FG 260	CI IS 210 FG 260
j)	Fasteners	SS 304	SS 304	SS 304

**Note : In all areas where Group A pumps are installed and will handle Sea Water like CWPB Pit the material of construction of all components of the pumps shall be Duplex Stainless steel.**

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## TECHNICAL SPECIFICATION FOR HORIZONTAL CENTRIFUGAL PUMPS



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**1.00.0 SCOPE**

- 1.01.0 This specification covers the design, material, construction features, manufacture, inspection, testing the performance at the Vendor's/Sub-Vendor's Works and delivery to site of Horizontal Centrifugal Pumps.

**2.00.00 CODES AND STANDARDS**

- 2.01.0 The design, material, construction, manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these specifications shall be construed to relieve the Vendor of this responsibility. The Equipment supplied shall comply with the latest applicable Indian Standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards.


**2.02.0 List of Applicable Standards.**

1	IS : 1520	Horizontal Centrifugal Pumps for clear cold fresh water.
2	IS : 5120	Technical requirements of roto dynamic special purpose pumps.
3	API : 610	Centrifugal pumps for general refinery service.
4	IS : 5639	Pumps Handling Chemicals & corrosion liquids.
5	IS : 5659	Pumps for process water.
6	HIS	Hydraulic Institute Standards, USA
7	ASTM-1-165-65	Standards Methods for Liquid Penetration Inspection.

- 2.03.03 In case of any contradiction with aforesaid standards and the stipulations as per the technical specifications as specified hereinafter the stipulations of the technical specifications shall prevail.

**3.00.00 DESIGN REQUIREMENTS**

- 3.01.00 The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve over the operating range of 40% to 120% of the duty point. The maximum efficiency of pump shall be preferably be within +/- 10% of the rated design flow as indicated in the data sheets.
- 3.02.00 The total head capacity curve shall be continuously rising from the operating point towards shut-off without any zone of instability and with a minimum shut-off head of 15% more than the design head.

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3.03.00 Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.

3.04.00 Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation:

SPEED	Antifriction Bearing	Sleeve Bearing
1500 rpm and below	75.0 micron	75.0 micron

3.05.00 The noise level shall not exceed 85 dBA. Overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment.

3.06.00 The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements. Continuous Motor rating (at 50 deg.C ambient) shall be atleast ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump.

3.07.00 The kW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).

3.08.00 Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal.

3.09.00 The Contractor under this specification shall assume full responsibility in the operation of pump and motor as a unit.


#### **4.00.0 DESIGN CONSTRUCTION**

4.01.00 Design and construction of various components of the pumps shall conform to the following general specifications. for material of construction of the components, data sheets shall be referred to.

#### **4.02.0 Pump Casing**

4.02.01 Pump casing shall have axially or radially split type construction. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature.

4.02.02 Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation.

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**4.03.00 Impeller**

4.03.01 Impeller shall be closed, semi-closed or open type, and it shall be designed in conformance with the detailed analysis of the liquid being handled.

4.03.01 The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation.

**4.04.00 Impeller/Casing Wearing Rings**

4.04.01 Replaceable type wearing rings shall be provided at suitable locations of pumps. Suitable method of locking the wearing ring shall be used. Wearing rings shall be provided in pump casing and/or impeller as per manufacturer's standard practice.

**4.05.00 Shaft**

4.05.01 The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.

4.05.02 The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation.

**4.06.00 Shaft Sleeves**

4.06.01 Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates so as to distinguish between the leakage between shaft and shaft sleeve and that past the seals/gland.


4.06.02 Shaft sleeve shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.

**4.07.00 Bearings**

4.07.01 Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished

4.07.02 The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 16,000 hrs. of continuous operation at maximum axial and radial loads and rated speed.

4.07.03 Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly.

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4.07.04 Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing.

#### **4.08.00 Stuffing Boxes**

4.08.01 Stuffing box design should permit replacement of packing without removing any part other than the gland.

4.08.02 Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standards. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping valves, fittings etc. for the gland sealing connection.

#### **4.09.00 Mechanical Seals**

4.09.01 Wherever specified in pump data sheet, mechanical seals shall be provided. Unless otherwise recommended by the tenderer, mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped.

4.09.02 The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply.

#### **4.10.00 Pump Shaft Motor Shaft Coupling**


4.10.01 The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.

#### **4.11.00 Base Plate**

4.11.01 A common base plate mounting both for the pump and motor shall be provided. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided.

#### **4.12.00 Assembly and Dismantling**

4.12.01 Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.

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**4.13.00 Drive Motor (Prime Mover)**

- 4.13.01 The kW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified. In case, where parallel operation of the pumps are specified, the actual motor rating is to be selected by the tenderer considering overloading of the pumps in the event of tripping of operating pumps.

**5.00.00 TESTING FOR HORIZONTAL CENTRIFUGAL PUMPS**

The manufacturer shall conduct all tests required to ensure that the equipment furnished shall conform to the requirements of this specification and in compliance with the requirement of applicable Codes and Standards. The particulars of the proposed tests shall be submitted to the Owner for approval before conducting the tests.

**5.01.00 Hydrostatic Tests**

All pressure parts shall be hydraulically tested at 200% of pump rated head or at 150% shut off head whichever is higher. The test pressure shall be maintained for 1/2 hr. and no leakage shall be permitted. While arriving at the above pressure, the maximum suction head specified in Data Sheet shall be taken into account.

**5.02.00 Performance Tests**


- 5.02.01 All the pumps shall be tested in the Manufacture's Works at rated speed for capacity, efficiency and brake horse power. Pumps shall be given running test over the entire operating range covering from the shut off head to the maximum flow. The duration of test shall be minimum one (1) hour. A minimum of seven readings approximately equidistant shall be taken for plotting the curves with one point at design flow. Testing of pumps shall be in accordance with stipulations of Hydraulic Institute Standards or as applicable equivalent
- 5.02.02 The test shall be preferably conducted with the actual motor being furnished.
- 5.02.03 Only those pumps shall be subjected to strip down examination visually to check for mechanical damages after testing at shop in case abnormal noise level and excessive vibration is observed during the performance test. Otherwise strip down examination is limited to bearing inspection only.
- 5.02.04 The pump accessories e.g. the thrust bearing, couplings etc. shall be subjected to tests as per manufacturer's standards.

**5.03.00 Mechanical Balancing**

All rotating components of the pumps shall be statically balanced. In addition to static balancing, rotating components of the pumps shall be balanced dynamically at or near the operating speed. Tenderer shall furnish acceptance norm for this test.

**5.04.00 Visual Inspection**

Pumps shall be offered for visual inspection by the bidder before shipment. The components of the pumps shall not be painted before inspection.

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**5.05.00 NPSH Test**

NPSH test shall be conducted with water as medium if required. NPSH shall not be mandatory in case type test certificates are furnished for the similar rating of pumps.

**5.06.00 Noise and Vibration Measurement**

Noise and vibration shall be measured during the performance testing at shop as well as during the site test.

5.06.01 The noise level shall not exceed 85 dBA. Noise level measurement will be made as per applicable internationally acceptable standard. The measurement shall be carried out with calibrated integrating sound level meter meeting the requirement of IEC:651 or BS:5969 or IS:9779. Sound pressure level will be measured all round the pump and motor set at a distance of one meter from the nearest surface of the machine and at a height of 1.5 m from the floor level. A minimum of six (6) points should be covered for measurement. The measurement shall be done with a slow response on the A-weighted scale. The average of the A-Weighted sound pressure measurements expressed in decibels to a reference 0.0002 microbars shall not exceed the specified value.

The tests shall be carried out on the machine operating at rated speed and as near as possible to the rated power. Corrections for background noise and correction on account of test environment will be considered in line with applicable standard. For this purpose all the additional data required should necessarily be collected during the test.

5.06.2 Vibration check will also be done as per HIS. Vibration would be checked at thrust bearing locations on horizontal, radial and vertical direction. The acceptance limits would be as per HIS. The instrument used would be IRD 308 or equivalent with velocity pick-up. Vibration limits to be specified as per the speed of the pump.


**5.07.00 Material Test Certificate**

5.07.01 Material of the various pump components shall be tested in accordance with the relevant standards. Test certificates for these shall be furnished for the Owner's approval.

5.07.02 Where stage inspection is desired by BHEL/customer all material test certificates shall be correlated and verified with the actual material used for construction before starting fabrication by BHEL/customer's inspector who will stamp the material. In case mill test certificate for the material are not available, the supplier shall carry out physical and chemical tests at his own cost from a testing agency, approved by BHEL/Customer, as per the requirement of specified material standard. The sample for physical and chemical testing shall be drawn up in presence of BHEL/Customer's inspector who shall also witness the testing.

**5.08.00 Non Destructive Testing**


- (a) UT shall be carried out on shafts of diameter more than 50 mm.
- (b) DP tests shall be carried out on shaft and impeller.

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- (c) No weld repair shall be allowed on cast iron.


#### 5.09.00 Field Testing

- 5.09.01 After installation, the pumps offered shall be operated to prove satisfactory performance as individual equipment as well as a system run. If the performance at site is found not to the requirements then the equipment shall be rectified or replaced by the Vendor, at no extra cost to the Owner. The procedure of the above testing will be mutually agreed between the Owner and the contractor. Noise and vibration tests shall also be repeated at site.
- 5.09.02 Based on observation of the trial operation, if modifications and repairs are necessary, the same shall be carried out by the contractor to the full satisfaction of the engineer and then the performance and guarantee tests to be repeated at site as per relevant clauses of the specification.

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## TECHNICAL SPECIFICATION FOR METERING PUMPS



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### 1.00.0 GENERAL

- 1.01.01 Specification cover the design, material, construction features, manufacture, inspection, testing the performance at the vendor's/sub-vendor's works, delivery to site, erection, commissioning and testing of metering pumps.

### 2.00.0 GENERAL DESIGN FEATURES

- 2.00.01 Pumps shall be simplex positive displacement hydraulically operated diaphragm design, driven by squirrel cage induction motor through suitable speed reduction unit. Maximum pump stroke speed shall not exceed 100 per minute.
- 2.00.02 The stroke shall be continuously adjustable to give a capacity variation 0-100% range while the pump is running or stopped. Adjustment of capacity shall be done by manual control facility (micrometric adjusting type) to be provided locally for each of the pump.
- 2.00.03 The stroke shall be continuously adjustable to give a capacity variation 0-100% range while the pump is running or stopped. Adjustment of capacity shall be done by manual control facility (micrometric adjusting type) to be provided locally for each of the pump.
- 2.00.04 Capacity variation may be effected by changing eccentricity of the driving crank or by suitable hydraulic circuit. Pump accuracy shall be industry standard  $\pm 1\%$  of capacity setting.
- 2.00.05 Pumps shall be provided with an integral relief valve, spring operated to release pressure when delivery line blockage occurs.
- 2.00.06 Crankcase shall be constructed of high quality cast iron, which will also house the gearbox and guides of cross head.
- 2.00.07 Guided, controlled travel, double-ball check valves or equivalent, shall be provided both on the suction and discharge side.
- 2.00.08 Material of construction of the various parts shall be as per the details furnished elsewhere in the specification. However all parts coming in contact with acid shall be of Hastelloy 'B' and for alkali it should be of SS-316 only.
- 2.00.09 Suitable gland seal shall be provided to prevent leakage.
- 2.00.10 Electric drive motor particulars should follow enclosed electrical chapters.

### 3.00.00 TESTING


#### 3.01.00 Testing and Inspection at Manufacturer's Works

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- 3.01.01 The manufacturer shall conduct all tests required to ensure that the equipment furnished conforms to the requirements of this Specification and is in compliance with requirements of the applicable codes. The particulars of the proposed tests and the procedures for the tests shall be submitted to Owner for approval before conducting the tests.
- 3.01.02 The Owner's representatives shall be given full access to all tests for which the Manufacturer shall inform the Owner allowing adequate time so that if the Owner so desires, his representatives can witness the test.
- 3.01.03 All materials and castings used for the equipment shall be of tested quality. The test certificates shall be made available to Owner.
- 3.01.04 The pump casing shall be hydraulically tested at 200% pump operating pressure or 150% of design pressure whichever is higher. The test pressure shall be maintained at least for ½ an hour.
- 3.01.05 The rotating parts of pump drive shall be subjected to static balancing.
- 3.01.06 All pumps shall be tested at the shop for capacity, volumetric accuracy, repetitive accuracy, power and volumetric efficiency. The tests are to be done according to the requirements of the "Hydraulic Institute" of U.S.A. and Indian Standards as applicable.
- 3.01.07 The pump accessories e.g. gear box, speed reduction unit etc. will be subjected to tests as per manufacturer's standards. The test results shall be furnished to the Owner.
- 3.01.08 The combined variation of the pump and motor should be restricted within limits specified by Hydraulic Institute Standard, USA when the pump operated singly or in parallel.
- 3.01.09 All pumps shall be subject to strip down examination visually to check for mechanical damages after performance testing at shop.
- 3.01.10 Diaphragm of the metering pump shall be type tested as per applicable code/standard.
- 3.01.11 Performance test shall be carried out for the setting of pressure relief valve.
- 3.01.12 Test reports and certificates of all the above-mentioned tests to ensure satisfactory operation of the system shall be submitted to the Owner for approval before dispatch.

### 3.02.00 Test at Site

After erection at site pumps as detailed under different groups shall be operated to prove satisfactory performance as individual equipment as well as a system. If the performance at site is found to be not to the requirements, then the equipment shall be rectified or replaced by the Vendor at no extra cost to the Owner.

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**TECHNICAL SPECIFICATION  
FOR  
VERTICAL CENTRIFUGAL PUMPS**

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### 1.00.00 GENERAL INFORMATION

1.01.00 The general guidelines as illustrated in the subsequent clauses of this section shall be applicable for vertical pumps to be procured under the scope of this package.

### 2.00.00 CODES AND STANDARDS

2.01.00 In addition to the requirements spelt out elsewhere in the specification, the equipment to be provided under this section shall specifically conform to the following codes, standards, specifications and regulations, as applicable, including all the latest amendments subsequent to the year of publication as mentioned below.

2.01.01 IS 1710/1989: Vertical Turbine Pumps for Clear, Cold and Fresh Water.

2.01.02 IS 5120/1977: Technical requirements - Rotodynamic special purpose pumps.

2.01.03 IS 5639/1970: Pumps for handling chemical and corrosive liquids.

2.01.04 IS 5659/1970: Pumps for process water.

2.01.05 IS 6536/1972: Pumps handling volatile liquids.

2.01.06 IS 9137/1978: Code for acceptance for centrifugal, mixed flow and axial  
Flow pumps - Class 'C'

2.01.07 BS 5316 Acceptance tests for Centrifugal, mixed flow Part-I/1976  
And axial flow pumps - Class 'C' Tests (ISO 2548/1973)

2.01.08 BS 5316: Acceptance tests for Centrifugal, mixed flow Part-II/1977  
And axial flow pumps - Class 'B' Tests (ISO 3555/1977)

2.01.09 ANSI B 73.2M Vertical inline centrifugal pumps for chemical process 1984

2.01.10 API 610/1989: Centrifugal pumps general refinery services.

2.01.11 Hydraulic Institute Standards of USA (1983).


2.01.12 PTC 8.2/1965: Power Test Codes - Centrifugal pumps.

### 3.00.00 Accessories:

All the pumps under this specification shall be complete with following standard/special accessories.

### 3.01.00 Standard accessories:

- a) Pump motor coupling along with coupling guard
- b) Common base plates for pump and motor.

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- c) Lubrication system along with all internal piping, valves, fittings, specialties etc. as required.
- d) Counter flanges for suction/ discharge nozzles along with fixing nuts, bolts and gaskets.
- e) Anchor bolts, nuts, seating steel works, etc. as necessary for mounting the pump-motor unit on Civil foundations.
- f) Suitable vent (with valves)/ lifting/ handling attachments for the pump/ motor/ Accessories.
- g) Suitable drain connections with isolating valves as applicable.
- h) Set of "Special" Tools & Tackles for Pumps and motors, if any.
- i) Erection and commissioning spares, "on as required" basis.
- j) Bidder shall provide various drawings, data, calculations, test reports/ certificates, Operation and maintenance manuals, As-built drawings, etc. as specified and as necessary.

### **3.02.00 Services included in Bidder's Scope:**

3.02.01 The pumps shall be guaranteed to meet the performance requirements as specified vide datasheet – A and also for trouble free operation after commissioning.

### **4.00.00 TECHNICAL REQUIREMENTS:**

4.01.00 The pumps shall be Electric motor driven.

4.02.00 The Pumps shall conform to HIS

4.03.00 Vertical type pumps with 1500rpm.

4.04.00 Minimum efficiency of vertical pump will be 40%.

4.05.00 No negative tolerance shall be permitted in rated capacity & TDH.

4.06.00 No negative tolerance shall be permitted in efficiency at rated capacity.

4.07.00 The shut off head of pumps shall be at least 115% of pump rated TDH.

4.08.00 The pumps shall be capable of developing the required total head at rated capacity for Continuous operation. The pumps shall operate satisfactorily at any point on the Q-H Characteristic curve over a range of 0% to 130% capacity and shall be suitable for Continuous operation between 30% to 130% capacity.


4.09.00 Selection of the pumps shall be such that the design point shall be met even with negative manufacturing tolerance.

4.10.00 The total head capacity curve shall be continuously rising towards the shut off, the pumps shall preferably be non-overloading type and stable.

4.11.00 The pumps shall be capable of running over the entire range of NPSH conditions required without any noise, vibration or cavitations.

4.12.00 The pumps shall be of stiff shaft design. The minimum internal clearances should be sufficiently more than the max. Static deflection of the shaft. Shaft size selected must take into consideration the critical speed as specified in API-610.

4.13.00 Pumps and motors shall run smooth without undue noise and vibration. The vibration shall be within 75 microns for pump - motor set. The noise level shall be limited to 85 dB at distance of 1.0M.

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**4.14.00** High reliability of the pumps is an essential requirement and therefore it gets weight age over its efficiency. It is therefore essential that the bidder choose a standard proven model from the range of pumps manufactured.

**4.15.00** If water handled by pump is dirty/ not suitable for lubrication/ cooling, the bidder shall provide requisite strainer/ filters, tanks, motorized valves, etc. after the tap off for the required service, the arrangement provided shall be subject to Purchaser's approval.

**5.00.00 OTHER REQUIREMENTS:**

**5.01.00** The materials of construction for various components specified are the minimum Requirements indicated in datasheet – A section C and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty.

**6.00.00 PAINTING FOR PUMPS:**

- a) The surface of SS, Gun metal, brass, bronze and non metallic component shall not be applied with any painting.
- b) The Steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shop blasting etc. as per the agreed procedure.

For all the steel surfaces inside the (indoor installation) building, a coat of red oxide primes of min. thickness of 50 microns followed up with under coat of Synthetic Enamel paint of min. thickness of 50 microns shall be applied. the top coat shall consist of two coats each of min. thickness of 50 microns of synthetic enamel paint and thus total thickness shall be min. 200 microns.

**7.00.00 PERFORMANCE REQUIREMENTS**

**7.01.00** Pump (s) shall preferably be designed to have the best efficiency at the specified duty point. Further, the pumps (s) shall be suitable for continuous operation at any point within its 'range of operation'.

**7.02.00** Under all circumstances, the 'range of operation' of the pump (s) shall exclude any Unstable operating zone of the head-capacity curve.

**8.00.00 DESIGN AND CONSTRUCTION**


Pumps shall be of vertical shaft, complete with bowl, column pipe, discharge head and base plate with all accessories. General design and constructional features of the pumps shall be as follows:

**8.01.00 BOWL ASSEMBLY**

**8.01.01** This will be either a single, mixed flow or axial flow type with discharge co-axial with shaft. Type of impeller shall be chosen on the basis of the pump specific speed and the characteristics of handling fluid.

**8.02.00 IMPELLER SHAFT, LINE SHAFT AND HEAD SHAFT**

**8.02.01** Shaft size shall be selected on the basis of maximum torque to be applied on the pump shaft. Critical speed of the shaft shall be sufficiently away from the pump operating speed and in no case shall lie between 90% and 110% of the rated speed.

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8.02.02 Impeller shaft shall be guided by bearings provided in each bowl or above and below the impeller shaft assembly. The butting faces of the shaft shall be machined square to the assembly and the shaft shall chamfer at the edges.

8.02.03 Line shaft may be single or multiple pieces as required. In case of multiple pieces, line shaft shall be coupled as per the standard practice of the manufacture. For screwed coupling, directions shall permit tightening of the joint during pump operation.

8.02.04 Replaceable shaft sleeves shall be furnished at applicable location, particularly under stuffing box and at other locations, as considered necessary.

### 8.03.00 BEARINGS

#### 8.03.01 SHAFT BEARINGS

Adequate number of properly designed bearings shall be provided for smooth and trouble free operation of the pump. Number of bearings shall consider the number of shaft pieces used and the critical speed of the shaft. Bearings shall be either lubricated by external clear water/oil/grease or self-lubricated. In case of external water/oil lubrication, complete lubrication arrangement shall be furnished with the pump.

#### 8.03.02 THRUST BEARING

Thrust bearing of adequate size and capacity shall be provided to take the vertical thrust of the impeller arising out of the pump operation and dead weight of the rotating Components. Life of the thrust bearing shall be guided by the design standard of the pump. Thrust bearing shall be capable of running continuously at maximum load. Thrust bearing shall be either grease or oil lubricated. Lubrication arrangement shall be such that the lubricant does not contaminate the handling fluid. The arrangement shall also be adequate to protect the bearing, while the pump coast down to stop in case of power failure of the station. Pre-lubrication of the thrust bearing, if recommended by the pump manufacturer, shall be taken care of in designing the lubrication system. Cooling of the thrust bearing, if necessary, shall be done by the handling fluid/external Water, depending on the fluid handled. Location of the thrust bearing may be at the pump body or at the driver, or at both depending on the requirement.

## CHAPTER 32

### 32.00.00 LAYOUT REQUIREMENT

#### 32.01.00 The general layout criteria to be adopted for this project are indicated below.

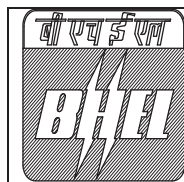
1. Minimum clear working space around equipment : 1200mm
2. Clear Head room within Main Plant Building for pipes, ducts structures & cable trays etc. : 2.5 m (Minimum)
3. No. of Fire Escape staircases in the main plant with fire doors at each landing : Min-4 Nos. per unit - However the number shall meet the requirement of insurance companies.
4. Adequate space for handling/removal of pumps, heaters, heat-exchanger, fans, Mills, during maintenance.
5. Independent floor drains with separate down comers shall be provided where sprinkler system are provided.
6. Valves in the Bidder's scope shall be located in accessible positions. All piping shall be routed at a clear height of 2500 mm (min.) from the nearest access level to clear man movement.
7. Provision of monorail beams with chain pulley blocks/HOT cranes along with hoists, as required shall be decided during detailed engineering stage and are in bidder scope.
8. Approach for removal of equipment for maintenance shall be provided.
9. A/C and Ventilation ducts, Bus ducts, and Critical Piping routes to be identified at conceptual stage.
10. Fuel oil (F.O) piping shall be routed over trestles. The headroom for F.O. Trestle in Boiler/ESP area shall be 8.0M till the road behind chimney as per the layout requirement. The headroom for F.O. trestle in outlying area shall be 3.0M except at rail/road crossing where the headroom shall be 8.0M. F.O. trestle legs or supports shall be located so as to clear the road spaces, approach to maintenance bays of different equipment buildings located in the route of F.O. trestle.
11. Routing of cable trays & piping
  - i) Trestle height in outlying area : 3 Meters(BOS/BOP)
  - ii) Trestle height from C-row to road Behind chimney /in front of XFMR Yard Boiler/ESP area : 8 Meters(BOS/BOP)
  - iii) Cable/ Pipe trestles height at rail/ road crossings shall be 8M. (BOS/BOP)
  - iv) Head room below cable / pipe rack in transformer yard area for movement of spare GT shall be 12.0 Meters.
  - v) A walkway with hand rails & toe guards of 600mm (minimum) width shall be provided all along length of the trestle for maintenance of cables & pipes. Ladders for



approach to these platforms shall be provided near roads, passage ways and turning points.

- vi) At the crossing of pipe/ cable trestles with the dry ash pipe rack/CHP cable rack trestle, pipe/ cable trestle shall be locally raised to provide a head room of 2.5 M over the walkways of dry ash pipe rack/CHP cable trestles.
- vii) Head room below cable/pipe rack along Mill bay shall be 12.0 Meters.
- viii) Head room for man movement shall be 2.5 m at ground floor, over all platforms etc.
- ix) Minimum clear hand space required for
  - a) The application of thermal insulation 100 mm
  - b) Welding work 150 mm
  - c) Bolt tightening 150 mm
- 12. Piping in main plant area (i.e. boiler/ESP/ID fan/chimney/transformer yard) shall be routed above ground on trestles with a height of minimum 8M. Further, piping in outlying area shall be routed over trestles with a height of 3M. However, height of trestles at approach roads to various buildings/ facilities shall be 8M.
- 13. Fire water piping within the Plant boundary shall be routed above ground on pedestals. However, fire water pipes in Main Plant Island shall be routed in trenches filled with sand and covered with pre cast RCC covers. Fire water pipes shall be protected in main plant area as per TAC requirement. Fire water piping at road crossing shall be encased/culvert. Fire water pipe at rail crossing shall be on trestle of BOS 8M height from rail top.
- 14. All other safety requirements as per the factories act, National Electricity code shall be observed while developing the layout.
- 15. Insulation of equipment/piping for personnel protection is to be provided if the temperature exceed 60 deg C.
- 16. Chequered plate edges should have continuous supports/ stiffeners.
- 17. Each equipment room shall be provided with alternate exits in case of fire /accidents as per requirements of factory act and TAC.
- 18. Each building shall have an identified vacant space for equipment unloading and maintenance and preferably a separate bay altogether in buildings housing heavy equipment. Provision for handling equipment by monorail hoist and/or overhead crane shall be made as specified.
- 19. Cubicle for operating personnel shall be located for all buildings at safe place near the equipment.
- 20. All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces specified elsewhere in this specification shall be complied with.
- 21. All gratings shall be of electro forged type with adequate bearing & locking on the supporting structure.

22. Approach to all elevated structures like Fans, Pumps, etc shall be through steel stairs with gratings & hand rail.
23. All cranes shall be provided with approach rung ladders at least at two places. Where ever cranes can't be maintained in situ on the carriage, facility to draw them to maintenance platforms as well as provision of suitable platforms shall be considered.
24. All fresh air ventilation louvers shall be 1000 mm from floor level and directed downward at an angle.
25. The VFD control equipment and transformers for ID fan shall be located along with the ESP control equipment in the ESP/ VFD control room.
26. Three (3) nos. of staircases per ESP of each unit shall be provided. Two (2) nos. of the staircase shall be located on the inlet side and one (1) no. on the outlet side of ESP.
27. The grating platform shall be provided in oil equipment room, control fluid room and valve room.
28. Approach platform shall be provided from ESP outlet to ID fan suction gate.
29. Minimum access opening required 3.5M wide x 4M high or, (with rolling shutter) transportation wherever entry of truck, for material more depending upon this envisaged equipment size to be handled.
30. Toilet and drinking water facility required in all buildings and on all floors wherever operating personnel are to be deployed.
31. Local Pits/trenches in Main Plant building are to be avoided. However pits/sumps which are unavoidable such as CW (Circulating Water System) pits etc shall be provided with required dewatering arrangements by means of drainage pumps and piping upto the nearest drainage network. Bidder shall provide required sump pumps/drainage pumps/submersible pumps & Piping etc.
32. Pump shall be permanently fixed in the pits/sumps. If the pit depth is shallow, vertical top mounted sump pumps shall be provided and in deep pits self priming drainage pumps (horizontal type) at floor level or alternatively submersible type pumps may be provided.
33. Each pit/sump shall be provided with two numbers (2 x 100% Capacity) of respective type pumps so that the entire pit is evacuated within 15-20 minutes and the operation of the pumps shall be interlocked through level measurement devices to be installed in the pit/sump so that the pumps shall start automatically and empty the pit.



**TITLE :**  
**2X660 MW ENNORE SEZ STPP**

**SPECIFICATION NO. PE-TS-412-155A-A001**

**SECTION : II**

**TECHNICAL SPECIFICATION FOR CONDENSATE  
POLISHING UNIT**

**SUB-SECTION : IIB**


**REV. NO. 00**

**DATE :**

## **SECTION – II**

### **GENERAL TECHNICAL REQUIREMENTS**

#### **SUB-SECTION IIB - GENERAL TECHNICAL REQUIREMENTS (ELECTRICAL)**

	<b>TITLE :</b> <b>GENERAL TECHNICAL REQUIREMENTS</b>  <b>FOR</b>  <b>LV MOTORS</b>	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : <b>II-B</b>
		SECTION : <b>D</b>
		REV NO. : <b>00</b> DATE : 29/08/2005
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## 1.0 INTENT OF SPECIFICATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer's work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

## 2.0 CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement for rotating electrical machines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

## 3.0 DESIGN REQUIREMENTS


3.1 Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A


3.2 Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information  
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.


### 3.3 Starting Requirements

3.3.1 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

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<p>The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.</p>		
<p>3.3.3 The following frequency of starts shall apply</p> <p>i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.</p> <p>ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)</p> <p>iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor</p>		
<p>3.4 <b>Running Requirements</b></p>		
<p>3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.</p>		
<p>3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.</p>		
<p>3.5 <b>Stress During bus Transfer</b></p>		
<p>3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.</p>		
<p>3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.</p>		
<p>3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.</p>		
<p>3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.</p>		
<p>4.0 <b>CONSTRUCTIONAL FEATURES</b></p>		
<p>4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy</p>		
<p>4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.</p>		
<p>Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled</p>		
<p>4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.</p>		

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4.4.	Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.	
4.5	Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.	
4.6	In case Class ‘F’ insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class ‘B’ insulation. In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.	
4.7	<b>Terminals and Terminal Boxes</b>	
4.7.1	Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.  Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet “A”.	
4.7.2	unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.	
4.7.3	Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.	
4.7.4	Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.	
4.7.5	Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.	
4.7.6	Degree of protection for terminal boxes shall be IP 55 as per IS 4691.	
4.7.7	Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.	
4.7.8.	Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.	
4.7.9	Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.	
4.8	Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.	
4.9	<b>General</b>	

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4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 **INSPECTION AND TESTING**

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 **DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT**

a) OGA drawing showing the position of terminal boxes, earthing connections etc.

b) Arrangement drawing of terminal boxes.


c) Characteristic curves:  
(To be given for motor above 55 kW unless otherwise specified in Data Sheet).

i) Current vs. time at rated voltage and minimum starting voltage.

ii) Speed vs. time at rated voltage and minimum starting voltage.

iii) Torque vs. speed at rated voltage and minimum voltage.  
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.


iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

	<b>TITLE</b>  <b>MOTOR</b>  <b>DATA SHEET - C</b>	<b>SPECIFICATION NO.</b> <b>PE-TS-412-155A-A001</b>
		<b>SECTION :II</b>
		<b>SUB-SECTION: IIB</b>
		<b>REV NO. 00 DATE 04/01/2017</b>
		<b>SHEET 1 OF 2</b>

S. No.	Description		Data to be filled by successful bidder
<b>A.</b>	<b>General</b>		
1	Manufacturer & country of origin		
2	Motor type		
3	Type of starting		
4	Name of the equipment driven by motor & Quantity		
5	Maximum Power requirement of driven equipment		
6	Rated speed of Driven Equipment		
7	Design ambient temperature		
<b>B.</b>	<b>Design and Performance Data</b>		
1	Frame size & type designation		
2	Type of duty		
3	Rated Voltage		
4	Permissible variation for		
5	a	Voltage	
6	b	Frequency	
7	c)	Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)		
9	Synchronous speed & Rated slip		
10	Minimum permissible starting voltage		
11	Starting time in sec with mechanism coupled		
12	a) At rated voltage		
13	b) At min starting voltage		
14	Locked rotor current as percentage of FLC (including IS tolerance)		
15	Torque		
	a) Starting		
	b) Maximum		
16	Permissible temp rise at rated output over ambient temp & method		
17	Noise level at 1.0 m (dB		
18	Amplitude of vibration		
19	Efficiency & P.F. at rated voltage & frequency		
	a) At 100% load		
	c) At 75% load		

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			



	<b>TITLE</b>  <b>MOTOR</b>  <b>DATA SHEET - C</b>	<b>SPECIFICATION NO.</b> <b>PE-TS-412-155A-A001</b>
		<b>SECTION :II</b>
		<b>SUB-SECTION: IIB</b>
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		<b>SHEET 2 OF 2</b>

<b>S. No.</b>	<b>Description</b>	<b>Data to be filled by successful bidder</b>
	c) At starting	
<b>C.</b>	<b>Constructional Features</b>	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level ( kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
<b>D.</b>	<b>Characteristic curves/ drawings</b> (To be enclosed for motors of rating $\geq 55\text{KW}$ )	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

<b>NAME OF VENDOR</b>			<b>SEAL</b>	<b>REV.</b>	
<b>NAME</b>	<b>SIGNATURE</b>	<b>DATE</b>			



# TITLE

## 2 X 660 MW ENNORE STPP TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT

# SPECIFICATION NO.

PE-TS-412-158-11000-A001

SECTION: II SUB SECTION –II B

REV 00


SHEET 1 of 2

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

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

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

- SYSTEM VOLTAGE CODES:  
(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V  
(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V
- CABLE VOLTAGE CODES:  
A = 11KV (Power cables)  
B = 6.6KV (Power cables)  
C = 3.3KV (Power cables)  
D = 1.1KV (LV & DC system power & control cables)  
E = 0.6KV (0.5 sq. mm. Control cables)

	<b>TITLE</b>  <b>2 X 660 MW ENNORE STPP</b>  <b>TECHNICAL SPECIFICATION FOR</b>  <b>CONDENSATE POLISHING UNIT</b>	<b>SPECIFICATION NO.</b>  PE-TS-412-158-11000-A001
		SECTION: II    SUB SECTION –II B
		REV 00
		SHEET 2 of 2

## (C) CABLE CODES

### PVC Copper

A = Armoured FRLS  
C = unarmoured FRLS

B = Armoured Non-FRLS  
D = Unarmoured Non-FRLS

### PVC Aluminium

E = Armoured FRLS  
G = unarmoured FRLS

F = Armoured Non-FRLS  
H = Unarmoured Non-FRLS

### XLPE Copper

J = Armoured FRLS  
L = unarmoured FRLS

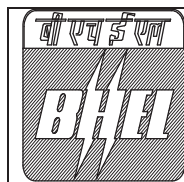
K = Armoured Non-FRLS  
M = Unarmoured Non-FRLS

### XLPE Aluminium

N = Armoured FRLS  
Q = unarmoured FRLS

P = Armoured Non-FRLS  
R = Unarmoured Non-FRLS

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



**TITLE :**  
**2X660 MW ENNORE SEZ STPP**

**TECHNICAL SPECIFICATION FOR CONDENSATE  
 POLISHING UNIT**

**SPECIFICATION NO. PE-TS-412-155A-  
 A001**

**SECTION : II**

**SUB-SECTION : IIC**

**REV. NO. 00**

**DATE :**

## **SECTION – II**

### **GENERAL TECHNICAL REQUIREMENTS**


#### **SUB-SECTION IIC - GENERAL TECHNICAL REQUIREMENTS (C&I)**

LIST  
OF  
C&I DOCUMENTS/  
DELIVERABLES



|

LIST OF VENDOR DELIVERABLES FOR C&I FOR CPU SYSTEM			
SI.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY
1	PE-V0-412-155-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM	A
2	PE-V0-412-155-I902	CONTROL SCHEME/LOGIC DIAGRAM(TO BE IMPLEMENTED IN DCS)	A
3	PE-V0-412-155-I903	HMI PICTURES/PLANT SCHEMATICS	I
4	PE-V0-412-155-I904	INSTRUMENT SCHEDULE with set points	A
5	PE-V0-412-155-I905	GROUPING AND TERMINATION	A
6	PE-V0-412-155-I906	I/O LIST (ANALOG & BINARY)	A
7	PE-V0-412-155-I907	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A
8	PE-V0-412-155-I908	DATASHEETS FOR INSTRUMENTS, JBs,Analysers etc.along with catalogue	A
9	PE-V0-412-155-I909	INSTRUMENT HOOK-UP DRAWING	A
10	PE-V0-412-155-I910	QUALITY PLANS/CHECK LISTS (For all applicable instruments)	A
11	PE-V0-412-155-I911	CABLE SCHEDULE & INTERCONNECTION	I
12	PE-V0-412-155-I912	ANNUNCIATION & SOE LIST	A
<p>NOTES:</p> <p>1. ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION.</p> <p>2. CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/CUSTOMER APPROVED FORMATS LIKE MS EXCEL,MS ACCESS OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST,FIELD JB TERMINATIONS, CABLE SCHEDULE &amp; INTERCONNECTION, etc. SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.</p>			

## **ACTUATORS**






	<b>SPECIFICATION FOR MOTORISED VALVE ACTUATOR</b>		SPECIFICATION NO.: PE-DG-412-145-I902	
			VOLUME II B	
			SECTION D	
			REV. NO. 03	DATE: 09.05.17
			SHEET 1	OF 3
<b>Data Sheet A &amp; B</b>				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
<b>GENERAL*</b>	* PROJECT	2x 660 MW ENNORE SUPERCRITICAL TPP		
	OFFER REFERENCE			
	* TAG NO. SERVICE			
	* DUTY	<input type="checkbox"/> ON / OFF <input type="checkbox"/> INCHING		
	* LINE SIZE (inlet/outlet): MATERIAL			
	* VALVE TYPE	<input type="checkbox"/> GLOBE <input type="checkbox"/> GATE <input type="checkbox"/> REG. GLOBE <input type="checkbox"/> BUTTERFLY		
	* OPENING / CLOSING TIME			
	* WORKING PRESSURE			
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%		
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY		
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY		
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY		
<b>CONSTRUCTION AND SIZING</b>	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IP:68		
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL		
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.		
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.		
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. <b>FOR INCHING SERVICE - 150 STARTS/HR MINIMUM &amp; FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.</b>		
<b>HANDWHEEL</b>	* REQUIRED	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
	* ORIENTATION	<input type="checkbox"/> TOP MOUNTED <input type="checkbox"/> SIDE MOUNTED		
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.			
<b>ELECTRIC ACTUATOR</b>	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY		
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY		
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT- <b>INCLUSIVE OF I.S. TOLERANCE</b>		
	ACTUATOR APPLICABLE WIRING DIAGRAM	<input type="checkbox"/> ENCLOSED (BIDDER TO CONFIRM) A: <input type="checkbox"/> DRG. NO. 3-V-MISC-24227 R00 B: <input type="checkbox"/> DRG. NO. 3-V-MISC-24550 R00 C: <input type="checkbox"/> DRG. NO. 3-V-MISC-24283 R00 D: <input type="checkbox"/> DRG. NO. 4-V-MISC-90271 R11 E: <input type="checkbox"/> For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram		
	COLOUR SHADE	<input type="checkbox"/> BLUE (RAL 5012) <input type="checkbox"/> .....		
	PAINT TYPE (## Refer Notes)	<input type="checkbox"/> ENAMEL <input checked="" type="checkbox"/> EPOXY <input type="checkbox"/> .....		
	SHAFT RPM	BIDDER TO SPECIFY		
	OLR SET VALUE	BIDDER TO SPECIFY		
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY		
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY		
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC		
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER <input type="checkbox"/> 230 V <input type="checkbox"/> 110 V		



	<b>SPECIFICATION FOR MOTORISED VALVE ACTUATOR</b>		SPECIFICATION NO.: PE-DG-412-145-I902		
			VOLUME II B		
			SECTION D		
			REV. NO. 03	DATE: 09.05.17	
			SHEET 2	OF 3	
<b>Data Sheet A &amp; B</b>					
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		
	@ ENCLOSURE CLASS OF MOTOR	<input checked="" type="checkbox"/> IP 68 <input type="checkbox"/> FLAME PROOF			
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B			
	@ WINDING TEMP PROTECTION	<input checked="" type="checkbox"/> THERMOSTAT (3 Nos., 1 IN EACH PHASE) <input type="checkbox"/> -----			
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED			
<b>INTEGRAL STARTER</b>	INTEGRAL STARTER	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED			
	TYPE OF SWITCHING DEVICE	<input checked="" type="checkbox"/> CONTACTORS <input type="checkbox"/> THYRISTORS			
	TYPE	<input checked="" type="checkbox"/> CONVENTIONAL <input type="checkbox"/> SMART (NON-INTRUSIVE)			
	STEP DOWN CONT. TRANSFORMER	<input checked="" type="checkbox"/> REQUIRED			
	OPEN / CLOSE PB	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED			
	STOP PB	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED			
	INDICATING LAMPS	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED			
	LOCAL REMOTE S/S	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED			
	STATUS CONTACTS FOR MONITORING	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED			
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (MOTOR THERMOSTAT TRIP, O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, PHASE LOSS, S/S IN LOCAL or OFF MODE, STOP PB OPTD, TORQUE OPEN/CLOSE CUTOFF)			
<b>INTERPOSING RELAY/OPTO COUPLER</b> (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	<input type="checkbox"/> INTERPOSING RELAY <input type="checkbox"/> OPTO COUPLER <input checked="" type="checkbox"/> EITHER			
	QUANTITY	<input checked="" type="checkbox"/> 2 NOs. <input type="checkbox"/> 3 Nos. *			
	DRIVING VOLTAGE	<input checked="" type="checkbox"/> 20.5 – 24V DC <input type="checkbox"/> _____ V DC			
	DRIVING CURRENT	<input checked="" type="checkbox"/> 125mA MAX <input type="checkbox"/> _____ mA MAX			
	LOAD RESISTANCE	<input checked="" type="checkbox"/> > 192 ohms - <25 k ohms <input type="checkbox"/> > _____ ohms - < _____ ohms			
<b>TORQUE SWITCH</b> (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY			
	OPEN / CLOSE	<input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos. / <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 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			
<b>LIMIT SWITCH</b> (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY			
	OPEN : INT : CLOSE	<input type="checkbox"/> 1 No. <input checked="" type="checkbox"/> 2 Nos.	2 Nos. (ADJ.)	<input type="checkbox"/> 1 No. <input checked="" type="checkbox"/> 2Nos.	
	CONTACT TYPE	2 NO + 2 NC			
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC			

\*For inching type drives IPR 3 Nos. to be considered for inching operation.



	<b>SPECIFICATION FOR MOTORISED VALVE ACTUATOR</b>		SPECIFICATION NO.: PE-DG-412-145-I902	
			VOLUME II B	
			SECTION D	
			REV. NO. 03	DATE: 09.05.17
			SHEET 3	OF 3
<b>Data Sheet A &amp; B</b>				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
<b>POSITION TRANSMITTER</b>	POSITION TRANSMITTER (For inching duty & other specific applications)	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	MFR & MODEL NO.	BIDDER TO SPECIFY		
	TYPE	<input type="checkbox"/> ELECTRONIC (2 WIRE) R/I CONVERTER <input checked="" type="checkbox"/> ELECTRONIC (2 WIRE) CONTACTLESS		
	SUPPLY	<input checked="" type="checkbox"/> 24V DC <input type="checkbox"/> .....		
	OUTPUT	<input checked="" type="checkbox"/> 4-20mA		
	ACCURACY	± 1% FS		
<b>SPACE HEATER</b>	@SPACE HEATER	REQUIRED		
	@ POWER SUPPLY (NON INTEGRAL)	230V AC, 1 PH., 50 Hz		
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY		
	@ RATING			
<b>TERMINAL BOX</b>	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED		
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ <input checked="" type="checkbox"/> IP 68 @ <input type="checkbox"/> .....		
	@ EARTHING TERMINAL	REQUIRED		
	PLUG & SOCKET (9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	<input type="checkbox"/> REQUIRED <input checked="" type="checkbox"/> NOT REQUIRED <input type="checkbox"/> 2 NOS. <input type="checkbox"/> .....		
<b>CABLE GLANDS</b>	@ POWER CABLE GLAND	SIZE: suitable for 3Cx2.5sq mm Cu		
	@ SPACE HEATER CABLE GLAND	SIZE:-		
	OTHER CONTROL CABLE GLANDS	QUANTITY & SIZE: Cable gland suitable for 8Px0.5 sq mm & 2P x 0.5 sq mm cable.		
<b>WEIGHT</b>	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.	
<b>NOTES:</b> 1. <b>SCOPE:</b> DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY. 2. <b>CODES &amp; STANDARDS:</b> 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 AND IS-4722 3. ACTUATOR SHALL HAVE HARDWIRED CONTACTS FOR FOLLOWING SIGNALS (a) ACTUATOR IN LOCAL MODE (b) ACTUATOR IN REMOTE MODE  4. BIDDER TO ENSURE AVAILABILITY OF SPARE 1NO + 1NC LIMIT SWITCH & TORQUE SWITCH. 5. SS TAG NAME PLATE SHALL BE PROVIDED. 6. TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C. 7. CABLE GLANDS OF DOUBLE COMPRESSION TYPE, Ni PLATED BRASS MATERIAL SHALL BE PROVIDED. 8. 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. 9. THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%. 10. THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING. 11. LOCAL DIGITAL POSITION INDICATOR SHALL BE PROVIDED FOR INCHING DUTY DRIVES.  12. COMMANDS SHALL BE LATCHED AT INTEGRAL STARTER END.  13. ALL SPARE CONTACTS ON SWITCHES SHALL BE TERMINATED IN JB MOUNTED ON ACTUATOR. 14. ACTUATORS FOR HAZARDOUS AREA SHALL BE CERTIFIED FLAME PROOF FOR ZONES 1 & 2. 15. THE OPERATING SPEED OF VALVE SHALL BE INLINE WITH SPECIFICATION TO THE EXTENT POSSIBLE. 16. ALL LIMIT SWITCHES SHALL CONFIRM TO IEC-60947-5-1. 17. TERMINATION BLOCK INTEGRAL TO ACTUATOR WILL BE MEETING CUSTOMER SPECIFICATION REQUIREMENT TO THE EXTENT POSSIBLE.  18. BIDDER TO SELECT THE OPTION IP RELAY/OPTOCOUPLER FOR TYPE OF ISOLATING DEVICE. IP RELAY SHALL BE 12V DC/24V DC COIL, 250V AC CONTACTS. 19. FINAL VENDOR WIRING DIAGRAM OF ACTUATOR SHALL BE SUBMITTED AFTER ORDERING. <b>\$\$ TORQUE SWITCH &amp; LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.</b> <b>## EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.</b>				
NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @ = TO BE FILLED BY ES				

## **FIELD & MEASURING INSTRUMENTS**

|

**CHAPTER-3****FIELD AND MEASURING INSTRUMENTS****3.00.00 FIELD & MEASURING INSTRUMENTS (PRIMARY & SECONDARY INSTRUMENTS)****3.01.00 GENERAL REQUIREMENTS**

**3.01.01** Instruments, control devices and other equipment accessories covered under this specification shall be furnished in accordance with I&C specification sheets and drawings enclosed herewith and the requirements of all applicable clauses of this specification.

**3.01.03** The instrumentation/control equipment and accessories shall be from the latest proven design for which the performance and high availability have been demonstrated by a considerable record of successful operation in power station service for similar applications. The bidder shall furnish sufficient evidence to fully satisfy the Owner in this regard.

**3.01.04** For plug in type instruments, The plug & sockets shall be polarized to prevent wrong connections and have facility for secure coupling in plug-in position to prevent loose connections.  
Signal/Electrical connection shall be screwed connection with double compression type Nickel-plated brass cable glands for Explosion proof area, Flame proof area and high vibration prone area.

**3.01.05** Every instrument requiring power supply shall be provided with a pair of easily replaceable glass cartridge fuse of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.

**3.01.06** All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. The enclosures of all electronic instruments shall conform to IP-65 unless otherwise specified (Explosion proof for NEC article 500, class 1, Division 1 area & flame proof) and an anti corrosive paint shall be applied to the field mounted enclosures / instruments. All the field instruments shall also be provided with SS tag nameplate and double compression type Nickel-plated brass cable gland. Gaskets, Fasteners, Counter and mating flange shall also be included wherever required with the field instruments.

**3.02.00** Following minimum requirement of field instruments shall be fulfilled by Bidder (In addition, Redundancy criteria for field instruments shall be as specified else where in specification): -



**DESEIN****Vol-V : Instrumentation & Control Works**

- iii. Level Transmitters (Type as per Owner approval) for open sump/tank/bunker/vessel/heaters.
- iv. Stand pipes on both side of tank for all level instruments (LT, LS & LG).
- v. Flow elements with flow transmitter & Flow meter for flow measurement of as decided by owner
- vi. Pressure gauges and temp. Gauges at inlet and outlet of each heat exchanger and cooler.
- vii. DPG, DPT & DPS across the filters/strainers.
- viii. Tapping points/test points shall be provided.
- x. All Thermocouples & RTDs shall be Duplex.
- xi. All Field Instruments used in acid or alkaline atmosphere shall be with standard Anti corrosion coating i.e. the combination of Polyurethane and epoxy resin baked coating (ANSI/ISA-71.04).
- xii. All primary instruments installed at "Minus level or Floor" shall be with protection class of IP 68.
- xiii. Transmitters (all type) for monitoring & controls purpose.



**DESEIN****Vol-V : Instrumentation & Control Works**

- xvii All field mounted push button, selector switch etc. shall be as per IEC or NEMA 4X protection.
- xviii All limit switch shall be conform to IEC-60947-5-1.
- xxi. Temp. Transmitters are envisaged with RTD & Thermocouples for monitoring services/application only. However any RTD & Thermocouples are used for control, interlock & protection application, same shall be directly wired to DDCMIS/DCS/PLC using instrumentation & Extension cables respectively.
- xxiii. Contacts less, electronic 2-wire position transmitters shall be provided for all inching type motorised valve and dampers.
- xxvii. Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application. For HFO, LFO Applications, SS capillary with thin wafer element with ANSI RF flanged ends are to be provided. For hazardous area, explosions proof enclosure as described in NEC article 500 shall be provided.

**FIELD INSTRUMENTS SHALL BE SUPPLIED & OFFERED AS PER DATA SHEETS SPECIFIED BELOW:**



2 x 660 MW ENNORE SEZ Supercritical Thermal Power  
Project at Ash Dyke of NCTPS  
Spec. No. CE/C/P&E/EE/E/OT.No.03/2013-14

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**DESEIN****Vol-V : Instrumentation & Control Works****3.03.00 TRANSMITTERS, SWITCHES, GAUGES AND PANEL MOUNTED INSTRUMENTS****3.03.01 Pressure, Differential Pressure, DP type Level and Flow Transmitters (PT, DPT, LT & FT)**

Smart Transmitters of the electronic type shall be furnished.

Transmitters shall be equipped with mounting brackets suitable for a mounting in transmitter enclosures.

In general, Transmitters are envisaged to be grouped at several places as to be decided during detailed engg. stage. For this purpose, suitable enclosures complete with all tubing, fittings, purge meters, loop cable trays etc. shall be provided.

<b>Type/Construction</b>	:	Sealed capacitance/ Inductance/ Silicon resonance type
<b>Material</b>		
- Body	:	Die cast Aluminum with epoxy coating for air & flue gas SS316 for other services
- Diaphragm	:	316 SS
- Measurement element	:	Teflon seal
- Valves	:	Carbon steel for non-corrosive Applications SS316 for corrosive applications.
Output signal	:	4 to 20 m Amp. DC (Two wires) HART Compatible
Local Indicator	:	LCD indicator (5 digit) with scale of Engg. unit
Overall Accuracy	:	$\pm 0.04\%$ or better of Span for BTG package $\pm 0.065\%$ or better of Span for BOP packages $\pm 0.2\%$ or better of span for remote seal type transmitter.
Turn down ratio	:	100:1 in general
Stability	:	$\pm 0.15\%$ of URL for 5 years.
Response time	:	150 msec.
Power supply	:	24V DC nominal
Drive capability	:	600 Ohms nominal
Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
Span and Zero	:	Locally adjustable, non-interacting



2 x 660 MW ENNORE SEZ Supercritical Thermal Power  
Project at Ash Dyke of NCTPS  
Spec. No. CE/C/P&E/EE/E/OT.No.03/2013-14

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**DESEIN****Vol-V : Instrumentation & Control Works**

Zero suppression /  
elevation : At least 100% of Span

**Connection**

- Process : 1. Half (1/2) inch NPT (F)  
Quarter (1/4) inch NPT  
with/without oval flanges

- Electrical : Suitable for Plug in type connection (Both side of transmitter), unused entry with blind plug.

**Accessories**

- For Absolute Pressure Transmitters: Two (2) valve SS316 manifold

- For Gauge & Vacuum pressure transmitter : Three (3) valve SS316 manifold

- For DP, level & flow transmitter : Five (5) valve SS316 manifold

- For oil and corrosive liquids : Separator diaphragm seals

- For all transmitters : Mounting bracket

Manifold should not be mounted on the transmitter, Manifold shall be non integral and standalone type. Snubbers/Pulsation dampners shall be used where the process media is unstable for measurement such as the discharge of a pump. Over range protection shall be used where necessary. The coil syphons & condensate pots shall be used for steam services. Transmitters shall be provided with suitable drain & vent points.

**3.03.02 PRESSURE SWITCHES (PS) & DIFFERENTIAL PRESSURE SWITCHES (DPS)**

Applicable Standards : IS3624 - 1966/ISA-RP-8.1 except as modified in spec.

Type/Construction : Bourdon/Sealed Diaphragm Piston  
Actuated preferable. Indicators with contacts are not acceptable.

**Materials**

- Bellows : 316 SS

- Bourdon tube : 316 SS

- Movement : 316 SS

- Enclouser : Die-cast aluminum with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere.

- Protective Diaphragm : Teflon





**DESEIN****Vol-V : Instrumentation & Control Works**

Accuracy	:	$\pm$ One (1) percent or better
Repeatability	:	$\pm$ 0.5(half) percent or better
Setting & Differential	:	Adjustable
<b>Contact</b>		
- Number	:	DPDT /2 SPDT
- Type	:	Auto reset with internal Adjustable snap action micro switch
- Rating	:	5 Amp, 240V AC / 0.2 Amp, 220V DC
Connection - instrument	:	Half (1/2) inch NPT Male Process
Electrical	:	Suitable for Plug in type connection. All the switches are internally connected and brought to the surface with Amphenol male/female connection. Cabling need not terminated inside the switch. Cable ends are to be soldered in connector and to be inserted for easy maintenance.
- Over range protection	:	One Fifty (150) percent of full scale
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
<b>Accessories</b>		
- 3 / 5 valve manifold	:	As applicable for all switches
- Self cleaning type pulsation dampners/Snubber (Material SS316)	:	Pump and compressor discharge lines
- Syphon	:	For all steam lines
- Protective separating diaphragm	:	For fuel oil & corrosive liquid lines.
Mounting	:	Local (in LIE/LIR for BTG package).

**3.03.03 PRESSURE & DIFFERENTIAL PRESSURE GAUGES (PG & DPG)**

Applicable standard	:	IS:3602-1966, IS/3624, ASME B 40.1
Type/Construction	:	
-760 mm to 1.0Kg/cm2	:	Bellows/Diaphragm
-Above1.0Kg/cm2	:	Bourdon Tube
- Suction side of pumps	:	Compound gauge
<b>Materials</b>		
- Bourdon tube	:	316 SS
- Bellows	:	316 SS
- Movement	:	316 SS
- Case	:	SS 316/ Die-cast aluminum with stoved enamel black finish. Epoxy coating



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		shall be provided for corrosive atmosphere.
- Protective Diaphragm	:	Teflon
Dial size	:	150mm with shatter proof glass
Scale Details	:	Graduations in black lines on white dial, on white dial, 270 Deg. pointer deflection scale provided with glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller. Pointer stop for all gauges.
Accuracy	:	$\pm$ One (1) percent or better
Connection - Instrument Process	:	1/2 inch NPT Male Bottom
Mounting	:	Local
	:	1/2 inch NPT Male (Back entry) mounted on local gauge board.
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

**Accessories**

- 3 way needle valve/manifolds	:	For all gauges
- Self cleaning type	:	Pump and compressor discharge lines
Pulsation dampener/snubber (S316)	:	
- Syphon	:	For all steam lines
- Protective separating	:	For fuel oil and corrosive liquid lines

**Other particulars**

- External Zero adjustment	:	For all gauges
- Safety device	:	

Ranges 5 to 20 Kg/cm <sup>2</sup>	:	Rubber blow out disc with open front construction.
Ranges above 20 Kg/cm <sup>2</sup>	:	Neoprene safety diaphragm at the back with solid front construction.
- Over range protection	:	One Fifty (150) percent of full scale

**Other Requirements**

	:	Movement mechanism shall be glycerin filled for oil services & vibration prone area.
	:	For Fuel oil & corrosive liquid lines diaphragm type sensors required. Armored capillary of 10 M for Fuel oil & Corrosive liquid service.



- : Contact type pressure gauges are not acceptable for interlock & protection.
- : For condensate storage tank the pressure gauge in terms of 0-10000 mm wc or suitable range having **dial size of 300mm or bigger size** shall be provided.

### 3.03.04 TEMPERATURE TRANSMITTERS

Type	:	SMART type configurable from control room through HART protocol (HMS System).
Display type	:	Indicating type (5 digit LCD Display),
Accuracy	:	$\pm 0.10\%$ ,
Ambient temperature error	:	0.1% per 10°C change
Output	:	4-20 mA DC (2 wire system) HART compatible signals for analogue monitoring inputs to the distributed control system (DDCMIS), DCS & PLC.
Protection class	:	NEMA 4/IP66 or equivalent degree of protection for enclosure/ (Explosion/Flame proof for NEC Class-1, Division 1 area)/ flame proof (IEC-79.1, Part I). As applicable).
Material of accessories	:	SS316.
Stability	:	$\pm 0.1\%$ or $\pm 0.1$ deg C of reading (whichever is great) for 2 years in case of RTD inputs and for 1 year in case of Thermocouples inputs.
Operating Voltage	:	16 – 48 V DC
Calibration	:	as per NIST monograph 125 for T/C & European Curve Alpha = 0.00385 for RTD .
Ref. Junction compensation	:	Provided
Span/zero adjustment	:	Locally adjustable, Non interacting
Auto calibration	:	Provided
Burn out protection upscale	:	Provided
Input - output isolation	:	Provided
Circuit ungrounded	:	Provided

Any RTD & Thermocouples shall be directly wired to DDCMIS/DCS/PLC for metal temperature application, bearing & winding temp application only.

The Temperature transmitter shall accept Universal dual inputs of all types of thermocouples & RTD, 0-5V input signals etc.



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Temp. Transmitter shall be extremely stable against Ambient temp variation, The accuracy figure shall be inclusive of effect due to ambient temperature variation.

**3.03.05 RESISTANCE TEMPERATURE SENSORS WITH THERMOWELLS**

Applicable Standard	:	ASME PTC 19.3 - Latest Revision DIN EN 60751:1996, BS EN/IEC60751:2008
Element	:	Platinum, R0=100 ohm 4-wire Duplex for Process Temp. Measurement  Platinum, R0=100 ohm 3-wire Duplex for Bearing & Winding Temp. Measurement
Sheath Material/ Insulation	:	316SS/Compacted Magnesium Oxide
Sheath O D	:	8 MM
- Gauge	:	18 AWG
Terminals	:	Spring loaded high temperature ceramic base with silver plated brass for high vibrating locations.
Calibration	:	As per DIN Standard – 43760, Class A
Head	:	Hex Head, Die Cast Aluminum (Screwed) with galvanized SS chain
Response Time	:	6-10 Sec bare & 30 Sec. With protective sheath/thermowell
Accuracy	:	± 0.35 degree C or Class-A whichever is better.
Electrical connection	:	Gold plated Plug in type. Double entry – one unused entry with blind plug
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

**THERMOWELL**

Applicable Standard	:	ASME PTC 19.3 TW - 2010
- Construction	:	Tapered drilled from Bar stock (Straight for Air & Gas systems)
- Material	:	- 316 SS/F11/F22/F91 - water and steam Services depending upon process parameters. - Inconel for air & flue gas services For furnace zone, impervious ceramic protecting tube of suitable material along



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with Incoloy supporting tubes and adjustable flanges.

For Mill classifier outlet long life solid sintered tungsten carbide material or better of high abrasion resistance.

Bidder shall provide calculation for thermowell as per ASME – PTC-19.3 2010. "All Thermowells in high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safer size and design of Thermowells".

- Process Connection	:	(i) M 33 x 2 (ii) SS316 Flanged, for Air & Gas systems, with mating flanges, fasteners, gaskets etc.
- Extension	:	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
Immersion length	:	Within $\pm 10$ mm of center line of pipe and as per ASME – PTC-19.3 - 2010
Extension neck length	:	Minimum 100 mm above insulation of pipe and Minimum 160 mm when there is no insulation on pipe.
IBR Certification	:	For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations
<b>Note</b>	:	<b>Extension</b> /Compensating/paired cable exposed to atmosphere in the conventional method melts away due to high temperature at the top of mill or due to coal burning. Hence The terminals of temperature sensors shall not be at the top of mills itself. The temperature sensors wires are to be laid up to JB though SS tube of required diameter and the head shall be placed nearer to the JB.

### ~~3.03.06 THERMOCOUPLES WITH THERMOWELLS~~

Applicable standard	:	ASME PTC 19.3- Latest Revision ANSI-MC 96.1 – 1982, IEC 584-2
Element	:	Duplex
- Sheath	:	8 MM OD
- Sheath Material	:	316 SS
- Spring Loaded	:	Yes
- Nipple/Union	:	Yes
- Packed connector	:	Compacted magnesium Oxide ungrounded



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with two nipples of SS 316 having 1/2"NPT(M) threads at both ends

Thermowell : To suit Temp. switch with same design criteria as specified for RTDs.

Electrical : Suitable for Plug in type.

All the switches are internally connected and brought to the surface with Amphenol male/female connection. Cabling need not terminated inside the switch. Cable ends are to be soldered in connector and to be inserted for easy maintenance.

**Other Particulars**

- Capillary length : As per requirement (min 10 meters)
- Immersion Length : Within + ten (10) mm of center line of pipe with adjustable nuts.
- Extension neck length : Minimum 50 mm above insulation of pipe /As per approved hookup drawings.
- Packing glands : Yes
- IBR Certification : For high pressure service, Steam Temp, Fuel oil temp. measurement as per IBR rules and regulations
- N.B : Switches designed for cross ambient operation shall be used in applications where the ambient temperature will approximate or exceed the switch set point.

**3.03.09 TEMPERATURE GAUGES (TG)**

Applicable standard : IS : 3602,BS:5235 ISA:RP:8.1 except as modified in this specification

**Type/Construction**

- Thermometer : Industrial type, Gas in Filled type with separable thermowell
- Thermowell : Bar stock

**Material**

- Bulb : 316 SS
- Capillary : Armoured SS (Applicable for capillary Type)
- Casing : SS 316/ Die-cast aluminum with stoved enamel black finish. Epoxy coating



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		shall be provided for corrosive atmosphere
Dial Size	:	150mm with shatter proof glass
Scale Details	:	270 degree dial rotation/deflection. Graduations in black lines on white dial provided with glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller .Pointer stop for all gauges
Accuracy	:	$\pm$ One (1) percent or better
Response time	:	Maximum 15 seconds without thermowell and 30 seconds with thermowell
Connection		
- Pipe	:	M33 x 2
- Thermowell	:	To suit instrument with same design criteria specified for RTDs.
- Process Connection	:	(i) M 33 x 2 (ii) SS316 Flanged, for Air & Gas systems, with mating flanges, fasteners, gaskets etc.
- Extension	:	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
Other Particulars		
- Capillary length	:	5Meters/10 Meters as required
- Immersion Length	:	Within + ten (10) mm of center line of pipe with adjustable nuts.
- Extension neck length	:	Minimum 50 mm above insulation of pipe /As per approved hookup drawings.
- Stop at Maximum value	:	For all gauges of scale
- Pointer	:	Externally adjustable
	:	In general, Contact type Temp. gauges are not acceptable for interlock & protection.
		Contact type Temp. gauges are acceptable for interlock & protection in case of bearing temp. only.
- Over range protection	:	150 percent (%) of full scale
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
IBR Certification	:	For high pressure service, Steam





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Temp., Fuel oil temp. measurement  
as per IBR rules and regulations

**3.03.10 TEST THERMOWELLS (TW)**

Applicable Standard	:	ASME PTC 19.3 TW - 2010
Type/Construction	:	Machined from Bar Stock
Material	:	316 SS/F11/F22/F91
Connection	:	
- Pipe	:	M33 x 2
- Test Instrument	:	To suit test instruments
Accessories	:	Plug with chain
IBR Certification	:	For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations Bidder shall provide calculation for thermowell as per ASME – PTC- 19.3 TW - 2010.

Test wells shall be provided on main steam, reheat steam, extraction steam, feed water, condensate, spray water lines and other piping as required to meet ASME test requirements.

**3.03.11 DIRECT MOUNTED LEVEL TRANSMITTERS (LT)**

Displacer type level transmitter shall not be used in the process anywhere in the plant.

**3.03.12 Ultrasonic Level Transmitter (for Water sump/Tank level, Raw water reservoir level, Cooling water fore bay level measurements)**

Principle of Operation	:	Detection of reflected ultrasonic pulse
Measuring Ranges	:	Up to 30 meters (typical)
Signal Processing	:	Microprocessor Controlled Signal Processing
Operating Freq.	:	10 KHz to 50 KHz (typical)
Display	:	Head mounted alpha-numeric back lit LCD/LED
Calibration & Configuration	:	Accessible from front of panel & HART calibrator.
Diagnosis	:	On-line
Status	:	For power, Hi / Lo / V. Hi / V. Lo- level indication, fault etc.
Construction	:	Plug-on board
Power supply	:	240 V AC 50 Hz / 24V DC
Signal Output	:	4-20 mA DC with HART (isolated) - 600 Ohm load.
Hysteresis	:	Fully adjustable preferred
Output contacts	:	2SPDT Potential free changeover contacts @ 8A 230V AC.
Accuracy & Repeatability	:	$\pm 0.25\%$ of span or better
Resolution	:	$\pm 0.1\%$ of span
Temperature Compensation:	:	To be provided with Transducer.



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Operating temp.	:	Transmitter-50 deg C and Sensor – 80 deg C
MOC Sensor	:	Body- PVDF and Face – Polyurethane
Humidity	:	1% to 95% non condensing.
Enclosure	:	IP-67 Epoxy painted die cast Aluminum or SS316L housing.
Cable Connection	:	3/4" ET
Mounting	:	2" – 4" NPT or flanged
Accessories	:	Cable gland, prefab cable, mounting accessories like EPDM seal, SS316 flanged etc.
		Additional separate local display unit with large Alphanumeric back light LCD/LED & to be provided for the applications which will be decided during detailed engineering.

**3.03.13 CAPACITANCE TYPE LEVEL TRANSMITTER**

The total system shall consist of capacitance probe, pre-amplifier and transmitter

Type	:	Capacitance type
Probe	:	a) Rod or suspended electrode. b) Rope type probes may be used only where required probe length is greater than 3 meters
Probe Mounting	:	Stainless steel 1-1/2 ANSI RF Flange / ¾" NPT (M)
Material of construction	:	316 SS
Insulation	:	PTFE Part/Full as per service.
Transmitter	:	The transmitter shall receive output of the preamplifier and convert it into 4-20 mA DC output signal.
Accuracy	:	± 1% of Full scale
Repeatability	:	± 0.5 % of Full scale
Load	:	Min 600 Ohms
Enclosure	:	Powder/Epoxy coated Die cast aluminum. with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
Ambient temperature	:	0-60 °C.
Mounting	:	Wall / Surface
Supply voltage	:	240V AC, 50Hz / 24V DC
Response time	:	100 m sec or better
Cable connection	:	¾" ET
Accessories	:	Counter flange, Cable gland, prefab cable if any
Preferable features	:	Alarm output contacts with adjustable set point facility

**3.03.14 GUIDED WAVE RADAR/RADAR LEVEL TRANSMITTER**

Type	:	Guided wave Radar (Contact type)/Radar (Non contact type) as finalized by owner.
Application	:	For Turbine Lube oil tank, HFO & LDO tank level,



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		Condenser Hotwell, LP heaters, CBD tank level, Stator water expansion level, and other Low pressure, Vacuum vessels.
Environment Class	:	Highly abrasive with Gases and Fumes
Orientation	:	Vertical
Probe Type	:	Flexible Single lead with chuck
Probe Material	:	SS 316L
Connection Size & Type	:	2" Flanged ANSI 300 lb SS316L material
Connection material	:	SS 316L
Accuracy	:	+/- 5 mm
Resolution	:	± 1 mm
Type (Transmitter)	:	SMART, 2 Wire
Operating Principle	:	Time Domain Reflectometry
Output	:	4-20 mA, DC with <b>HART protocol</b> and 600 Ω output load.
Electrical Connection	:	½" NPT
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
Electrical Power	:	11-42 V DC
Housing material	:	Die Cast Aluminum
Vent & Drain Plug material	:	SS
Side Flange Material	:	SS
Local Display	:	Provided (LCD Digital)
Units of Measurement	:	Length M
Electromagnetic compatibility:	:	EN-61326

**3.03.15 3 D TYPE ACOUSTIC WAVE LEVEL TRANSMITTER**

Type	:	Acoustic Wave Level Transmitter (3 D type)
Application	:	Coal and Ash Bunker Level, Volume & Mass.
Temperature compensation	:	Required for high temp applications
Operating Principle	:	Non - Intrusive acoustic wave transmission & Reflection
Frequency Range	:	3 – 10 KHz
Accuracy	:	+/- 0.25 % for even surface & ± 0.5% for uneven surface.
Resolution	:	1 mm
Output	:	4-20mA DC with HART
<b>Display Unit:</b>		
Type	:	Head mounted LCD Display with Engg. Units
Location	:	Suitable location at bunker / Silo operating floor area
Protection Class	:	IP 65 or better// flame proof (IEC-79.1, Part I) As applicable).
<b>Material Of construction:</b>		



~~D. Application : Ash Silos~~

3.03.18

**LEVEL INDICATORS (Gauge Glass) (LI)**

<b>Type/Construction</b>	:	<b>a) Reflex</b> b) Tubular (For tanks open to atmosphere only)
Material:		
a) Glass	:	Tempered borosilicate resistant to thermal shock
b) Case	:	Carbon steel
c) Integral cocks and	:	i) Forged carbon steel with drain valves stainless steel internals ii) Rubber lined corrosion resistant 316 stainless steel (for Demineralised and Osmosis water service)
d) Fittings	:	i) Forged carbon steel ii) Rubber lined 316 steel/PVC for corrosive liquids Demineralised and Osmosis water service) iii) 304 Stainless Steel for non-corrosive liquids
e) Packing	:	Teflon
Dial size/scale	:	150 mm /1.5 Meters maximum length with
Scale details	:	Aluminum/SS316 scale Graduated in mmwc
Connection	:	25 Nb/40 Nb ANSI Flanged
Accessories	:	a) Integral cocks b) Drain valves c) Bolts, nuts and gaskets d) Illuminating lamps as required e) Periscope as required
Tests	:	Tested at two hundred (200) percent of the maximum process pressure
Other details	:	For larger lengths, additional gauge glasses shall be provided with minimum of 50 mm overlap.

3.03.19

**FLOAT & BOARD TYPE LEVEL GAUGE**

Type of Instrument	:	Mechanical Type (Float Operated)
Service/ Application	:	As per service requirement
Measuring Range	:	as per requirement
Material Specification		
a) Float Material	:	SS316 having 2 nos. Guide wires
b) Float Wire Pulley	:	Shall comprise of 2 nos. Cast Aluminum Pulley hosing Assembly with SS 304 pulley and pulley shaft. Steel ball bearings shall be provided in pulley housing for easier float movement. Float wire material shall be



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SS316L. Between 2 pulleys, 1" NB G.I. short pipe with tentative length as per P&ID

- |  |   |  |
|--|---|--|
| c) Guide wire Assembly                           | : | CS chamber with spring and adjuster having 1" Class 150 ANSI RF MS flange. Guide wire rope shall be SS316L.                                |
| d) Counter Weight                                | : | MS counter – weight with Aluminum Pointer and Brass assembly Pull Chain.   |
| e) Scale   | : | SS 316/Aluminum material in mm with 1 % accuracy.  |
| Nozzle Details                                   | : | For float wire pulley assembly, one tapping and for guide wire assembly two tapping at the top of the tank; Size 1" NB (Top Mounting Type) |
| Process Connection                               | : | Flanged as per ANSI B 16.5 to suit 1" NB nozzle (Nozzle length - 150 mm for float wire, 100 mm for guide wire)                             |
| Accessories (to be supplied with the instrument) |   |  |
| a) Counter flange                                | : | All mating Flanges, Nozzle   |
| b) Mounting Accessories                          | : | All mounting accessories   |
| c) Tag Plate                                     | : | To be provided (material SS316)  |

**3.03.20****MASS FLOW METER****Sensor**

- |                                 |   |  |
|---------------------------------|---|--|
| Measuring Principle             | : | Coriolis Mass flow.                                    |
| Primary Element                 | : | Flow Tube of 316SS or better                           |
| Heating Arrangement             | : | Integral with Flow meter.                              |
| Temperature Control For Heating | : | To be provided.  |
| Process Connection              | : | ANSI RF Flanged and rating as per process requirement. |
| Drain                           | : | Self-draining facility                                 |
| Accessories                     | : | Counter flanges, Mounting nuts, bolts, gaskets etc.    |

**Transmitter**

- |                         |   |   |
|-------------------------|---|---|
| Measured quantities     | : | Mass Flow rate, Total Mass Flow, Density, Temperature as minimum.             |
| Input Signal Processing | : | Digital Processing.   |
| Display                 | : | Digital Display (LCD).  |
| Output                  | : | 2 Nos. isolated output of 4-20mA DC selectable from four measured quantities. |
| Load                    | : | < 750 ohms.   |
| Power supply            | : | 240V AC, 50 Hz. From UPS  |
| Accuracy                | : | 0.15% of measured value for Liquid<br>0.5% of measured value for Gas          |
| Repeatability           | : | 0.05%   |
| Housing                 | : | IP 65 (Explosion proof for NEC Class-1, Division 1 area)                      |
| Hazardous duty Version  | : | FM Standards.   |



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Output Signal	:	Pulse
Material of Construction	:	AISI 316
Sensor Seal	:	PTFE / higher based on temperature
Flow range	:	As required.
Linearity	:	0.25% or better.
Repeatability	:	0.02% or better.
Ambient temperature	:	50 deg C
Mounting	:	On-Line mounting with flanges of stainless steel.
Enclosure	:	IP 65
Accessories	:	Nuts, bolts, gaskets etc.
<b>Transmitter</b>		
Electronics	:	Solid State
Power Supply	:	240V AC, 50Hz. UPS
Input	:	Input from Sensor
Display	:	4 1/2 digit LCD
Output	:	Isolated 4-20mA DC HART
Measuring Accuracy	:	0.5% of full scale range
Totalized Value	:	Required
Housing	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
Nameplate	:	Tag number, service engraved in stainless steel tag plate
Accessories	:	Clamping strip, bracket, prefab cable etc. Special tool kit for calibration/ configuration .

**3.03.23 Flow Transmitter (Ultrasonic)**

Type	:	ULTRA SONIC, 2-wired
Sensing element	:	Non-contact
Output	:	4-20mA with HART Protocol
Accuracy	:	± 0.1% FS
Supply	:	24 V DC
Enclosure class	:	IP-65
<b>Transmitter</b>		
Mounting	:	On Nozzle
Mounting position	:	Top mounted
Housing	:	Plastic
Display	:	Head mounted LCD Display and remote LCD display
Process connection	:	NPT/Flanged
Electrical connection :	:	NPT
Turn Down ratio	:	1:100
Measuring range	:	Adjustable (as per process requirement)
Totaliser	:	Required
Accessories	:	As per process requirement Additional separate local display unit with large Alphanumeric back light LCD/LED & to be provided for the applications which will be decided during



- b) Nuts, bolts, gaskets, mesh etc.  
Special tool kit for calibration/configuration.

### 3.03.25 Electromagnetic Flow meter

Electromagnetic flow meters shall have separate transmitter having accuracy  $\pm 0.2\%$  with zero stability feature, suitable for process medium with  $\leq 5$  micron Siemens conductivity, flanges material SS-316, electrode & measuring tube material SS-316, liner material Teflon and enclosure IP-66, local digital display configurable as totaliser, 4-20 mA output signal HART compatible with zero and span field adjustable. Application – DM Water and for other application as decided by owner.

### 3.03.26 FLOW GAUGES (FG)

- Type/Construction :
- a) On-line type Rotameter for 50 Nb and below lines
  - b) Bypass type Rotameter for above 50 Nb lines.

#### Material

#### - For On-line type

- Metering Tube : Borosilicate glass  
Float : 316 SS  
Packing : Teflon  
End fittings : 304 SS

#### -For Bypass type

- Metering Tube : Borosilicate glass  
Float : 316 SS  
Packing : Teflon  
End Fittings : 304 SS  
Orifice Plate : 316 SS  
Carrier ring : 304 SS  
Flanges & Mating flanges : Same as pipe material, 200 lbs ANSI - RF

- Impulse pipe : Same as pipe material  
Fittings : 2000 ANSI, SW ends to match with pipe material.  
Dial Size/Scale length : 250 mm  
Scale Details : Direct reading type engraved on detachable Aluminum scale  
Accuracy :  $\pm$  Two (2) percent  
Reproducibility : Half (1/2) percent  
Rangeability : 1:10  
Connection : SCRD NPT





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Accessories	:	a) Isolating valves (for Bypass type only)
		b) Bolts, Nuts and Gaskets as required
Tests	:	Shall be tested at two hundred (200) percent of the maximum process pressure

**3.03.27 SIGHT FLOW GLASS INDICATORS**

Type/Construction	:	Flapper type.
<b>Materials</b>	:	
Body	:	Carbon steel/SS316 as per process requirement
Glass	:	Toughened Borosilicate
Gaskets	:	Neoprene
Bolts & nuts	:	SS
Flappers / Rotating Wheel	:	316 SS
Flappers / Rotating Wheel holder	:	304 SS
Process Connection	:	SW (Socket Welded)
Accessories	:	Scale, Bolts, Nuts, Cover plates and Gaskets as required
Tests	:	Tested at two hundred (200) percent of the maximum process pressure.

**3.03.28 SOLID FLOWMETER**

Type	:	Online Impact type Microprocessor Based
Measuring Principle	:	The system measurement is basically pertains to the measurement of horizontal deflection using LVDT, created by the impact of solid flow upon online sensing plate. The horizontal deflection being proportional to the impact forces, LVDT convert this horizontal movement into electrical signal. The inbuilt integrator convert this signal into time based flow rate indication & provide totalized flow also.
Sensing plate	:	316 SS
Sensing head	:	Sensing mechanism shall be mounted outside the process flow line.
Enclosure	:	316 SS
Enclosure protection	:	IP 67 class
Accuracy	:	+/-1%
Repeatability	:	+/- 0.2%
Drift	:	Both zero & span $\pm$ 2% / month
Output	:	4-20mA DC isolated, load 600 ohm (min)
Digital communication	:	yes, (HART) facility
Power supply	:	240 V AC, 50Hz. UPS
Ambient condition	:	Temperature -60 <sup>o</sup> C, RH-95% Environment – Highly Dusty



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Accessories : Shall be complete with all the accessories including digital display for flow rate, integral vents, baffles for air separation, etc. which ever required for satisfactory operation.

Note:-

1. The above on line flow meter shall not create any obstruction on flow.
2. User's list shall be submitted to support on proven satisfactory performance for similar process application.

3.03.29

**Instrument Air System**

The instrument Air Supply System for various pneumatic Control & Instrumentation devices like pneumatic actuators, power cylinders, I/P converters, pneumatically operated valves etc. shall be complete in all respect with necessary Air Filter Regulators, valves, piping/tubing etc.. Each pneumatic instrument shall have an individual air shut off valve. The pressure-regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built in filter-housing blow down valve.

Filter shall be of minimum 5-micron size & sintered bronze material.

On collection of water in the drains of instrument air lines, mechanical automatic drains and periodically solenoid operated drains (with electronic timer - 15m, 30m, 60m and 2 Hours & Timing adjustable) are to be provided.

For mechanical type & Electrical type, the locations to be provided in the instrument air lines of boiler area, Chimney area, turbine area etc., shall be decided during detailed Engineering.

**Bulk header** nearby the crowded applications shall be provided and from this bulk header individual air lines with necessary isolation valves are laid to the application.

These bulk header are to be provided with **mechanical / electronic based automatic Drains**.

Individual moisture separator for O<sub>2</sub> analyzer or vital application shall be provided nearby the instrument so as to enhance the cell life or the performance of vital final control elements.

3.03.30

**Air Filter Regulator (AFR)**

Constant bleed type AFR with an accuracy of  $\pm 1.0$  % inlet pressure range of 5-8 kg/ cm<sup>2</sup> and suitable spring ranges (AFR) for use with positioners in control valves, control damper, E/P converters and shut off valves for phosphor bronze filter element; Filtering particles above five microns. Weather and water proof enclosure. Material of accessories will be SS316.

**Air filter regulators shall be provided in the :**

- (a) Air supply line to valve positioners / power cylinders
- (b) Air supply line to electric to pneumatic converters.





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- (c) Air supply line to pneumatic interlocked block valves.
- (d) For each instrument rack, field instruments enclosure for purging.

3.03.31 **Electro-Pneumatic Convertors (E/P)**

Two wire type E/P convertors with an accuracy of  $\pm 0.25\%$  accepting 4-20 mA dc signals from control system and converting to 0.2 to 1 kg/cm<sup>2</sup> air pressure to operate valve positioner of all final control elements; Housed in cast aluminum casing (with polyurethane paint); NEMA 4 or equivalent degree of protection for enclosure. Material of accessories will be SS. E/P convertors shall have fail freeze (stay put) feature also. Process connection shall be 1/4" NPT (F) and Electrical connection shall be 1/2" NPT (F). Zero/span adjustment facility shall be provided. The E to P convertors shall **retain the pneumatic signal (last value) even in failure of control signal** and shall have **self volume boosters**. Necessary air lock devices and pressure switches for air pressure low alarming shall be provided.

3.03.32 **Solenoid Valves**

Solenoid valves shall be provided with control valves / pneumatic control valves hooked up with process interlock requirements and where direct tripping is involved. The number of ways for solenoid valve shall be provided as indicated below:

- (a) Two (2) way solenoid valves shall be provided, where process line of less than 50 mm with low pressure and temperature application.
- (b) Three (3) way solenoid valve shall be provided commonly, where the pressure is admitted or exhausted from a diaphragm valve or single acting cylinder, e.g, Pneumatic operated spray water block valve.
- (c) Four (4) way solenoid valve shall be provided for operating double acting cylinders, e.g, Pneumatically operated on-off type dampers.
- (d) For operation of the fuel oil corner nozzle valves, fuel oil trip valves etc., **double coil solenoid valve** ( latch coil & relatch coil) shall be adopted.  
**Single coil usage requires always power and loss of power leads to closure of above valves resulting the unit trip or loss of generation.**
- (e) Solenoid Valve coils shall be Class-H high-temperature or Class-F construction as applicable and shall be designed for continuous duty. Three-way solenoid valves shall be designed for universal operation so that the supply air may be connected to any port. Solenoid enclosures shall be NEMA-4)/ (Explosion proof for NEC Class-1, Division 1 area)/ flame proof (IEC-79.1, Part I) As applicable). Body material of solenoid valve shall be Die Cast Aluminum or SS316.
- (f) All solenoid shall be with varister, LED indication, surge suppress diode and circuits.

3.03.33 **Power Cylinders (Pneumatic)**

Mounting Type	:	a) Fixed position mounting (End mounting).
	:	b) Trunnion mounting
Control Signal	:	0.2 to 1 Kg/Sq. cm. from I/P converter for modulating purposes. 24V/48VDC operated solenoid valve operating on pneumatic line.



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		The Pilot solenoid will have separate coils for open closing purpose.
Supply Air	:	0-7 Kg / Cm <sup>2</sup> .
Selection	:	Based upon thrust / torque, stroke length, angular movement, full-scale travel time, repeatability, space factor etc. Provision for air-to-open and air-to-close operation.
Casing	:	IP-65.
Accessories (as required)	:	<ul style="list-style-type: none"> <li>a) Air lock relay</li> <li>b) Hand wheel.</li> <li>c) Air filter regulator with gauge.</li> <li>d) Volume Booster.</li> <li>e) Limit Switches.</li> <li>f) Positioner with Input, Output and supply pressure gauges.</li> <li>g) Pilot Solenoid Valve (Double Coil type)</li> <li>h) Position Transmitter (4-20 mA DC linear output, LVDT or non contact type).</li> </ul>
Fail-safe operation	:	Stay put, open or close position on pneumatic / electrical power supply failure as per process safety criteria.
Repeatability	:	Better than 0.5% of full travel.
Hysteresis	:	Less than 1% of full travel.

**3.03.34 Nucleonic Type Density Meter (For Ash Handling Plant):-**

Type	:	Nuclear type radiation
Application	:	Abrasive Slurries & Corrosive Chemicals
Accuracy	:	< 1% of Span
Orientation	:	As per requirement.
System Type	:	Radiation Source & Scintillation Detector
Meter Material	:	SS 316L/ Aluminium with PVC coating
Connection material	:	SS 316L
Compensation	:	Temp. Compensation required
Type (Transmitter)	:	SMART, 2 Wire HART based
Operating Principle	:	As the density increase, the lower the radiation field at detector and vice versa
Output	:	With photomultiplier, 4-20 mA, DC
Electrical Connection	:	½" NPT
Enclosure Class	:	IP 66
Local Display	:	Provided
Accessories	:	Radiation Survey Meter and all erection/installation hardware

**3.03.35 Non - Nucleonic (Vibration) Type Density Meter (For DM & AHP Plant):-**

Application	:	Liquid Density measurement
<b>Detector</b>		



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- |    |                      |   |                               |
|----|----------------------|---|-------------------------------|
| 1. | Orientation          | : | As per requirement.           |
| 2. | Case Material        | : | SS 316/ Cast Aluminium alloy  |
| 3. | Wetted part material | : | SS 316                        |
| 4. | Operating Principle  | : | Vibration Density measurement |

**Convertor**

- |    |                       |   |   |
|----|-----------------------|---|---|
| 1. | Output                | : | 4-20 mA DC isolated.                                      |
| 2. | Electrical Connection | : | ½" NPT  |
| 3. | Enclosure Class       | : | IP 65   |
| 4. | Local Display         | : | Digital 5 digit, density display with temp. compensation. |
| 5. | Accuracy              | : | +/- 1%  |
| 6. | Response time         | : | < 1 minute.   |
| 7. | Power Supply          | : | 240 V AC, +/- 10%, 50 Hz. From UPS                        |

**3.03.36****PULL CORD SWITCH**

- |                       |   |   |
|-----------------------|---|---|
| Type                  | : | Addressable Type  |
| Body                  | : | Cast Iron   |
| Contact rating        | : | Continuous 10 Amp, Breaking 2 Amp. (240 V AC)   |
| No. of contact        | : | 2 NO + 2 NC   |
| Reset facility        | : | Manual Reset  |
| Type of enclosure     | : | Die Cast Aluminum   |
| Degree of protection  | : | Flame proof/Explosion proof for NEC class 1, Division 1 area  |
| Local trip indication | : | Required  |
| Accessories           | : | <ol style="list-style-type: none"> <li>1. Canopy over lever of pull Cord switch.</li> <li>2. Linking of switches through a single cable for each section.</li> <li>3. Each pull cord switch shall be provided with red LED indication lamp for prominent visible indication of tripping.</li> <li>4. "One number indicator panel which shall display the exact number of safety switches (pull cord and belt sway switches) operated in a loop of conveyor. It shall also monitor the condition of field cable connecting the switches in series &amp; generate signal if field cable is found broken or short. The indicator panel shall display the operated switch number. The same indication shall also be available in CHP PLC operator station.</li> </ol> |

**3.03.37****BELT SWAY SWITCH**

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- Failure Diagnostics
- Long Term Stability
- Fast Response
- IP 66 / NEMA4X Protection
- Supplied with Calibration Certificate Traceable to National & International Humidity Standards
- Sensor protection with sintered filter
- Local LCD Display for Dew Point

**3.03.42****Junction Boxes**

- |       |   |   |  |
|-------|---|---|--|
| v.    | Type  | : | Flame proof/weather proof  |
| vi.   | Enclosure   | : | IP-65/Explosion/Flame Proof as per area classification.              |
| vii.  | Material  | : | FRP with protective Coating  |
| viii. | Cable entry   | : | Bottom or Side   |
| ix.   | Cable glands  | : | Double compression type – Nickel plated brass with PVC hoods.        |
| x.    | Mounting  | : | Indoor/Outdoor   |
| xi.   | No. of terminals  | : | As required with standardization with 20% spare of each size & type. |
| xii.  | Terminals   | : | Phoenix/Wago (screw less cage clamp type spring loaded)              |
| xiii. | Grounding   | : | Two terminals for body and shield ground                             |
| xiv.  | Door  | : | Hinged, lockable type.   |
| xi.   | Suitable mounting clamps and other accessories shall be in scope of bidder.   |   |  |
| xii   | The brackets, bolts, nuts, screws, glands, lugs required for erection shall be of brass, included in bidder scope of supply. High voltage & insulation resistance test shall also be conducted. |   |  |
| Xiii  | M6 Ni plated Brass earthing stud shall be provided (external 2 nos. internal 1 no.)   |   |  |
| xiv   | Gasket (Normal)- Neoprene thickness 6.0 mm  |   |  |

**3.03.43****Interposing Relays (IPR)**

Electro magnetic type IPRs with modular design, plug-in type connections, suitable for channel/DIN rail mounting in cabinets; coil rating 24V D.C; 2 set of silver plated change over contacts rated for 0.5A 220 V DC/8 A 240 V AC. Free wheeling diode across relay copper coil and self reset type status LED indicator flag (electronic) shall be provided. Manual forcing/override facility is required. The test voltage for relay shall not be less than 4 KV with operating temperature from –20 deg. C to 60 deg. C. The relay shall have the necessary approvals like V0 inflammability class in accordance with UL94”, IEC60664/IEC60664A/DIN VDE 0110. Facility to stimulate IPR manually shall be provided. The VA burden of relays shall be suitable to match the capacity of output modules. Interposing relay & sockets for mounting the interposing relay shall be of same make only.

**3.03.44****RECORDERS (CHARTLESS)**

- |                   |   |   |
|-------------------|---|---|
| Type              | : | Micro-processor based, Digital TFT display type |
| - No. of Channels | : | Forty Eight (48) point).                        |



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Input	:	110 V PT Volts
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

**3.03.57 TRANSDUCERS FOR POWER FACTOR**

Input	:	PT (110V)
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

**3.03.58 TRANSDUCERS FOR MVAR**

Input	:	CT & PT (110V/1A)
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

**3.03.59 DIFFERENTIAL FREQUENCY TRANSDUCERS (FOR SYNCHRONIZATION)**

Input	:	110 V PT
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

**3.03.60 DIFFERENTIAL VOLT TRANSDUCERS (FOR SYNCHRONIZATION)**

Input	:	System voltage
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

**3.03.61 PUSH BUTTONS (PB)/ ILPBs FOR ON/OFF, OPEN/CLOSE, START/STOP**

Type	:	Momentary/Miniaturised Suitable for mosaic grid 24x48 Mm with 2 PB and 3 coloured LED.
------	---	--

Contact Configuration	:	2 NO + 2 NC
Contact Material	:	Hard Silver Alloy
Contact Rating	:	500V / 10 A
Insulation Voltage terminals and earth	:	2 KV for 1 minute between

Lamp Rating :-

a) Voltage	:	240 V AC
b) Watt	:	2 Watt (approx.)

Colour



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- Red – ON/Start/Open ILPB
- Green – OFF/Stop/Close ILPB
- Red - energized, running, Start, valve open LED/Lamp
- Green - de-energized, stopped, valve closed LED/Lamp
- Light yellow - abnormal, discrepancy LED/Lamp
- Red – OFF/Stop/Close PB
- Green – ON/Start/Open PB
- Red - Emergency trip push buttons with red flap / hinged Transperent arylc cover.

- 3.03.62 PUSH BUTTON FOR Control DESK:** **Momentary mosaic grid mounted**  
24x48 mm size, single PB 18x40 mm  
**Colours for DESK RELEASE - Yellow, Desk Lamp test - Blue, Desk Ack - Green**
- 3.03.63 PUSH BUTTON FOR SEQUENCE START/RELEASE :** Momentary (Miniaturised) suitable for mosaic grid 24x48 mm  
3 PB + 5 LED
- 3.03.64 PUSH BUTTON FOR ANNUNCIATION**  
Contacts
- Number & Type : As per requirement
  - Breaking capacity : 1 Amp, 220V DC  
10 Amp, 600V AC
- Different colours for Accept/Ack - Green, reset Grey, Lamp test – Blue, System Test – Yellow & Audio Ack - Black.

<b>3.03.65</b>	<b><u>BELT WEIGHING SYSTEM</u></b>
<b>3.03.65.1</b>	<b>General</b>
	The mechanical design and constructional features for belt weigher has been described under mechanical section, hence not repeated here, Similarly motor specifications for the same has been covered under electrical specification, hence not repeated here.
	<p>The belt weighing system shall have its own local control panel to be located in electrical equipment room. The local panel shall include:</p> <ul style="list-style-type: none"> <li>(a) Local flow rate indication</li> <li>(b) Integrated flow rate indications</li> <li>(c) System alarm annunciation</li> <li>(d) Local Calibration facility</li> <li>(e) Power on/off</li> </ul> <p>All these above display shall be backlit LCD type with 12mm character height. NI Cd Battery back up (60 minutes backup) shall be provided for the measurement system.</p> <ul style="list-style-type: none"> <li>(a)Application : Bulk material, Powder material</li> <li>(b)Drive Protection : Reverse Polarity, Communication failure</li> </ul>





**5.11.00 Technical Specifications of Conductivity Analyser**

- |    |                     |   |
|----|---------------------|---|
| a) | Applicable standard | ASME PTC 19.11-1970 except as modified in this specification.               |
| b) | Type:               |   |
|    | i) Cell             | Flow through type/ removable type (withdraw able with sealing valve)        |
|    | ii) Monitors        | Electronic (Microprocessor based) indicating type with multi range facility |
| c) | Material :          |   |
|    | i) Cell             | Epoxy resin/SS316   |
|    | ii) Electrode       | Platinised/SS316  |
|    | iii) Monitors body  | Carbon steel/Aluminum/Polycarbonate   |
| d) | Monitor output      |   |
|    | i)                  | 4-20 mA D.C. with HART protocol spare out put                               |
|    | ii)                 | 4-20mA DC with HART protocol for DDCMIS<br>Output load : 500Ω               |
| e) | Power supply        | 240V, AC, 50 Hz from UPS  |
| f) | Accuracy            | ± 1% of full scale span   |
| g) | Stability           | ± 1% of full scale per month<br>non-cumulative                              |
| h) | Repeatability       | ± 0.3% of span  |



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- i) Annunciation contacts from monitors
  - i) Number 2SPDT
  - ii) Type Snap action micro switch
  - iii) Rating 5 amp, 240 V, 0.2 Amp, 220V DC
- j) Connection:
  - i) Cell
    - On line/pipe mounted  
(ON LINE in sample table)  
1/4 (Quarter) inch NPT (F) SCRD for  
on-line type and Three quarter (3/4) inch NPT (M)  
SCRD for pipe mounted.
  - ii) Monitors flush panel mounting
- k) Electrical Half (1/2) inch NPT (F) SCRD
- l) Accessories
  - i) Automatic temperature compensation in the range 0-100°C
  - ii) Ammonia (NH<sub>3</sub>) removal equipment.
  - iii) Sample coolers
  - iv) Flow and pressure regulators
  - v) SS316 impulse tubing and fittings
  - vi) Isolation & drain valves as required
  - vii) Other accessories as required
  - viii) Adequate length of cables for connecting coils to monitors
  - ix) Sample rate set valves
  - x) Alarm settings and Alarm indications on monitor.
- m) Other particulars Cell shall be suitable for maximum pressure of 7 kg/cm<sup>2</sup> and maximum temp. of 100°C
- n) Response time ≤ 3 seconds





**5.12.00 Technical Specification of pH Cell and Transmitters**

- |    |                                      |  |
|----|--------------------------------------|--|
| a) | Applicable Standard                  | pH electrodes shall conform to IS: 6804-1972 except as modified in this specification  |
| b) | Type:                                |  |
|    | i) Cell                              | Measuring and Reference Electrode Combination with Flow through type (SS316/Polypropylene flow chambers) for power plant's steam & water application. Sensor shall not be affected by flow variation. Sensor shall be designed for power plant applications. |
|    | ii) Monitors                         | Electronic (microprocessor based) indicating type with adjustable range facility.  |
| c) | Material:                            |  |
|    | i) Measuring & reference             | Toughened sensitive  |
|    | ii) Electrode                        | pH glass   |
|    | iii) Monitor body                    | Carbon steel/Aluminum/Polycarbonate  |
| d) | Monitor output                       |  |
|    | i)                                   | 4-20 mAmp D.C. with HART protocol spare out put  |
|    | ii)                                  | 4-20mA DC with HART protocol for DDCMIS<br>Output load : 500Ω  |
| e) | Power supply                         | 240V AC, 50 Hz from UPS  |
| f) | Accuracy/repeatability               | + 0.03 pH/+0.02PH  |
| g) | Resolution                           | + 0.01 pH or 1 mV. 1C  |
| h) | Stability                            | 0.02 pH per week   |
| i) | Annunciation contacts from monitors: |  |



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- |    |             |   |  |
|----|-------------|---|--|
|    | i)          | Number  | 2 SPDT 'Hi' and 'Lo'                         |
|    | ii)         | Type  | Snap action micro switch                     |
|    | iii)        | Rating  | 5 amp, 240V AC, 0.2 Amp, 220V DC             |
| j) | Connection: |   |  |
|    | i)          | Process   | One-quarter (1/4)inch NPT(F) SCRD<br>ON-LINE |
|    | ii)         | Electrical  | Half (1/2) inch NPT(F) SCRD                  |
| k) | Mounting:   |   |  |
|    | i)          | Cell  | Pipe Mounted                                 |
|    | ii)         | Monitors  | Flush panel mounting                         |
| l) | Accessories |   |  |
|    | i)          | Automatic temperature compensation with fast response integral temperature sensors in the range 0-100°C |  |
|    | ii)         | Co-axial cable as required  |  |
|    | iii)        | Sample coolers  |  |
|    | iv)         | low and pressure regulators   |  |
|    | v)          | Standard pH solutions   |  |
|    | vi)         | SS316 impulse tubing and fittings   |  |
|    | vii)        | Isolation & drain valves as required  |  |
|    | viii)       | Electrode holders   |  |
|    | ix)         | Other accessories as required   |  |
|    | x)          | Sample rate set valves  |  |
|    | xi)         | Alarm settings and indications on monitor.  |  |
|    | xii)        | RFI/EMI shielded, weather and corrosion proof casing  |  |



**5.14.00 Technical Specification of Silica Analyzer (SI OX)**

- |    |                     |   |
|----|---------------------|---|
| a) | Applicable standard | ASME PTC 19.11-197 except as modified in this specification   |
| b) | Type                | Multi Channel ( max of each Three channel)<br>Colorimetric Analyzer (with auto reagent shut off feature in case of sample loss or power loss) built in phosphate inhibition feature. Micro processor based. |
| c) | Material:           |   |
|    | i) Case             | Die cast aluminum   |
| d) | Cycle/Response Time | Twelve (12) minutes Maximum   |
| e) | Analyser output     | i) 4 to 20 m Amp DC for spare output<br>ii) 4 to 20 m Amp DC Isolated output for DCS/PLC  |
| f) | Power supply        | 240V AC, 50 Hz from UPS   |
| g) | Accuracy            | $\pm 1\%$ of span   |
| h) | Repeatability       | $\pm 2\%$ of full scale   |
| i) | Sensitivity         | 0.2 micrograms/liter  |
| j) | Connection:         |   |
|    | i) Process          | Quarter (1/4) inch NPT(F) SCRD  |
|    | ii) Electrical      | Half (1/2) inch NPT (F) SCRD  |
| k) | Ranges              | As per sample stream detail table   |



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- |    |                        |  |
|----|------------------------|--|
| l) | Mounting               | Flush  |
| m) | Annunciation contacts: |  |
|    | i) Number              | 2 SPDT   |
|    | ii) Type               | Snap action micro switch   |
|    | iii) Rating            | 5 amp 240V AC 0.2 Amp 220V DC  |
| n) | Accessories            |  |
|    | i)                     | Automatic temperature compensation between 5 to 50 deg C   |
|    | ii)                    | Automatic zeroing provision  |
|    | iii)                   | SS316 tubing & vessels   |
|    | iv)                    | All chemical reagents for 12 months operation of the analyzer  |
|    | v)                     | Sample rate set values   |
|    | vi)                    | Comprehensive diagnostic and alarm features.   |
|    | vii)                   | <b>Auto sampling facility with necessary valves &amp; solenoids in the sample lines shall be provided.</b> |

**5.16.00 Technical Specification of Sodium Ion Analyzer**

- |    |      |   |
|----|------|---|
| i) | Type | Microprocessor based Continuous flow through sample type with sodium responsive |
|----|------|---|



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		electrode and reference electrode having pH adjustment facility (Max 3 streams)
ii)	Case material	Die-cast aluminum/SS/Polycarbonate
iii)	Analyzer power supply	240V AC, 50 Hz from UPS
iv)	Analyzer output	i) 4-20 mA DC for spare output ii) 4-20 mA DC isolated output for DDCMIS
v)	Accuracy	Better than $\pm 5\%$ of full scale
vi)	Response Time	6 minutes. max
vii)	Sensitivity	0.1 ppb
viii)	Annunciation contacts:	
	- Number	2 SPDT
	- Type	Snap action microswitch
	- Rating	5A 240V AC, 0.2A, 220V DC
	- Mounting	Flush
ix)	Terminal points	All components piped & wired to terminal points
x)	Accessories	i) Flow regulator ii) Flow gauges iii) Sample rate set valves iv) Other accessories as required to make the system complete v) Chemical reagents as applicable for 12 months consumption



**5.18.00 Technical Specification of Chloride Analyzer**

- |       |                        |  |
|-------|------------------------|--|
| i)    | Type                   | Microprocessor based Continuous flow through sample type.  |
| ii)   | Analyzer power supply  | 240V AC, 50 Hz, Single Phase from UPS  |
| iii)  | Analyzer output        | i) 4-20 mA, DC spare output<br>ii) 4-20 mA, DC isolated output for DDCMIS  |
| iv)   | Accuracy               | Better than $\pm 10$ % of full scale   |
| v)    | Sensitivity            | Better than 1 ppm  |
| vi)   | Range                  | As per Requirements.   |
| vii)  | Annunciation contacts: |  |
|       | - Number               | As per schedule, 2 SPDT  |
|       | - Type                 | Snap action micro switch   |
|       | - Rating               | 5A, 240V AC, 0.2A, 220V DC   |
|       | - Mounting             | Flush  |
| viii) | Terminal points        | All components piped & wired to terminal points  |
| ix)   | Accessories            | i) Flow regulator<br>ii) Flow gauges<br>iii) Sample rate set valves<br>iv) Other accessories as required to make the system complete |

**5.19.00 Technical Specification of Chlorine Analyzer**

- |      |                        |   |
|------|------------------------|---|
| i)   | Type                   | Microprocessor based Continuous flow through sample type with automatic temperature compensation. |
| ii)  | Analyzer power supply  | 240V AC, 50 Hz, Single Phase from UPS   |
| iii) | Analyzer output        | i) 4-20 mA, DC spare output<br>ii) 4-20 mA, DC isolated output for DDCMIS                         |
| iv)  | Accuracy               | 0.005 mg/ltr. or 1% of range.   |
| v)   | Sensitivity            | 0.001 mg/ltr. (1 ppb)   |
| vi)  | Range                  | As per schedule.  |
| vii) | Annunciation contacts: |   |
|      | - Number               | As per schedule, 2 SPDT   |



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	-	Type	Snap action micro switch
	-	Rating	5A, 240V AC, 0.2A, 220V DC
	-	Mounting	Flush
viii)		Terminal points	All components piped & wired to terminal points
ix)		Accessories	i) Flow regulator ii) Flow gauges iii) Sample rate set valves iv) Other accessories as required to make the system complete

**5.20.00 Technical Specification of Residual Chlorine Analyser****SENSOR**

Method	:	Amperometric
Electrodes	:	Gold Cathode/Silver Anode
Cell Material	:	PVC
Electrolyte	:	Potassium Bromide

**TRANSMITTER**

Type	:	Microprocessor Based with self diagnostic features
Transmitter Output	:	4 – 20 mA
Enclosure Protection	:	IP65
Enclosure Material	:	Polyester coated Al.
Electrical Connection	:	½" NPT (F)
Mounting	:	FIELD
Display Type	:	LCD
Display Details	:	4 digit backlit LCD matrix
Diagnostics	:	Required
Meter Range	:	0-1 mg/l
Resolution	:	0.01 ppm
Area Classification	:	SAFE
Electromagnetic Compatibility	:	BUILT – IN
Temp. Compensator	:	AUTO – BUILT – IN
Temp. Compensating element	:	PT100



**CHAPTER-12****FLOW ELEMENTS**

**12.00.00** This specification covers the design, material, construction features, manufacture, inspection and testing at the VENDOR'S/SUB-VENDOR'S WORKS and delivery to site of Flow Elements.

The equipment furnished to this specification shall conform exactly to the requirements herein, unless modified by the respective Data Sheet of the equipment.

**12.01.00** The design, material, construction features, manufacture, inspection and testing of flow elements shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards. Nothing in this specification shall be construed to relieve the Bidder of this responsibility.

**12.02.00 Technical Requirement**

316SS long radius, weld in flow nozzles with D and D/2 pressure tapings; 316SS flow orifice plate assembly with flange tap connections;  $\beta$  ratio of 0.4 to 0.7. Element material of SS 316. The material of Flow nozzle shall be A182F91, where pipe material is A335P91. The material of all type of accessories will be SS316. End connections for flow elements will be butt welded except orifice plate on condensate return line to CST, which will be flanged. The accuracy of the flow element shall be  $\pm 0.5\%$  or better.

Standards

The flow elements (Orifice plates) shall be designed in accordance with ASME PTC – 19.5 (Pt – II), ISA RP3.2, 1960 or BS 1042/ISO 5167.

The flow elements (Flow Nozzles) shall be designed in accordance with ASME PTC – 19.5 (Pt – II), or BS 1042/ISO 5167.

Construction and installation of flow nozzles and orifices shall conform to the requirements of ASME Performance Test Code PTC-19.5 as mentioned above and discharge coefficients shall be predicted in accordance with data published in ASME Research Report on Fluid Meters.

Flow nozzles shall be provided for critical measurements where weld-in construction is required. Flow nozzles shall be made with quater, triple or dual sets of pressure taps installed in the pipe wall where required considering spare one set of pressure tap. Installation of flow nozzles and pressure taps shall be made in the pipe fabricator's shop.

Anubars shall be used where pressure loss is critical and/or conditions permit their reliable installation.

Concentric orifice plates shall only be provided for other flow measurements where flanged construction and higher pressure losses are acceptable. Orifice plates shall be





made of stainless steel. Orifice flanges shall be of the raised face weld neck type with dual sets of taps. Thickness of Orifice plate shall be 3 mm for pipe diameter up to 300 mm and 6 mm for pipe diameter above 300 mm.

Coriolis principle based mass flow meters shall be used for flow (mass & volume) measurement of liquid fuel.

Aerofoil/ Venturi tubes shall be provided for Air flow measurement.

Flow element shall be accompanied by IBR certification. Hydraulic test pressure shall be considered 1.5 times of design pressure at normal temperature.

SS nameplate to flow elements shall include Tag no/ KKS No./SI. No./ Body Material/Beta ratio/line size & thickness/ direction of flow.

BIDDER to ensure that maximum pressure drop/loss shall be limited to 30% of Differential Pressure for flow Nozzle & 60% of DP for Orifice plate.



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**12.05.00 PERFORMANCE**

The Bidder shall submit type test certificate from a recognized test house certifying evaluation of construction standard, accuracy of calibration.

**12.06.00 TESTS AND INSPECTION**

All equipment components shall be individually tested to ensure correct functioning. Following tests shall also be conducted:

- a) Calibration test
- b) Dimensional check
- c) Material test

Wet calibration shall be carried out as on each size and design of flow element as per ASME PTC or BS 1042/ISO 5167. The other tests shall conform to ASME-PTC 19.5. The Bidder shall submit the reports for all the tests carried out for Owner's review and records. The functional test shall also be witnessed by owner as per approved QAP.



**CHAPTER-11****CONTROL VALVES WITH ACTUATORS****11.00.00 CONTROL VALVES, ACTUATORS AND ACCESSORIES****11.01.00 GENERAL REQUIREMENTS**

11.01.01 This section covers the design and construction requirements of Control Valves, their Actuators and Accessories. Except as otherwise specified herein, the Control Valves and accessory equipment furnished under this specification shall be designed, constructed and tested in accordance with the latest applicable requirements of code for Pressure Piping ANSI B31.1, the ASME Boiler and pressure vessel code, Indian Boiler Regulation (IBR) and other standards referenced herein as well as in accordance with all applicable requirements of the "Federal Occupational Safety and Health Standards, USA", or acceptable equal standards.

11.01.02 The design of Control Valves shall comply with relevant codes and standards, account for relevant design criteria viz. environmental conditions, power and air supply, established reliability (reliability target and life expectancy), design of enclosures as specified in Sections earlier.

11.01.03 All Control Valves and accessories furnished under the Section shall be of Owner approved make, fully meeting the qualifying requirements.

11.01.04 Each control valve station shall be provided with pneumatic bypass control valve or Inching type motorised bypass valve as per process requirement and subject to owner approval. In addition each control valve shall also have upstream motorised valve. Downstream motorised valve shall also be provided as per process requirement and as finalized during detailed engineering.

**11.02.00 CONTROL VALVE CONSTRUCTION AND SIZING****11.02.01 General**

1. Valve Construction shall be in accordance with the requirements specified herein. (Bidder to also refer NIT drawing # 114-18-0100).
2. The design of all valve bodies shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes.
3. The valve sizing shall be suitable for obtaining maximum operating conditions with valve opening at approximately 80% of total travel. Valves shall be open not less than 15 % of full opening for minimum flow condition and shall be capable of handling at least 120% of the required maximum flow at full open condition. Actual pressure drop is indicated in the specification sheets. Permissible pressure drop shall be calculated and



used by the Bidder for sizing calculations. Valve sizing shall be in compliance with the latest edition of ISA Handbook on control valves, ISA standards "ANSI/ISA-75.01.01, Flow Equations for Sizing of Control Valves" with due consideration for the measures to avoid choked flow. Bidder shall ensure that the valve outlet velocity does not exceed 8 meters/second for liquid services, 150 m/second for steam services and 50% of sonic velocity for flashing services by selecting proper body size for the required Cv.

4. a. The Bidder shall provide valves designed to prevent cavitations, wire drawing, flashing on the downstream side of valve and in downstream piping, when operating through full range under the specified conditions.

For cavitating services, valves with anti cavitation trims shall be offered. This shall ensure cavitation prevention by multiple stages of pressure drops. Detailed calculations shall be furnished by bidder to establish cavitations occurrence or otherwise for various process conditions each service wise.

For flashing services such as heater drains, control valve design shall be specially effected to ensure suitability for the adverse high pressure drops and minimise its detrimental effects on control valve parts.

Bidder shall furnish detailed catalogue, calculations, write ups to establish compliance to these stipulations with the selection of each valve. No price implications during engineering stage would be admissible to comply with these stipulations and intents of specification.

- b. The Liquid pressure recovery factor (FL) shall be 0.995 or better for severe flashing/cavitation services.
- c. The Liquid pressure recovery factor (FL) shall be 0.985 or better for low flashing/cavitation services.
5. Each valve shall be designed for tight shut-off against pressure, the valves shall have maximum permissible leakage rate as per ISA RP 39.6 Leakage Class IV (0.01% of rated valve capacity) or specified other wise.

~~Control Valves for Application such as HP/LP heaters emergency level control, SH spray & RH Spray control, Emergency makeup to Hotwell, Deaerator drain to condenser hotwell & heavy oil heating, HFO & LDO and Pressurizing control system, condenser normal make up control valve shall have permissible leakage rate as per leakage class V (ANSI/FCI).~~

All SH/RH block valves, shut off valve of LDO & HFO and BEP recirculation valve shall have leakage class MSS-SP-61.



6. The valve design shall take into account noise abatement considerations. The design objective will be to limit the generation of valve induced noise to 85 dBA at 1 Meter from the valve surface under actual operating conditions. The noise abatement shall be obtained by valve body and trim design and piping arrangement and not by the use of silencers.
7. The Bidder shall be responsible for proper sizing of the valve and selection of appropriate model and materials of constructions for meeting the operating requirements specified herein and details subsequently furnished during the detailed engineering stage.
8. The valve travel time shall be less than 10 second for non critical services valves.
9. Rangeability should be 50 to 1 (min.) for non critical services valves.
10. Control Valve's Linearity, Hysteresis, Accuracy shall be  $\leq \pm 1\%$  and Sensitivity shall be  $\leq \pm 0.5\%$ .

Bidder shall furnish the Control Valve data sheets and sizing calculations with the proposal which will be subjected to owner approval during detailed engineering. The bidder shall furnish all valves as per Owner approved data sheets and drawings.

#### 11.02.02 Valve Construction

1. All valves shall be of globe body design and straightway pattern. Straightway pattern valves shall be either single or double ported as specified. Double ported and single ported valves shall have high lift cage guided plugs, unless otherwise specified.
2. Where specified, valves with cage guided plugs and quick change trim shall be supplied. The quick change trim shall consist of a cage and seat ring clamped in the valve body by the valve bonnet and sealed with a spiral wound stainless steel asbestos gasket. The trim shall be removable through the top after bonnet removal without any cutting or welding of the valve. Where applicable, plugs shall be designed to include pressure balancing for cage guided valves.
3. Direct acting and self-contained pilot type valves may have low lift plugs.
4. Cast iron valves are not acceptable.
5. Bonnet joints for all control valves shall be of the flanged and bolted type or other construction acceptable to the Owner. Bonnet joints shall be designed for easy disassembly and for assurance of correct valve stem alignment. Bonnet joints of the internal threaded or union type will not be acceptable.
6. Plugs shall be of one-piece construction either cast, forged, or machined from solid bar stock. Plugs shall be screwed and pinned to valve stems or shall be integral with the valve stems.



7. When Teflon packing is used, the lower valve stem which passes through the stuffing box shall be polished to at least  $2 \times 10^{-4}$  millimeters r.m.s.
8. Valves gland packing shall normally be Teflon on liquid and gas services up to  $100 \text{ kg/cm}^2$  and  $230 \text{ Deg.C}$  Teflon impregnated asbestos shall be used above  $230 \text{ Deg.C}$  and graphite impregnated asbestos with lubrication shall be used for steam services.
9. All valves shall be arranged so that the plugs may be removed from the valve bodies from the bonnet side.
10. Each valve shall have an arrow permanently fixed on the valve body to indicate the correct direction of flow.
11. Each valve shall have a stainless steel name plate permanently fastened to the yoke which shall be visible when the valve is in service. The name plate shall include
  - a. Tag No. and Valve Serial No.
  - b. Body material, size and pressure rating
  - c. Trim material, size characteristics
  - d. Action on air failure
  - e. Spring range
  - f. Stem travel
  - g. Valve action, etc.

## 11.02.03

**Valve Materials**

1. Valve material shall be as specified in Supplier's approved Control Valve Specification sheets. The following table defines abbreviations used for valve materials:

S.No.	Abbreviations	Description
a	BR	Bronze ASTM B 61
b	CS	Carbon Steel Forged - ASTM A 105 Cast - ASTM A 216 Grade WCC
c	1- ¼ CR	1-1/4 % Chromium Alloy Steel Forged – ASTM A 182 Grade F11 Cast – ASTM A 217 Grade WC6
d	2- ¼ CR	2-1/4 % Chromium Alloy Steel Forged – ASTM A 182 Grade F22 Cast – ASTM A 217 Grade WC9
e	5 CR	5% Chromium Alloy Steel Forged – ASTM A 182 Grade



		F5 Cast – ASTM A 217 Grade C5
f.	SS	Stainless Steel AISI Type 316 ASTMA 351 Grade CF8M

2. Body material shall be selected by the Bidder to be compatible with the nature of the fluid, service conditions, and piping material to which it is welded and shall be subjected to Owner approval. In general, cast or forged carbon steel bodies shall be provided for non-corrosive process applications up to 275 Deg.C. Alloy Steel castings shall be provided when the media is non-corrosive and the temperature exceeds 275 Deg.C and is within 550 Deg.C. Stainless Steel of suitable grade shall be provided when media is corrosive and the temperature is below 300 Deg.C.

Sr. No.	Service	Body Material
1.	Non Corrosive, Non Flashing, and non cavitations service for process temp. up to 275 deg. C like Aux. steam flow to Deaerator, Cond. Flow to deaerator, Fuel Oil, Atomising steam service etc.	Cast Carbon Steel ASTM A216 Gr. WCB/WCC
2.	Non Corrosive, Non Flashing, and non cavitations service for process temp. above 275 deg. C. and up to 550 deg. C. and for CRH flow to Deaerator.	Cast Alloy Steel ASTM A217 Gr. WC9
3.	Severe Flashing/ cavitations service like Feed Control Valve, Spray Control valves, LP/HP heater emergency level control valve, HP BP spray control valve, Deaerator Overflow control valve etc.	Cast Alloy Steel ASTM A217 Gr. WC9
4.	Low Flashing/ cavitations service like LP/HP heater normal level control & Condensate/feed water below 275 deg. C.	Cast Alloy Steel ASTM A217 Gr. WC6
5.	DM Water Application (Condenser Hotwell normal & Emergency make up etc.)	Cast type 316 Stainless Steel ASTM A351 Gr. CF8M

3. Unless otherwise specified, all control valves shall have stems, guide bushings, plugs, seat rings, stem lock pins, stuffing box parts, and other trim, all made of stainless steel. Valve guide posts and bushings shall be stellite faced for valves where specified. Stellite faced guide posts and bushings shall be differential hardened. For applications involving high pressure drop as also for flashing and cavitation services, trim material shall be properly chosen to ensure required degree of hard facing (such as 17-4 PH SS) so as to avoid erosion.

Sr. No.	Service	Trim Material
1.	Non Corrosive, Non Flashing, and non cavitations service for process temp. up to 275 deg. C. like Aux. steam flow to Deaerator, Cond. Flow to deaerator, Fuel Oil, Atomising steam service etc.	SS316 Stellite
2.	Non Corrosive, Non Flashing, and non cavitations service for process temp. above 275 deg. C. and up	SS316 Stellite





	to 550 deg. C. and for CRH flow to Deaerator.	
3.	<del>Severe Flashing/ cavitations service like Feed Control Valve, Spray Control valves, LP/HP heater emergency level control valve, HP BP spray control valve, Deaerator Overflow control valve etc.</del>	440 SS
4.	Low Flashing/ cavitations service like LP/HP heater normal level control & Condensate/feed water below 275 deg. C.	17-4 PH SS
5.	DM Water Application (Condenser Hotwell normal & Emergency make up etc.)	17-4 PH SS

4. Where stellite facing is not specified, hardened stainless steel shall be furnished for all surfaces subject to wear.
5. Manufacturer recommended materials for cage guided valves may be substituted for materials specified provided they satisfy the specified service conditions. Also where substitutions are made, the manufacturer shall guarantee performance of recommended materials to be equal to or better than the specified materials for conditions specified.

Bidder may offer valve with body and trim material better than the specified material and in such case, bidder shall furnish the comparisons of properties including cavitations resistance, corrosion resistance, temp. resistance, erosion resistance, hardness etc. of the offered material vis a vis specified material for owner approval.

#### 11.02.04 **End Preparation**

1. Valve body ends shall be butt-welded type.
2. Flanged ends shall be of a pressure class equal or greater in pressure-temperature rating to the body design pressure and temperature indicated on the control valve. Unless otherwise specified, steel flanges shall be raised face type. Flanged ends for valves shall be in accordance with ANSI B 16.5.
3. Welded end for control valves where specified shall be socket-weld per ANSI B 16.11 for control valves of sizes 50 mm (2") and below and Butt welded connections per ANSI B16.25 for control valves 65 mm (2-1/2") and above. The end preparation for butt welded control valves shall be matched to the corresponding details for the piping on which the valve is installed.
4. All end preparations shall be as per Owners requirements indicated during Contract stage.

#### 11.02.05 **Miscellaneous Parts**

1. Extension bonnets shall be used on all valves when the maximum temperature of the flowing fluid is greater than 275 deg. C or when specifically required in the control valve.
2. Stem travel indicators shall be provided on all valves.





**11.03.00 VALVE OPERATIONS**

- 11.03.01 All control valves shall be furnished with pneumatic spring opposed diaphragm, spring less diaphragm, or piston operators as specified herein.
- 11.03.02 The bidder shall be responsible for proper selection and sizing of valve operators in accordance with the pressure drop and maximum shut-off pressures.
- 11.03.03 Valve operators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance of stem force, at least 0.15 kg/sq. cm per linear millimeter of seating surface, shall be provided in the selection of the operator to assure tight seating unless otherwise specified. The operators shall be designed to produce the required stem force with supply air pressure of 3.5 kg/sq. cm maximum unless otherwise specified.
- 11.03.04 Diaphragms shall be moulded synthetic rubber and diaphragm housing shall be of pressed steel construction. Diaphragms shall not be fabricated of natural rubber.
- 11.03.05 Piston operators shall use cast pistons and cylinders with O-ring seals. Operators shall be supplied with name plates which indicate the diaphragm air pressure at full open and full closed positions. for single seated valves the pressures shall be listed for maximum differential and for zero differential across the valve.
- 11.03.06 Pistons and cylinders shall be cast aluminum. Piston rod and extension shall be chrome plated stainless steel. Cylinder seal bushings shall be brass and seal rings shall be nitrile. Yoke shall be cast iron.
- 11.03.07 Valve operators shall be capable of operating at 60 °C continuously.

**11.04.00 CONTROL VALVE ACCESSORIES & DEVICES**

The following accessory equipment shall be provided for control valves:

- 11.04.01 **Air Locks:** Air locks shall be designed to shut off the diaphragm loading air line if the supply air pressure to the associated pilot or Positioner fails. Air locks shall be of the automatic reset type and shall be furnished with alarms.
- 11.04.02 **Hand Wheels:** Hand Wheels shall be provided. Hand wheels shall be side mounted unless specified to be top mounted. However the mounting shall be as decided during engineering to offer maximum accessibility.
- 11.04.03 **Limit Switches:** Each control Valves shall be provided with limit switches for monitoring of end position in DDCMIS/DCS/PLC. Switches shall have not less than two normally open and two normally closed contacts in both open and close directions. Electrical rating of the limit switch contacts shall be 240V AC, 5 amp or 220V DC, 0.5 amp. Limit switches should be National Acme Co., or Honeywell micro switch type or Owner approved equal. The enclosures of the limit switches



shall be as per NEMA-4 Standard. Limit switches shall be constructed to withstand the temperatures encountered in the actual service. Explosion proof construction shall be furnished where required by applicable code or these specifications. Limit switches shall be factory mounted on the valves with provisions for adjusting the mounting. The Bidder shall stroke the valves to check limit switch operation prior to shipment.

Limit/micro switches can be offered as an integral part of Smart valve positioner.

- 11.04.04 **Smart Valve Positioner:** Control valve actuators for modulating and throttling services shall be provided with HART protocol based smart electro pneumatic valve Positioner to ensure accuracy & repeatability of response. The valve Positioner shall be designed suitable for vibration and service conditions of a steam electric power station.

The Positioner shall have the following features:

- a) Shall provide a pneumatic output signal of range 0.2 to 1.0 kg/cm<sup>2</sup> or as desired for the actuator.
- b) Shall have integral type position transmitter, input & output gauges, local keypad, display, 4-20 mA input and 4-20 mA output for position indication in DDCMIS/CCR/PLC.
- c) Shall be suitable for direct mounting on control valve assembly both for rotary & linear valves.
- d) Shall be capable of functioning under hot, humid & vibrating conditions.
- e) Shall have dust tight, corrosion resistant & weather proof IP 65 metal casing.
- f) Shall be operated at signal range of 4-20 mA for full travel of the valve. Split range operation in few case may be required. This facility shall also be available in positioner.
- g) Shall have in built mechanical position indicator.
- h) Shall have fail safe & fail freeze function as per loop process requirement.
- i) Shall have in built auto tune facility.

- 11.04.05 **Solenoid Valves:** Solenoid Valve will be provided for the following

- i. **ON / OFF Duty type Control Valve**
- ii. For over-riding the controller signal with Modulating type Control valves.
- iii. For control valve stay put position requirement on controller signal failure with Modulating type Control valves.
- iv. For construction and detailed specification of Solenoid valve, Chapter 3, Vol. V shall be referred by bidder.

- 11.04.06 **Diffusers :** Diffusers shall be provided as per service application requirements. The diffuser shall be designed to reduce the pressure drop across the control valve below the critical value and reduce the sound pressure level. Details of the diffusers shall be submitted.



11.04.07 **External Volume Chambers:** External volume chambers with adjustable bleed valves shall be provided for Control Valve. Volume chambers shall be furnished, mounted on the control valve yoke assembly.

11.04.08 **Position Transmitters:** Position transmitters shall be provided for control valves as a part of smart positioner. The signal shall be 4-20 mA DC range, 24 V DC. For non smart positioners applications and power cylinders, contact less position transmitter shall be provided by bidder.

11.04.09 **Tubing and Air Sets:** All pneumatic tubing required to interconnect devices assembled together shall be furnished complete with each control valve. The tubing shall be fully annealed soft temper copper tubing conforming to ASTM B68 to B75 (USA). Swage lock flare less tubing fittings shall be used for tubing connections (Swage lock or approved equal).

Each device requiring an air supply shall be equipped with a combination filter-regulator. Devices mounted together on a valve yoke may be served by a single regulator, provided the supply pressure is satisfactory and the regulator capacity is not exceeded. Filter-regulators shall be mounted on the device served.

Filter- regulators shall be suitable for a 10 kg/sq. cm maximum inlet pressure. Filter-regulators shall have built-in housing blow down valves and a 2 inch pressure gauge. The filter shall be of size not more than 5 microns and shall be made of sintered bronze.

11.04.10 **Pressure Switch**

Pressure switch suitable for the above the pneumatic system shall be provided. The contact rating shall be 2 A for 240 AC, .2 A, 220 VDC 2 SPDT Contact. Enclosure IP 65.

11.04.11 **I/P Converter**

For non smart positioners applications and power cylinders i/p converters shall be required and owner approval shall be obtained for the use of i/p converter for such applications.

Electro-pneumatic, outdoor type, field mounted Linear. 4-20 MA DC input and 0.2 – 1.0 kg/Cm<sup>2</sup> output. Die cast aluminum casing with IP65 or equivalent enclosure class. Accuracy of  $\pm 0.5\%$  of span or better and repeatability of  $\pm 0.5\%$  of span or better will be provided. Easily accessible span and zero adjustment will be provided I/P converter shall be provided with all accessories and erection hardware. The I to P converters shall retain the pneumatic signal (last value) even in failure of control signal and shall have self volume boosters.

11.04.12 **Separate moisture separator unit** for ensuring dryness of air entering I/P as well as the power cylinder is to be supplied **with each control valve and control damper.**

11.05.00 **FOR FOLLOWING CRITICAL APPLICATION SPECIAL CONTROL VALVES ARE REQUIRED.:**



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- iv. **Back up panel system** shall be designed for handling ~~the situation in clause 2.12.00 for failure of HMI.~~
- v. **For electrical layout, complete backup panel with mosaic** shall have to be provided for complete on/off operations with necessary meters, DDU's, synchroscope etc. as specified elsewhere in specification.
- iv. Control panel cum desk with HW annunciation windows, ILPBs, Ammeters, PBs, voltmeters, indicators, mimic, recorders etc. shall be provided as per Annexure A – Control System Philosophy for BOP packages. Profile/Overall GA of backup control panel cum desk for BOP packages shall be same as indicated in drawing no. 114-05-0105 attached with NIT.

**2.06.00****PROTECTION, CLASS OF CABINETS / PANELS, ENCLOSURES ETC.**

- a) All panels, desks cabinets, consoles & enclosures furnished at least comply with the requirements of protection classes as indicated below.
- |    |  |                |
|----|--|----------------|
| 1. | In-door Air-conditioned (A.C.) areas - | IP32/42 (min.) |
| 2. | In-door Non A.C. areas:                |                |
|    | (a) Ventilated enclosures -            | IP42           |
|    | (b) Non Ventilated.                    | IP 54          |
| 3. | Out-door                               | IP55 /<br>IP65 |
|    | (As per the requirement)               |                |
- b) Distribution boxes, junction boxes, cold junction compensation boxes, terminal boxes and all other field mounted equipment to be furnished as per this specification shall have weather protection conforming to IP 65.
- c) The design of panels, cabinets, enclosures and packaging density of components mounted therein shall be such that the temperature rise does not exceed 10 deg. C above the ambient under the worst conditions.
- d) The panels housing electronic hardware shall be provided with flame and smoke detectors by bidder.
- e) Enclosures for peripheral equipments like printers, etc. shall take care of noise and shall ensure minimum possible noise disturb to the working personnel.

**2.06.01**

Guards, barriers and access doors, covers of plates shall be marked to indicate the hazard, which may occur upon removal of such devices. Danger or caution signs shall be used to warn of specific hazards such as voltage or current. The marking shall be permanently affixed to the equipment.

**2.07.00****~~System Documentation~~**

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**6.15.00 Local Instrument Racks & Enclosure**

Transmitters and switches located in the field shall be grouped together and shall be installed in the enclosure (closed transmitter racks) in case of outdoor area such as Boiler area etc. And in open type Rack in case of covered area. Racks shall be factory prefabricated & painted and complete with internal tubing, manifold valve, isolation valves, integral junction boxes with outside access door, illumination etc. Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging.

**6.15.01 Closed Type Instruments/Transmitter Racks**

- (a) Required number of Instruments/transmitter racks shall be furnished to house transmitters, switches and converters by grouping them suitably, area- wise / function-wise.
- (b) The Transmitter enclosure shall be constructed of 3 mm thick steel plate. The enclosures shall preferably be of modular construction and with two end plate assembly bolted to the frame.
- (c) The enclosure shall approximately be 1200 millimeters wide, 1000 millimeters deep and 2200 millimeters high to allow easy access to the internals. Racks shall be reinforced as required to ensure true surfaces and to provide adequate support for instruments and equipment mounted therein. Double interlocking doors with three point locking arrangement shall be provided and shall be arranged for maximum possible access to the interior. Center posts or any member which would reduce access shall not be provided.
- (d) Doors shall have concealed quick removal type pinned hinges and locking handles. Doors locks shall accept the same key all over the plant. Neoprene material Gaskets shall be used between all mating sections to achieve dust proof enclosure rating for the modules and a IP-65 waterproof and dust tight rating on the terminal boxes. All Enclosures shall have access doors on front side.
- (e) Bulkheads, especially designed to provide isolation from process line vibration shall be installed on modular bulk head plates of the transmitter enclosures to meet the process sensing line connection requirements. Removable top and bottom plates shall be furnished.
- (f) All internal wirings and/or data bus connections, if any, between the transmitters and terminal junction box shall run through flexible dust tight conduits connected to the terminal box hub. No exposed wirings within transmitter racks, both open and closed type, is admissible.
- (g) All racks shall have a common closed drain trough to connect transmitter drain points to a common header after suitable pressure breaking. Covered funnels shall be used for saturated liquid and steam service, where as, open funnels may be used for cold liquid services. The trough shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header.
- (h) 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 owner's recommendations.

**(i) Service Power and Lighting**



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- (i) Each enclosure shall be provided with universal type power receptacle, light fixture & LED lamps with wire guard and lighting switch etc. Lighting switches shall be door actuated & mounted inside the panel. Outlet box, switch box and device covers shall be of galvanized stamped steel. Light switches and power 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.
  - (ii) Power Supplies for miscellaneous devices shall be provided with 2P 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.
- (j) Control Air
- (i) A control air supply header shall be furnished in each enclosure having pneumatic devices. The header shall be 25 MM NB brass header stock drilled and tapped for 8 millimeter valves.
  - (ii) A valve with double compression end fittings shall be installed in each tap. Not less than three spare connections shall be furnished in each enclosure. The air header shall originate at a bulkhead penetration or fitting located in one of the bulkhead plates. Each pneumatic instrument shall have individual air shut-off valve.
  - (iii) Pressure reduction shall be achieved by air filter regulator sets. One filter regulator shall be furnished for each group of components making a system.
- (k) Service Air
- A 15 mm NB service air header shall be furnished in each enclosure housing draft and coal mill instruments. The header shall be furnished complete with a pressure regulating valve, pressure gauge and valve quick disconnect connections. A hose for connecting each header to the draft instrument line four way valve shall be furnished. The hose shall be self-storing nylon tubing having a burst pressure 15 Kg/Sq. cm. The service air header shall originate at a bulkhead penetration or fitting located on one of the bulkhead plates.
- (l) Power supplies
- Bidder shall supply all required transformers, regulators and other power supply equipment to adapt sources of power to the requirements of the enclosure mounted equipment. This shall include but not be limited to internal instrument illumination transformers. The circuits shall be separately isolated with MCBs.
- (m) Equipment Installation
- Special attention shall be given in the piping layout to avoid air traps in liquid filled piping, or water pockets in piping.
- (n) Impulse piping/tubing



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- (i) Transmitter enclosures shall be complete with impulse piping & tubing, valves from enclosure bulkhead connection to all instruments and necessary drain / blow down connections. The type ,size, material and pressure class of pipes/ tubes, fittings, valves etc. Shall be suitable for the intended applications.
  - (ii) Blow down piping / tubing may be shared, but individual instrument piping/ tubing and valves shall be furnished. Piping/ Tubing material within enclosures shall conform to the application requirements. The final flexible connection to each instrument shall be fabricated with a double offset so that it may readily be disconnected to permit "in situ" calibration of the instrument.
  - (iii) Bulkhead connection shall be used when instrument piping/tubing enters the enclosure. For instruments lines which enter through the bottom of the enclosure, the primary process line from the instrument valve shall be neatly installed, anchored and terminated at approximately 150 millimeters above the floor of the enclosure. The enclosure shall have a removable, gasketed floor plate to provide an effective seal around the incoming field primary process line. An angle shall be installed 600 millimeters above the floor, running the length of the enclosure for anchoring of incoming field process lines.
  - (iv) Pulsation dampeners shall be furnished wherever required.
  - (v) Drain pots shall be furnished for instruments measuring flue gas parameters and vacuum.
  - (vi) All liquid filled blow down lines, except those measuring vacuum shall be connected to a header extended through one end of the enclosure and turned downward for directing the blow down into drain. Gas filled lines and lines equipped with drain pots shall not be connected to the blowdown header. The connection between the blowdown valve and blow down header shall be constructed so that it can be removed to permit the connection of test instruments to the blow down valves.
  - (vii) The draft instrument line four-way valves shall be installed so that the quick disconnect fitting is readily accessible for connection with the service air hose.
  - (viii) Pipe and stainless steel tube welding shall comply with the provisions of the latest applicable ANSI code for Pressure piping.
  - (ix) Instrument piping and tubing shall be hydrostatically tested at one and one-half times the maximum system pressure for that instrument except for low pressure and vacuum measurement the test pressure will be as per piping standard.
- (o) Instrument tubing
- (i) Pneumatic tubing shall be installed in a neat workmanlike. It shall be supported frequently enough that it does not shake when subjected to vibration. All tubes which enter or leave the enclosure shall be terminated on bulkhead fittings in the bulkhead plate.
  - (ii) Pneumatic tubing material shall be 6mm OD brass/ 316 stainless steel tubing, unless otherwise specified. Flareless tubing fittings shall be used for tubing connections smaller than one inch. Tubing shall be stretched before installation to assure straightness. Special tools shall be used for all



bending and forming operations. Tubing shall be carefully handled to avoid flat spots, kinks, and short bends. All piping and tubing shall be air blown after erection and before attachment to equipment at either end.

#### 6.15.02 Open Type Transmitter Racks

- (a) Open type transmitter racks may be provided for mounting Transmitters, switches, gauges, converters and other accessories in rooms, buildings and closed areas like the power house building.
- (b) The open type racks may be shop or site fabricated. Transmitters, switches, converters and transducers of enclosure class IP-65 or better can be directly mounted on open racks. However, enclosures not conforming to the above protection standard shall have to be housed in enclosures conforming to the above protection standard prior to mounting them on open structures.
- (c) Racks shall be constructed on structural members of adequate strength and rigidity to ensure proper support to the mounted instruments and equipment. Racks shall be of welded construction throughout. 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. Each rack shall be provided with a canopy (sheet thickness of 3 mm) to protect the instrument from dripping water or falling objects.
- (d) For Operational convenience, the open type racks shall be used for mounting pressure and temperature gauges and switches and the local operating stations for electrical drives in the vicinity. Gauges mounted in racks shall be bottom connected and secured by double lock nuts. All gauges shall be located within 1500 mm from the floor for easy readability.
- (e) The structural design shall be such that no item shall interfere with maintenance and removal of instrument, equipment and their accessories.
- (f) Service Power and lighting
  - (i) Each rack shall be provided with Universal type power receptacle, LED lamp light fixture with wire guard and lighting switch etc. Outlet box, switch box and device covers shall be galvanized stamped steel. Light fixtures shall be installed on the canopy of the rack.
  - (ii) Power supply for respectacles and lighting shall be arranged. Power supplies for miscellaneous devices shall be provided with 2P MCB located within the rack JB. MCBs shall be mounted in blocks. MCB ratings will given on electrical schemetic diagrams. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.
- (g) Control Air  
Same as for closed type transmitter rack. Refer 6.15.01 (j) above





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- (h) Service Air  
Same as for closed type transmitter rack. Refer 6.15.01 (k) above
- (i) Power Supplies  
Same as for closed type transmitter rack. Refer 6.15.01 (l) above
- (j) Equipment installation  
  
Contractor shall prepare rack fabrication and piping drawings indicating the layout of each instrument. The drawings shall clearly indicate contractor's piping arrangement for sharing of process connections between two or more instruments. Special attention shall be given in the piping layout to avoid air traps in liquid filled piping or water pockets in piping intended to be dry.
- (k) Impulse Piping/Tubing  
Same as for closed type transmitter rack. Refer 6.15.01 (n) above
- (l) Instrument Tubing  
Same as for closed type transmitter rack. Refer 6.15.01 (o) above

**6.15.03****Wiring of the Racks**

- (a) A fully enclosed IP 65 type junction box shall be provided in each rack for housing the terminal blocks connectors, power supply fuses and other electrical accessories, as required.
- (b) Junction boxes for modular enclosures shall be fabricated externally on one end of each enclosure assembly to accept field wiring/cabling through the top or bottom of the junction box. A hinged door shall give access to the interior of the junction box.
- (c) All electrical connections between instruments and the junction box terminal blocks shall be made. In addition all utility wiring for lighting and service power shall be installed.
- (d) All wiring used within the enclosures shall conform to NEC/ IEC standards. All wiring shall run through flexible or rigid conduits and shall be terminated at suitable terminal blocks. Sufficient clearance shall be provided for all control and instrument leads and all incoming and outgoing leads shall be connected to terminal blocks suitably located for connecting external circuits.
- (e) High impedance circuits shall be connected using shielded or coaxial wire suitable for the service.
- (f) Conduits shall be supported properly at regular intervals with suitable conduit clamps.
- (g) Wire shall be neatly arranged and routed/laid in PVC trough/tray.

**6.15.04**

In general, local Instrument enclosures & racks shall be designed considering above cl no. 6.04.00 to 6.14.00 and chapter 9, Vol. V.



## **APPLICABLE CODES AND STANDARDS**

**1.08.00 CODES AND STANDARDS**

**1.08.01** All equipments, system and service covered under this specification shall comply with the requirements of the latest statutes regulations and safety codes as applicable in the locality where the equipments/systems will be installed. The Bidder shall fully acquaint himself with these requirements and shall ensure compliance with them.

The equipments, systems and services furnished as per this specification shall conform to the codes and standards mentioned in Cl. no. 1.08.02 of this Section. However in the event of any conflict between the requirements of two standards or between the requirements of any standard and this specification, the more stringent requirements shall apply unless confirmed otherwise by the Owner in writing. The decision of the Owner shall be final and binding in all such cases.

The Bidder's scope of supply shall include some items such as thermowells, and other in-line devices for main steam, hot reheat, cold reheat, feed water system falling under the purview of Indian Boiler Regulation (IBR) Act. It shall be the responsibility of the Bidder to obtain the necessary approval of the concerned Inspecting Authority/Chief Inspector of Boilers for the design and design calculations and manufacturing and erection procedures as called for under the IBR act for all items requiring such certifications.

The requirements of statutory authorities (e.g. MOEF, Inspectors of factories, IBR, TAC, BEE, CPCB/TNPCB etc) with regards to various plants areas like Main plant, Fuel oil plant/system, Chlorination Plant, Fire Fighting system, Emission Measurement, Ambient Air Monitoring system etc. shall be complied, even if not actually spelt out.

**1.08.02 Reference Codes and Standards**

The design, manufacture, inspection, testing, site calibration and installation of all equipment and systems covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable ANSI,



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ASME, IEEE, NEC, NEMA, ISA, DIN, VDE, NFPA, IEC, EIA, TIA and Indian Standards and their equivalents. Bidder to note that in no case, OEM/manufacturers own standards shall be accepted.

#### 1.08.02.01 Temperature Measurement

1. Performance Test Code for temperature measurement ASME PTC 19.3 (1974 – R 1998)
2. Temperature measurement - Thermocouples ANSI-MC 96.1 – 1982, IEC 584
3. Temperature measurement by electrical resistance thermometers - IS-2806.
4. Thermometer-element-platinum resistance-IS-2848, IEC 751/DIN 43760
5. RTD Design Code – DIN EN 60751:1996, BS EN 60751 : 2008
6. Thermowell Design Code – ASME PTC 19.3 TW – 2010

#### 1.08.02.02 Pressure Measurement

1. Performance Test Code for pressure measurement - ASME PTC 19.2 (2010)
2. Bourdon tube pressure and vacuum gauges - IS 3624, IS 3602, ASME B 40.1

#### 1.08.02.03 Electronic measuring Instruments & Control hardware

1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973), IS 9319
2. Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 - 1974.
3. Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1:ANSI MC 12.1 - 1975.
4. Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975): ISA-S26 (1968).
5. Surge withstand capability (SWC) tests - ANSI C 37.90A (1974) IEEE Std. 472 (1974). IEC – 255.4.
6. Printed circuit boards - IPC TM-650, IEC 326 C
7. General requirements and tests for printed wiring boards - IS 7405 (Part-I) - 1973
8. Edge socket connectors - IEC 130-11.
9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2.
10. Dimensions of attachment plugs & receptacles ANSI C73-1973.
11. Direct acting Electrical Indicating Instruments: IS-1248-1968.

#### 1.08.02.04 Instrument Switches and Contacts

1. Contact rating - AC services NEMA ICS Part-2 125, A600
2. Contact rating - DC services NEMA ICS Part-2-125, N600.



**1.08.02.08 Control Valves**

1. Control Valve sizing - Incompressible fluids - ISA S39.2 - 1972.
2. Control valve sizing - Compressible fluids - ISA S39.3 - 1973, ISA S39.4 - 1974.
3. Face to face dimensions of control valves - ANSI B16.10
- 1) ISA Hand book of control valves - ISBN B1047-087664-234-2.
- 2) Valves - flanged, threaded and welding end : ANSI B 16.34(2009)
- 3) Casting : ASTM A 216 / A 351 (2008)
- 4) Welded end connection : As per ASME boiler and pressure vessel code / ANSI.B 16.34(2009), B16.25 (2009), B 16.11(2009).
- 5) Defect removal: ANSI B 16.34 2009.
- 6) Cleaning : ASTM A 380 2006.
- 7) CV test : As per ISA procedure S 75.02 (2008).
- 8) Control Valve seat leakage : ANSI/FCI 70.2

**1.08.02.09 Enclosures**

1. Types of enclosures - NEMA Std. ICS-6-110.15 through 110.22 (Type 4 to 13).
2. Racks, panels, and associated equipment - EIA: RS-310-B (ANSI C83.9 - 1972)
3. Protection Class for Enclosure, Cabinets, Control Panels and Desks - IS-13947-1962.

**1.08.02.10 Apparatus, enclosures and installation practices in hazardous areas**

1. Classification of hazardous area - NFPA Art. 500, Vol.70-1984.
2. Electrical Instruments in hazardous dust locations - ISA-RP 12.11
3. Intrinsically safe apparatus - NFPA Art.493 Vol.4.1978
4. Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Art. 496 1982.



**1.08.02.12 Annunciators**

1. Specifications and guides for the use of general purpose annunciators - ISA RP 18.1-1979.
2. Surge withstand capability tests - ANSI C.37.90a - 1974 and IEEE std. 472-1974

**1.08.02.13 Interlocks, Protections**

1. Relays and relay system associated with electric power apparatus - IEEE std.3.13.
2. Surge withstand capability tests - ANSI C.37.90a - 1974 and IEEE Std. 472 - 1974.
3. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I) 1973.
4. Turbine water damage prevention - ASME - TDP-1980.
5. Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.

**1.08.02.14 Process Connection and Piping:**

1. Codes for pressure piping power piping ANSI B31.1
2. Seamless carbon steel pipe ASTM A-106.
3. Forged and Rolled Alloy steel pipe flanges, forged fittings, valves and parts - ASTM A-182.
4. Material for socket welded fittings - ASTM A-105.
5. Seamless ferrite alloy steel pipe - ASTM A-335.
6. Pipe fittings of wrought carbon steel and alloy steel - ASTM A-234.
7. Composition bronze or metal castings - ASTM B-62.
8. Seamless copper tube, bright annealed ASTM B-168.
9. Seamless copper tube - ASTM B-75.
10. Dimensions of fittings - ANSI B-16.11
11. Valves flanged and butt welding ends - ANSI B16.34.
12. Nomenclature for Instrument tube fittings ISA-RP-42.1 - 1982.

**1.08.02.15 Instrument Tubing**

1. Seamless carbon steel pipe - ASTM - A106.
2. Material for socket weld fittings - ASTM - A105.
3. Dimensions of fittings - ANSI B16.11
4. Code for pressure piping, welding, hydrostatic testing - ANSI B31.1.

**1.08.02.16 Cables**

1. Thermocouple extension wires/cables - ANSI C 96.1 - 1982.
2. Colour coding of single or multi-pair cables – VDE 0815



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3. Guide for design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422 - 1977.
4. Requirements of vertical tray flame test - IEEE 383 - 1974.
5. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33 - 81.
6. Oxygen index and temperature index test - ASTM D-2863.
7. Smoke generation test - ASTM D-2843 and ASTM E-662.
8. Acid gas generation test - IEC-754-1.
9. Swedish chimney test - SEN - 4241475 (F3)
10. Instrumentation cables and internal wiring IS-1554 (Part-I, 1976) and IS-5831(1984).
11. Standard for Control, Thermocouple Extension and Instrumentation cable - NEMA WC57-2004 (IECA S-73-532, Rev. 2, 2004)□
12. PVC insulated (heavy duty) Electric cables for working voltages upto and including 1100V - IS:1554 (Part-I)
13. Conductors for insulated electric cables and flexible cords. - IS:8130
14. PVC insulation and sheath of electric cables - IS:5831
15. Mild steel wires, strips and tapes top armoring cables - IS:3975
16. Water Immersion Test - VDE 0815
17. Drums for electric cables - IS : 1048

**1.08.02.18 Flow measurement**

1. ASME Performance Test Code PTC-19.5 (2004), ISA RP3.2
2. BS 1042
3. ISO 5167



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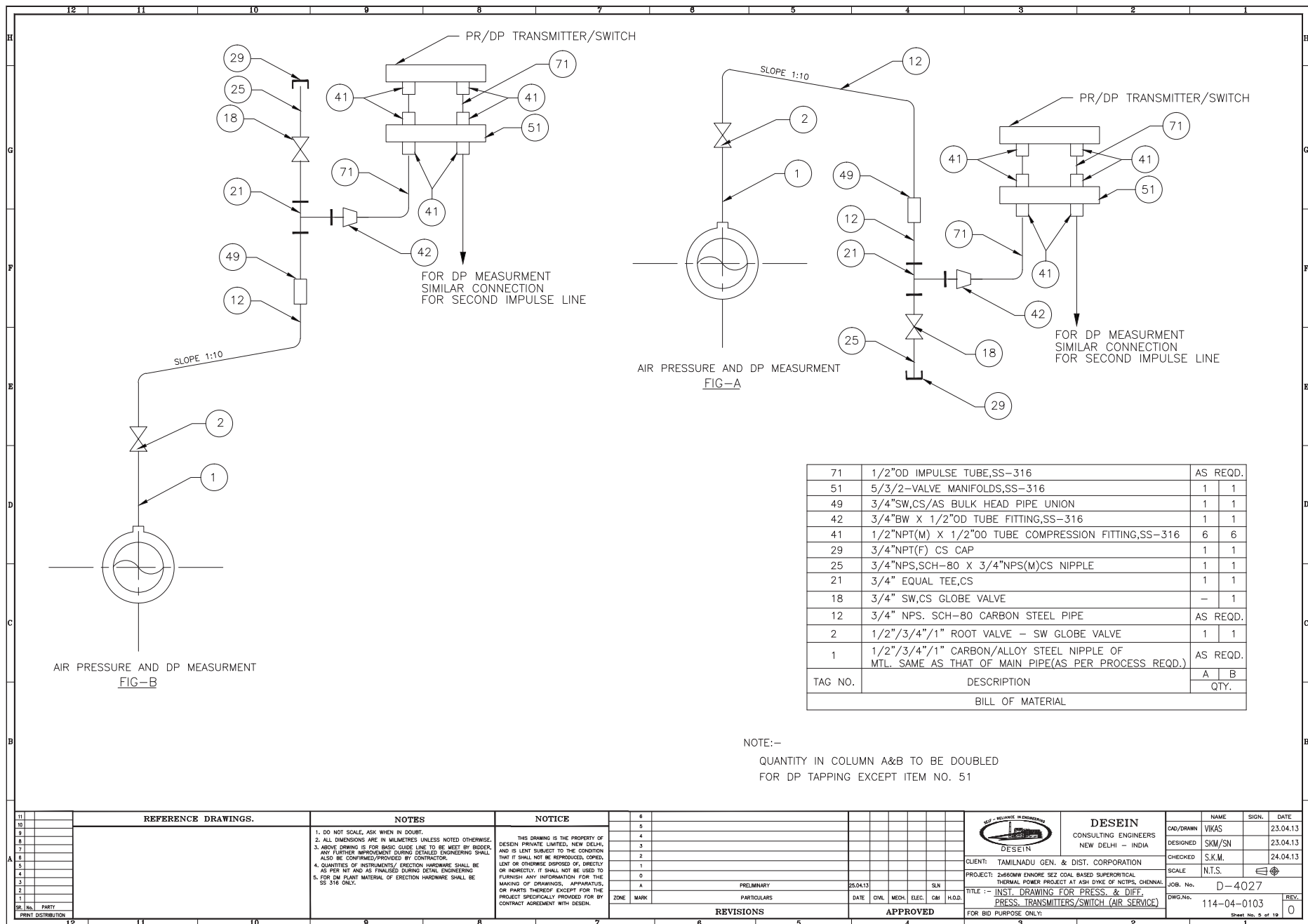
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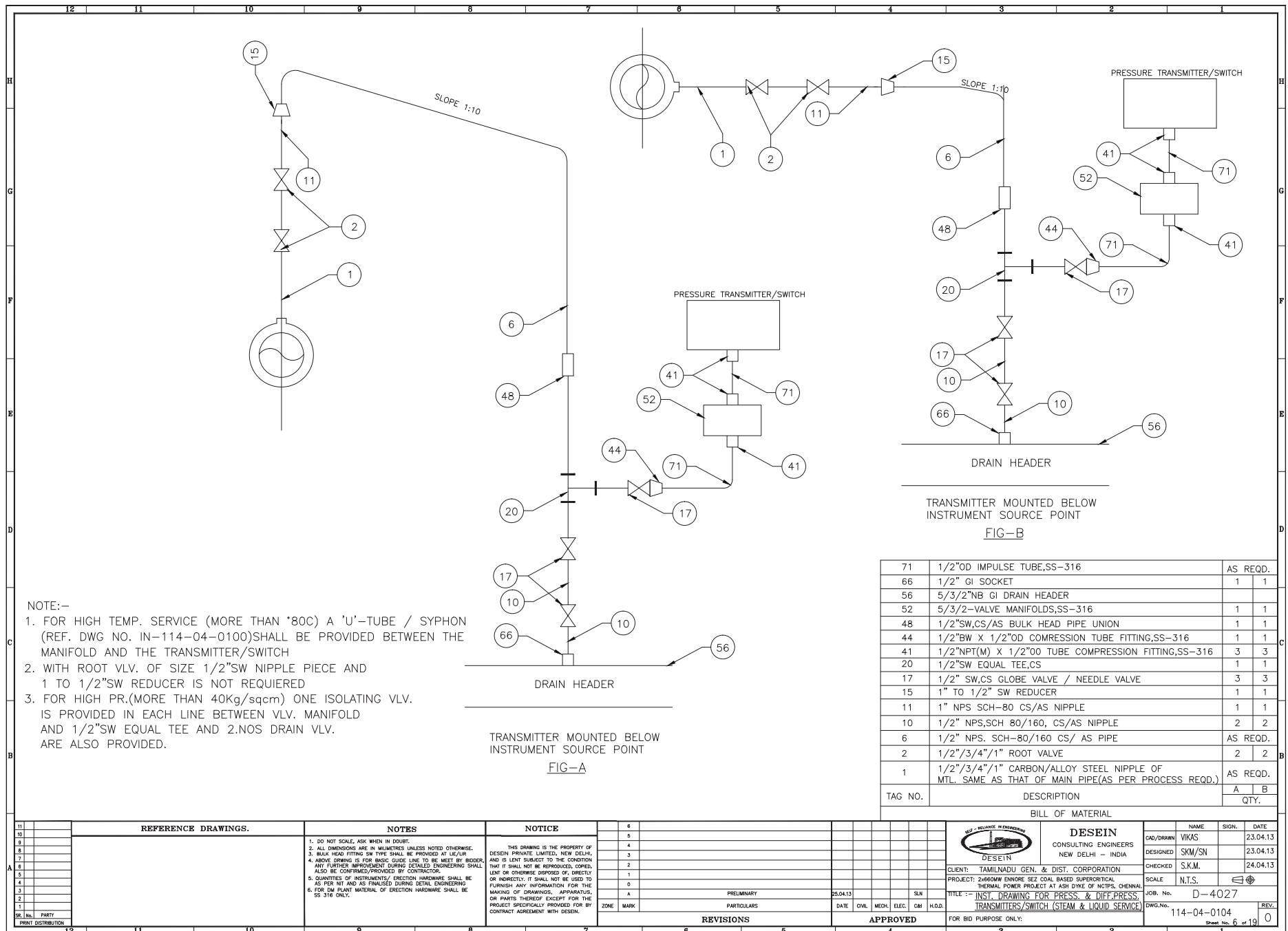


# INSTRUMENT INSTALLATION DIAGRAM

|

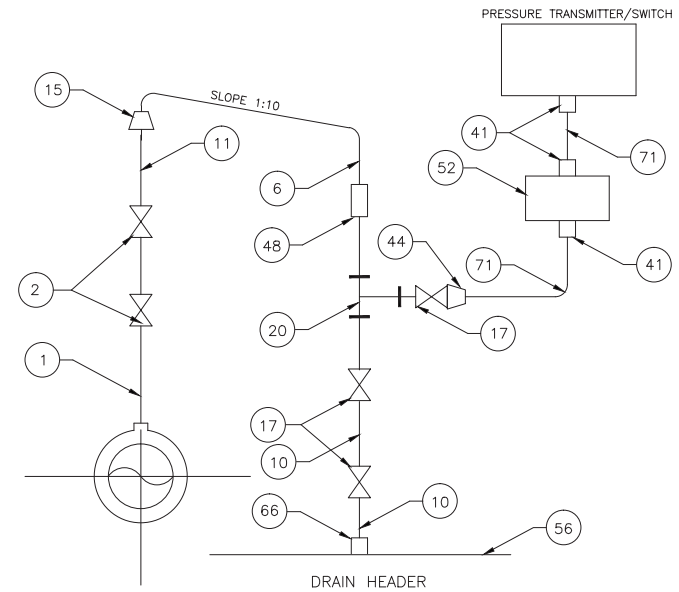
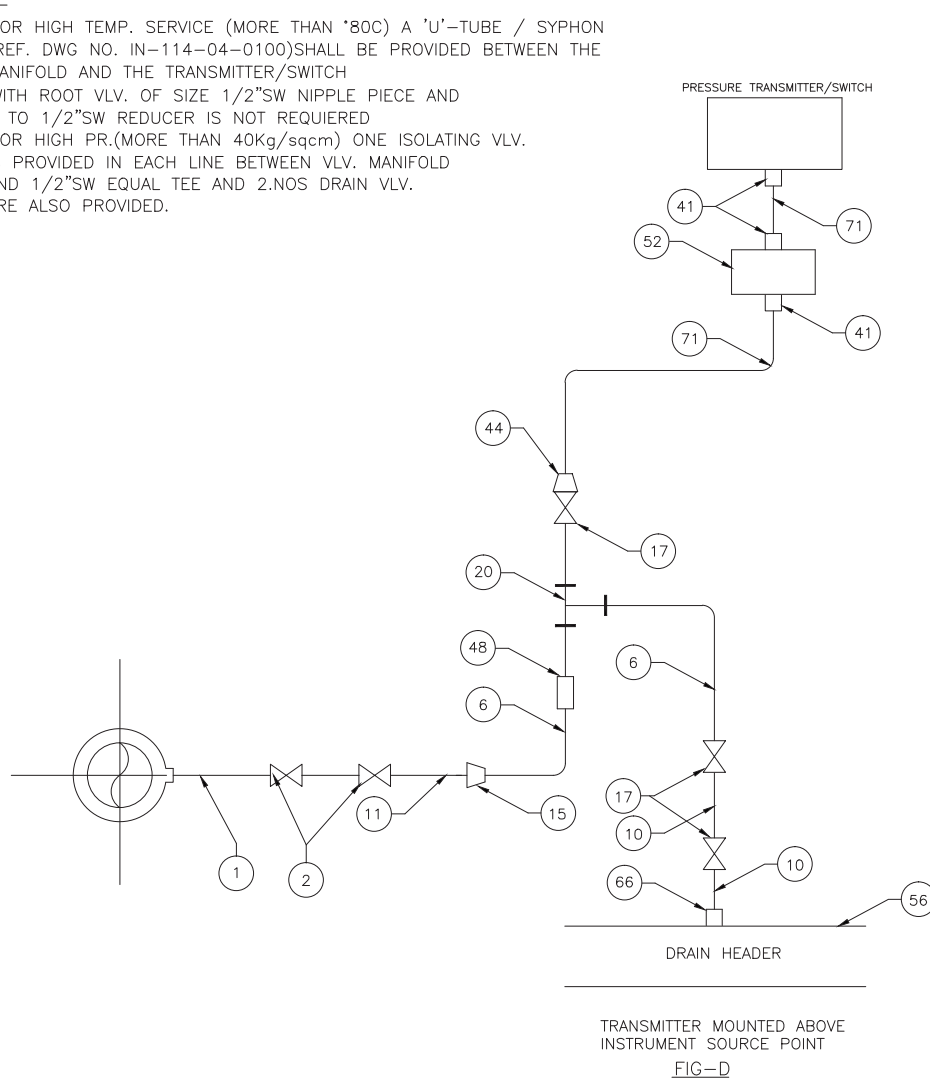






NOTE:-

1. FOR HIGH TEMP. SERVICE (MORE THAN 80°C) A 'U'-TUBE / SYPHON (REF. DWG NO. IN-114-04-0100) SHALL BE PROVIDED BETWEEN THE MANIFOLD AND THE TRANSMITTER/SWITCH
2. WITH ROOT VLV. OF SIZE 1/2" SW NIPPLE PIECE AND 1 TO 1/2" SW REDUCER IS NOT REQUIRED
3. FOR HIGH PR. (MORE THAN 40 Kg/sqcm) ONE ISOLATING VLV. IS PROVIDED IN EACH LINE BETWEEN VLV. MANIFOLD AND 1/2" SW EQUAL TEE AND 2 NOS DRAIN VLV. ARE ALSO PROVIDED.



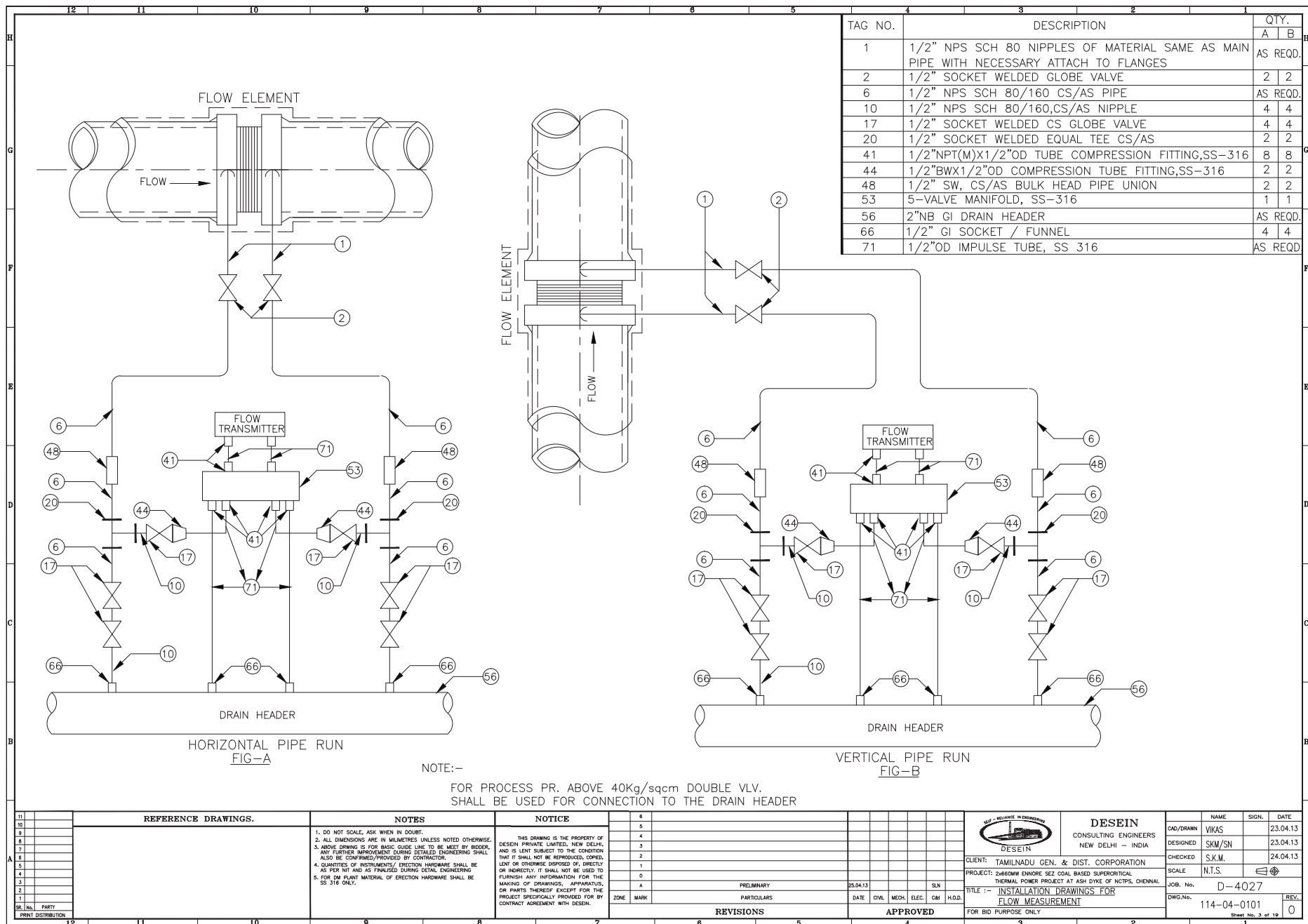
71	1/2"OD IMPULSE TUBE,SS-316	AS REQD.
66	1/2" GI SOCKET	1 1
56	2"NB GI DRAIN HEADER	
52	5/3/2-VALVE MANIFOLDS,SS-316	1 1
48	1/2"SW,CS/AS BULK HEAD PIPE UNION	1 1
44	1/2"BW X 1/2"OD COMPRESSION TUBE FITTING,SS-316	1 1
41	1/2"NPT(M) X 1/2"OD TUBE COMPRESSION FITTING,SS-316	3 3
20	1/2"SW EQUAL TEE,CS	1 1
17	1/2" SW,CS GLOBE VALVE / NEEDLE VALVE	3 3
15	1" TO 1/2" SW REDUCER	1 1
11	1" NPS SCH-80 CS/AS NIPPLE	1 1
10	1/2" NPS,SCH 80/160, CS/AS NIPPLE	2 2
6	1/2" NPS. SCH-80/160 CS/ AS PIPE	AS REQD.
2	1/2"/3/4"/1" ROOT VALVE	2 2
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PER PROCESS REQD.)	AS REQD.
TAG NO.	DESCRIPTION	C D QTY.

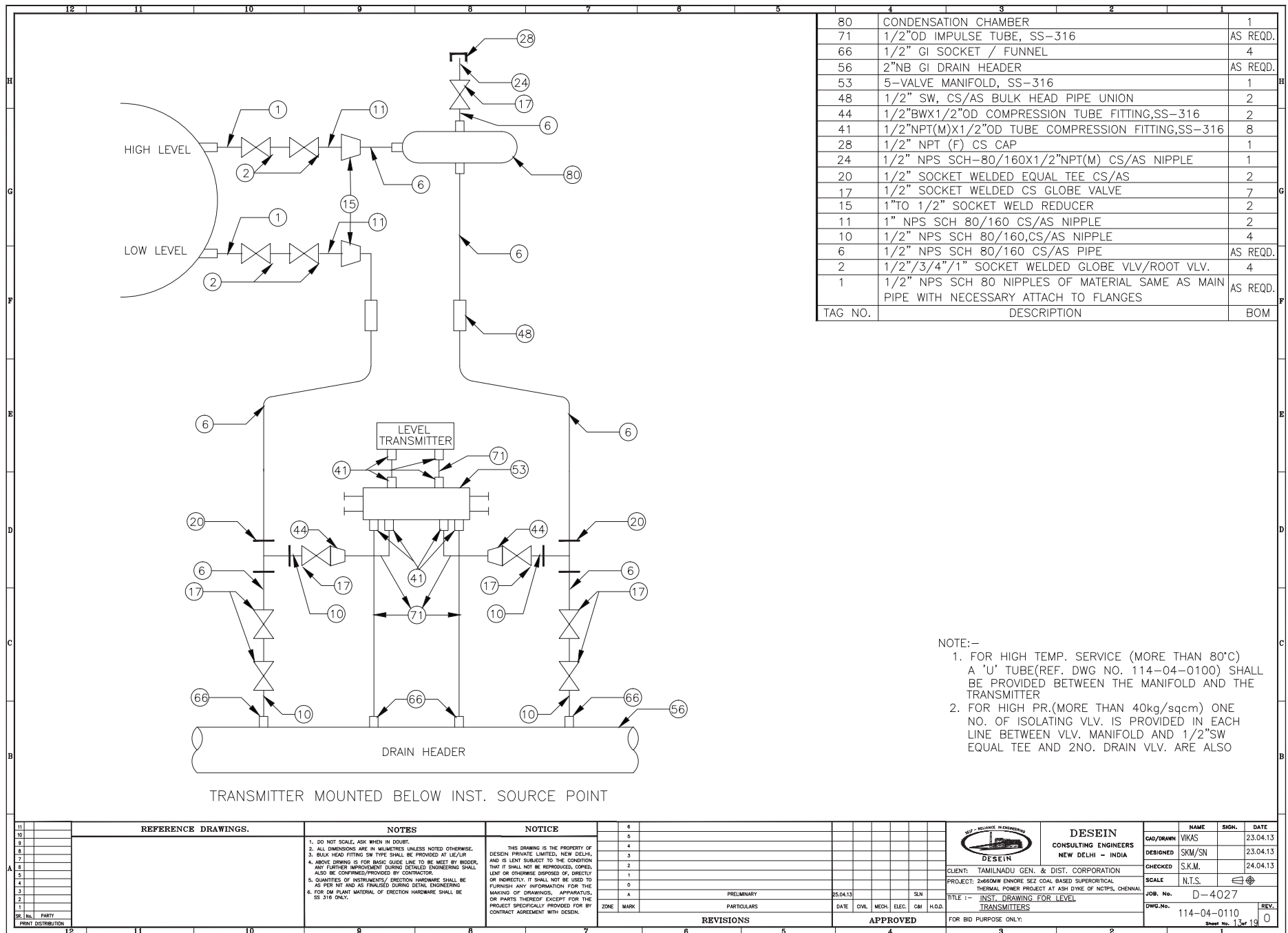
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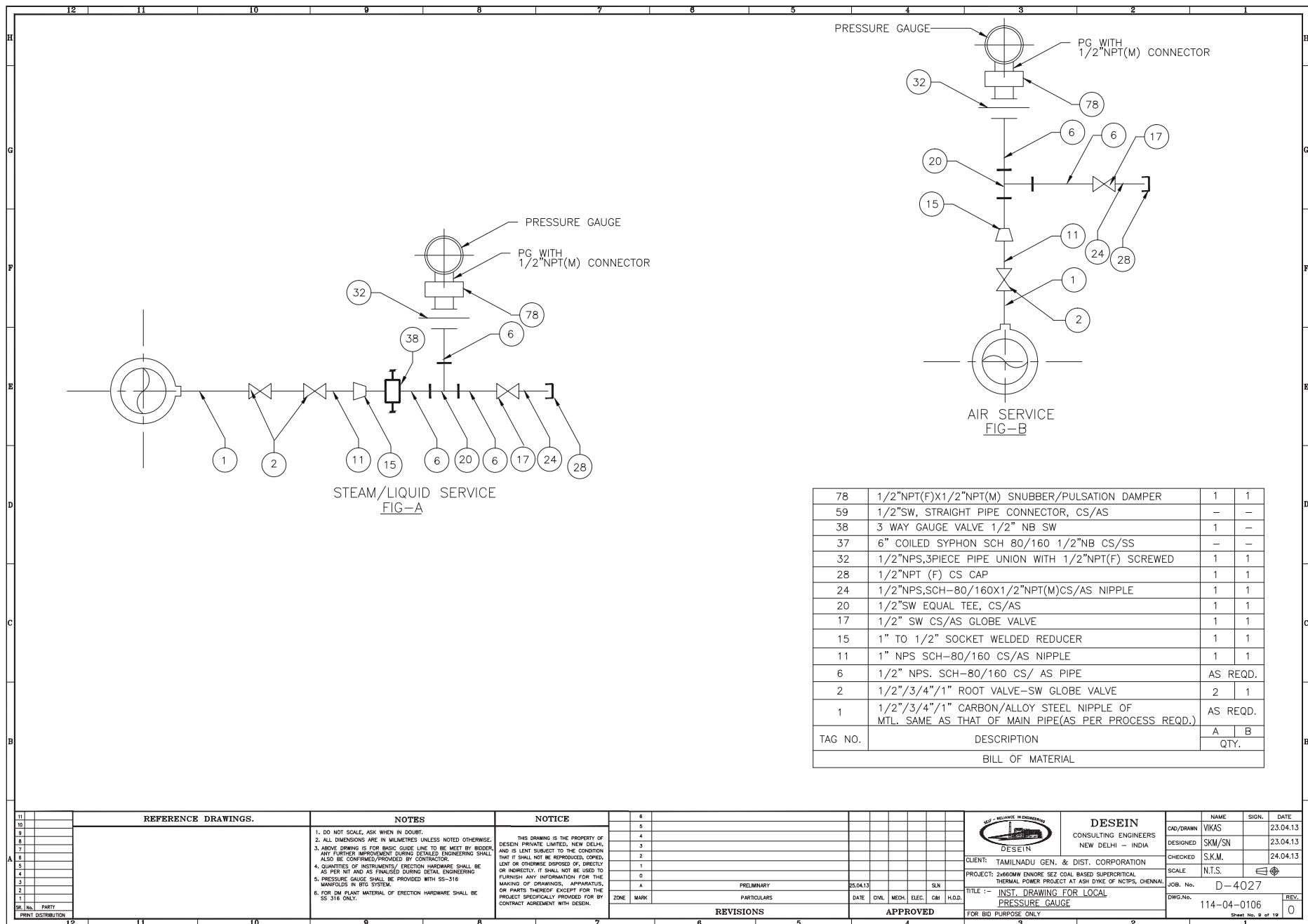
11		REFERENCE DRAWINGS.		NOTES		NOTICE		6		5		4		3		2		1	
10				1. DO NOT SCALE, ASK WHEN IN DOUBT.		THIS DRAWING IS THE PROPERTY OF DESEIN PRIVATE LIMITED, NEW DELHI, AND IS LENT SUBJECT TO THE CONDITION THAT IT SHALL NOT BE REPRODUCED, COPIED, LENT OR OTHERWISE DISPOSED OF, DIRECTLY OR INDIRECTLY. IT SHALL NOT BE USED TO FURNISH ANY INFORMATION FOR THE MAKING OF DRAWINGS, APPARATUS, OR PARTS THEREOF EXCEPT FOR THE PROJECT SPECIFICALLY PROVIDED FOR BY CONTRACT AGREEMENT WITH DESEIN.		PRELIMINARY		25.04.13		MECH.		SLN					
9				2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.				DATE		CIVIL		ELEC.		CM		H.O.D.			
8				3. BULK HEAD FITTING SW TYPE SHALL BE PROVIDED AT LIE/UR.				PARTICULARS											
7				4. ABOVE DRAWING IS FOR BASIC GUIDE LINE TO BE MET BY BIDDER. ANY FURTHER IMPROVEMENT DURING DETAILED ENGINEERING SHALL ALSO BE CONFIRMED/PROVIDED BY CONTRACTOR.				REVISIONS											
6				5. QUANTITIES OF INSTRUMENTS/ ERECTION HARDWARE SHALL BE AS FOR KIT AND AS FINALIZED DURING DETAIL ENGINEERING				APPROVED											
5				6. FOR DW PLANT MATERIAL OF ERECTION HARDWARE SHALL BE SS 316 ONLY.				FOR BID PURPOSE ONLY:											
4								DESEIN											
3								CLIENT: TAMILNADU GEN. & DIST. CORPORATION											
2								PROJECT: 2x600MW ENCORE SEZ COAL BASED SUPERCRITICAL THERMAL POWER PROJECT AT ASH DIKE OF NCTPS, CHENNAI											
1								TITLE :- INST. DRAWING FOR PRESS. & DIFF.PRESS. TRANSMITTERS/SWITCH (STEAM & LIQUID SERVICE)											
SR. No.		PARTY						JOB. No.		D-4027									
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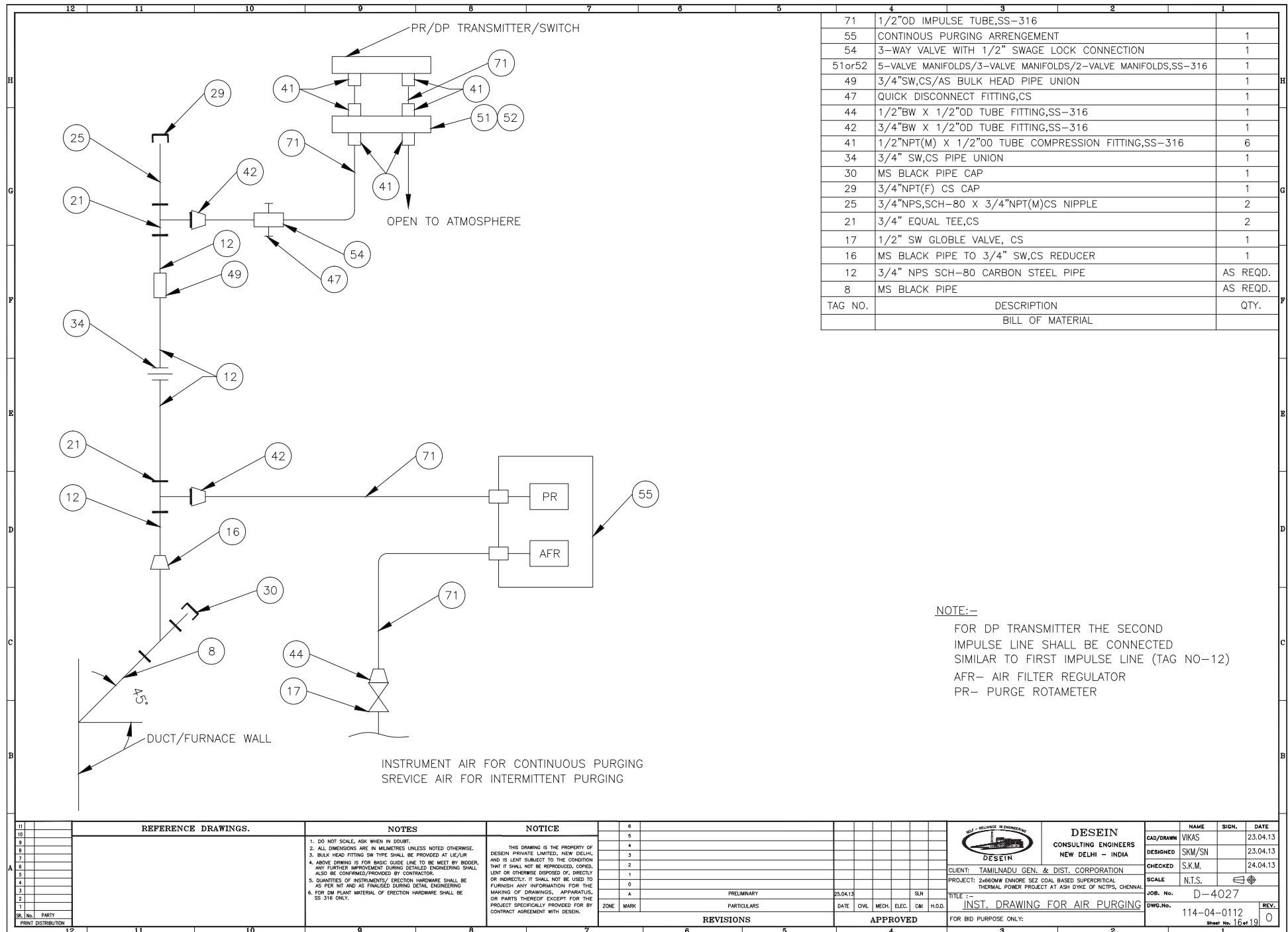


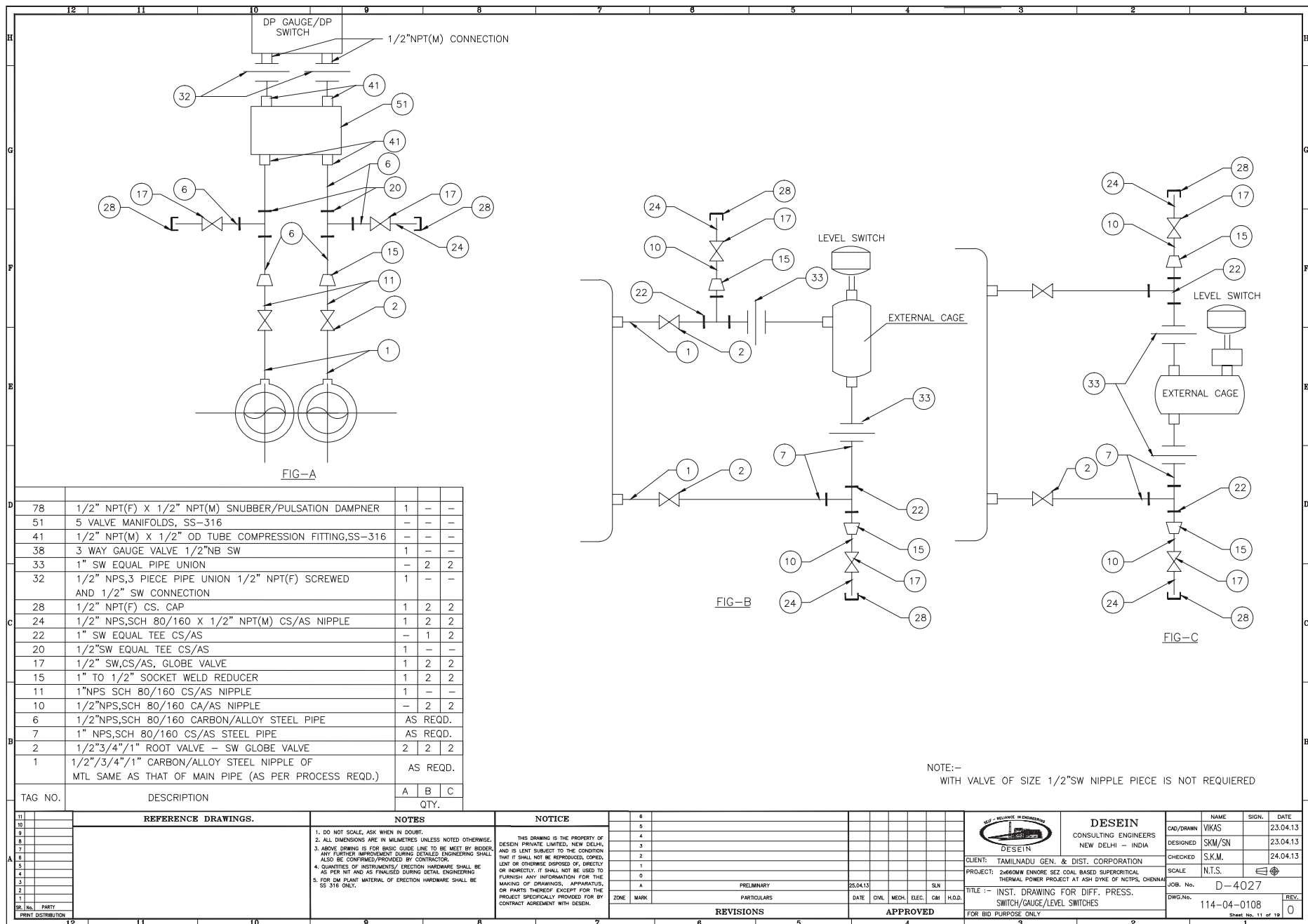














	<b>TITLE :</b> <b>2X660 MW ENNORE SEZ STPP</b>	SPECIFICATION NO. PE-TS-412-155A-A001	
		SECTION : III	
	<b>TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT</b>		
		REV. NO. 00	DATE :

## SECTION III


	<b>TITLE :</b> <b>2X660 MW ENNORE SEZ STPP</b>		SPECIFICATION NO. PE-TS-412-155A-A001	
			SECTION : III	
	<b>TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT</b>			
			REV. NO. 00	DATE :

### SCHEDULE OF PRE-BID CLARIFICATION

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

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


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

	<b>TITLE :</b>		SPECIFICATION NO. PE-TS-412-155A-A001
	<b>2X660 MW ENnore SEZ STPP</b>		SECTION : III
	<b>TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT</b>		
	REV. NO. 00	DATE :	

### COMPLIANCE CUM CONFIRMATION SCHEDULE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnishing same with the offer:

- a.) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions/ deviations with regard to same.
- b.) QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/Customer approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. The charges for 3<sup>rd</sup> party inspection (Lloyds, TUV or equivalent ) for imported components shall be included in the base price of the equipment by the bidder.
- c.) All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval. GA drawings, as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.
- d.) There are no other deviations with respect to specification other than those furnished in the 'Schedule of Deviations'.
- e.) The offered materials shall be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty, materials shall be subject to approval in the event of order.
- f.) The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL).
- g.) All sub vendors shall be subject to BHEL/CUSTOMER approval.
- h.) Any special tools & tackles, if required, shall be in bidder's scope.
- i.) Demonstration parameters shall stand valid till the satisfactory completion of demonstration test and its acceptance by BHEL/Customer.

	<b>TITLE :</b> <b>2X660 MW ENNORE SEZ STPP</b>		SPECIFICATION NO. PE-TS-412-155A-A001	
			SECTION : III	
	<b>TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT</b>			
			REV. NO. 00	DATE :

### DECLARATIONS

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

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

Bidders Company Name .....

Authorized representative's  
Signature .....

Name .....

Bidder's Name

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

**SCHEDULE OF DEVIATIONS WITH COST OF WITHDRAWAL****PROJECT:- 2X 660 MW ENNORE SEZ STPP****CONDENSATE POLISHING UNIT****TENDER ENQUIRY REFERENCE:-****NAME OF VENDOR:-**

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


**COMMERCIAL DEVIATIONS**


**PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE**

<b>NAME</b>	<b>DESIGNATIONS</b>	<b>SIGN &amp; DATE</b>

**NOTES:**

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