

Form No.		PRODUCT STANDARD TC ENGINEERING HYDERABAD	TC 65156-32
			Rev No. 03
			Page 1 of 10
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED. It must not be used directly or indirectly in any way detrimental to the interest of the company.		<u>Instruction to bidders:</u> - Bidders are advised to contact BHEL for essential technical queries in writing within one week of issue of Enquiry. Offers with incomplete information will not be considered for evaluation, and are likely to be rejected without any further correspondence with the Bidder. - Unsolicited requests from bidders for alterations to their already submitted offer will not be permitted. These would not be taken cognizance, and offers will be evaluated without taking into account such requests/correspondence. - Any technical features over & above BHEL enquiry specification requirements proposed by Bidder will not be given preference for the purpose of evaluation. - Bidders shall comply BHEL specifications in total. Incomplete offers will be rejected. In case feasible deviations are proposed by the bidder and subsequently withdrawn, no commercial implications can be claimed by the bidder. - The make of Bidder bought out items shall be as per vendor list. In case Bidder proposes alternate make / model of bought out item due to non-availability of statutory certification etc., the same shall not be binding on BHEL. Such changes shall be explicitly listed in deviation list with applicable price (for removal of the said deviation, if applicable) explicitly indicated (with specific item no) in the PRICED price schedule. - In the event of any conflict between these specifications, data sheets, related standards, codes etc. the bidder shall refer the matter to the purchaser for clarifications and only after obtaining the same shall proceed with the manufacture / procurement of the items in question. - Bidder shall submit duly filled deviation format enclosed with this specification along with technical offer, otherwise, it will be presumed that there are no deviations from this specification. Offer without this deviation list will not be evaluated & shall be rejected. If, there are no deviations, bidder shall submit signed copy of deviation format, mentioning "No Deviations". - Changes if any made by BHEL during technical evaluation on the specification requirements or Bill of material, bidder is requested by the purchase to submit impact price (amount to be reduced or increased to the original offered price) for those changed items only, other items for which there are no technical changes, unit rates shall be maintained as it is. In case of any technical query, bidders may contact the following BHEL engineer: Name: Ravi Designation: Deputy Engineer Deptt: TC Engineering Phone: +91 40 2318 4162 Email: ravichilukuri@bhel.in	
		Ref. Doc	

Form No.		PRODUCT STANDARD TC ENGINEERING HYDERABAD		TC 65156-32																							
				Rev No. 03																							
				Page 2 of 10																							
<u>TECHNICAL ADDENDUM FOR DRY GAS SEAL SKIDS</u> <u>Project: BPCL KRL NGC</u>																											
1 <u>GENERAL</u> This specification is applicable for the variants mentioned in the table below and is an addendum to TC55450-R03 (Specification for Dry Gas Seal Skids for Centrifugal Compressors). Vendor shall explicitly bring out any conflict between this specification and its attachments with TC55450-R03.																											
2 <u>VARIANT TABLE</u> <table border="1"> <thead> <tr> <th>Project</th> <th>Description</th> <th>Material Code</th> <th>Remarks</th> </tr> </thead> <tbody> <tr> <td rowspan="3">BPCL NGC</td> <td>Filter Skid</td> <td>TC9765156324</td> <td rowspan="3">The filter skid shall supply primary seal gas to two compressor casings and shall be provided with seal gas inlet change over valve and Filter condensate drain Valve.</td> </tr> <tr> <td>Control Skid</td> <td>TC9765156332</td> </tr> <tr> <td>Seal Gas Skid Spares as per price schedule, Sl no 1(c).</td> <td>TC9765156340</td> </tr> </tbody> </table>							Project	Description	Material Code	Remarks	BPCL NGC	Filter Skid	TC9765156324	The filter skid shall supply primary seal gas to two compressor casings and shall be provided with seal gas inlet change over valve and Filter condensate drain Valve.	Control Skid	TC9765156332	Seal Gas Skid Spares as per price schedule, Sl no 1(c).	TC9765156340									
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Form No.		PRODUCT STANDARD TC ENGINEERING HYDERABAD	TC 65156-32																																																						
			Rev No. 03																																																						
			Page 3 of 10																																																						
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5 SEAL GAS SKID DIMENSIONS & PIPING ORIENTATION 5.1 All the seal gas piping nozzles shall be terminated on top of the skids except drains. 5.2 Every effort shall be done to minimize the skid footprint. Efforts shall be made to minimize the skid size to 2000 mm x 1500 mm (Filter Skid) & 1500 mm x 1000 mm (Control Skid).																																																									
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Form No.		PRODUCT STANDARD TC ENGINEERING HYDERABAD	TC 65156-32																									
			Rev No. 03																									
			Page 4 of 10																									
5.3 Vendor shall further try to reduce the above indicated dimensions based on its 3-D modeling of the skids. 6 <u>DOCUMENTATION</u> 6.1 The following documents as a minimum shall be supplied by the vendor. The number of hard copies & CD/DVD/USB shall be as per TC55450-R03. - As-built GA drawings. - As-built Instrument datasheets including instrument vendor datasheets, GA drawings & sizing calculations. - Spares list. - Packing list. - Material test certificates. - Filter degree of filtration test certificate. - Explosion protection certificates for all electronic instruments. - Terminal wiring details of Junction Box. - Skid Photographs. - Instruction, Service and Maintenance manual. - Guarantee Certificates. 6.2 Two sets hard copies & one number CD/DVD of the above documents shall be submitted to BHEL prior to dispatch of the skids. 7 <u>LIST OF INSTRUMENTS</u> <table border="1"> <thead> <tr> <th>SL No.</th> <th>Instrument</th> <th>Qty Note (2)</th> <th>Minimum Specification</th> <th>Vendor</th> <th>Model</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Differential Pressure Gauges</td> <td>12</td> <td>IP66; panel mount Range: as required Dial Size: 150mm Pr.Conn. : ¼" NPTF Static Pr. : 210 kg/cm2(g)</td> <td>Switzer, GIC, Wika</td> <td>Switzer 109-V-E-2-6-0-S or eqv.</td> </tr> <tr> <td>2</td> <td>Pressure Gauges</td> <td>27</td> <td>IP67; panel mount Accuracy: ±1% of full scale, over range protection: 1.3 times of FS Dial Size: 150mm Pr.Conn.: ½" NPTM Case & Bezel: All SS Construction Wetted parts: * Solid front type for seal gas line. Liquid filled / with pulsation dampner. Over range protection: SS316</td> <td>GIC, Wika,</td> <td></td> </tr> <tr> <td>3</td> <td>Differential Pressure Transmitter</td> <td>12</td> <td>Smart-HART / FF Protocol Intrinsic safe Ex-ia / FISCO & flameproof Ex-d certified for IEC Zone1, Gas IIA, B, C Min Load: 600 ohms All SS construction Pr.Conn.: ½" NPTF</td> <td>Emerson</td> <td>HART: 3051CD 3A 07 A1 J H2 B7 K8 L4 M4 Q4 QT D4 T1 DF D1 HR5 FF: 3051CD 3F 07 A1 J A01 D01 H2 B7 IA (IE) L4 M5 Q4 T1 DF</td> </tr> </tbody> </table>					SL No.	Instrument	Qty Note (2)	Minimum Specification	Vendor	Model	1	Differential Pressure Gauges	12	IP66; panel mount Range: as required Dial Size: 150mm Pr.Conn. : ¼" NPTF Static Pr. : 210 kg/cm2(g)	Switzer, GIC, Wika	Switzer 109-V-E-2-6-0-S or eqv.	2	Pressure Gauges	27	IP67; panel mount Accuracy: ±1% of full scale, over range protection: 1.3 times of FS Dial Size: 150mm Pr.Conn.: ½" NPTM Case & Bezel: All SS Construction Wetted parts: * Solid front type for seal gas line. Liquid filled / with pulsation dampner. Over range protection: SS316	GIC, Wika,		3	Differential Pressure Transmitter	12	Smart-HART / FF Protocol Intrinsic safe Ex-ia / FISCO & flameproof Ex-d certified for IEC Zone1, Gas IIA, B, C Min Load: 600 ohms All SS construction Pr.Conn.: ½" NPTF	Emerson	HART: 3051CD 3A 07 A1 J H2 B7 K8 L4 M4 Q4 QT D4 T1 DF D1 HR5 FF: 3051CD 3F 07 A1 J A01 D01 H2 B7 IA (IE) L4 M5 Q4 T1 DF
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Form No.		PRODUCT STANDARD TC ENGINEERING HYDERABAD		TC 65156-32							
				Rev No. 03							
				Page 5 of 10							
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									Accuracy: 0.075% of span with TD of 1:10 Static Pr.: 210kg/cm2(g) Integral LCD indicator In built lightning & surge protection Integral Manifold: SS 316L	Yokogawa	HART: EJA 110A E H S4 GU 2 CEB KU22 A D4 A1 M11 FF: EJA 110A FH S4 GU 2 CDB A D4 A1 M11 EE FS15 (KS26 / SS25)
						4	Pressure Transmitter	32	3-way valve for DP and 2- way valve for pressure SIL certified for ESD / PLC Range : as required	Emerson	HART: 3051CG * A 07 A1 J H2 B7 K8 L4 M4 Q4 QT D4 T1 DF D1 HR5 FF: 3051CG * F 07 A1 J A01 D01 H2 B7 IA (IE) L4 M5 Q4 T1 DF Note : * is as per range
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						5	SMART / FF positioner for control valve.	For PDC V & On- Off valve partia l stro ke test	Positioner with Intrinsic safe Ex-ia / FISCO & flameproof Ex-d certified for IEC Zone1, Gas IIA, B & C and metallic housing. ‘Valve operating signature’ in the form of hard copy and CD’	Metso, Fisher, Dresser, Flowserve & Samson	HART: Metso ND930 * HXT or eqv. FF: Metso ND930 * FXT or eqv. Note : * is as per requirement
						6	Flow Meter	10	Internal magnetic float or Rota meter design or an integral orifice and differential-pressure (DP) cell SMART-HART protocol Intrinsic safe Ex-ia & flameproof Ex-d certified for IEC Zone1, Gas IIA, B & C Pr.conn: Flanged		The exact flow device type shall be provided during detail engineering and shall not have any delivery or commercial implication.
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Form No.		PRODUCT STANDARD TC ENGINEERING HYDERABAD		TC 65156-32								
				Rev No. 03								
				Page 6 of 10								
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							7	Junction Box	9	Flameproof Ex-d certified for IEC Zone1, Gas IIA, B & C, weather proof IP65, Die cast aluminum LM-6 body with nickel plated brass double compression glands & plugs. The terminals for JB's connected to Intrinsic safe instruments shall be light blue and for ex-proof instrument, shall be grey / blue colour.	Baliga lighting, FCG flame proof control gears, FCG Power Industries, Flameproof Equipments.	
							8	Duplex filter (Coalescing type) with change over transfer valve	1 set*	With change over valve Startup diff. Pr.: * Max. Pr. For change over: * Filter vessel: SS316L Change over valve: SS 316L	Forain-Italy, Indufil-Germany, Boll & Kirch-Germany, Hydac-Germany, Italvalv.	Filter sizing shall be as per API614. In case of condensate formation after PDCV as per Dew Point analysis, vendor to locate the filter after PDCV, hence TWO sets of Duplex filters.
							9	Pneumatic DP control valve	02 nos.	Material of body: SS316 L Material of Trim: * ANSI / FCI 70.2 Minimum class IV. Noise level shall not exceed 85db. Source treatment for noise shall be by using special trims like anti-noise trims; in case noise exceeds the allowable level. Bellow seal for corrosive & toxic gases like H2S, H2 etc. Actuator: Pneumatic diaphragm	Note-6.	
							10	Duplex filter regulator with SS housing and changeover transfer valve	02 sets	As per system requirement	Norgren, Parker, Boll & Kirch, Hydac, Pall	Shall be provided with three way ball valves
							11	In line check valves	As reqd	As per system requirement	Audco, BDK, ATIPL, DFT	
							12	Needle valves	As reqd	As per system requirement	Audco, BDK, ATIPL, DFT	
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Form No.		PRODUCT STANDARD TC ENGINEERING HYDERABAD		TC 65156-32								
				Rev No. 03								
				Page 7 of 10								
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							13	Instrument root & Isolation valves	As reqd	As per system requirement	Audco, BDK, ATIPL, DFT	
							14	Tubes, Tube fittings and manifolds	As reqd	As per system requirement	Swagelok, Parker Hannifin corp.	
							15	Cable: SMART Instruments	As reqd	Single pair 1.5 mm2, FRLS cable twisted in pair individually shielded with aluminium Mylar tape with drain wire and armoured.. primary insulation : PE.	Note-6	
							16	Cable: FF instruments	As reqd	Type A as per IEC 61158-2 0.82mm2/18AWG for Spur Cable.	Belden, Kerpen	
							17	Change over valve in startup gas & Condensate Drain valve	2 no.	Full bore, On-off ball valve ANSI / FCI 70.2 Minimum class VI TSO. The body as well as the actuator shall meet the testing requirements as per API 617 latest revision. Actuator: Pneumatic cylinder with spring return scotch yoke type SOV: 24 VDC SS316 Body Enclosure/Valve Assy, Ex-i IIC, SIL 3 certified, Universal type, class H insulation with integral diode protection, Make: Herion or ASCO, 02 nos for each valve Proximity type IS SIL certified limit switches, P&F make	NOTE-6	
							18	Temperature Gauges	06 nos.	Bi-metallic thermometer, every angle IP67, direct mount Accuracy: ±1% of full scale Dial Size: 150mm Inst Conn: ½” NPTM bottom. Case & Bezel: All SS Construction Solid front type for gas line	Note-6	
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Form No.		PRODUCT STANDARD TC ENGINEERING HYDERABAD		TC 65156-32	
		Rev No. 03			
		Page 8 of 10			

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SL No.	Instrument	Qty Note (2)	Minimum Specification	Vendor	Model
19	Temperature Gauge thermowell	06 nos.	Instrument connection: 1/2" NPTF Pr. Connections: 1-1/2" flanged as per skid rating All SS316 Construction. NACE certification Bore dia: suitable for TG	Note-6	Refer attached drawing.
20	Canopy for all transmitters, positioners & junction boxes				As reqd
21	LT for condensate Pot	1 no		ABB Emerson Endress+Hauser Krohne L & J Tech Magnetrol Vegagrieshaber	Emerson 3300 series or eqv.
22	MIMIC Panel	1 Set			Refer attached photograph.

Notes:-

- All instrument makes shall be as per this list.
- Any item not covered in this list shall be from a reputed manufacturer unless otherwise specified in this specification elsewhere.
- For the items, which are not covered in the list or vendors not indicated, vendor shall procure the same from their standard sub-vendors.
- If the quantity indicated above is more than the numbers required as per project specific P&I diagram, the additional quantity with ranges same as used within skid & shall be supplied loose.
- All the items of the same type of instrument shall be of same make.
- Additional Vendor List as attached.
- Incase the above listed quantity is less than that required by the vendor as per vendor proposed P&ID, these additional instruments shall be considered by vendor.

8 DEVIATION FORMAT:

Bidder shall submit duly filled deviation format (as given below) along with technical offer, otherwise, it will be presumed that there are no deviations from this specification. Offer without this deviation list will not be evaluated & shall be considered for rejection. If, there are no deviations, bidder shall submit signed copy of this format, mentioning "No Deviations".

Sl. No.	Clause No. of Spec	Deviation	Reason for deviation	Deviation category	
				Product/design limitation	Optimization
1					
2					

9 CHECKLIST:

(TO BE FILLED BY THE VENDOR AND SUBMITTED ALONG WITH THE OFFER WITHOUT WHICH OFFER WILL NOT BE CONSIDERED)

Sl. No.	Requirement	Vendor Confirmation YES / NO

Ref. Doc

Form No.		PRODUCT STANDARD TC ENGINEERING HYDERABAD	TC 65156-32
			Rev No. 03
			Page 9 of 10

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a.	Compliance to BHEL specification and its annexures.	
b.	Deviation (if any) included in offer with reason.	
c.	Price implication for deviation removal is indicated in Priced offer in case of any deviation.	
d.	Skid GA & BOM (with make/model) attached with technical offer.	
e.	Signed and stamped copy of BHEL specification attached with technical offer.	
f.	Spares BOM (with make/model) attached with technical offer.	
g.	Price schedule attached with technical offer with 'QUOTED' marked against each item.	
h.	PTR attached with technical offer.	

10 SPARES REQUIREMENT:

SL NO	SPARE ITEM DESCRIPTION / SPARE PHILOSOPHY	QTY
a	Seal gas filter element with gaskets / O-rings (1 set is equal to 100% filter replacement for skids): 6 Set.	1 set
b	Local Gauges: DP, Pressure, flow, temperature, thermowell, level etc.-10% or min 01 no. each type with all accessories	
c	Transmitters: DP, Pressure, Level etc.-10% or min.1 no. each type with all accessories	
d	Transmitters: Variable Area Flow / DP Flow etc.-10% or min.1 no. each type with all accessories	
e	Orifice Plates: 10% or minimum one blind plate of each type, size and thickness.	
f	<u>Control valve spares:</u> i. 10 % or minimum 1 no of each type, size, rating of Trim consisting of seat, seat ring/ seal ring, plug with stem, cage (wherever applicable), packing material. ii. 10% (subject to minimum of 1) of Positioners (Smart) with links of each type and make. iii. 10% (subject to minimum of 1) of Diaphragm. iv. 10% (subject to minimum of 1) of Air filter regulators of each type and size. v. 10% (subject to minimum of 1) of Bonnet Gaskets/ gland packing's, piston O-rings, Stem Seal O-rings, bearing & liner. vi. 10% (subject to minimum of 1) of any special accessories provided along with the control valve like solenoid valves, boosters, position transmitters (wherever applicable), proximity switches etc.	
g	<u>On-Off valve spares:</u> i. 10% (subject to minimum of 1) of partial stroke testing devices with links of each type and make. ii. 10% (subject to minimum of 1) of Air filter regulators. iii. Seal kit consisting of O rings, gland packing, gaskets, etc. iv. 10% (subject to minimum of 1) of proximity switches. v. 10% (subject to minimum of 1) of solenoid valves of each type. vi. 10% (subject to minimum of 1) of accessories like quick exhaust valves and temperature dependent fuses.	
h	<u>Instrument valves, manifolds & fittings:</u> i. Fittings, lugs, nipples, sockets, blinds, unions: 10% or min. 1 no each type. ii. ½", ¾", 1", 1-½", 2" (etc.) valves (ball, Globe, Gate, Needle, NRV etc.) : 10% or min. 1 no each type. iii. 2 valve & 3 valve manifolds, isolation valves, instrument valves, tube fittings, check valves, filter, regulator, orifice plates etc.: 10% or min. 1 no each type.	

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Form No.		PRODUCT STANDARD TC ENGINEERING HYDERABAD	TC 65156-32	
			Rev No. 03	
			Page 10 of 10	

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11 PRICE SCHEDULE:

Enquiry ref. no.

Date:

Offer ref no.

Date:

Sl no.	DESCRIPTION	Qty	PRICE
1.	<u>Seal Gas Control system consists of the following:</u>		
a	Seal Gas Filter Skid MCA1046: TC9765156324	1 set	
b	Seal Gas Control Skid MCA1046: TC9765156332	2 set	
c	Seal Gas Skid Spares MCA1046: TC9765156340 (as per clause 10)	1 set	
2.	<u>Additional price to withdraw the deviations to following clauses:</u> <u><Vendor To Indicate Clause Nos></u>		
3.	<u>Optional offer for addition of each of the following instrument inclusive of root valves, piping & installation materials etc.</u>	Optional price for each item	
a	Filter cartridges / elements with gaskets / o-rings (100%)	1 set	
b	Pressure Transmitter	1 unit	
c	DP Transmitter	1 unit	
d	Pressure Gauge	1 unit	
e	Differential Pressure Gauge	1 unit	
f	Smart Positioner	1 unit	
g	Solenoid valve	1 unit	
h	Flow transmitter	1 unit	
i	Level transmitter	1 unit	
j	On-Off Valve	1 unit	
4.	<u>Pre-Commissioning, Commissioning Supervision</u>		
a	Per diem for Commissioning activities for seal gas skid at site inclusive of Travel, boarding, lodging, and local conveyance.	Per diem	
5.	Total Price for Evaluation {1+2}		

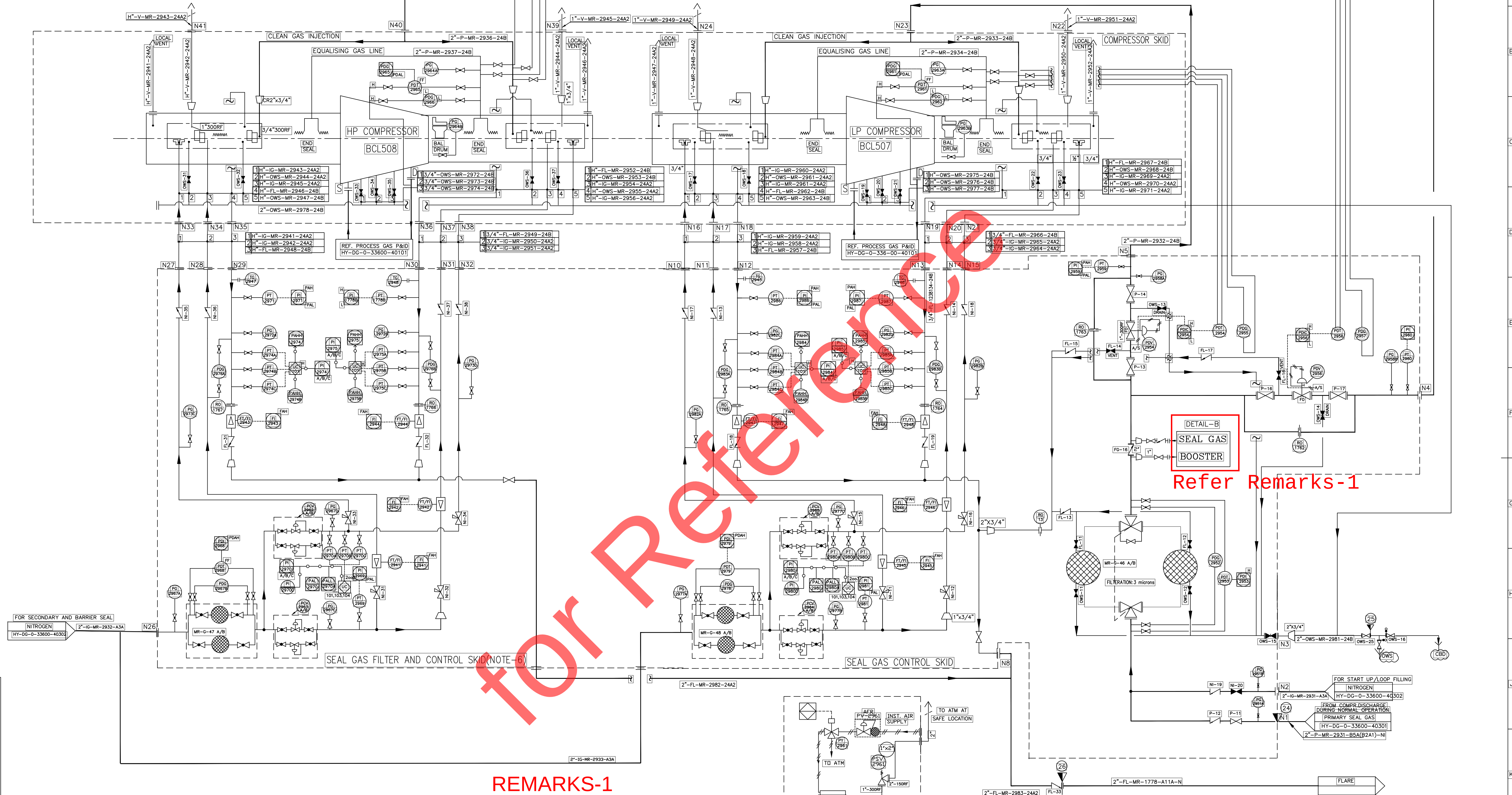
Notes:

- i. The word 'TYPE' means the Make, Model no., Type, Range, Size/ Length, Rating, Material as applicable.
- ii. The individual prices for the spares and optional items above are valid for one year to order as and when the requirement arises.
- iii. Any additional requirements which are essential for proper functioning of the dry gas seal system but not indicated in specification are included in the offer.

Vendor's signature & seal

Ref. Doc

TC65156-32 R03_ATTACHMENT-1 (P&ID)



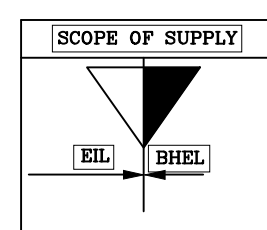
REMARKS-1
1) Booster system shall be supplied by BHEL. Vendor shall provide interface Nozzle connections as indicated.

DETAIL-B
SEAL GAS BOOSTER SKID

REFERENCE DRAWINGS:
1. LUBE OIL P&I DIAGRAM : HY-DG-0-336-00-40302
2. PROCESS GAS P&I DIAGRAM : HY-DG-0-336-00-40301

NOTES:

- 1) THERE SHOULD BE NO POCKETS OR DEAD LEGS IN CLEAN GAS SUPPLY LINE.
- 2) FOR INTERLOCK TABLE, REFER LUBE OIL P&I DIAGRAM : HY-DG-0-336-00-40302
- 3) ALL INSTRUMENT TAG NUMBERS SHALL BE PREFIXED WITH UNIT NO. 'MR'.
- 4) ALL THE PRESSURE INSTRUMENTS SHALL HAVE A PROCESS CONNECTION OF 3/4" SW GLOBE VALVE AS ROOT VALVE (AS PER SPEC). THE TEMPERATURE INSTRUMENTS SHALL HAVE A PROCESS CONNECTION OF 1/2" 300# RF.
- 5) SEAL GAS PIPING MATERIAL WITHIN THE SEAL GAS FILTER & CONTROL SKIDS SHALL BE SS304/SS316/SS321 AS PER VENDOR.
- 6) NUMBER OF SEAL GAS SKIDS SHALL BE FINALIZED AFTER SUB VENDOR INPUT.



PROJECT : BSVI MS BLOCK PROJECT		OWNER : M/S BPCL-KR	
UNIT : COR PLATFORMING		CONSULTANT : ENGINEERS INDIA LIMITED	
EIL DRG NO. : B034-79-41-MR-1129,1130		REV 4	
ITEM NO. : NET GAS COMPRESSOR - MR-C-02		NAME OF CUSTOMER : BPCL KR	
NAME OF PROJECT : BSVI, NET GAS COMPRESSOR		Bharat Heavy Electricals Ltd. Hyderabad	
DATE	NO. OF	DATE	NO. OF
26.04.18	1	26.04.18	1
26.04.18	1	26.04.18	1
26.04.18	1	26.04.18	1
TITLE : SEAL GAS P&I DIAGRAM		HY-DG-0-336-00-40304	
SHEET NO. 1		NO. OF SHEET 1	

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	<u>SPECIFICATION FOR DRY GAS SEAL SKIDS FOR CENTRIFUGAL COMPRESSORS</u>			
	1. <u>Scope</u> This specification covers the minimum requirements of design, detail engineering, fabrication and supply of completely assembled Gas Seal Control System (with impulse piping, tubing and wiring) for a Centrifugal Gas Compressor consisting of (a) Seal Gas Filter Skid & (b) Seal Gas Control Skid compatible with Dry gas seals. The detail of the different operating cases, Gas composition, ambient conditions and design parameters of the different lines, etc are furnished in the project specific DGS specification which is a part of this enquiry. 2. <u>Brief description of Seal Gas Filter Skid and Seal Gas Control Skid for Centrifugal Compressor:</u> 2.1 The Vendors minimum Scope of Supply and Work shall be as indicated below. a) Seal Gas P&I Diagram as per Variant Table 4 of this specification. b) Latest edition of API 614. c) List of Instruments, make & model as per Table 1 of this specification. 2.2 The scope of supply shall include the following for each compressor: 1) Seal Gas Filter Skid 2) Seal Gas Control Skid 3) Mating flanges with gaskets, bolts and nuts at terminal points 4) Spare filter cartridges — 05 sets (Each set consists of number of cartridges required for one Filter Bowl). 5) Loose supplied items like: i. Interconnection pipes and fittings between both assemblies. ii. Loose cable glands. iii. Foundation bolts and accessories iv. Instruments not mounted on the skids, etc. v. Any other item in Vendor's scope but not assembled on the skids 2.3 The function of the system is: - - To supply and monitor process gas/ Nitrogen/ other gas, as applicable for primary injection to dry gas seals. - To supply and monitor Nitrogen/ start up gas for purging - To supply and monitor Inert gas (Nitrogen) for Secondary seals - To supply and monitor Inert gas (Nitrogen)/ Instrument Air for barrier seals - To monitor primary gas leakage and initiate Alarms/Shutdown in response to variation in leakage.			

Rev. No.	Revisions	Prepared	Approved	Date
03	Refer to record of revisions	RAM	VVS	17/09/2010

- 3.1 Gas Seal Control System shall be designed as two Package Units: - a) Seal Gas control skid and b) Seal Gas filter skid. Each skid shall be stand-alone type and shall be formed out of suitable structural steel. ~~A common skid shall be supplied in place of individual skids at a) and b) above, whenever indicated in the enquiry.~~
- 3.2 Equipments, Instruments, Regulators, Shut off ball valves, Modulating valves, Isolating valves, In-line check valves, Piping/Tubing with fittings, etc. shall be mounted and assembled on the respective skid.
- 3.3 All the materials in contact with primary seal gas inlet and vent shall be of SS 316L or Equivalent forging/casting materials and suitable for the gas composition specified in Dry Gas Seal specification. Also, they shall comply with NACE-MR-01-75 latest edition
- 3.4 All the materials in secondary seal inlet and vent lines, barrier seal inlet and vent lines shall be of ~~SS316~~ or Equivalent forging/casting materials.
- 3.5 Vendor to ensure that the Primary seal leakage to flare header lines along with the instruments shall be designed for the design parameters of seal gas lines up to NRV.
- 3.6 Vendor to provide the condensing pot as per design code ASME VIII div I as required along with control system instrumentation for automatic draining as part of scope of supply, for variants as per Table-4. Also, vendor to check the requirement and indicate in their offer for other variants in case of the following instances.
 - a) The gas passes through various elements in the system and shall be mixed with Hydrocarbons, which may become condensed on cooling. The vendor to provide suitable arrangement, if required to keep dryness in the gas in all operating conditions and removal of condensate as required for seals. Vendor to provide DEW point curve for our review along with the offer.
- 3.7 Whenever, the condensate pot is provided, the level transmitter shall be provided by selecting either of the following options which shall be selected after the placement of the order.
 - a) Guided wave radar type instrument shall be used for level measurement up to 1219 mm. For all level measurement above 1219 mm diaphragm seal type differential



PRODUCT STANDARD
TURBINES AND COMPRESSORS
HYDERABAD

TC-55450

REV No.: 03

Page 4 of 32

4.7 Filtration grade:

- Solids: Beta 75(98.7% efficient) on 2 microns or greater.
- Liquids : Beta 75(98.7% efficient) on 1 microns or greater.

5. Piping

5.1 The Pipe sizes and terminal points shall be as per the Seal Gas P&ID indicated in variant ~~table-4~~.

5.2 The exact pipe size and terminal points shall be finalised as per the project specific P&ID diagram provided during detailed Engineering after the placement of order.

5.3 Vendor shall supply the companion flanges, gaskets, O-rings, Stud nuts, etc. for all flanged end connections.

5.4 All piping and other items shall be as described below

Item	For rating upto #300	For rating upto #600	For rating #900 & # 1500
Pipe Schedule	Schedule 80 S	Schedule 80 S	Schedule 160 S
Flanges & 2" Valves	# 300 RF	# 600 RTJ	#900RTJ & #1500RTJ as applicable
Fittings & Valves upto 1½"	SW # 3000 rating	SW # 3000 rating	BW # Sch 160
Fittings for 2"	BW # Sch 80	BW # Sch 80	BW # Sch 160
SS Piping/ Tubing for instruments and control valve	½" piping (schedule 80S) / 12.7x2.1 mm thk Tubing for primary seal inlet and vent lines (Please refer Table 4 and Material code for requirement of Piping / Tubing against this enquiry)		¾" piping (schedule 160S) for primary seal inlet and vent lines
	12.7mm x 2.1mm thk for Secondary & Barrier seal lines		
	6mm x 1mm thk for pneumatic line for control valve		

5.5 Materials shall be as described below. PMI to be done for all materials, fittings & weld materials.

Item	Seal gas inlet & vent upto flare	Sec.seal inlet & vent	Barrier seal inlet & vent
Pipes and tubes	SS 316L	SS 316 L	SS316 L
Flanges & Valves	SS 316L	SS 316 L	SS316 L
Fittings	SS 316L	SS 316 L	SS316 L
Manifolds	SS 316L	SS 316 L	SS316 L
Filters	SS 316L	SS 316 L	SS316 L

5.6 The dimension of all fittings shall be as per ASME/ANSI standard.

5.7 In general, the following type of valves shall be provided.

- a) For piping root valves Globe valves shall be used.

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TC55450.	COMP. FILE
DOC	FILE NAME



PRODUCT STANDARD
TURBINES AND COMPRESSORS
HYDERABAD

TC-55450

REV No.: **03**

Page 5 of 32

- b) For isolation, gate valves shall be used
- c) For equalisation and bypass, globe valves shall be used
- d) For instrument air, Ball valves shall be used
- e) For throttling in secondary and barrier seal lines, needle/globe valves shall be used.

5.8 All Butt-welded joints shall be TIG welded and the welds shall be 100% radio graphed.

5.9 Vent/ Drain/ Any header shall be bigger in size than the individual lines connected to it.

5.10 Supports shall be provided for all items inclusive of pipelines/ tubing/instruments.

5.11 All lines shall be cleaned in order to remove all dust, rust, slag, and all other foreign particles from internal and external parts.

5.12 All the vent/ drain holes, if any shall be plugged with threaded plugs/caps.

5.13 All the instruments shall be provided with individual root isolating valves. The double valves shall be provided for all high-pressure (pressures more than 40 ata) isolation, equalization, vent & drains.

5.14 Design pressure at 170° C of all piping, valves, fittings, instruments, filters shall be as described below

Item	For #300 rating	For #600 rating	For rating #900 & # 1500
Primary seal inlet and vent lines	30 Kg/cm ² (g)	60 Kg/cm ² (g)	90 Kg/cm ² (g) for #900 & 152 Kg/cm ² (g) for #1500
Secondary & Barrier seal lines	20 Kg/cm ² (g)	20 Kg/cm ² (g)	20 Kg/sq.cm(g)

5.15 Hydro test pressures for seal gas filter skid and seal gas control skid shall be carried out with water after the instrument dismounting and isolation of tubing line. After the test the piping should be blown with air. The hydraulic pressure is as follows:

Item	For #300 rating	For #600 rating	For rating #900 & # 1500
Primary seal inlet and vent lines	60 Kg/sq.cm(g)	120 Kg/sq.cm(g)	180 Kg/cm ² (g) for #900& 300 Kg/cm ² (g) for #1500
Secondary & Barrier seal lines	30 Kg/sq.cm(g)	30 Kg/sq.cm(g)	30 Kg/sq.cm(g)

5.16 The items used for Seal gas inlet & vent upto flare, the following shall be strictly followed

- a) All austenitic stainless steel grades shall be solution annealed after welding.
- b) Ferrite No. Test: For all austenitic stainless steels, the weld deposit shall be checked for ferrite content. Ferrite No. (FN) not less than 3% and not more than 10% is required to avoid sigma phase embrittlement during heat treatment. FN shall be determined by Ferrite scope prior to post weld heat treatment.

- 6.1 The detailed technical specifications of Instruments, Filter Regulators, Valves, Junction Boxes and other equipment shall be furnished by the vendor.
- 6.2 All instruments & junction boxes shall be weather proof to IP-65 and shall be certified suitable for use in intrinsic safe circuit and explosion proof for area classification IEC Zone-1, Gr. IIA, IIB and IIC, T3 certified by a statutory body.
- 6.3 All Instruments shall have internal terminal blocks of anti-vibration type for cable termination suitable for terminating a minimum of 1.5sq.mm size cable conductors. Flying Leads are not acceptable.
- 6.4 All the instruments shall have Proven Track Record of 8000 hours of successful uninterrupted operation.



PRODUCT STANDARD
TURBINES AND COMPRESSORS
HYDERABAD

TC-55450

REV No.: 03

Page 7 of 32

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- 6.5 ~~All the instruments and quantity shall be as specified in Table 1. The project specific requirements shall be finalised after the order placement. All the instruments shall be of Smart type and compatible to Hart communication until and unless specified otherwise.~~
- 6.6 In some specific projects as indicated in variants of table-4, the transmitters connected to DCS shall be of Foundation field bus type. The instruments and their accessories like field bus cables, connectors, junction boxes, etc shall be supplied compatible for FF Bus.(FNICO/FISCO)
- 6.7 Vendor to confirm compliance for the sub-vendors indicated as per Table-1. For the items, which are not covered in the list or vendors are not indicated, vendor has to procure from their standard sub-vendors
- 6.8 Vendor shall confirm that the bill of material furnished along with offer is only indicative and the final BOM, which shall be furnished during detailed Engineering (after order placement) for the approval of BHEL. The additional items, if any required for complying BHEL specification at later stage or for the satisfactory working of the seals shall be supplied by vendor without any price/delivery implications.
- 6.9 The body of the control valves shall be as per Piping Material Specification and as a minimum trim shall be with stelliting.
- 6.10 The vendor shall furnish the following test certificates for the instruments
- a) Calibration/ test certificates
 - b) Material test certificates
 - c) Sub-vendor conformity certificates.
 - d) Third part statutory certificates
- 6.11 Vendor shall submit necessary statutory body certificates for the instruments & Junction Boxes, cable glands, etc from the following statutory authorities.
- a) BIS (Bureau of Indian Standards)
 - b) CIMFR, Dhanbad
 - c) Petroleum and Explosives Safety Organization (PESO), Nagpur India (earlier CCOE)
- Please note that the above are mandatory for all flame proof instruments of Indian origin.
- 6.12 Vendor shall submit necessary statutory body certificates for the instruments & Junction Boxes, cable glands, etc from Petroleum and Explosives Safety Organization (PESO), Nagpur India (earlier CCOE) in addition to the certificates from the country of origin for all flame proof items of foreign origin.
- 6.13 All the Device Description (DD) and common file format (CFF) files for all HART and FF instruments shall be supplied in CD/DVD for configuration.
- 6.14 The earth connections of all electrical components shall be brought to common bar for further connection to earth pit at site.
- 6.15 Electrical Junction Box shall be with LM-6 body, 2Nos of Outlet Connections of 1½" NPT at bottom and 12nos of Inlets of size ½" NPT. All inlets and outlets shall be complete with double compression cable glands. Blanking plugs shall be provided for all spare inlets/outlets. Material of cable gland shall be Nickel plated Brass material with PVC hood.



PRODUCT STANDARD
TURBINES AND COMPRESSORS
HYDERABAD

TC-55450

REV No.: 03

Page 10 of 32

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- c) In each Fieldbus segment, only one close loop can be connected (if applicable), remaining spur connection in the segment can be used for open loop.
- d) Wiring/ termination blocks shall have built-in short circuit protectors.
- e) Vendor shall provide field terminator for each segment inside Fieldbus junction box.
- f) The junction boxes shall have metallic enclosure.

8.4 Tag plates shall be provided for all the Equipment, instruments & cables. Cable tags shall be provided for both ends.

8.5 All components (instruments, valves, cable glands, junction box etc.) shall be identified by means of a plate placed on the structure with stainless material tearing rivets. All instruments shall have a second stainless steel plate fixed to the instrument body by means of a steel wire. The junction boxes shall be equipped with a second plate fixed to its cover by means of an oil-proof adhesive (Loctite or similar). ALL THE PLATES SHALL BE MANUFACTURED AND ENGRAVED ACCORDING TO PROJECT SPECIFIC P&ID.

8.6 Identification ferrules and lugs for termination shall be provided at junction box end and instrument end.

8.7 All the Electrical Instruments shall be neatly concealed wired and terminated in a local junction box requiring only connection to purchaser's wiring. The cable connecting the instrument to junction box shall be armoured.

8.8 Stainless Steel perforated Cable Trays shall be used for cable laying. The edges of cable trays shall be covered suitably using rubber sleeve.

8.9 The JB grouping and terminal allocation shall be as per BHEL cable schedule (provided during detailed engineering).

8.10 Junction boxes will be installed on the side plates of the panel; the distance between the bottom of these junction boxes and the ground must be at least 800 mm and 500 mm in case of adjacent boxes.

8.11 Seal gas gauge board shall be equipped with n°2 earthing bosses.

8.12 Inside each panel a SS bar measuring 16 mm², rectangular-sectioned shall be included for the connection of ground cables coming from the instruments or other.

9. The supplier shall furnish the following Documents

9.1 Along with offer:

- Compliance for BHEL specification and its Annexures
- Signed and stamped Filled up check-list (Table-2).
- Price Schedule as per table-5.
- Proven Track Record as indicated in Clause no 10.0.
- Dew Point Curve.

9.2 Within 2 weeks of Placement of Order/ LOI:

- a) Vendor shall visit BHEL office within one week of receipt of PO / LOI to collect the project specific information for engineering their drawings / documents.



PRODUCT STANDARD
TURBINES AND COMPRESSORS
HYDERABAD

TC-55450
REV No.: 03
Page 12 of 32

12. Material tests for filter and Changeover Valve for Duplex Filter (as a minimum)

	Type of Check and Test	Certificate Designation	Type of Inspection
12.1	Chemical Analysis	Mills Certificates	Verification of test report certificates by Lloyds
12.2	Mechanical Tests	Certified check by manufacturer	- do -
12.3	Non destructive Tests (as per manufacturer's standard)	- do -	- do -
12.4	Hydrostatic Test (Filter Housing and valve body)	Witness	Lloyds
12.5	Degree of filtration (filter element)	Certificate from manufacturer	Verification of test report certificates by Lloyds

13. Marking and Shipping

13.1 Name plates

The Individual components shall be provided with Nameplates giving important details like make, model etc. Each component shall be provided with stainless steel Tag plates duly punching Tag Nos. as applicable on it.

13.2 Preparation for Shipment

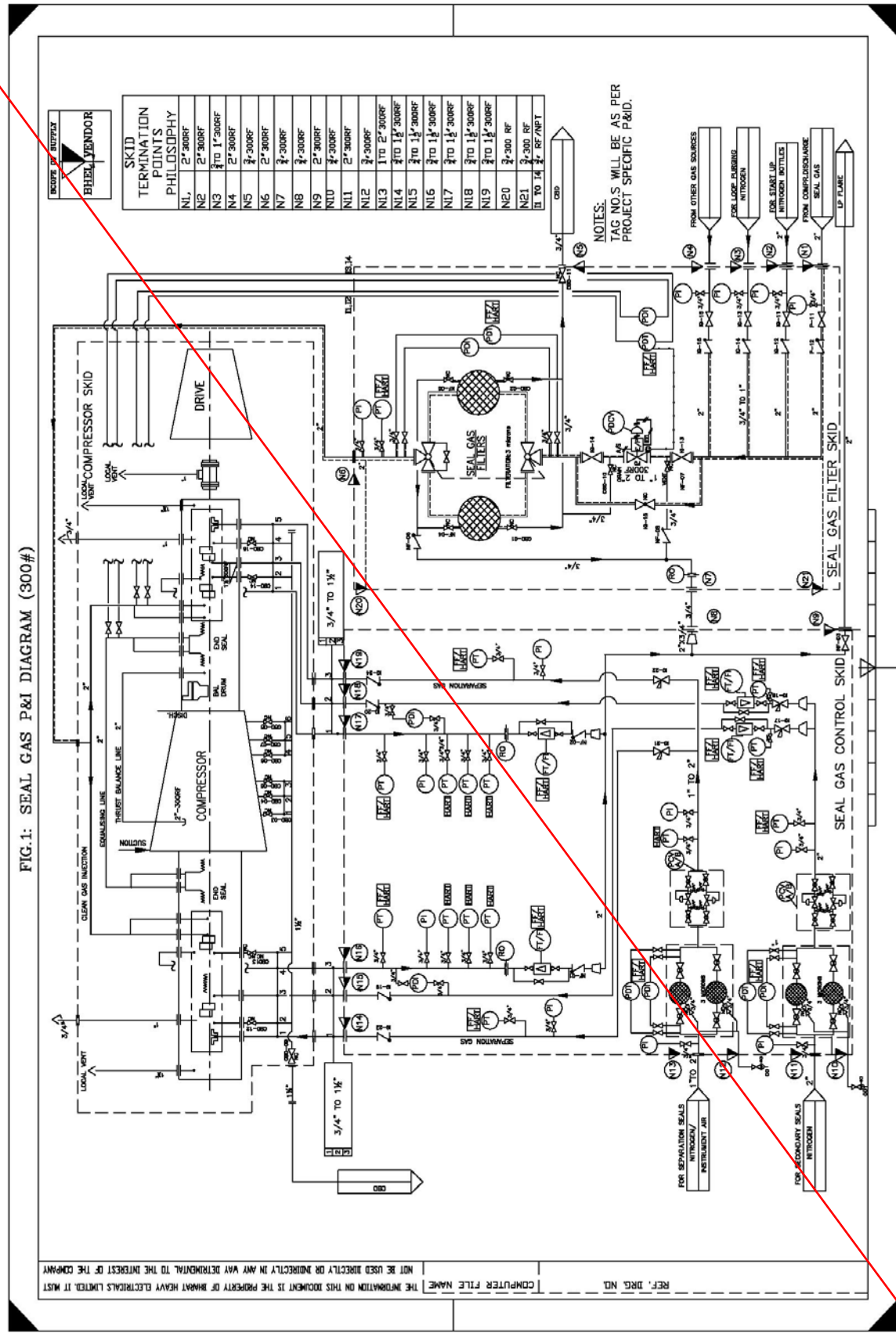
- Equipment shall be suitably prepared for shipment. The preparation shall make the equipment suitable for 6 months of outdoor storage from the date of shipment.
- Each assembly shall be marked with details like, drawing no, job number, PO No. etc. at a convenient location.
- Exterior carbon Steel surfaces shall be given at least two coats of Epoxy paint.
- Flanges openings shall be provided with metal closures.
- Pipe union openings shall be suitably closed with Swagelok (or Parker) fittings.
- Lifting Points and lifting lugs shall be clearly identified.
- All Loose supplied items like interconnection pipe and fittings between both assemblies, loose cable glands, spare filter cartridges, foundation bolts, etc., which are in Vendor's scope shall be listed out separately in the packing list.
- Adequate amount of silica gel or equivalent shall be provided in the box before despatch for the removal of moisture till installation.
- All safety instructions for storage and handling shall be indicated on external surface of the box.



PRODUCT STANDARD
TURBINES AND COMPRESSORS
HYDERABAD

TC-55450
REV No.: 03
 Page 14 of 32

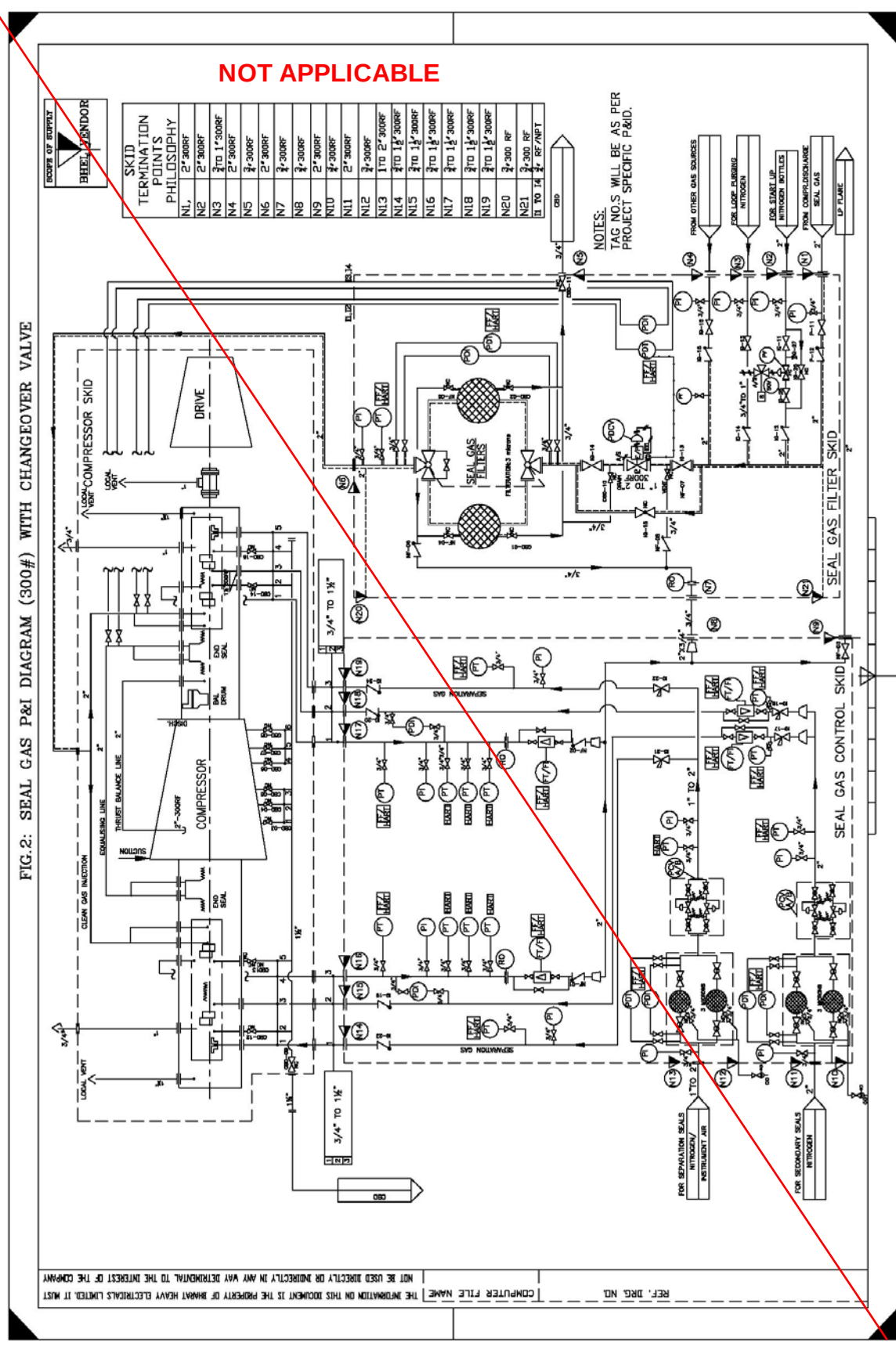
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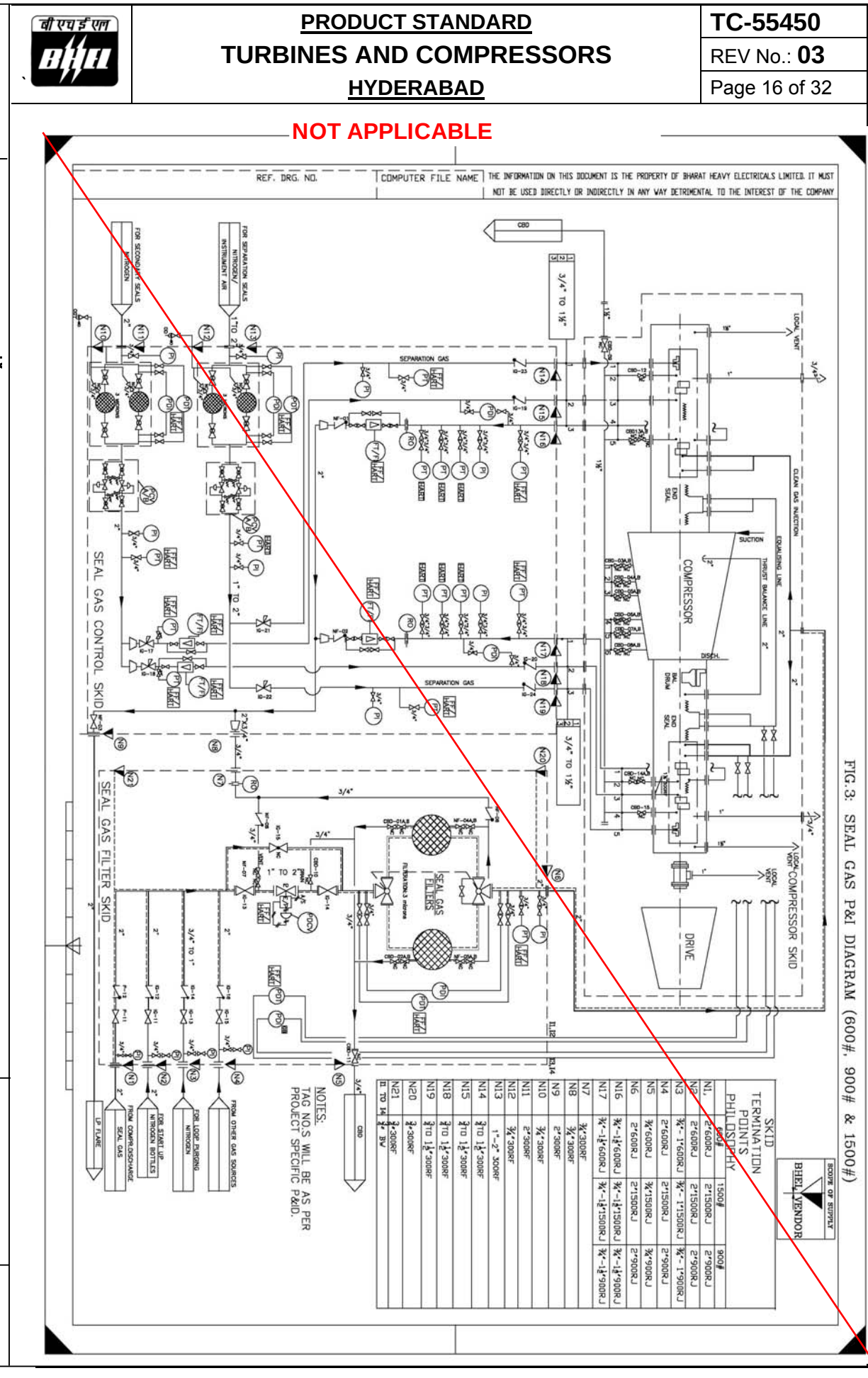


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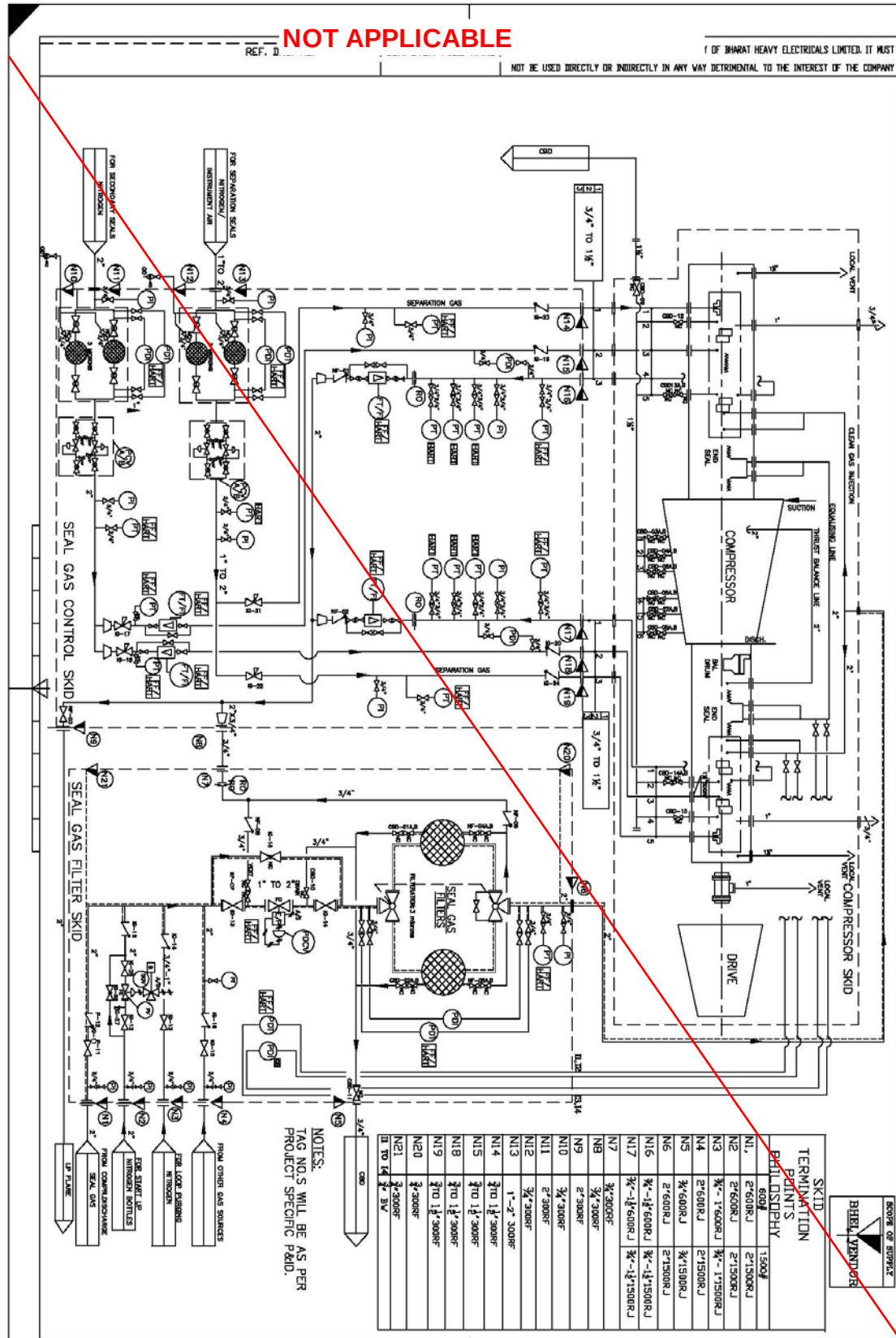
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PRODUCT STANDARD TURBINES AND COMPRESSORS HYDERABAD

TC-55450
REV No.: 03
Page 17 of 32







PRODUCT STANDARD
TURBINES AND COMPRESSORS
HYDERABAD

TC-55450

REV No.: **03**

Page 19 of 32

Table 1: Technical Specifications of Instruments and other components
(* Vendor to furnish Information along with offer)

SL. No.	Instrument	Qty Note (2)	Minimum Specification	Vendor	Model
1	Differential Pressure Gauges	6 nos.	Differential Pressure Indicator	Switzer	109-V-E-2-6-0-S
			IP66; panel mount		
			Range : *		
			Dial Size : 150mm		
			Pr.Conn. : 1/4"PT-F		
			Static Pr. : 210 kg/cm2(g)		
2	Pressure Gauges	16 nos	Pressure gauge	GIC/ WIKA/ WAREE	
			IP67; panel mount		
			Accuracy: ± 1% of full scale		
			Range : *		
			Dial Size : 150mm		
			Pr. Connections: 1/2"NPT-M		
			Case and Bezel : All SS Construction		
			Wetted parts : *		
3	Differential Pressure Transmitters	6 nos	Smart (Hart Protocol/ FF) Transmitters	Emerson	HART model: 3051CD 3A 07A1 J B7 KD L4 M5 Q4 QT T1 DF D1 TR
			Range : *		FF model: 3051CD 3F 07 A1 J D01 B7 IE(or IA) L4 M6 Q4 T1 DF
			intrinsic safe & explosion proof IEC Zone 1, Gas IIA, B & C		
			Min Load: 600 ohms		
			All SS construction		
			Pr. Connections: 1/2"NPT-F		
			Accuracy: 0.075% of span	XIL	HART model: EJX 110A EH S4 GU 2 CEB/ V1U/A /D4/A1
			Min. Static Pr.: 210 kg/cm2(g)		FF model: EJX 110A FH S4 GU 2 CDB/ D4/ A / A1/ FS1(or KS2) / LC1/ D46
			LCD indicator		
			In built lightning & surge protection		
			Integral Manifold: SS 316L 3-way valve for DP and 2-way valve for pressure (Below 600# only. For 600# and above integral manifold not to be used) shall be included in the model number by the vendor		
			SIL certified(for HART)		
4	Pressure Transmitters	21 nos (for fig. 2 & 4)	Smart (Hart Protocol/ FF) Transmitters	Emerson	HART model: 3051CG X A 07A1 J B7 KD L4 M5 Q4 QT T1 DF D1 TR Note : X is as per range
			Range : *		FF(FNICO/FISCO) model: 3051CG X F 07A1 J D01 B7 IE(or IA) L4 M6 Q4 T1 DF Note : X is as per range
		17 nos (for fig. 1, 3 & 5)	Others same as sl.no. 3		

				YIL	HART model: EJX XXX A E X S4 GU 2 CEB/ V1U/A /D4/A1 Note : X is as per range
					FF model: EJX XXX A F X S4 GU 2 CDB/ D4/ A / A1/ FS1 (or KS2) / LC1/ D46 Note : XXX is as per range
5	Smart Positioner for DP control valve (sl.no 15)	1 no	Smart(Hart Protocol/ FF) Positioner with dual certification (Explosion proof and Intrinsic safe) and metallic housing "Valve's operating signatures" in the form of hard copy and also CD along with each control valve to be supplied with smart positioner.	Metso	HART model: ND 930 X H X1 T Note : X as per requirement
					FF model: ND 930 X F X1 T Note : X as per requirement
6	Flow Meters	4 nos	Metal Tube Variable Area flow meter (with 2 electrical entries with 1 blind plug), 2 wire SMART (HART protocol /FF) Range : * intrinsic safe & explosion proof IEC Zone 1, Gas IIA, B & C	Krohne	H250/RR/X/MX/EG/ESK/EEEx Note : X as per requirement
7	Guided wave radar LT for drain pot	1no.	Smart (Hart Protocol/ FF) Transmitters Pr.conn: Flanged	Emerson or E&H or Magnetrol or Krohne	
8	Diaphragm seal type LT for drain pot	1 nos	Smart (Hart Protocol/ FF) Transmitters Range : * Others same as sl.no. 3 Pr. Connections: 3" Flanged Flush flange with spacer ring minimum SS316 with Flushing / Filling Connection (1/2"size)	Emerson	HART model: 3051CD 2A 02 A1 J S2 B7 KD L4 M5 Q4 QT T1 DF D1 TR + 1199 WDF XX A FFW 76 DA A 9 H U + 1199 MDF XX A FFW 76 DA A 9 H U Note : XX as per requirement
				YIL	Equivalent models for HART and FF
9	Magnetic level gauge for drain pot	1no.	Body matl.: SS 316L Pr.conn: 1" Flanged The maximum visible range of a single gauge shall not exceed 1470 mm	Levcon or Chemtrols or Technomatic or Krohne	

F c R T m e v D- N . t 10 o . 6-				PRODUCT STANDARD TURBINES AND COMPRESSORS HYDERABAD		TC-55450 REV No.: 03 Page 21 of 32
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			Ball check valve (offset design) required.			
10	Drain valve for drain pot	1no.	Smart/FF positioner as per sl.no 5 Others as per sl.no 15			
11	Change over valve in startup gas	1no.	On-off ball valve ANSI / FCI 70.2 Minimum class VI. the body as well as the actuator shall meet the testing requirements as per API 617 latest revision. Actuator: Pneumatic cylinder with spring return scotch yoke type SS, Universal type, IS or Exp.proof (as per project reqt.), Voltage (as per project reqt.) Solenoid valve : Make: Norgren or ASCO Proximity type IS SIL certified limit switches	Flowserve or IL, palghat or Koso, palghat or Tyco		
12	---	5 nos	Electrical Junction Box with LM-6 body	Baliga lighting or FCG flame proof control gears Or FCG Power Industries Or Flameproof Equipments P Limited		
13		2 nos	FF JB			FF JB Loose supply by BHEL. Vendor to make provision for mounting the same.
14	Duplex filter (Coalescing type) with change over transfer valve	1 nos	- Each filter 100% capacity with change over valve - Startup diff. Pr. : * - Max. Pr. For change over : * - Filter vessel : SS 316L - Change over valve : SS 316L	Forain Italy or Indfil Germany or Bolt & kirch, Germany; or Hydac, Germany.		
15	Pneumatically operated control valve for DP control valve	1 nos	Material of body : SS 316 L Material of Trim : * Suitable for use in IEC Zone 1, Gas IIA, and IIB & IIC area. ANSI / FCI 70.2 Minimum class IV. Noise level shall not exceed 85db. Source treatment for noise shall be by using special trims like anti-noise trims, in case noise exceeds the allowable level. Bellow seal for corrosive & toxic gases like H2S, H2 etc. Actuator: Pneumatic diaphragm/ cylinder with spring return scotch yoke type	Fisher-Sanmar or IL, Palghat or Dresser valve India Pvt Ltd.		
Ref. Doc.	C	COMP. FILE	FILE NAME			
		TC55450.	DOC			

- (1) All instrument makes shall be as per this list. Any item not covered in this list shall be from a reputed manufacturer unless otherwise specified in this specification elsewhere. For the items, which are not covered in the list or vendors not indicated, vendor has to procure from their standard sub-vendors.
- (2) If the quantity indicated above is more than the numbers required as per project specific P&I diagram, the additional quantity with ranges same as used within skid shall be supplied loose.
- (3) All the items of the same type of instrument shall be of same make.

Fc R T m ev D- N .E 10 o. 6-		PRODUCT STANDARD TURBINES AND COMPRESSORS HYDERABAD		TC-55450																														
				REV No.: 03																														
				Page 23 of 32																														
Table 2: Check List (TO BE FILLED BY THE VENDOR AND SUBMITTED ALONG WITH THE OFFER WITH OUT WHICH OFFER WILL NOT BE CONSIDERED) <table border="1"> <thead> <tr> <th>Cl.no</th> <th>Description</th> <th>Vendor's Confirmation (Yes/No)</th> </tr> </thead> <tbody> <tr> <td>9.1(a)</td> <td>Compliance for BHEL specification and its Annexure</td> <td></td> </tr> <tr> <td>2.1</td> <td>Compliance to clause no 2.1.</td> <td></td> </tr> <tr> <td>3.3,3.4, 5.1,5.4 & 5.5</td> <td>Compliance of materials and sizes to clause no 3.3, 3.4, 5.1, 5.4 & 5.5.</td> <td></td> </tr> <tr> <td>3.6(b)</td> <td>The DEW point curve enclosed along with the offer.</td> <td></td> </tr> <tr> <td>6.7</td> <td>Compliance for the sub-vendors list indicated as per Table-1. For the items, which are not covered in the list or vendors not indicated, vendor has to procure from their standard sub-vendors. Vendor to confirm compliance for the same.</td> <td></td> </tr> <tr> <td>6.8</td> <td>Vendor shall confirm that the bill of material furnished along with offer is only indicative and the final BOM, which shall be furnished during detailed Engineering (after order placement) for the approval of BHEL. The additional items, if any required at later stage for complying BHEL specification or for the satisfactory working of the seals shall be supplied by vendor without any price/delivery implications.</td> <td></td> </tr> <tr> <td>9.1(c)</td> <td>Price Schedule as per table-5 enclosed. Also, signed filled copy of Price schedule (without prices) enclosed with technical offer</td> <td></td> </tr> <tr> <td>9.1(d)</td> <td>Proven Track Record as indicated in Clause no 10.0 enclosed.</td> <td></td> </tr> <tr> <td>18.3</td> <td>Any additional requirements which are essential for proper functioning of the dry gas seal system included in the offer.</td> <td></td> </tr> </tbody> </table> Vendor's Signature Vendor's Company seal					Cl.no	Description	Vendor's Confirmation (Yes/No)	9.1(a)	Compliance for BHEL specification and its Annexure		2.1	Compliance to clause no 2.1.		3.3,3.4, 5.1,5.4 & 5.5	Compliance of materials and sizes to clause no 3.3, 3.4, 5.1, 5.4 & 5.5.		3.6(b)	The DEW point curve enclosed along with the offer.		6.7	Compliance for the sub-vendors list indicated as per Table-1. For the items, which are not covered in the list or vendors not indicated, vendor has to procure from their standard sub-vendors. Vendor to confirm compliance for the same.		6.8	Vendor shall confirm that the bill of material furnished along with offer is only indicative and the final BOM, which shall be furnished during detailed Engineering (after order placement) for the approval of BHEL. The additional items, if any required at later stage for complying BHEL specification or for the satisfactory working of the seals shall be supplied by vendor without any price/delivery implications.		9.1(c)	Price Schedule as per table-5 enclosed. Also, signed filled copy of Price schedule (without prices) enclosed with technical offer		9.1(d)	Proven Track Record as indicated in Clause no 10.0 enclosed.		18.3	Any additional requirements which are essential for proper functioning of the dry gas seal system included in the offer.	
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Ref. Doc C TC55450. DOC	COMP. FILE FILE NAME																																	

Fc R T m ev D- N . 10 o. 6-		PRODUCT STANDARD TURBINES AND COMPRESSORS HYDERABAD		TC-55450 REV No.: 03 Page 24 of 32																																										
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PRODUCT STANDARD
TURBINES AND COMPRESSORS
HYDERABAD

TC-55450

REV No.: 03

Page 25 of 32

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TC55450.	COMP. FILE
DOC	FILE NAME

	Diff. Pr. Transmitters, I/P converters, DP Switch, Pr. Switches, Junction Box, Flow meters	- Calibration certification - Explosion proof/ Intrinsic safe certification			
7	Filter regulators, Valves	- Make, Model	--Do--	--Do--	--Do--
8	Piping/Tubing	- Materials Certification	--Do--	- Review of Mills certificates	
9	Pipe fittings and swagelok type fittings	- Materials Certification	--Do--	-Verification - Review of Certificates	--Do--
10	Instrument Hook-ups	- Material Certificate	--Do--	Review of certificates	--Do--
11	Line cleaning	Compliance	--Do--	Verification	--Do--
12	Hydraulic Testing of Piping	- Leakage	-Do--	Witness	--Do--
13	HP test with Helium or Nitrogen as per API 614	- Leakage	--Do--	Witness	--Do--
14	Air Leak test for the Hydraulic tested lines	- Leakage	--Do--	Witness	--Do--
15	Name Plates	- Correctness	--Do--	Physical check	--Do--
16	Painting - Pre-Treatment, Chemical Cleaning, Degreasing De-rusting and Phosphating - Two coats of Primer and Two coats of final Paint	- Thoroughness - Thoroughness	No Rust Finish	Physical check Physical check	Supplier BHEL/CUSTOMER
17	Wiring	- Continuity	Wiring diagram	Verification	--Do--



PRODUCT STANDARD
TURBINES AND COMPRESSORS
HYDERABAD

TC-55450

REV No.: **03**

Page 26 of 32

Table – 4: Variant Table

VAR NO.	DESCRIPTION	MATERIAL CODE	REMARKS
1	FILTER SKID- IOCL BARODA WGC	TC9755450017	
2	CONTROL SKID- IOCL BARODA WGC	TC9755450025	
3	FILTER SKID- BPCL-NET GAS-LP	TC9755450033	
4	CONTROL SKID- BPCL-NET GAS-LP	TC9755450041	
5	FILTER SKID- IOCL BARODA VGO	TC9755450050	
6	CONTROL SKID- IOCL BARODA VGO	TC9755450068	
7	NOT USED	NOT USED	
8	CONTROL SKID- BPCL NET GAS-HP	TC9755450084	
9	FILTER SKID- BPCL-CCR(MOTOR)	TC9755450092	
10	CONTROL SKID- BPCL-CCR(MOTOR)	TC9755450106	
11	FILTER SKID- IOCL VADODARA NHT	TC9755450114	
12	CONTROL SKID- IOCL VADODARA NHT	TC9755450122	
13	FILTER SKID- CPCL DHDT	TC9755450130	
14	CONTROL SKID- CPCL DHDT	TC9755450149	
15	FILTER SKID- GGSR-HPCL MITTAL	TC9755450157	
16	CONTROL SKID- GGSR-HPCL MITTAL	TC9755450165	
17	FILTER SKID- HMEL CCR	TC9755450173	
18	CONTROL SKID- HMEL CCR	TC9755450181	
19	FILTER SKID- HMEL DHDT	TC9755450190	
20	CONTROL SKID- HMEL DHDT	TC9755450203	
21	FILTER SKID- HMEL DCU	TC9755450211	
22	CONTROL SKID- HMEL DCU	TC9755450220	
23	FILTER SKID- ONGC TRIPURA	TC9755450238	
24	CONTROL SKID- ONGC TRIPURA	TC9755450246	
25	FILTER SKID- BRPL	TC9755450254	
26	CONTROL SKID- BRPL	TC9755450262	
27	FILTER SKID- MRPL DCU	TC9755450270	
28	CONTROL SKID- MRPL DCU	TC9755450289	
29	FILTER SKID- MRPL DHDT	TC9755450297	
30	CONTROL SKID- MRPL DHDT	TC9755450300	
31	FILTER SKID- GSFC-HP-2BCL 507	TC9755450319	As per CCI-MCA-1001-27
32	CONTROL SKID- GSFC-HP-2BCL 507	TC9755450327	As per CCI-MCA-1001-27
33	FILTER SKID- GSFC-BCL 407A	TC9755450335	As per CCI-MCA-1001-27
34	CONTROL SKID- GSFC-BCL 407A	TC9755450343	As per CCI-MCA-1001-27
35	FILTER SKID- GSFC-LP-2BCL 407A	TC9755450351	As per CCI-MCA-1001-27
36	CONTROL SKID- GSFC-LP-2BCL 407A	TC9755450360	As per CCI-MCA-1001-27

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FILE NAME
TC55450.
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Fc R T m ev D- N . 10 o. 6-		PRODUCT STANDARD		TC-55450																																																								
		TURBINES AND COMPRESSORS		REV No.: 03																																																								
		HYDERABAD		Page 27 of 32																																																								
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F c m N o.	R T ev D- . 10 6-		PRODUCT STANDARD			TC-55450
			TURBINES AND COMPRESSORS			REV No.: 03
			HYDERABAD			Page 28 of 32
Table – 4: Variant Table						
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	51	Seal gas Filter Skid	Rating: #300 Insts Tubing Hookup:	TC9755450513	Fig.1	
	52	Seal gas Control Skid	DCS Insts: HART Protocol	TC9755450521	Fig.1	
	53	Spares for Seal gas filter skid and control skid		TC9755450530	Fig.1	
	54	Seal gas Filter Skid	Rating: #300 Insts Piping Hookup:	TC9755450548	Fig.1	
	55	Seal gas Control Skid	DCS Insts: HART Protocol	TC9755450556	Fig.1	
	56	Spares for Seal gas filter skid and control skid		TC9755450564	Fig.1	
	57	Seal gas Filter Skid	Rating: #300 Insts Hookup: Tubing DCS Insts: HART Protocol	TC9755450572	Fig.2	
	58	Seal gas Control Skid	With Changeover valve	TC9755450580	Fig.2	
	59	Spares for Seal gas filter skid and control skid		TC9755450599	Fig.2	
	60	Seal gas Filter Skid	Rating Insts Hookup #300 Piping DCS Insts HART Protocol	TC9755450602	Fig.2	
	61	Seal gas Control Skid	With Changeover valve	TC9755450610	Fig.2	
	62	Spares for Seal gas filter skid and control skid		TC9755450629	Fig.2	
	63	Seal gas Filter Skid	Rating Insts Hookup #300 Tubing DCS Insts FF Instruments	TC9755450637	Fig.1	
	64	Seal gas Control Skid		TC9755450645	Fig.1	
	65	Spares for Seal gas filter skid and control skid		TC9755450653	Fig.1	
	66	Seal gas Filter Skid	Rating Insts Hookup #300 Piping DCS Insts FF Instruments	TC9755450661	Fig.1	
	67	Seal gas Control Skid		TC9755450670	Fig.1	
	68	Spares for Seal gas filter skid and control skid		TC9755450688	Fig.1	
	69	Seal gas Filter Skid	Rating Insts Hookup #300 Tubing DCS Insts FF Instruments	TC9755450696	Fig.2	
	70	Seal gas Control Skid		TC9755450700	Fig.2	

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Ref. Doc. TC55450. DOC	71	Spares for Seal gas filter skid and control skid	Startup Gas	With Change over valve	TC9755450718	Fig.2			
	72	Seal gas Filter Skid	Rating Insts Hookup	#300 Piping FF Instruments	TC9755450726	Fig.2			
	73	Seal gas Control Skid	DCS Insts		TC9755450734	Fig.2			
	74	Spares for Seal gas filter skid and control skid	Startup Gas:	With Changeover valve	TC9755450742	Fig.2			
	43	Seal gas Filter Skid	Rating Insts Hookup	#600 Piping/Tubing	TC9755450432	Fig.3			
	44	Seal gas Control Skid	DCS Insts	HART Protocol	TC9755450440	Fig.3			
	45	Spares for Seal gas filter skid and control skid			TC9755450459	Fig.3			
	78	Seal gas Filter Skid	Rating Insts Hookup	#600 Piping/Tubing FF Instruments	TC9755450785	Fig.3			
	79	Seal gas Control Skid	DCS Insts		TC9755450793	Fig.3			
	80	Spares for Seal gas filter skid and control skid			TC9755450807	Fig.3			
	81	Seal gas Filter Skid	Rating Insts Hookup	#600 Piping/Tubing HART Protocol	TC9755450815	Fig.4			
	82	Seal gas Control Skid	DCS Insts		TC9755450823	Fig.4			
	83	Spares for Seal gas filter skid and control skid	Startup Gas:	With Changeover valve	TC9755450831	Fig.4			
	84	Seal gas Filter Skid	Rating Insts Hookup	#600 Piping/Tubing FF Instruments	TC9755450840	Fig.4			
	85	Seal gas Control Skid	DCS Insts		TC9755450858	Fig.4			
86	Spares for Seal gas filter skid and control skid	Startup Gas:	With Changeover valve	TC9755450866	Fig.4				
87	Seal gas Filter Skid	Rating Insts Hookup	#1500 Piping HART Protocol	TC9755450874	Fig.3				
88	Seal gas Control Skid	DCS Insts		TC9755450882	Fig.3				
89	Spares for Seal gas filter skid and control skid			TC9755450890	Fig.3				



PRODUCT STANDARD
TURBINES AND COMPRESSORS
HYDERABAD

TC-55450

REV No.: 03

Page 30 of 32

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TC55450.	COMP. FILE
DOC	FILE NAME

90	Seal gas Filter Skid	Rating	#1500	TC9755450904	Fig.3
91	Seal gas Control Skid	Insts Hookup	Piping	TC9755450912	Fig.3
92	Spares for Seal gas filter skid and control skid	DCS Insts	FF Instruments	TC9755450920	Fig.3
93	Seal gas Filter Skid	Rating	#1500	TC9755450939	Fig.5
94	Seal gas Control Skid	Insts Hookup	Piping	TC9755450947	Fig.5
95	Spares for Seal gas filter skid and control skid	DCS Insts	HART Protocol System	TC9755450955	Fig.5
96	Seal gas Filter Skid	Rating	#1500	TC9755450963	Fig.5
97	Seal gas Control Skid	Insts Hookup	Piping	TC9755450971	Fig.5
98	Spares for Seal gas filter skid and control skid	DCS Insts	FF Instruments	TC9755450980	Fig.5
		Drain Pot	system		

Table – 4-A: Variant Table

75	Seal gas Filter Skid	Rating Insts Hookup	#900 Piping/Tubing	TC9755450750	Fig.3
76	Seal gas Control Skid	DCS Insts	HART Protocol	TC9755450769	Fig.3
77	Spares for Seal gas filter skid and control skid			TC9755450777	Fig.3

Fc R T m ev D N 10 6-		PRODUCT STANDARD TURBINES AND COMPRESSORS HYDERABAD		TC-55450 REV No.: 03 Page 31 of 32
		Table-5 PRICE SCHEDULE SEAL GAS CONTROL SYSTEM		
		Enquiry ref. No: Offer ref no.		Date: Date:

Table-5
PRICE SCHEDULE
SEAL GAS CONTROL SYSTEM

Enquiry ref. No:

Offer ref no.

Date:

Date:

SI no.	DESCRIPTION	Qty	PRICE
01	Seal Gas Control system consists of the following	1 set	
	a) Seal Gas Filter Skid		
	b) Seal Gas control skid		
	c) Filter cartridges – 5 sets		
	d) Matting flanges & accessories for all terminal points– 1 set		
	e) Loose supplied items		
02	Seal Gas Control system Spares as per following	1 set	
	a) Pressure Gauges, Differential Pressure Gauges, level gauges-10% or min 1 no. each type.		
	b) Transmitters (both Fieldbus and SMART) for Pressure, Level, Variable area Flow & Differential Pressure-10% or min.1 no each type.		
	c) Control valve spares-10% or min 1 no. each type of the following: i. Proximity type limit switches. ii. Airfilter Regulator. iii. Solenoid valve. iv. Bonnet Gasket/Special Gasket. v. Gland packing. vi. Stem seal o-rings/Piston o-ring. vii. SMART/Fieldbus positioner. viii. Trim set. ix. Diaphragm, actuator assembly		
	d) Manifolds- 3.way and 5 way, isolation valves, instrument valves, tube fittings, check valves, filter regulators -10% or min.1 no each type.		
03	Optional offer for addition of each of the following instrument inclusive of root valves, piping, & installation materials etc.		
	a) Pressure Transmitter	1 set	
	b) DP Transmitter	1 set	
	c) Pressure Gauge	1 set	
	d) DP Gauge	1 set	
	e) Smart Positioner as per sl.no 5 of table-1	1 set	
	f) Solenoid valve.	1 set	
	g) Variable area Flow transmitter.	1 set	
04	Additional price to with draw the deviations to following clauses:		

Note:

(1) The individual prices for the spares and optional items against sl nos 02 and 03 above are valid for one year to order as and when the requirement arises.

(2) Any additional requirements which are essential for proper functioning of the dry gas seal system but not indicated in specification are included in the offer.

Vendor's signature & seal

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PRODUCT STANDARD
TURBINES AND COMPRESSORS
HYDERABAD

TC-55450

REV No.: 03

Page 32 of 32

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UOP Engineering Department

STANDARD SPECIFICATION**6-14-7** Page 1 of 14**CONTROL VALVES**

DATE STATUS APVD AUTHD

4APR14 Reaffirmed RED RGP

TABLE OF CONTENTS

1.	GENERAL	
1.1	Scope	2
1.2	References	2
2.	VALVE CAPACITY	
2.1	C _v	3
2.2	Range	3
2.3	Calculations	3
2.4	Noise Requirements	4
3.	BASIC CONSTRUCTION	
3.1	Materials	4
3.2	Shutoff	4
3.3	Fabrication	4
3.4	Electrical Accessories	4
4.	BODY / BONNET CONSTRUCTION	
4.1	Material and Gasketing	4
4.2	Flanges	5
4.3	Internal Passage Ways	5
4.4	Extension Bonnets	5
4.5	Flow Direction	5
5.	PACKING	
5.1	Fluid Temperatures up to 450°F (232°C)	6
5.2	Fluid Temperatures above 450°F (232°C)	6
5.3	Environmental Packing	6
6.	TRIM CONSTRUCTION	
6.1	Closure Member Form	6
6.2	Three-Way Valve Closure Members' Seating	6
6.3	Separable Closure Member and Stem Connection	6
6.4	Rotary Valve Shaft Blowout	6
6.5	Unbalanced Single Ported Globe	6
6.6	Balanced Single Ported Globe	7
6.7	Balanced Double Ported Globe	7
6.8	Split Body Globe	7
6.9	Shaft Deflection	7
7.	ACTUATORS	
7.1	Actuator Types	7
7.2	Yoke and Stem / Shaft	7
7.3	Required Actuator Thrust	8
7.4	Dynamic Performance Requirements	8
8.	TRIM MATERIALS	
8.1	Trim for General Service with no H ₂ S	11
8.2	Trim for General Service Containing H ₂ S or for Caustic Service	11
8.3	Trim for Severe Service (High ΔP, Flashing, Cavitation, Caustic, Particulate)	11
9.	ACCESSORIES	
9.1	Air Filter Regulator Set	12
9.2	Positioners	12
9.3	Electro-Pneumatic Transducers	13
9.4	Auxiliary Handwheels	13
9.5	Limit Stops	13
9.6	Limit Switches	13
9.7	Solenoid Valves	13
10.	VALVE MARKINGS	
10.1	Valve Name Plate	14
10.2	Metal Tagging	14

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UOP Engineering Department

STANDARD SPECIFICATION**6-14-7** Page 2 of 14**CONTROL VALVES**

DATE STATUS APVD AUTHD

4APR14 Reaffirmed RED RGP

1. GENERAL**1.1 Scope**

- a. This Standard Specification covers the basic requirements for control valves, actuators and accessories. The specified valve type, trim metallurgy, and vendor C_v data represent basic requirements for valve design, and shall be used for valve selection.
- b. Exceptions or variations shown in the UOP Project Specifications take precedence over requirements shown herein.

1.2 References

Unless noted below, use the edition and addenda of each referenced document current on the date of this Standard Specification. When a referenced document incorporates another document, use the edition of that document required by the referenced document.

- a. The Instrumentation, Systems, and Automation Society (ISA) 75.01.01, "Flow Equations for Sizing Control Valves"
- b. ISA 75.05.01, "Control Valve Terminology"
- c. ISA 75.13.01, "Method of Evaluating the Performance of Positioners with Analog Input Signals and Pneumatic Output"
- d. ISA 75.17, "Control Valve Aerodynamic Noise Prediction"
- e. ISA 75.25.01, "Test Procedure for Control Valve Response Measurement from Step Inputs"
- f. ISA Standards for fabrication of control valves
- g. Fluid Controls Institute, Inc. (FCI) 70-2, "Control Valve Seat Leakage"
- h. International Electrotechnical Commission (IEC) 60534-8-3, "Industrial Process Control Valves, Noise Considerations, Control Valve Aerodynamic Noise Prediction Method"
- i. IEC 60534-8-4, "Industrial Process Control Valves, Noise Considerations, Prediction of Noise Generated by Hydrodynamic Flow"
- j. IEC 60529, "Degrees of Protection Provided by Enclosures (IP Code)"
- k. IEC Standards for fabrication of control valves
- l. National Electrical Manufacturers Association (NEMA) Standards Publication No. 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)"
- m. Canadian Standards Association (CSA) C22.2 No. 94, "Special Purpose Enclosures"

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**CONTROL VALVES**

DATE	STATUS	APVD	AUTHD
------	--------	------	-------

4APR14	Reaffirmed	RED	RGP
--------	------------	-----	-----

- n. National Association of Corrosion Engineers (NACE) International Standard MR0103, "Materials Resistant to Sulfide Stress Corrosion Cracking in Corrosive Petroleum Refining Environments"
- o. American Society of Mechanical Engineers (ASME) B16.5, "Pipe Flanges and Flanged Fittings"
- p. ASME B16.47, "Large Diameter Steel Flanges"
- q. ASME B46.1, "Surface Texture"
- r. American Society for Testing and Materials (ASTM) Standards
- s. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Standards
- t. National, state, and local governmental regulations and laws

2. VALVE CAPACITY**2.1 C_v**

Valve capacities shall be referred to in terms of C_v coefficients. C_v for these purposes, will be defined as U.S. gallons per minute (GPM) of water (specific gravity of 1.00) that the valve will pass with 1.0 pounds per square inch (PSI) pressure drop at rated travel.

2.2 Range

The calculated C_v 's, as shown in the UOP Project Specifications, represent valve capacity requirements for the normal, maximum and minimum operating conditions, where applicable.

2.3 Calculations

- a. The valve C_v selected shall be larger than the maximum calculated C_v . The valve characteristic selected should produce a closure member position of 35 to 65% of travel at normal flowrate. The combination of valve C_v and characteristic should generally produce a valve operating range of 10 to 90% of travel for all of the flow conditions specified.
- b. The Calculated C_v is based on ISA standard 75.01.01, and includes the factors F_L and/or x_T . The values for F_L and x_T are generally from ISA standard 75.01.01. The Calculated C_v does not include any factors relating to the installation of the valve (i.e., $F_p = 1.0$). The selected valve size and Approximate Valve C_v include allowances for such factors. The Contractor shall advise vendor of the connecting pipe size and schedule.
- c. Calculated C_v 's shall be verified by the vendors.



UOP Engineering Department

STANDARD SPECIFICATION**6-14-7** Page 4 of 14**CONTROL VALVES**

DATE	STATUS	APVD	AUTHD
4APR14	Reaffirmed	RED	RGP

2.4 Noise Requirements

The maximum permissible calculated noise level of the valve supplied for the operating conditions specified on the UOP Project Specifications is 85 dBA (calculated per ISA 75.17 or IEC 60534-8-3 / IEC 60534-8-4). The estimated noise level shall be verified based on final design criteria and vendor's / Contractor's final calculations.

3. BASIC CONSTRUCTION**3.1 Materials**

Materials specified shall comply with ASTM Standards. Valves in wet H₂S (sour) service shall comply with NACE standard MR0103.

3.2 Shutoff

Shutoff classification and testing shall be per FCI 70-2. Class V shutoff shall be tested at full specified shutoff ΔP . If no shutoff ΔP is specified, then the leakage shall be tested with the maximum specified inlet pressure and 0 pressure at valve outlet.

3.3 Fabrication

All valves and accessories shall be in general accordance with ISA, MSS, and IEC standards and recommended practices for fabrication of control valves. All definitions shall be per ISA / IEC standards.

3.4 Electrical Accessories

Electrical accessories shall comply with local electrical codes. Enclosure classification shall be per NEMA Standards Publication 250, or CSA enclosure ratings (CSA C22.2 number 94) or by using the IP scale enclosure rating (IEC 60529) dependent on local code requirements.

4. BODY / BONNET CONSTRUCTION**4.1 Material and Gasketing**

- a. Bonnets, bottom flanges, closures, and other process-wetted pressure containment assemblies shall be of the same material as the valve body but not necessarily from the same foundry pour or "heat". Bonnets shall be of the integral or bolted type construction with fully retained gasketing. Threaded bonnets are not acceptable. Bonnet bolts shall not be used to attach actuators or mounting brackets.
- b. Valves in hydrogen or hydrogen-effluent service shall have bonnet flange and lower blind flange fitted with retained metallic or spiral wound gaskets suitable for this service.

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**CONTROL VALVES**

DATE	STATUS	APVD	AUTHD
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4APR14	Reaffirmed	RED	RGP
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- c. Split body globe valves shall be of through bolted construction. Body flanges shall be either ring type joint or have fully retained gaskets. Body gaskets shall be solid Teflon. Two extra sets of body gaskets shall be furnished for each valve.

4.2 Flanges

- a. Flanged valves shall have flanged connections integral with the body. Slip on flanges are not acceptable.
- b. Flange classes are specified in accordance with ASME B16.5 or ASME B16.47. Flange classes listed in the UOP Project Specifications are based upon design pressure and temperature conditions only and do not account for other loads. The final design of all flanges shall account for gasket seating and external loads. Differential thermal expansion, including joints between dissimilar materials, and transient thermal conditions such as start-up/shutdown and operational upset shall be accommodated.
- c. Flanges intended for use with spiral wound gaskets shall have a flange surface finish of 125 microinch Ra minimum to 250 microinch Ra maximum. Flanges intended for use with other gaskets shall have a flange surface finish within the optimal range for the specified gasket. Finishes shall be judged by visual comparison with surface finish roughness standards conforming to ASME B46.1. Flange finishes shall be protected from damage during fabrication, heat treatment, shipping, storage, and installation.

4.3 Internal Passage Ways

Internal passage ways shall offer minimum restriction to flow. Pockets and shoulders tending to create turbulence or solids accumulation shall be minimized.

4.4 Extension Bonnets

Extension bonnets shall be supplied when the operating temperature is below the minimum or above the maximum manufacturer's recommended temperature for the standard bonnet.

4.5 Flow Direction

- a. The direction of flow shall be clearly marked on the valve body.
- b. The vendor shall determine the direction of flow which is best suited for the valve type and operating conditions shown on the valve data sheets.

**CONTROL VALVES**

DATE	STATUS	APVD	AUTHD
4APR14	Reaffirmed	RED	RGP

5. PACKING

The valve manufacturer is responsible for verifying that the packing is suitable for the process fluid, operating conditions and any contaminants listed. The following are intended as general guidelines for packing.

5.1 Fluid Temperatures up to 450°F (232°C)

Packing shall be a TFE material either of the molded Teflon V-ring or braided type.

5.2 Fluid Temperatures above 450°F (232°C)

Grafoil, graphite ribbon / filament, or Kevlar packing shall be used.

5.3 Environmental Packing

Packing designed to further reduce fugitive emissions may be used where required by local codes.

6. TRIM CONSTRUCTION**6.1 Closure Member Form**

a. The closure member form shall be solid contoured, tapered, splined, or solid V-ported. Where low lift V-port plugs are specified, they may be of hollow construction. Acorn type plugs are not acceptable for angle valves regardless of valve size.

b. Valve flow characteristics shall be as defined in ISA 75.05.01.

6.2 Three-Way Valve Closure Members' Seating

Top and bottom guided three-way valve closure members for diverting service shall seat from outside the inlet chamber. Closure members for combining service shall seat from inside the outlet chamber. Cage guided three way valve trim, including metallurgy, shall be designed to minimize the risk of galling.

6.3 Separable Closure Member and Stem Connection

Separable closure members and stems for sliding stem valves shall be connected by tapered or proprietary thread design and be pinned. Full penetration welded assemblies are acceptable.

6.4 Rotary Valve Shaft Blowout

Rotary valves shall have a shaft design that eliminates the possibility of blowout.

6.5 Unbalanced Single Ported Globe

Unbalanced, single ported globe valves shall be closure member guided. Stem guided valves are not acceptable.

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UOP Engineering Department

STANDARD SPECIFICATION**6-14-7** Page 7 of 14**CONTROL VALVES**

DATE	STATUS	APVD	AUTHD
------	--------	------	-------

4APR14	Reaffirmed	RED	RGP
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6.6 Balanced Single Ported Globe

Balanced, single ported globe valves shall be cage guided. Trim, including metallurgy shall be designed to minimize the risk of galling.

6.7 Balanced Double Ported Globe

Balanced, double ported globe valves shall be top and bottom guided. For 6" and larger valves, the post and guide bushing shall be designed to prevent rotation of the closure member and stem.

6.8 Split Body Globe

The split body globe valve's closure member shall seat from the top regardless of actuator action. Seat ring shall be of clamped-in design.

6.9 Shaft Deflection

Rotary stem valves (butterfly, ball, eccentric plug, eccentric disc, etc.) shall incorporate a shaft design and suitable guiding to prevent excessive shaft deflection at all specified valve positions and corresponding pressure drops.

7. ACTUATORS**7.1 Actuator Types**

- a. Pneumatic spring diaphragm actuators: On air failure, the actuator shall move the valve to the position specified on the UOP Project Specification.
- b. Pneumatic spring piston actuators: On air failure, the actuator shall move the valve to the position specified on the UOP Project Specification.
- c. Pneumatic double acting piston actuators: A volume tank and accessories shall be connected to the actuator to move the valve to the position specified in the UOP Project Specification upon air failure. The volume tank shall be sized to fully stroke the valve through two cycles and construction shall be in accordance with local codes for pressurized vessels.
- d. Hand operated actuators: Handwheels shall be of the non-rising type with fine pitch threads for precise valve plug positioning. Provide stem position indicator. Handwheel shall be sized to provide the required thrust for valve positioning with 40 lbf (178 N) applied to handwheel rim.

7.2 Yoke and Stem / Shaft

- a. Yokes shall be of suitable rigid material for open type construction.
- b. Actuator stems / shafts shall be designed for the maximum developed thrust of the actuator without measurable deflection.

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**CONTROL VALVES**

DATE	STATUS	APVD	AUTHD
------	--------	------	-------

4APR14	Reaffirmed	RED	RGP
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c. Valves for modulating service shall have a clamped valve stem / shaft to actuator shaft / lever connection to eliminate backlash.

d. All valves shall be equipped with a valve stroke indicator.

7.3 Required Actuator Thrust**a. Sliding Stem Valves**

- (1) The actuator shall be sized to provide sufficient thrust to properly seat the valve at the air supply and shutoff conditions specified in the UOP Project Specifications.
- (2) In addition to the process induced force at the specified shutoff conditions plus the force required to overcome the packing friction, the actuator shall supply a minimum seat load of 100 lbf (445 N) per inch of orifice diameter for valves with 4" orifice size and below and a minimum seat load of 200 lbf (890 N) per inch of orifice diameter for valves with orifice size above 4".
- (3) For class V shutoff, or if the valve is closed against high pressure drop for long periods of time, the actuator shall supply a minimum seat load of 500 lbf (2224 N) per inch of orifice diameter for valves with 4" orifice size and below and a minimum seat load of 750 lbf (3336 N) per inch of orifice diameter for valves with orifice size above 4".
- (4) The valve vendor shall supply actuator sizing calculations if requested by UOP.

b. Rotary Valves

- (1) Rotary actuators shall be sized to operate at shutoff and flowing pressure drop. Upon request by UOP, valve vendor shall supply actuator sizing calculations for shutoff and at maximum torque requirements based on the service conditions.
- (2) All rotary valves shall be supplied with a positioner except when in on-off service.

7.4 Dynamic Performance Requirements**a. Modulating Control Valves**

Note: This section is not applicable to compressor antisurge control valves or modulating control valves greater than 24 inches.

- (1) Definitions:
 - (a) **Dead Band** - The range through which the control input signal may be varied, upon reversal of direction, without initiating an observable change in valve position.

**CONTROL VALVES**

DATE	STATUS	APVD	AUTHD
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4APR14	Reaffirmed	RED	RGP
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- (b) **Dead Time (Td)** - The interval of time between initiation of an input change or stimulus and the start of the resulting observable response.
- (c) **Overshoot** - The amount by which the step response initially exceeds the final steady state value (% of step change).
- (d) **Step Resolution** - The minimum step change in input signal to which the control valve system will respond while moving in the same direction.
- (e) **Step Response Time (T63)** - The time after an input signal step change until the output has reached 63% of the final steady state value.
- (f) **Step Response Time (T86)** - The time after an input signal step change until the output has reached 86.5% of the final steady state value.

(2) Requirements:

The valve vendor shall ensure that modulating control valve assemblies meet the following dynamic requirements. A control valve assembly includes all valve components; valve, actuator, positioner, I/P transducers, filter/regulators, boosters (if required or supplied) and solenoid valve (if supplied).

Testing of individual modulating control valve assemblies by the valve vendor is not a requirement. A method that is mutually agreed upon between the valve vendor and end user and Contractor to determine compliance with this specification is sufficient.

- (a) Speed of response, as defined in tables below, **for any step change in the range of 2 to 10% of full valve travel.**
- (b) Dead Band less than 0.5% of full valve travel.
- (c) Step resolution less than 0.25% of full valve travel
- (d) Overshoot less than 10%.

Speed of response table for modulating control valve assemblies in flow, differential pressure, or pressure control loops.

Valve Size (inches)	Maximum dead time (Td) (seconds)	Maximum T63 step response time (seconds)	Maximum T86 step response time (seconds)
0 - 2	0.25	0.5	0.75
3 - 6	0.5	1.0	1.5
8 - 12	0.75	1.5	2.25
14 - 20	1.0	2.0	3.0
22 - 24	1.25	2.5	3.75

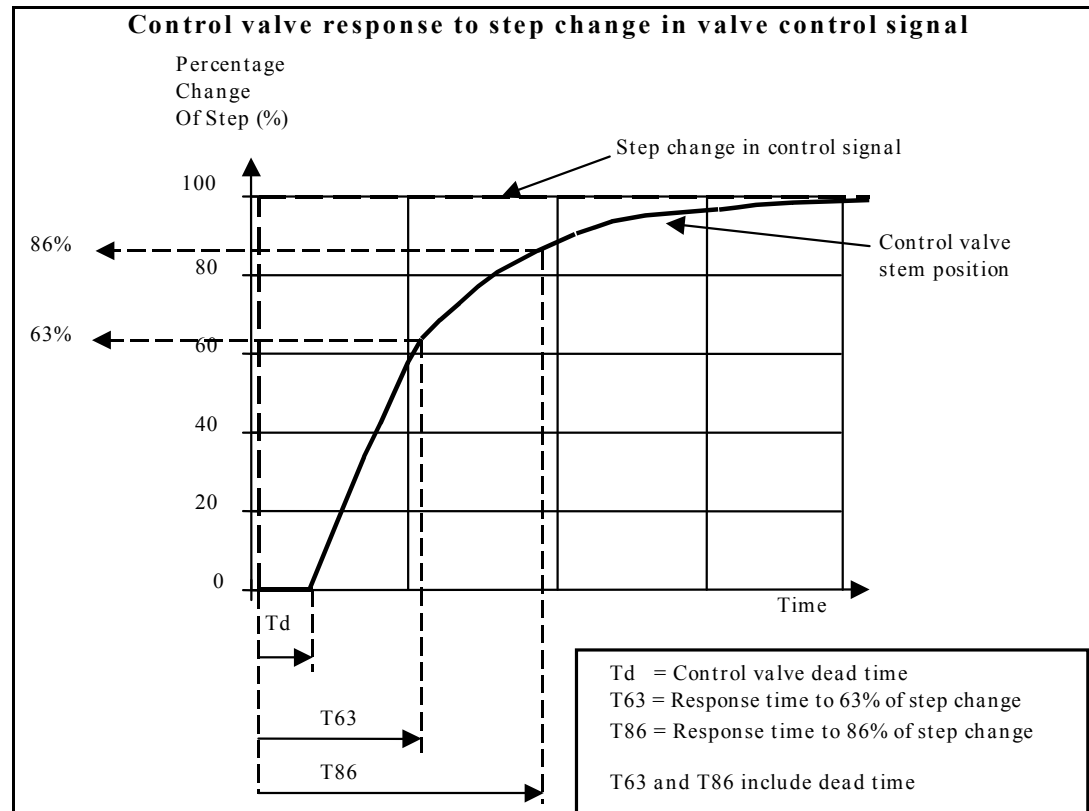
**CONTROL VALVES**

DATE STATUS APVD AUTHD

4APR14 Reaffirmed RED RGP

Speed of response table for modulating control valve assemblies in temperature, level, hand or analytical control loops.

Valve Size (inches)	Maximum dead time (Td) (seconds)	Maximum T63 step response time (seconds)	Maximum T86 step response time (seconds)
0 - 2	0.5	1.0	1.5
3 - 6	1.0	2.0	3.0
8 - 12	1.5	3.0	4.5
14 - 20	2.0	4.0	6.0
22 - 24	2.5	5.0	7.5

**b. On-Off Control Valves**

The stroke time for on-off valves is defined as the time from the moment of solenoid valve change of state (deenergization or energization as required) to the moment the control valve reaches the specified position.

c. Air Connections and Tubing Size

Actuator air connections and tubing size shall be large enough to meet the specified dynamic performance or stroking time. Actuators with diaphragms larger than 150 square inches (968 square centimeters) shall have at least a 1/2" actuator air connection.

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**CONTROL VALVES**

DATE	STATUS	APVD	AUTHD
4APR14	Reaffirmed	RED	RGP

8. TRIM MATERIALS

The following trim descriptions are intended as guidelines for trim types based upon service. The valve manufacturer is responsible for verifying that the trim material is suitable for the process fluid, operating conditions and any contaminants listed.

8.1 Trim for General Service with no H₂S

- a. The closure member shall be Type 416 stainless steel. An acceptable alternate is Type 316 stainless steel with Stellite sheath or solid Stellite.
- b. The seat ring shall be Type 416 stainless steel. An acceptable alternate is Type 316 stainless steel with Stellite sheath or solid Stellite.
- c. The seat ring retainer shall be of stainless steel compatible with the fluid.
- d. The cage shall be of stainless steel compatible with the fluid. The cage and closure member materials shall be selected to minimize risk of galling.
- e. The guide bushing or bearings shall be Type 440C stainless steel. An acceptable alternate is 17-4 pH stainless steel or Stellite.

8.2 Trim for General Service Containing H₂S or for Caustic Service

- a. The closure member shall be Type 316 stainless steel. An acceptable alternate is Type 316 stainless steel with Stellite sheath or solid Stellite.
- b. The seat ring shall be Type 316 stainless steel. An acceptable alternate is Type 316 stainless steel with Stellite sheath or solid Stellite.
- c. The seat ring retainer shall be of stainless steel compatible with the fluid.
- d. The cage shall be of stainless steel compatible with the fluid. The cage and closure member materials shall be selected to minimize risk of galling.
- e. The guide bushing or bearings shall be Type 316 stainless steel with Stellite sheath. Solid Stellite is an acceptable alternate.

8.3 Trim for Severe Service (High ΔP , Flashing, Cavitation, Caustic, Particulate)

- a. If a cavitation elimination valve trim style is used for a cavitating service, hardfacing may not be required.

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**CONTROL VALVES**

DATE	STATUS	APVD	AUTHD
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4APR14	Reaffirmed	RED	RGP
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- b. When a cavitation elimination valve trim style is not used, or hard facing is otherwise required:
- (1) The entire closure member surface exposed to the flow path, including guiding area, shall be Type 316 stainless steel with Stellite sheath. Solid Stellite or Ceramic are acceptable alternates. Hardfacing of seating and guide area only is not acceptable.
 - (2) The seat ring shall be Type 316 stainless steel with Stellite sheath on entire seating and surface area exposed to flow path. Solid Stellite is an acceptable alternate. Hardfacing of seating and guide area only is not acceptable.
 - (3) If the seat ring retainer is not exposed to high fluid velocities, it may be of stainless steel compatible with the fluid. However, a seat ring retainer in the outlet stream of the valve shall be Type 316 stainless steel with Stellite facing on all exposed surfaces. Solid Stellite is an acceptable alternate.
 - (4) The guide bushing or bearings shall be Type 316 stainless steel with Stellite sheath. Solid Stellite is an acceptable alternate.
 - (5) The cage shall be CA6NM chrome plated. An acceptable alternate is Type 316 stainless steel electroless nickel coated or solid Stellite. The cage and closure member materials shall be selected to minimize risk of galling.

9. ACCESSORIES**9.1 Air Filter Regulator Set**

An air filter regulator, complete with integral output gauge, shall be furnished for each air consuming device.

9.2 Positioners

- a. Positioners shall be used on all modulating control valves in order to achieve the dynamic performance requirements of section 7.4.a.
- b. Positioners shall have adjustable gain.
- c. Digital positioners with diagnostic capabilities to test for correct valve setup and to test for the dynamic performance requirements of section 7.4.a are recommended.
- d. Positioners shall have pressure gauges to indicate the air supply to the positioner, the air supply to the actuator and the control signal if pneumatic.
- e. Positioner control signal can be electronic 4 - 20mA, pneumatic or fully digital communication type.

**CONTROL VALVES**

DATE	STATUS	APVD	AUTHD
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4APR14	Reaffirmed	RED	RGP
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f. Positioners shall meet the following environmental conditions:

- (1) Temperature limits -40°F to 176°F (-40°C to 80°C).
- (2) Temperature effect less than 1% per 50°F (28°C).
- (3) Humidity 0 - 100%.

9.3 Electro-Pneumatic Transducers

- a. Transducers vibration effect shall be less than 1% of span when tested per ISA 75.13.01. The conformity (linearity), hysteresis and repeatability shall be equal to or better than 0.5%. Temperature effect shall be less than 1% per 50°F (28°C).
- b. Integral screwdriver adjustments for zero and span shall be located in an enclosure. Transducers shall be immune to reversal of normal current supply polarity.
- c. The total length of tubing between the electro-pneumatic transducers and control valve shall not exceed 10 feet (3 meters).
- d. An output gauge shall be furnished.

9.4 Auxiliary Handwheels

- a. Handwheels for sliding stem valves shall be the continuously connected, with neutral position, side mounted type.
- b. Handwheels for rotary valves shall be suitable for intermittent manual operation.
- c. Diaphragm case mounted handwheels are not acceptable.

9.5 Limit Stops

- a. Limit stops shall be designed to be adjustable and lockable (by means of locknut or other device), without actuator disassembly.
- b. Handwheels shall not be used as limit stops.

9.6 Limit Switches

Limit switches shall be actuated directly from the stem / shaft. They shall be adjustable and unaffected by vibration. They shall be hermetically sealed.

9.7 Solenoid Valves

Solenoid valves shall be close mounted to the actuator air connection.

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UOP Engineering Department

STANDARD SPECIFICATION**6-14-7** Page 14 of 14**CONTROL VALVES**

DATE	STATUS	APVD	AUTHD
4APR14	Reaffirmed	RED	RGP

10. VALVE MARKINGS**10.1 Valve Name Plate**

Each valve shall have a non-corrosive nameplate permanently fastened to the actuator yoke. The nameplate shall be visible when the valve is in service and fully insulated. The nameplate shall include the:

- a. Manufacturer's name or trademark
- b. Valve serial number
- c. Maximum valve body pressure rating
- d. Valve body material and body size
- e. Plug/Seat material
- f. Valve action and bench set
- g. C_v and characteristic

10.2 Metal Tagging

A Type 316 stainless steel tag containing valve tag number and manufacturer's serial number shall be riveted to the actuator yoke. Lettering shall be a minimum 1/4" (6 mm) high stamped to a minimum depth of 1/32" (1 mm).

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**FLOW METERS AND PRESSURE
INSTRUMENTS**

DATE	STATUS	APVD	AUTHD
4APR14	Reaffirmed	RED	RGP

~~(2) For gas lines, the taps shall be in the vertical on the top or not more than 45° from the vertical on the top~~

~~b. Other aspects of the pressure tapplings shall be in accordance with ISO 5167.~~

4. ABSOLUTE/GAUGE PRESSURE AND DIFFERENTIAL PRESSURE TRANSMITTER REQUIREMENTS
4.1 Construction

- a. For differential pressure transmitters, the transmitter body shall have a static pressure rating of 1500 psig (105 kg/cm²(g)) or 150% of the operating pressure at the operating temperature shown on the UOP Project Specification, whichever is greater.
- b. For absolute and gauge pressure transmitters, the transmitter body shall have a static pressure rating of 1500 psig (105 kg/cm²(g)) or 150% of the sensor upper range limit (URL) at the operating temperature shown on the UOP Project Specification, whichever is greater.
- c. Transmitter internals in contact with the process (wetted parts) shall be type 316 stainless steel. In services that are corrosive to available transmitter internals, where plugging may occur, or high viscosity fluids are encountered, diaphragm seals compatible with the process fluid shall be used to isolate the transmitter internals from the process fluid.
- d. For differential pressure transmitters, measuring elements shall be capable of withstanding pressure up to that of the static pressure rating on either side of the measuring element without damage to the element. Any resultant zero shifts shall be limited to less than 1% of the calibrated span of the transmitter.
- e. For absolute and gauge pressure transmitters, measuring elements shall be capable of withstanding pressure up to that of the static pressure rating without damage to the element. Any resultant zero shifts shall be limited to less than 1% of the calibrated span of the transmitter.
- f. Transmitters in wet H₂S (sour) service shall comply with NACE standard MR0103.

4.2 Performance

- a. Response Time and Update Rate
 - (1) For transmitters used in process control loops, response time and update rate shall be used in determining transmitter performance and both criteria shall be considered in the selection of the equipment. Response time is defined as the time it takes for the transmitter output to reach 63.2% of the actual step change in pressure. The response time includes any dead time associated with the initial step change in input signal and the transmitter output actually changing. Update rate is defined as the time interval between updates of the transmitted process measurement value.

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UOP Engineering Department

STANDARD SPECIFICATION**6-18-5** Page 6 of 9**FLOW METERS AND PRESSURE
INSTRUMENTS**

DATE STATUS APVD AUTHD

4APR14 Reaffirmed RED RGP

(2) As a minimum, pressure and differential pressure digital transmitters used in process control loops shall meet the following requirements:

- (a) Transmitters with an upper range limit of 30 inches (760 mm) H₂O or less, shall have a response time of 600 milliseconds or less. Other transmitters shall have a response time of 500 milliseconds or less.
- (b) Transmitters shall have an update rate at least as fast as the table below.

Controller Type	Output Signal Update Rate *
Flow (ΔP), Pressure, Differential Pressure	125 milliseconds
Level (ΔP)	500 milliseconds

* Faster update rate/response time transmitters may be required for certain applications such as compressor antisurge control systems. Slow update rate/response time transmitters may degrade control performance.

b. Process Measurement Communication Protocol

The transmitter output signal for the specified range may be 4 - 20 mA, 4 - 20 mA with a digital communication protocol superimposed, or fully digital communication. The communication protocol shall not prevent the instrument from measuring and transmitting the process pressure or differential pressure, except when the instrument is being configured.

c. Failure Mode

The transmitter electronics shall be capable of monitoring its performance during normal operation. The diagnostics shall be able to detect both an input sensor failure and transmitter electronics failure. The sensor or electronics failure shall be transmitted to the host system (e.g., DCS, PLC) using a low milliamp signal (e.g. <3.75 mA) or by using a fieldbus signal, depending on the capabilities of the host system.

d. Electronic Damping

The transmitter shall be capable of setting the electronic damping of the output to zero. Damping values shall be set to zero unless specified otherwise.

e. Accuracy

Better than $\pm 0.15\%$ of Span.

f. Combined pressure and temperature effects (Total Performance)

Better than $\pm 1\%$ of Span for a 50°F (28°C) temperature change, up to 1000 psig (70 kg/cm²(g)).

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UOP Engineering Department

STANDARD SPECIFICATION**6-18-5** Page 7 of 9**FLOW METERS AND PRESSURE
INSTRUMENTS**

DATE	STATUS	APVD	AUTHD
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4APR14	Reaffirmed	RED	RGP
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g. Stability

Better than +/- 0.5% of upper range limit for 1 year.

h. Calibration

The instrument calibration shall be completed by the vendor prior to shipment of the instrument. Where applicable, calibration via a smart communicator is sufficient.

4.3 Transmitter Installation

- a. For differential pressure transmitters, impulse lines shall not be longer than indicated on the UOP Standard Drawings. Longer impulse lines will increase measurement error due to any specific gravity differences in the high and low impulse lines.
- b. Transmitter output signal indicators shall be readable from the associated control valve assembly (or other valve(s) as denoted on the UOP Piping and Instrument Diagram). An integrally mounted indicator is acceptable. If the piping layout is such that an integrally mounted indicator is not readable from the associated valve(s), then a separate indicator suitable for remote mounting shall be supplied.

5. MISCELLANEOUS FLOW MEASUREMENT EQUIPMENT**5.1 Averaging Pitot Element**

- a. Averaging Pitot tube elements shall be permanently marked to indicate proper installation position and flow direction, unless they are bi-directional.
- b. As a minimum, the vendor's recommended straight run pipe length requirements shall be used; however, longer lengths are preferred.
- c. Blowout prevention is required for removable elements.
- d. In large pipe diameters, or where high flow velocity may cause the element to deflect or vibrate, extra heavy flow elements and/or double ended support shall be used.

5.2 Turbine Type Flow Meters

- a. The accuracy of the meter shall be +/- 0.5% of the flow rate or better, and the repeatability shall be +/- 0.1% or better.
- b. Turbine meters shall be designed with hydraulic balance to keep the rotor in place and shall have journal bearing construction. Designs using thrust bearing are not permitted.
- c. Material of construction for the journal bearing and rotor shaft shall be tungsten carbide. The materials of construction for the body and other wetted parts shall be suitable for hydrocarbon service as defined on the UOP Project Specification.

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UOP Engineering Department

STANDARD SPECIFICATION**6-18-5** Page 8 of 9**FLOW METERS AND PRESSURE
INSTRUMENTS**

DATE	STATUS	APVD	AUTHD
4APR14	Reaffirmed	RED	RGP

- d. The pickup coil shall be hermetically sealed or potted. The pickup coil wiring shall terminate at a terminal strip located on a remote mounted pulse amplifier. The wiring shall be suitable for the operating conditions shown on the UOP Project Specification. The length of wiring between the pickup coil and pulse amplifier shall be sufficient to permit the amplifier to be located as close to the meter as possible but not on the meter. The output signal of the amplifier shall be compatible with the associated remotely located equipment.
- e. Turbine meters shall be designed for operation at a minimum of 130% of the flow range specified, with no damage to the meter.
- f. Each turbine meter shall have a nameplate indicating the average pulses per unit volume over the meter range specified.
- g. Each turbine meter shall be calibrated for either vertical upflow or horizontal installation as specified on the UOP Project Specification. One copy of the calibration curve shall be provided with each meter.
- h. Strainers with the mesh size, material, and rating as noted on the UOP Project Specification shall be installed preceding each meter. Where the mesh size is not listed, the turbine meter vendor's recommendation shall be followed.
- i. Turbine meters shall be marked to indicate the direction of flow.
- j. Tools required for removal of the pickup coil shall be provided with the meter.
- k. For each meter, one spare rotor and one spare pickup coil shall be provided.

5.3 Positive Displacement Meters

- a. The meter body configuration shall be constructed to minimize the pressure drop through the meter.
- b. Counters, where specified, shall be of the non-reset type with calibration adjustments. Counters shall be weatherproof.
- c. Straight through strainers with mesh size, material, and rating as noted on the UOP Project Specification shall be installed preceding each meter.
- d. The accuracy of the measuring device shall be +/- 0.2% of full scale or better.
- e. Connections shall be clearly marked to indicate the direction of flow.

5.4 Rotameters

- a. Meter bodies shall be equipped with inlet and outlet float stops and, where feasible, cleanout plugs, which may be utilized as connection taps.

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**FLOW METERS AND PRESSURE
INSTRUMENTS**

DATE	STATUS	APVD	AUTHD
4APR14	Reaffirmed	RED	RGP

- b. Indicating scales shall have full length safety glass (or plastic) shielding, gasketed on both sides. Indicating scales shall be approximately 5 inches (125 mm) in length for extension meters used for transmitting service or for armored meters and 10 inches (250 mm) in length for local indicators not of the armored type. A 2-1/2 inch (65 mm) scale length for purge rate rotameters is acceptable.
- c. Gland assemblies shall be of "O" ring construction unless process conditions noted on the UOP Project Specification require otherwise.
- d. Tube construction shall be beaded, ribbed, or flat except for the plain tapered tubes used for armored type. Plain tapered tubes shall have internal guiding.
- e. Floats shall be self-cleaning and shall be designed for dimensional stability and maximum immunity to viscosity variations.
- f. Rotameters shall be completely assembled with all accessories before shipping.
- g. Accuracy shall be +/- 2% of full scale or better. For purge rate rotameters accuracy of +/- 10% of full scale is acceptable.

5.5 Magnetic Flow Meters

- a. The accuracy of the meter shall be +/- 0.5% of rate or better.
- b. The velocity through the tube shall determine the meter size based upon the selected vendors recommended velocities.
- c. The process conditions indicated on the UOP Project Specification shall be considered in the selection of the lining, electrodes and grounding requirements.
- d. The meter installation shall assure that the meter body remains full of liquid. Vertical upflow installations are preferred.

5.6 Other Flow meters

Other flow meter types, such as vortex, coriolis, thermal mass, etc., shall be in accordance with the applicable UOP Project Specification, notes and drawings.

6. NAMEPLATE

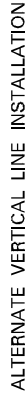
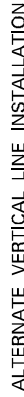
A non-corroding nameplate shall be permanently attached to the instrument and shall contain as a minimum the following information.

- a. Equipment tag number
- b. Manufacturer name
- c. Model
- d. Serial number

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P - PLUGGED

FOR ASME FLANGE CLASS 150, 300 AND 600

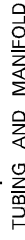
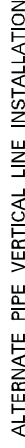


STEAM OR HIGH TEMPERATURE CONDENSING VAPOR SERVICE
FOR ASME FLANGE CLASS 150, 300 AND 600



UOP ENGINEERING DEPARTMENT

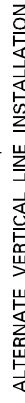
DETAIL C
HYDROFLUORIC ACID SERVICE



NOTE: C. MILLER

HIGH PRESSURE SERVICE

FOR ASME FLANGE CLASS 900, 1500 AND 2500



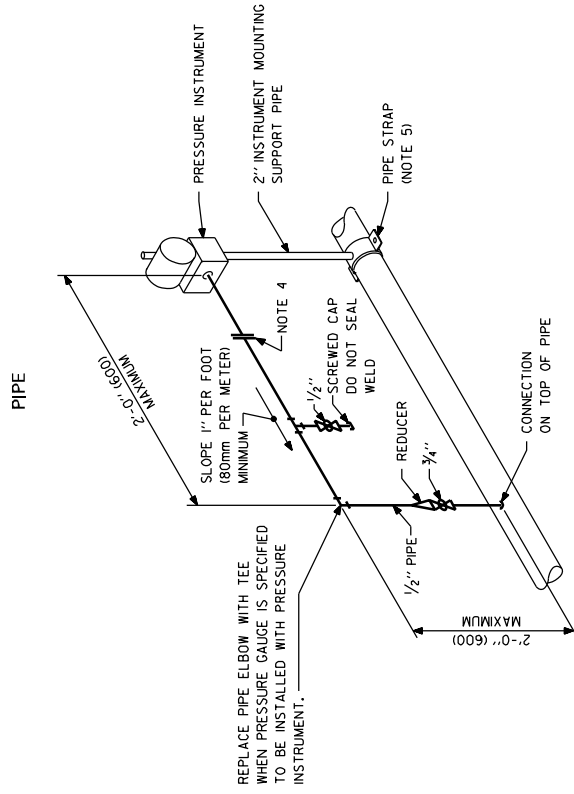
1. THE USE OF TUBING INSTEAD OF PIPE SHALL BE IN ACCORDANCE WITH UOP STANDARD SPECIFICATION 8-11 PIPING.
2. DO NOT SEAL WELD SCREWED CONNECTIONS AT INSTRUMENT.
3. PIPE AND NIPPLES BETWEEN FITTINGS SHALL BE OF MINIMUM LENGTH.
4. FOR HORIZONTAL LINES PRESSURE CONNECTION SHALL BE ON TOP OF THE LINE.
5. PULSATION DAMPENER, EXCESS FLOW CHECK OR DIAPHRAGM SEAL.
6. PULSATION DAMPNER AND/OR EXCESS FLOW CHECK VALVE, INSTALLED IN THE VERTICAL.
7. DIMENSIONS SHOWN IN PARENTHESSES ARE IN MILLIMETERS.

Page 977 of 1155

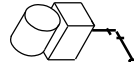
 GLOBE VALVE
 NEEDLE VALVE
 P - PLUGGED

PROVIDE SIPHON IN LINE FOR
STEAM OR HIGH TEMPERATURE
CONDENSING VAPOR SERVICE.
BEND IN FIELD

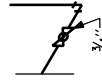
NOTE: PREFABRICATED GAUGE SIPHON
IS AN ACCEPTABLE ALTERNATE.



ALTERNATE INSTRUMENT



ALTERNATE VERTICAL LINE INSTALLATION



IND. ENGINEERING DEPARTMENT

PRESSURE INSTRUMENT PIPING ASSEMBLIES

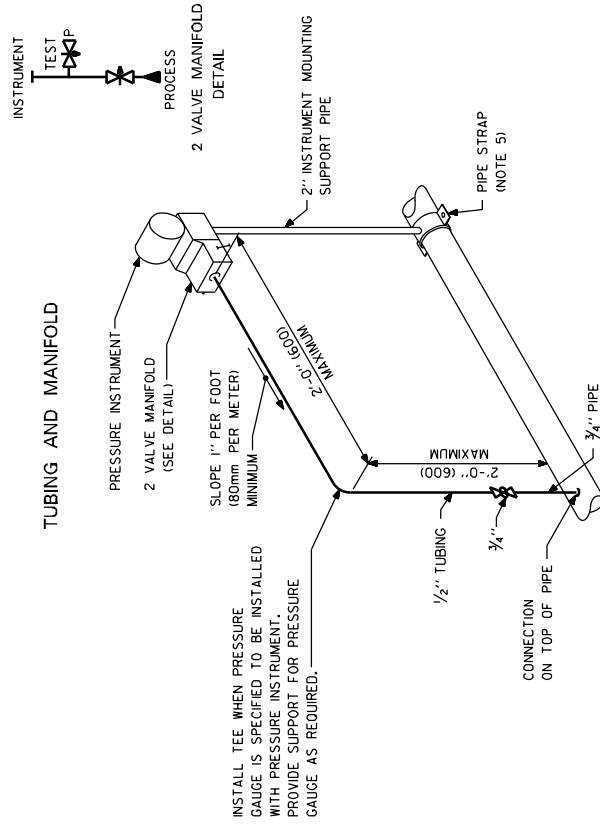
(FOR ASME FLANGE CLASS 150, 300 AND 600)

(FOR ASME FLANGE CLASS 150, 300 AND 600)

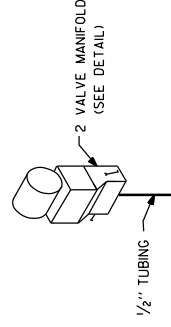
6-102-6

DATE	STATUS	APVD	AUTHID
26MAR14	REAFFIRMED	RED	RGP

TUBING AND MANIFOLD



ALTERNATE INSTRUMENT



ALTERNATE VERTICAL
LINE INSTALLATION

1. THE USE OF TUBING INSTEAD OF PIPE SHALL BE IN ACCORDANCE WITH UOP STANDARD SPECIFICATION 8-11 PIPING.
2. DO NOT SEAL WELD SCREWED CONNECTIONS AT INSTRUMENT.
3. PIPE AND NIPPLES BETWEEN FITTINGS SHALL BE OF MINIMUM LENGTH.
4. USE FLANGES FOR SOCKET WELD PIPING AND UNION FOR SCREWED PIPING. NOT REQUIRED WHEN USING REMOVABLE ADAPTOR ON INSTRUMENT BODY.
5. ALTERNATE MOUNTING: SUPPORT INSTRUMENT FROM ADJACENT PIPE RACK OR FROM STRUCTURAL STEEL. INSTALL SHALL ALLOW FOR PROCESS THERMAL EXPANSION OF PIPING.
6. DIMENSIONS SHOWN IN PARENTHESES ARE IN MILLIMETERS.

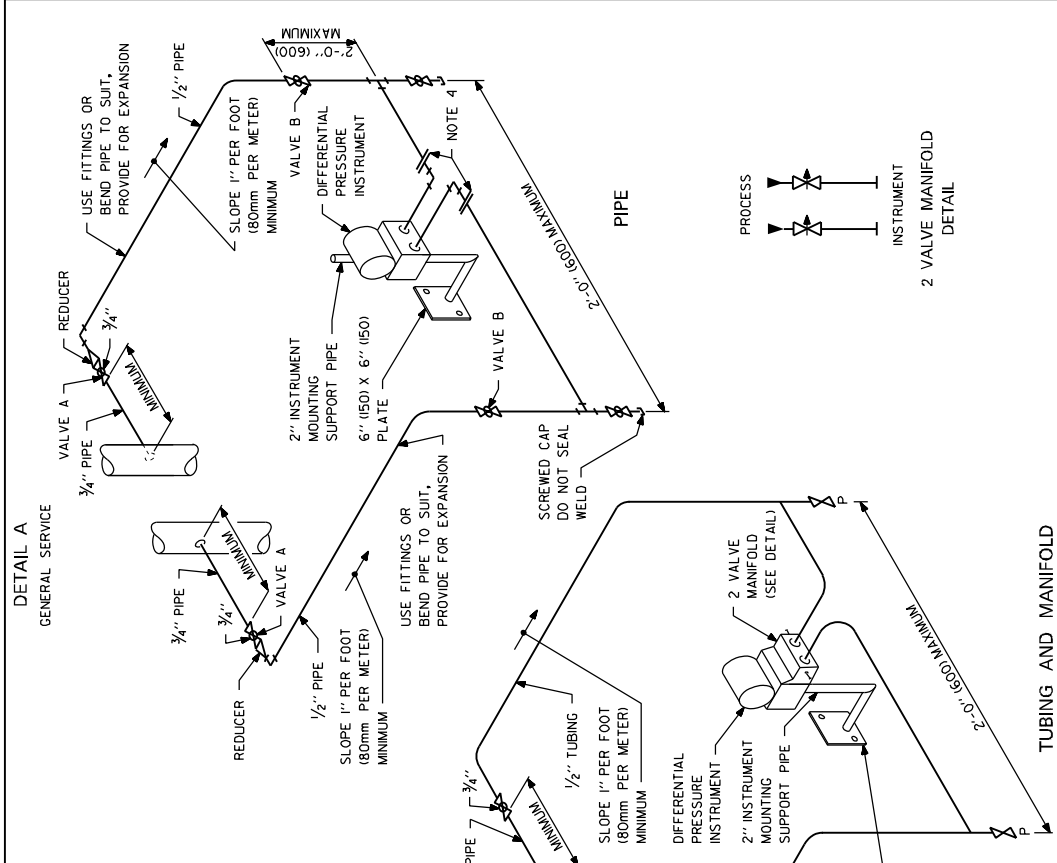
LEGEND

 GATE VALVE

 GLOBE VALVE

 NEEDLE VALVE

 P - PLUGGED



- NOTES:**
1. THE USE OF TUBING INSTEAD OF PIPE SHALL BE IN ACCORDANCE WITH LTOP STANDARD SPECIFICATION 8-11 PIPING.
 2. DO NOT SEAL WELD SCREWED CONNECTIONS AT INSTRUMENT.
 3. PIPE AND NIPPLES BETWEEN FITTINGS SHALL BE OF MINIMUM LENGTH.
 4. USE FLANGES FOR SOCKET WELD PIPING AND UNION FOR SCREWED PIPING. NOT REQUIRED WHEN USING REMOVABLE MOUNTING ADAPTORS ON INSTRUMENT BODY.
 5. PROVIDE UNION FOR SCREWED PIPING ONLY.
 6. THE USE OF A BYPASS OR A 5 VALVE MANIFOLD WITH AN EQUALIZING VALVE IS PERMITTED WHERE CONTAMINATION OR A HAZARDOUS CONDITION WILL NOT RESULT.
 7. VALVE B MAY BE ELIMINATED IF VALVE A IS EASILY ACCESSIBLE, ON THE SAME PLATFORM, AND NEARBY THE TRANSMITTER.
 8. PROCESS CONNECTIONS MAY BE AT DIFFERENT ELEVATIONS. TRANSMITTER SHALL BE CALIBRATED ACCORDINGLY.
 9. DIMENSIONS SHOWN IN PARENTHESES ARE IN MILLIMETERS.

QUALTRAX 11504

 **Honeywell**
UOP
LTOP ENGINEERING DEPARTMENT

DIFFERENTIAL PRESSURE INSTRUMENT PIPING ASSEMBLY
FOR LIQUID, STEAM OR CONDENSABLE VAPOR SERVICE
(FOR ASME FLANGE CLASS 150, 300 AND 600)

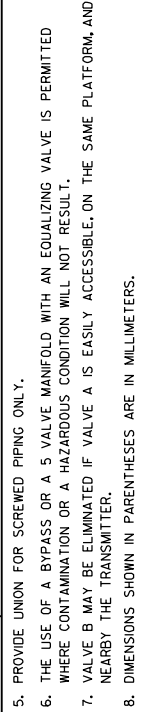
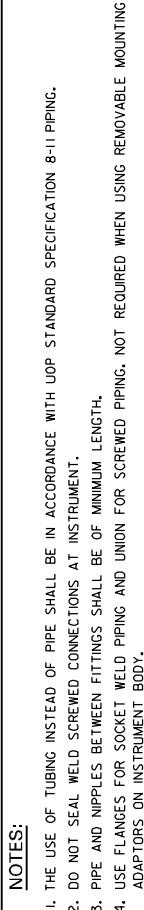
STANDARD DRAWING

6-144-6

DATE	STATUS	SPNSR	AUTHD
18OCT12	REAFFIRMED	RED	RGP

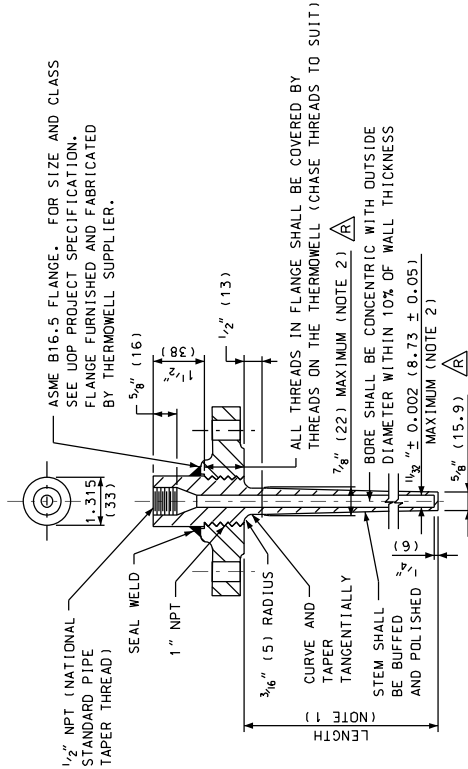
DETAIL B
LOW DIFFERENTIAL PRESSURE SERVICE

TUBING AND MANIFOLD



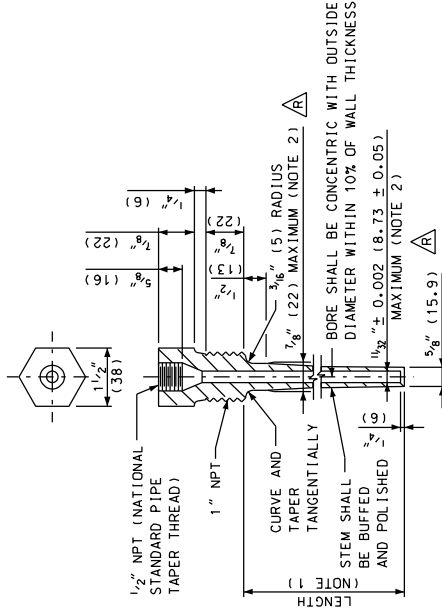
DATE	14-PR16
STATUS	REVISED
SPONSOR	RED
APPROVED	NUM

THERMOWELLS



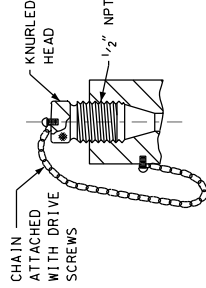
DETAIL A
FLANGED THERMOCOUPLE / RESISTANCE ELEMENT THERMOWELL

DETAIL B
FLANGED TEST THERMOWELL SAME AS DETAIL A
EXCEPT WITH PLUG AND CHAIN PER DETAIL Z



DETAIL E
SCREWED THERMOCOUPLE / RESISTANCE ELEMENT THERMOWELL

DETAIL F
SCREWED TEST THERMOWELL SAME AS DETAIL E
EXCEPT WITH PLUG AND CHAIN PER DETAIL Z



DETAIL Z

NOTES:

1. SEE UOP PROJECT SPECIFICATION FOR LENGTH DATA.
2. CONFIRM INSIDE AND OUTSIDE DIAMETER BASED ON TEMPERATURE ELEMENT AND MINIMUM WALL THICKNESS REQUIREMENTS.
3. USE OF FULL PENETRATION WELDS WITH 100% RADIOGRAPHIC TESTING AS AN ALTERNATE DESIGN IS ACCEPTABLE. PARTIAL PENETRATION WELDS ARE NOT ACCEPTABLE.
4. DIMENSIONS SHOWN IN PARENTHESES ARE IN MILLIMETERS.

ENGINEERING DESIGN BASIS PIPING

JOB NO : A870
PROJECT : MS Block Project
CLIENT : BPCL-KR

EIL SIGNATURE : Rajesh

CLIENT SIGNATURE:



0	28/Jul/2017	Issued For Engineering	AGRAWAL VIVEK	RAMESHWAR PRASAD	KHANNA L K
A	25/Oct/2016	Issued for Comments	AGRAWAL VIVEK	RAMESHWAR PRASAD	KHANNA L K
Rev. No.	Date	Purpose	Prepared by	Reviewed by	Approved by

Legend: ***Bold italic*** text denotes change with respect to previous revision.

Table of Contents

1.0 SCOPE	5
2.0 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS	5
2.1 ABBREVIATIONS	5
2.2 CODES & STANDARDS / PUBLICATIONS	5
3.0 GENERAL / DESIGN CONSIDERATIONS	7
3.1 EQUIPMENT LAYOUT	7
3.1.1 BASIS OF EQUIPMENT LAYOUT	7
3.1.2 DEVELOPMENT OF EQUIPMENT LAYOUT	7
3.1.3 PIPE RACK	8
3.1.4 TOWERS AND VERTICAL VESSELS	8
3.1.5 REBOILER	9
3.1.6 HORIZONTAL VESSELS	9
3.1.7 PUMPS	9
3.1.8 EXCHANGERS	10
3.1.9 AIR COOLERS	11
3.1.10 FIRED HEATERS	11
3.1.11 COMPRESSORS AND THEIR PRIME MOVERS	12
3.1.12 ACCESSIBILITY	13
3.1.13 LAYOUT AND ACCESS REQUIREMENTS FOR PLATFORM	13
3.1.14 CLEARANCES	14
3.1.15 ELEVATOR	14
3.2 UNIT PIPING	14
3.2.1 BASIS OF UNIT PIPING	14
3.2.2 PIPE WAYS/RACK PIPING	15
3.2.3 COLUMN / VESSEL PIPING & CONTROL VALVES	15
3.2.4 EXCHANGER PIPING	16
3.2.5 FIRED HEATER PIPING	16
3.2.6 PUMP PIPING	16
3.2.7 COMPRESSOR PIPING	17
3.2.8 RELIEF SYSTEM /BLOW DOWN SYSTEM PIPING	18
3.2.9 BOILER REGULATION REQUIREMENTS	18
3.2.10 STEAM HEADER AND SUPPLY LINES	19
3.2.11 STEAM TRACING	19
3.2.12 STEAM JACKETING	19
3.2.13 UTILITY STATIONS	19
3.2.14 ADDITIONAL REQUIREMENTS	20

3.3 OFFSITE & YARD PIPING	20
3.4 TANK FARM PIPING	21
3.5 FLARE PIPING	22
3.6 UNDERGROUND PIPING SYSTEM	22
3.7 FLEXIBILITY ANALYSIS AND SUPPORTING	22
3.7.1 PIPE SUPPORTING CRITERIA & GENERAL GUIDELINES	22
3.7.2 BASIC SPANS, GUIDES SPACING	23
3.7.3 SUPPORTING	23
3.7.4 CORROSION PAD REQUIREMENT	23
3.7.5 TRUNNION SUPPORTS	23
3.7.6 SUPPORTING FOR SMALL BORE LINES	24
3.7.7 SUPPORTING OF COLD INSULATED LINES	24
3.7.8 ANALYSIS TEMPERATURE	24
3.7.9 LINES REQUIRING MANDATORY FORMAL ANALYSIS	24
3.7.10 ADDITIONAL REQUIREMENTS	25
3.8 MATERIALS	25
3.8.1 PIPE	25
3.8.1.1 THICKNESS	25
3.8.1.2 BASIS FOR WALL THICKNESS CALCULATION	26
3.8.1.3 PIPE SIZE	27
3.8.1.4 TYPE	27
3.8.2 FITTINGS	28
3.8.3 FLANGES	28
3.8.4 GASKETS	29
3.8.5 VALVES	30
3.8.6 STRAINERS	30
3.8.7 TRAPS	30
3.8.8 NDE REQUIREMENTS (IF NOT SPECIFIED IN PMS)	30
3.9 THERMAL INSULATION OF PIPING, EQUIPMENT & VESSELS	31
3.10 PAINTING	31
3.11 WELDING	31
3.12 MISCELLANEOUS	32
4.0 SPECIFIC DESIGN REQUIREMENTS	32
4.1 HYDROGEN SERVICE REQUIREMENTS	32
4.1.1 PIPES, FITTINGS AND FLANGES	32
4.1.2 VALVES	33

4.1.2.1 GENERAL	33
4.1.2.2 HELIUM LEAK TEST	33
4.1.2.3 CS & AS VALVES	34
4.1.2.4 SS VALVES	34
4.2 TECHNICAL REQUIREMENTS FOR PIPING MATERIAL	35
4.2.1 GENERAL	35
4.2.2 PIPES	36
4.2.3 FITTINGS	36
4.2.4 FLANGES	36
4.2.5 VALVES	37
4.2.5.1 GENERAL	37
4.2.5.2 VALVE OPERATION REQUIREMENT	39
4.2.6 STRAINERS	39
4.2.7 TRAPS	40
4.2.8 HOSES	40
4.2.9 EXPANSION JOINTS	40
4.2.10 SUPPORTS AND SPRING ASSEMBLIES	41
4.2.11 GASKETS	41
4.2.12 STUDS, BOLTS, NUTS	41
4.2.13 SPECIAL SERVICE REQUIREMENTS	41
4.2.14 INSPECTION AND TESTING	42
4.2.15 MARKING	42
4.2.16 DISPATCH	42
5.0 OWNER / CLIENT SPECIFIC REQUIREMENTS	43

1.0 SCOPE

The Design Basis briefly covers the basic requirements for the design of Piping systems for Refineries, Petrochemicals, Onshore Piping & Gas Processing facilities covered by ASME B31.3. These shall be adhered to by Engineering / EPCC Contractor(s) or his subcontractor(s) during the course of engineering, procurement & construction.

2.0 ABBREVIATIONS, CODES & STANDARDS / PUBLICATIONS

2.1 ABBREVIATIONS

Code	Description
EDB	Engineering Design Basis
EPCC	Engineering, Procurement, Construction & Commissioning
ISBL	Inside Battery Limit
LSTK	Lumpsum Turnkey
OISD	Oil Industry Safety Directorate
OSBL	Outside Battery Limit
HAZ	Heat Affected Zone
BHN	Brinell Hardness Number

2.2 CODES & STANDARDS / PUBLICATIONS

The following codes & standards in their latest edition including latest addenda as on the date of first issue of this design basis shall be followed.

S.No.	Description	Standards / Codes	Edition	Remarks
1	International Codes/Standards		Latest	
1.1	Process Piping	ASME B31.3	Latest	PWHT required for CS Piping having thickness above 19MM
1.2	Pipe Flanges and Flanged Fittings	ASME B16.5	Latest	
1.3	Welding and Brazing Qual.	ASME BPV Sec. IX	Latest	
1.4	Non Destructive Examination	ASME BPV Sec.V	Latest	
1.5	Welding rods, electrodes & filler materials	ASME BPV Sec.II Pt.C	Latest	
1.6	Indian Boiler Regulations	IBR	Latest	
1.7	Expansion Joints Manufacturers' Association	EJMA Standards	Latest	
1.8	Layouts for Oil and Gas Installations	OISD-118	Latest	

S.No.	Description	Standards / Codes	Edition	Remarks
1.9	Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments Resistant Metallic Materials for Oilfield Equipment	NACE MR 0103	Latest	
1.10	Materials for use in H ₂ S containing Environments in Oil & Gas Production	NACE MR0175/ISO15156	Latest	
1.11	Sizing, Selection & Installation of Pressure Relieving Devices in Refineries	API RP 520	Latest	
1.12	Centrifugal Pumps for Petroleum, Heavy Duty Chemical and Gas Industry Service	API Std. 610	Latest	
1.13	Steam Turbines for Mechanical Drive Service	ANSI/NEMA SM 23	Latest	
1.14	Centrifugal Compressors for Petroleum, Chemical and Gas Industry Service	API STD. 617	Latest	
1.15	Air Cooled Heat Exchanger	API Std. 661	Latest	
1.16	Fired Heater	API STD. 560	Latest	
1.17	Evaluation of Pipeline and Pressure Vessel Steel for Resistance to Hydrogen Induced Cracking	NACE MR-0284	Latest	
1.18	Laboratory Testing of Metals for Resistance to Sulfide Stress Cracking in H ₂ S Environments	NACE TM-0177	Latest	
2	EIL Standards		Latest	
2.1	Standard Spec for Hot Insulation	6-44-0002	Latest	
2.2	Standard Spec for Cold Insulation	6-44-0003	Latest	
2.3	Standard Spec. For Steam Tracing	6-44-0007	Latest	
2.4	Standard Spec. For Steam Jacketing	6-44-0078	Latest	
2.5	Standard specification for application of torque and hydraulic bolt tension for flange joints	6-76-0002	Latest	
2.6	Welding Specification for fabrication of Piping	6-77-0001	Latest	

S.No.	Description	Standards / Codes	Edition	Remarks
2.7	Standard specification for surface preparation and protective coating (new construction)	6-79-0020	Latest	Color coding shall be as per BPCL agreed plan
2.8	Standard specification for positive material identification (PMI) at construction sites	6-82-0002	Latest	
2.9	Clearances	7-44-0501	Latest	
2.10	Accessibility for valves and Instruments	7-44-0502	Latest	
2.11	Table of Basic Span	7-44-0506	Latest	
2.12	Maximum Spacing of Guides for Vertical and Horizontal Pipes	7-44-0507	Latest	

3.0 GENERAL / DESIGN CONSIDERATIONS

3.1 EQUIPMENT LAYOUT

3.1.1 BASIS OF EQUIPMENT LAYOUT

Equipment Layout shall be developed based on the following data.

S.No.	Project Philosophy
1	P&IDs
2	Overall Plot Plan
3	Wind direction
4	Equipment Data Sheets
5	Indicative Equipment Layout from Process Licensor/EIL Process
6	Process Package
7	OISD Std. 118

3.1.2 DEVELOPMENT OF EQUIPMENT LAYOUT

The following aspects shall be considered during development of equipment layout.

S.No.	Project Philosophy
1	Process Requirement i.e. proper interconnection between equipment as per P&IDs to achieve the intended process parameters.
2	Economy of Piping material Minimize the quantity of costly piping.
3	Erection & Construction requirement-Erection scheme and schedule of all equipment must be considered during equipment layout to have smooth erection mainly in case of tall columns, heavy equipment like thick walled reactors, space for laying tall column, approach road for cranes / derrick for lifting the column or reactors and requirement of special foundation / pile etc.
4	Safety Requirements - As a minimum, 'OISD Std. 118' shall be followed. Safety shower location shall be marked in equipment layout.

S.No.	Project Philosophy
5	Operation and Maintenance Requirement like Overhead and side clearances for exchangers and pumps, Provision of exchangers tube bundle pulling area, Horizontal & overhead clearances for easy movement of working personnel, Crane approaches for air coolers/fired heaters/exchangers. Provision of catalyst loading/unloading facilities, Provision of monorail/mobile crane for maintenance of pumps, Provision of hydro extractor/monorail for maintenance of exchangers and Provision of EOT/HOT crane for compressors, Provision of Analyzer shelter.
6	Similar equipment grouping - All columns, exchangers, pumps etc. should be grouped together for convenience of maintenance and safety wherever feasible.
7	The technological structures should be inter-connected for easy movement of operational personnel. If lift is available within plant, interconnection to be provided to other technological structure / column/ pipe rack, to the extent feasible.
8	U/G piping corridors for main headers and U/G trenches (as applicable) should be marked in equipment layout. Trench piping shall be as per Structure design basis.
9	All areas requiring crane access for erection or specific maintenance purpose e.g. catalyst loading etc., hard stand for construction, tube bundle pulling area and drop-out/laydown areas shall be marked on the equipment layout.

3.1.3 PIPE RACK

S.No.	Type	Description
1	Pipe Rack Configurations	Preferably Straight. However, L/T/U/H/Z can be used based on area available
2	Preferred Pipe rack width depending on project requirements	Single Bay : 6M/8M/10M/12M Double bay : 16M/20M/
3	Maximum Tiers	4
4	Portal Spacing	6M to 8M All other spacing as per job requirements. Intermediate structural member shall be provided in pipe rack for supporting pipes as per requirement
5	Clearance beneath Pipe Rack - Units	4.5M Vertical X 3M Horizontal; First Tier at 6M.
6	Road Clearance	7M : Main Road 5M : Secondary Road
7	Pipe Rack Clearance - Offsites	2.2M
8	Space for Future Expansion - Units	As per Clause 5.0 S.No. 3.
9	Space for Future Expansion - Offsites	As per Clause 5.0 S.No. 3.
10	Water lines on Pipe Rack	As per Clause 5.0 S.No. 4.
11	Minimum Sleeper Height	As per Clause 5.0 S.No. 5.
12	Interconnecting platforms	Interconnecting platforms shall be provided between pipe rack & technological structures.

3.1.4 TOWERS AND VERTICAL VESSELS

S.No.	Type	Description
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S.No.	Type	Description
1	Location	Towers and vertical vessels in a row with a common centerline with OD minimum 4M away from Pipe Rack. Chemical Dosing vessels near dosing point to the extent possible, especially for ammonia and corrosion inhibitors and grouped together with escape routes
2	Minimum Clearance	Minimum 3M between Tower. Minimum 100mm horizontal gap between platforms of adjacent tower. Minimum 900mm clear aisle between plinths. Clearance shall allow full opening of Manhole.
3	Interconnecting platforms	To be provided at suitable levels where possible allowing for differential expansion.
4	Davit provision for heavy items (relief valves, blinds, etc)	On side of vessel away from pipe rack with clear drop out area at grade Clear access shall be provided at grade on the access side for lowering external & internal fittings, PSVs, Control valves etc from elevated equipment(columns, towers etc) by providing pipe davits.

3.1.5 REBOILER

S.No.	Type	Description
1	Location	Reboilers shall be located next to the tower they serve except fired heater type. Clearance for rodding to be provided for vertical reboilers. Vertical thermo siphon types to be supported by tower (except large vertical types which may require independent structure) and located away from pipe rack. Pressure drop calculations to be done before finalizing.
2	Elevation	As per P&ID.

3.1.6 HORIZONTAL VESSELS

S.No.	Type	Description
1	Location	Perpendicular to Pipe Rack and Min. 4M away from it.
2	Minimum Clearance	Minimum 2M or Minimum 900mm clear aisle, whichever is higher.

3.1.7 PUMPS

S.No.	Type	Description
1	Location	As per Clause 5.0 S.No. 7. Wherever possible, centerline of discharge shall be kept on common straight line.
2	Minimum Clearance	Minimum 900mm clear aisle between pumps Gap between each pump foundation and foundation of technical structure should be sufficient after piping, for access.
3	Maintenance	

S.No.	Type	Description
3.1		As per Clause 5.0 S.No. 8.
3.2		Sufficient space to be available for maintenance below pipe rack. Clear access of 4.5M vertically and 3M horizontally shall be provided centrally under main pipe ways for small mobile equipment to service pumps/motors, wherever these are installed under pipe ways with prior specific approval. Pumps outside rack shall be approachable by mobile equipments etc. from under the pipe rack.

3.1.8 EXCHANGERS

S.No.	Type	Description
1	Location	Floating head 4M from pipe rack
2	Minimum Clearance	Minimum 2M between the two exchangers. Minimum 900mm clear aisle. Heat Exchanger train should be suitably spaced such that shell/ tube inlet/ outlet piping do not foul with floating Head Covers. Minimum clearance of 1.0M shall be maintained between the edge of platform/structure and channel of exchanger.
3	Maintenance	
3.1	Maintenance of shell and tube type exchangers	Shell and tube type exchangers may have a removable shell cover with flanged head. Tube pulling or rod cleaning area must be allowed at the channel end. Piping shall have spools for easy removal of exchangers. Necessary space for removal of bonnet, channel and floating head shall be available.
3.2	Maintenance with Hydroextractor	Tube bundle pulling area shall be minimum the tube bundle length + 4M from the channel head for hydroextractor frame (1.0M on platform and rest clear in front of tech. structure subject to a minimum of 10M for crane movement)
3.3	Maintenance with monorail and chain pulley block	Tube bundle pulling area shall be minimum the tube bundle length + 1.5M from the channel head on the platform and 4M clear in front of Tech structure for vehicular movement.
3.4	Maintenance of vertical exchangers	In case of vertical exchanger suitable platform shall be provided below the top flange of channel or bonnet. For vertical exchanger, davit shall be provided for cover removal (as part of exchanger), if required, for maintenance. Structural for vertical exchanger shall be in such a way that bonnet on bottom can be freely removed during maintenance.
3.5	Maintenance of high pressure exchangers	For high pressure exchangers, shell pulling on rails shall be provided, as required.
3.6	Means of tube bundle removal	As per Clause 5.0 S.No. 9.
4		Piping above exchangers to be avoided to the extent possible. Piping, Instrument cables, Cable tray etc above exchanger shall be avoided. Cable tray, instrument, cables shall not be supported on saddle support of exchanger.

3.1.9 AIR COOLERS

S.No.	Type	Description
1	Location	As per Clause 5.0 S.No. 6.
2	Flooring and Shelter	For air coolers located on technological structure/rack, blind floor shall be provided if any part of pumps /equipment handling hydrocarbons are placed below them. In other cases, flooring with grating shall be provided. Rain shelter shall be provided for air coolers.
3	Supporting Structure	The width of the structure from where Air cooler assembly is supported shall be about 2.0m more than the Air cooler tube bundle length so that proper supporting of inlet/outlet piping manifolds can be done from the main members of pipe rack/technological structure to transfer piping load to main structural members
4	Maintenance	Davit shall be provided for lowering the motor, gear boxes etc. along with mobile trolley with retractable jacking arrangement of suitable load carrying capacity. Crane access shall be provided. Sprinkler system provided on Air fin cooler header side shall be of flanged type so that it can be removed during opening of header without hot work.
5	Vents & Silencers	The vents & silencers shall be located away from fin fans so that leaks are not blown towards fin fan. Air fin cooler inlet and outlet piping shall be symmetrical to the extent possible.

3.1.10 FIRED HEATERS

S.No.	Type	Description
1	Location	
1.1		Fired heaters are located upwind or sidewind of process units to blow any combustible leaks away from the open flame. They are located minimum 90M away from hydrocarbon tanks and 30M away from control room. Distances for equipments handling hydrocarbon from the fired heaters shall be as per OISD norms. Vessels / reactors directly connected to fired heaters are exception.
1.2		Fired heaters shall be arranged with centerline of the stacks on a common line in case of circular fired heaters and wherever a common stack is furnished to cater more than one fired heater the stacks shall be located at the end or side, which is away from the unit. In case of individual box fired heater, the edge of the fired heater on the rack side shall be matched. F.D. fans shall be located at one corner of fired heater area away from equipments handling hydrocarbons.
1.3		It shall be ensured that there are no working platforms within an elevation of 6M below the tip of stack and within a 25M radius of stack. However, the stack height is governed by the clearances from statutory authorities like Director General of Civil Aviation and Pollution Control Board.
1.4		Air Pre Heaters should be located in such a way that the modules can be removed by crane.

S.No.	Type	Description
2	Maintenance	
2.1		Vertical tube fired heaters must have access to permit a crane to remove and replace tubing.
2.2		Horizontal tube fired heaters must have horizontal free space equal to tube length plus crane parking space for tube pulling / maintenance / cleaning.
2.3		In case of bottom floor fired heaters, there shall be adequate headroom clearance underneath the fired heater for removal of burners.
2.4		In case of wall fired heaters min. 2M wide platform with escape route at each end is necessary.
3	Drainage	
3.1		Pits and trenches are not permitted under fired heater or any fired equipment. All the OWS/CRWS/SS drain points within 15M of Fired heater area shall be taken through closed pipe sewers.

3.1.11 COMPRESSORS AND THEIR PRIME MOVERS

S.No.	Type	Description
1	Location	
1.1		Compressors shall be located to keep suction lines as short as possible.
1.2		The gas compressors shall be located downwind side of fired heater so that leaks are not blown towards fired heater.
1.3		In general compressors are to be located under shed if required as per Clause 5.0 Point 18.1. When compressors are located under shed, sides to be kept fully open for the low shed or partially closed from top for high shed to avoid accumulation of heavier gases in the shed, however, in case of hydrogen compressors located under the sheds provision for top venting from compressor sheds shall be provided.
1.4		In case of a turbine driven compressor, if exhaust steam is condensed, turbine and compressor need to be located at an elevated level and condenser to be located below turbine.
1.5		A major consideration in centrifugal compressor location is the lube and seal oil console. It must be accessible from a road, must be lower than the compressor to allow gravity drain of oil to the consoles oil tank.
1.6		Intercoolers & Knockout pots may be kept within/outside the Compressor house shed, but, shall be kept near compressor house.
1.7		Compressor manufacturer may be consulted for recommended layout. Licensor's requirement, if any, shall also be taken into consideration.
2	Maintenance	
2.1		For compressors E.O.T/H.O.T as per clause 5.0 S.No. 18.2 to handle heaviest removable piece shall be provided for each compressor house.

S.No.	Type	Description
2.2		Maintenance bay for compressors shall be provided. Maintenance bay shall be accessible from road to facilitate unloading & loading on to truck etc.
2.3		Tube bundle pulling of exchangers shall be done by Tube Bundle Extractor. Provision shall be made for chain pulley block arrangement on both sides of heat exchanger for handling floating head, channel covers, etc
2.4		Compressor manufacturer may be consulted additional requirement for maintenance. Licensor's requirement, if any, shall also be taken into consideration.

3.1.12 ACCESSIBILITY

S.No.	Type	Description
1	Crane access	
1.1		Equipment, Structures shall be arrange to permit crane access to service air coolers, compressors & exchangers
1.2		A clear space for tube bundle removal shall be provided. Dropout bay may be considered for exchangers at elevated structures.
1.3		For High Pressure Exchanger, Shell pulling on rail shall be provided as required.
2	Pumps Maintenance	As per Clause 3.1.7
3	Access to lowering piping components	Clear access shall be provided at grade on the access side for lowering external & internal fittings, PSVs, Control valves etc. from elevated equipment (Column, Tower etc.) by providing pipe Davits.

3.1.13 LAYOUT AND ACCESS REQUIREMENTS FOR PLATFORM

S.No.	Type	Description
1	Platform requirement	
1.1		Air coolers shall have platforms with interconnected walk ways provided to service valves, fan motors and instruments.
1.2		Fired heaters located adjacent to one another shall have inter connecting platforms at various elevations.
1.3		Inter connecting platforms between adjacent towers shall be provided wherever feasible, taking into consideration expansion of towers.
1.4		Platforms shall be provided for columns/vertical vessels as per Clause 5.0 S.No. 35.
2	Access to Platforms - ladders and stairs	
2.1		Two means of access (i.e. two ladders or one ladder and one stair case) shall be provided for any elevated platform, which serves three or more vessels or exchangers and for battery limit valves operating platform.
2.2		Platforms, ladders & stairways shall be consistent with access & safety requirements.
2.3		Stairway for tanks to be provided on upstream of predominant wind direction.

S.No.	Type	Description
2.4		Dual access (i.e. one staircase and one ladder) shall be provided at large elevated structure if any part of platform has more than 22.65M (75 ft) of travel. Maximum distance to escape ladder/staircase shall not be more than 22.65M from any point on the platform. Additional ladders to ensure this shall be provided as required.
2.5		Air coolers platforms shall have Dual access (i.e. one staircase and one ladder).
2.6		Platforms shall be provided with stair access in the case of platforms provided for normal monitoring (once a day or more) or where samples are taken, where vessels or equipment items have operator attention such as compressors, heaters, boilers etc and main pipe rack at battery limits.
2.7		Ladder access shall be provided in the case of platforms for items that require occasional operating access including valves, spectacle blind and motor operated valves, heater stack sampling points and Man-ways above grade on equipment.
3	Ladder Design	
3.1		Wherever practicable, ladder shall be so arranged that users face equipment or platform rather than facing open space.
3.2		Landings shall be staggered. No ladder shall be more than 6M in one flight.
3.3		Ladder shall preferably have side entry to platform.

3.1.14 CLEARANCES

S.No.	Project Philosophy
1	Clearance requirements shall be as per 7-44-0501

3.1.15 ELEVATOR

S.No.	Project Philosophy
1	Requirements shall as per Clause 5.0 Point 17

3.2 UNIT PIPING

3.2.1 BASIS OF UNIT PIPING

S.No.	Project Philosophy
1	Piping & Instrument Diagrams
2	Equipment layout
3	Equipment Data sheet & Setting plan
4	Line list
5	Instrument Data sheet
6	Structural 3D model & building drawings
7	Topography of the plant
8	Piping material specification
9	Overall Plot Plan

S.No.	Project Philosophy
10	Proper access to all operating points including valves and for all orifice -tapping points, instruments in particular (refer 7-44-0502).
11	Proper access to interrelated operating points for specific purpose and for maintenance

3.2.2 PIPE WAYS/RACK PIPING

S.No.	Project Philosophy
1	Racks shall be designed to give the piping shortest possible run and to provide clear head rooms over main walkways, secondary walkways and platforms.
2	Predominantly process lines are to be kept at lower tier and utility & hot process lines on upper tier. Generally, hot lines and cold lines shall be kept apart in different groups on a tier.
3	Generally the top tier is to be kept for Electrical cable trays (if not provided in underground trench) and Instrument cable ducts/trays. Cable tray laying to take care of necessary clearances for the fire proofing of structure.
4	Generally the bigger size lines shall be kept nearer to the rack column.
5	Minimum spacing between adjacent lines shall be decided based on O.D. of bigger size flange (minimum rating 300# to be considered), O.D. of the smaller pipe, individual insulation thickness and additional 25 mm clearance. Even if flange is not appearing the min. spacing shall be based on above basis only.
6	Actual line spacing, especially at 'L' bend and loop locations, shall take care of thermal expansion / thermal contraction / non-expansion of adjacent line. Non-expansion / thermal contraction may stop the free expansion of the adjacent line at 'L' bend location.
7	Anchors on the racks are to be provided on the anchor bay if the concept of anchor bay is adopted. Otherwise anchors shall be distributed over two to three consecutive bays.
8	Anchors shall be provided within unit on all hot lines leaving the unit.
9	Process lines crossing units (within units or from unit to main pipeway) are normally provided with a block valve, spectacle blind and drain valve. Block valves are to be grouped and locations of block valves in vertical run of pipe are preferred. If the block valves have to be located in an overhead pipe-way, staircase access to a platform above the lines shall be provided.
10	Branches from main headers shall be preferably from top.

3.2.3 COLUMN / VESSEL PIPING & CONTROL VALVES

S.No.	Project Philosophy
1	Piping from column shall drop or rise immediately upon leaving the nozzle and run parallel and close as practicable to vessel. Reboiler outlet piping shall be as short as possible with minimum bends.
2	Piping shall be grouped as far as possible for the ease of supports and shall run on the rack side of the column.
3	Manholes shall be kept on the road side and shall be approachable from the platform.
4	Piping shall be supported from cleats welded on the Vessel. Small bore lines may also be supported from operating platform where taking support from cleat is not feasible.
5	Proper guides at recommended intervals shall be provided for long vertical lines.
6	Access platforms/ladders shall to be provided along the column for valves and instruments as per Clause 5.0 S.No.35. Minimum clear width of platform shall be 750mm.

S.No.	Project Philosophy
7	For ease of operation and maintenance, column and vessels which are grouped together, should preferably have their platforms at the same elevation and should be interconnected by walkways where feasible. However each column / vessel shall have an independent access also.
8	Piping at columns/vessel nozzles shall be arranged so that blanks can be easily installed for hydrotesting.
9	Unless specifically indicated in P&IDs control valves shall preferably be kept at grade or on technological platforms.
10	Piping intended for vacuum services shall be routed as short as possible with minimum bends and flanged joints.
11	Piping support cleats for safety valves shall be independent and meant for safety valves only. These cleats shall be designed considering impact loading during popping off.
12	Utility Connection nozzles shall be from side/top.
13	Drain valves to CBD/Blow down/OWS from vessels, etc to be located in such a way that the Level gauge view is not obstructed.

3.2.4 EXCHANGER PIPING

S.No.	Project Philosophy
1	Exchanger piping shall not run in the way of built in or mobile handling facilities.
2	Wrench clearance shall be provided at exchanger flanges.
3	Piping shall be arranged so that they do not hinder removal of shell end and channel cover and withdrawal of tube bundle.

3.2.5 FIRED HEATER PIPING

S.No.	Project Philosophy
1	Arrange piping to permit burner removal by providing break-up flanges in the piping
2	Burner valves shall be located close to the peepholes/sight doors for operation so that adjustment can be made while observing the flame from working level as per Clause 5.0 S.No. 46.
3	Piping to burners shall be arranged so that there are no pockets & shall distribute equal and sufficient quantity of oil/gas to all burners.
4	Block valves for emergency, snuffing steam valve shall be located at the recommended distance from the heater, preferably on the upwind side of the heater.
5	Piping from various passes of heater outlet nozzles should preferably be symmetrical. Transfer line from heater to column shall be as short as possible, without pockets, free draining and with minimum bends.
6	No piping shall be routed in the tube withdrawal area. If unavoidable, break up flanges shall be provided in the piping for removal.
7	Only flexible metallic SS (SS316/SS304) hoses shall be used for burner piping, if required.

3.2.6 PUMP PIPING

S.No.	Project Philosophy
1	Pump drives shall have clear access.
2	Pump suction piping shall be as short as possible and shall be arranged to avoid vapour pockets.
3	Reducers immediately connected to the pump suction shall be eccentric type with flat side up to avoid the accumulation of gas pocket.

S.No.	Project Philosophy
4	For pump suction, elbows shall not be directly connected to the suction flange. A straight piece minimum 3 times the line size shall be provided at the suction nozzle.
5	Pump discharge check valve if installed in vertical lines shall be fitted with a drain connection as close as possible downstream of the valve.
6	All small bore piping connected to pump (drain to OWS & CBD, seat and gland leak drain) shall have break up flanges for removal of pumps.
7	Piping shall be so arranged that the forces and moments imposed on the pump nozzle do not exceed the manufacturer recommended values / Double the allowable values of API 610.
8	Pump discharge piping should be routed away from the motor side.
9	Pump cooling water connection shall be taken from the top of circulating cooling water header.
10	Removal of pump shall be ensured. If required, breakup flanges may be provided on suction/discharge/Warm up lines/drains etc.
11	All small bore piping like warm up lines should be adequately protected /stiffened to prevent the cracking of welds due to the transfer of pump vibration.
12	Seal Plan for the pumps located in the same bay will be mirror image.

3.2.7 COMPRESSOR PIPING

S.No.	Project Philosophy
1	Suction lines shall be as short as possible
2	Suction piping shall have adequate flanged joints for ease of erection and maintenance.
3	Where the line between knockout drum and the compressor cannot be routed without pocket, low point drain shall be provided to remove accumulation of liquid. The system should be approved by Process.
4	A minimum straight length of suction pipe shall be provided as per manufacturer's recommendation.
5	Lube oil cooler space shall be provided in a way so as to facilitate tube bundle removal.
6	All operating valves on main suction and discharge piping shall be lined on one side as far as possible.
7	Piping shall be designed so that forces and moments imposed on the compressor do not exceed the manufacturer's recommendation.
8	Low points in the discharge line from an air compressor shall be avoided because it is possible for lube oil to be trapped and subsequently ignited. If low points are unavoidable, they shall be provided with drains.
9	In case of reciprocating compressor, piping shall be suitably supported to avoid vibrations due to pulsating flow. Unless requirements of no pockets are specified by the licensor, all the piping shall run at 500mm above grade level so that proper supports can be provided to minimize vibrations. Analog study shall be carried out for complete compressor piping including suction / discharge piping as per P&IDs and the study recommendations if any, shall be implemented.
10	Reciprocating compressor piping shall be provided independent supports (preferably RCC) from grade and shall not be supported from compressor shed / platform structure.
11	The small bore branches shall be checked for requirement of braced supports
12	Seal gas skid shall be placed below the compressor platform level so as to avoid entry of entrapped liquid in to dry gas seal unless otherwise recommended by Vendor.

S.No.	Project Philosophy
13	All the inlet & outlet piping of the compressor and drive shall be routed from one side, to the extent possible so as to enable free space for maintenance and EOT crane movement.
14	For reciprocating compressor, normal operating valves, strainers, and check valve piping loops shall be in a separate tier to the extent possible to avoid congestion in the compressor platform.

3.2.8 RELIEF SYSTEM /BLOW DOWN SYSTEM PIPING

S.No.	Project Philosophy
1	Wherever the inlet line size is higher than the safety valve inlet size, reducer shall be installed adjacent to inlet of safety valve.
2	Relief valve discharging steam, air or other non flammable vapour or gas directly to atmosphere shall be equipped with weep-hole / drain to prevent accumulation of liquid at valve outlet.
3	Liquid-phase blowdown piping connected to a gravity flow closed system shall be self draining to the blowdown system.
4	Liquid-vapour phase relief valves shall discharge into the flare header at an angle 45 degrees in the direction of header flow, to minimize the effect of kinetic energy and to avoid accumulation of liquid.
5	Pockets in the flare header and blowdown system shall be prohibited.
6	Relief valve discharge piping shall be taken to safe location as per following: 3M above top platform of column or structure, within 6M radius for steam and 8M for hydrocarbon/ toxic discharge 25M Horizontally away from fired heater for hydrocarbon. 50M Horizontally away from fired heater, if more than one hydrocarbon relief system of different set pressures is discharging into one common riser of vent stack.
7	Inlet and outlet piping of pressure relief valve shall be adequately supported to take care of the thrust induced by the relief valve during popping.
8	Reaction forces including both momentum & static pressure effects due to safety valve popping shall be ascertained in the connected piping according to API RP520 for systems discharging to atmosphere. The effect of these forces on the piping supports and the anchors of the piping system shall be calculated to ascertain that the allowable limits at these locations are not exceeded. The supporting structure also shall be adequately designed so that when subjected to these reaction forces the supporting elements connected to piping as well as the basic supporting structure i.e. platform members etc. are capable of withstanding them.
9	OWS vents shall be routed up to 3M above of nearby platform/structure.

3.2.9 BOILER REGULATION REQUIREMENTS

S.No.	Project Philosophy
1	All statutory requirements as per Indian Boiler Regulations (IBR) shall be met for IBR piping.
2	All materials used on lines falling under IBR must be accompanied with IBR Inspection Certificate in original. Alternatively, photocopy of the original certificate duly countersigned and attested by local boiler inspector is acceptable. Leading inspection authority viz. Lloyds, EIL, CEIL etc are authorised inspection authorities for IBR outside India, whereas, for Indian supply only IBR is the inspection authority.
3	IBR documents for lines falling under IBR must be approved by IBR authority of State in which the system is being installed.
4	All welders used for fabrication of IBR system must possess IBR welding qualification certificate.

S.No.	Project Philosophy
5	IBR system shall be designed to comply with IBR regulations as well as ASME B31.3. Design calculations for the same must be approved by IBR authority.
6	IBR approval is obtained with requisite fees payable to Indian Boiler Board of the State concerned.
7	The discretion of IBR authority of state is final and binding for the above cases. Project NDT/ PWHT requirements or IBR requirements which ever is stringent shall be followed.

3.2.10 STEAM HEADER AND SUPPLY LINES

S.No.	Project Philosophy
1	Steam header shall be located generally on the upper tier and at one end of the rack adjacent to columns.
2	Branch lines from horizontal steam header, except condensate collection points, shall be connected to the top of the pipe header.
3	Isolation valves (if provided) on the branch line shall preferably be provided on the horizontal run and outside the pipe rack.
4	All branch lines should be drainable.
5	Drip legs & compact steam trap assemblies with integral glandless piston valve and in-built strainer shall be provided at all low points and dead ends of steam header. Steam trap assemblies may be used for 900# and above. Drip legs at low points shall be closer to downstream riser.
6	All turbines on automatic control for startup shall be provided with a steam trap in the steam inlet line.
7	All traps shall be provided with strainers if integral strainers are not provided.
8	Expansion loops are to be provided to take care of the expansions within units.
9	Wherever condensate is to be drained, proper condensate draining facility shall be provided.

3.2.11 STEAM TRACING

S.No.	Project Philosophy
1	Shall be as per 6-44-0007. Material of tracer shall be as per Clause 5.0 S.No. 28.
2	Steam Manifolds shall be located preferably at upper levels in pipe-rack, accessible from a platform whereas Condensate Manifolds shall be located on grade. Manifolds shall be installed in vertical position. All steam tracing line shall be hydro tested before taking it in to service. Spiral wound gasket shall be used for steam tracing pipeline flanges.

3.2.12 STEAM JACKETING

S.No.	Project Philosophy
1	Shall be as per 6-44-0078. For jacketed lines using high pressure steam, actual calculations for core jacket and feeder pipe shall be performed before finalization.

3.2.13 UTILITY STATIONS

S.No.	Project Philosophy
1	Requisite number of utility stations shall be provided throughout the unit to cater to the utility requirement. Number of utility stations shall be such that all equipments shall be approachable from at least one utility station. The approach of utility station shall be considered 15M all around the station location.

S.No.	Project Philosophy
2	Utility stations shall have three connections [one for LP steam , one for Plant Air and one for Service Water] each of 1"NB unless otherwise specified in P&ID. Air and water lines shall have quick claw coupling with socket weld pipe end and steam line shall have flanged type hose connection and shall be directed downward. All connections shall have globe valve for isolation purpose. Inert gas hose, when required, shall be of flanged type and shall be isolated with blank/as per P&ID.
3	The Utility stations shall generally be located adjacent to pipe-rack column. Utility stations shall be provided on outer face of pipe rack column to the extent possible. The utility stations shall also be provided on elevated structures like technological structure, operating platforms of vertical equipments etc. based on operation and maintenance requirements. Operating platforms having manholes must be accessible from utility station.
4	Steam traps at offsite shall not be protruding beyond 300 mm outside the pipe rack structure.

3.2.14 ADDITIONAL REQUIREMENTS

S.No.	Type	Description
1	Safety Shower / Eye Wash	As per Clause 5.0 S.No. 16
2	Fire Fighting	Refer General Civil Design Basis

3.3 OFFSITE & YARD PIPING

S.No.	Type	Description
1	General philosophy	In general, offsites piping (except tankages area), electrical cable and instrumentation cable shall be laid as per Clause 5.0 Point 10. Wherever piping is laid on pipe sleepers & hard surfacing/gravel is provided below it, hard surfacing/gravel should be completed before start of pipe laying. Width of hard surfacing/gravel shall be about 1 meter more than the piping corridor on either side. This extra hard surfacing/gravel shall be for movement of operating personnel along the piping corridor. This movement area shall be approachable from the road at a distance of every 500 meters. For ensuring flushing of lines, all Cooling water headers/sub headers (including on racks) are to be provided with blind flanges (with 2"/4" tapping with valves) at each ends
2	Road Crossings & Access	Pipes at road crossing shall be as per Clause 5.0 Point 12. Culverts / overhead pipe bridges shall be adequately designed to take care of future requirements. -At road crossings overhead pipe bridges shall be used for areas where pipe racks are provided and for pipes on sleepers, culverts shall be provided. Pipe bridges/culverts shall be adequately designed to take care of future requirements. All road crossing shall be routed through pipe bridges unless otherwise the process requirements call for. Walkways & ladder shall be provided for pipe bridges. For the culverts, access (500 mm) shall be provided for inspection and maintenance. Ladder shall be provided in every 250 meters in offsite new pipe rack for inspection.
3	Layout	

S.No.	Type	Description
3.1		Clearances between lines shall be minimum 'C' as given below. $C = (D_o + D_f) / 2 + 25 \text{ mm} + \text{Insulation thickness(es)}$ Where, D_o - outside diameter of smaller pipe (mm) D_f - outside diameter of flange(min 300#) of bigger pipe (mm) However this 'C' spacing between the offsite piping on the rack/sleeper can be suitably increased so that the lines should not touch each other after insulation/lateral expansion.
3.2		Adequate clearance shall be provided for every long & high temperature lines to avoid clashing at the bends. Actual line spacing, especially at 'L' bend and loop locations, shall take care of thermal expansion / thermal contraction / non-expansion of adjacent line. Non-expansion / thermal contraction may stop the free expansion of the adjacent line at 'L' bend location.
3.3		Expansion loops for all lines shall generally be kept at the same location.
3.4		Vents shall be provided on all high points & drains shall be provided at all low points. Drain valves at sleeper piping shall be kept outside the sleeperway if the same is not accessible and valves shall be put in horizontal only. At all such places where piping is extended to make drain valves accessible - 2 nos. of stiffeners, irrespective of pipe rating, shall be provided at 90° to each other from the main pipe to impart adequate stiffness to the branch connection. The stiffeners shall be made of 6mm thick flats of material equivalent to the pipe material.
3.5		Spacing of guides on each line on a pipe bay shall not exceed the value given in 7-44-0507.

3.4 TANK FARM PIPING

S.No.	Type	Description
1	Layout	
1.1		The number of pipelines in the tank dyke shall be kept minimum and shall be routed in the shortest practicable way to main pipe track outside the tank dyke, with adequate allowance for expansion. Within one tank dyke the piping connected to that tank shall only be routed.
1.2		Manifolds shall be located outside the tank dyke & by the side of the roads, easily accessible by the walkway.
1.3		Special consideration shall be given as regards to spacing of nozzles while installing special item like hammer blind, MOV etc.
1.4		Pipe crossing the dyke wall shall pass through a sleeve suitably sealed. Coating & wrapping for pipe sleeves & pipes crossing dyke walls, shall be as requirements of 6-79-0020

S.No.	Type	Description
2	Settlement	If exceptionally high settlement is expected, it shall be taken care during stress analysis as per Clause 5.0 Point 27.
3		Coating and wrapping for pipe sleeves and pipes crossing dyke walls, shall be as per standard specification for surface Preparation and protective coating (6-79-0020).

3.5 FLARE PIPING

S.No.	Type	Description
1	Layout	Flare header shall be sloped towards flare knock-out drum. Expansion loop shall be provided in horizontal plane as per requirement to accommodate thermal expansion. The desired slope shall be ensured throughout including flat loop. Flare header shall be supported on shoe of height ranging from 100mm to 400mm.
2	Stress Analysis and supporting	Proper thermal analysis temperature shall be established including the possibility of temperature gradient along the line before providing expansion loops. Efforts shall be made to minimize the number of loops. Flare line between knock out drum and water seal drum shall be designed for pressure fluctuations and adequately supported to avoid vibrations.

3.6 UNDERGROUND PIPING SYSTEM

S.No.	Type	Description
1	Design and Layout	As per Structural Design Basis.

3.7 FLEXIBILITY ANALYSIS AND SUPPORTING

3.7.1 PIPE SUPPORTING CRITERIA & GENERAL GUIDELINES

Piping system shall be properly supported taking into account the following:

S.No.	Project Philosophy
1	Sustained Loads including weight of Piping (Bare pipe, service fluid, valves, flanges etc), Weight of Insulation (if any), - Weight of online equipments (if any), Weight of instruments (if any). Thermal loads due to operating/design/steam out/decoking or any other possible abnormal condition. Occasional Loads such as Wind/Seismic loads(as and when required). Pressure relief loads due to safety valve operation, Dynamic loads due to pulsating flow/two phase with slug flow, Pressure-Thrust loads in case of expansion joints, Differential settlement for tanks.

S.No.	Project Philosophy
2	The design of piping systems shall take into account the different conditions expected during operation, start-up, shut-down, cold branch in case of standby pump, tracing, etc. Hydrocarbon lines shall be designed for steam-out conditions, if so specified in Process document. System where combination of different operating conditions are envisaged, such system shall be analysed for all possible combinations e.g. ejector system etc.

3.7.2 BASIC SPANS, GUIDES SPACING

S.No.	Project Philosophy
1	Pipe supporting shall preferably follow the basic span as given in 7-44-0506 except for flare line in offsite on trestles in which case the basic span shall be restricted to max. 18.0 metres. For sizes not covered in 7-44-0506, basic span shall be established based on project requirement. For piping on rack or sleeper, as a minimum, providing resting support on every grid of pipe rack/sleeper is mandatory.
2	Guides shall be provided on straight run of pipes at intervals as specified in 7-44-0507, unless specifically becomes non-viable due to flexibility problems.

3.7.3 SUPPORTING

S.No.	Project Philosophy
1	Guides, anchors, special supports like spring supports and sway braces shall be provided based upon detailed analysis of piping system to restrict the forces on nozzles of critical equipments like pumps, compressors, turbines, exchangers, Air coolers etc.
2	A permanent support, either resting or spring support shall be provided for lines which do not need any supporting otherwise but require supporting during maintenance.
3	In the heaters where steam air decoking provision is there, the main lines and decoking lines should be supported in such a way that either of the lines should not be in the hanging position when not in operation.
4	Piping passing through the technology structure or passing near the concrete column etc. should have adequate space to avoid restriction of line movement during thermal expansion. The gap should take care the thermal expansion along with insulation thickness.
5	Pipe support design shall be such that deflection in piping systems due to sustained loads shall not exceed 15mm, between two adjacent supports.
6	The use of expansion joints shall be considered only when space or pressure drop limitation does not permit pipe bends. Expansion joint of axial type shall generally be avoided.
7	All pipes supports shall be so designed that there is no undue tension on equipment flanges. Forces and moments due to weight, thermal loads and other imposed loads on the equipment nozzle must not exceed the allowed loads for the equipment. In case the same is exceeded, categorical written confirmation of acceptance of the higher loads shall be obtained from the equipment supplier.

3.7.4 CORROSION PAD REQUIREMENT

S.No.	Project Philosophy
1	As per Clause 5.0 S.No. 49.

3.7.5 TRUNNION SUPPORTS

S.No.	Project Philosophy
1	As far as possible long trunnion types of supports (more than 0.5 mtr.) are to be avoided. In case long trunnion support is unavoidable in straight length of pipe, trunnion height to be preferably restricted to 0.5m and balance height to be made up by providing extended structure.

3.7.6 SUPPORTING FOR SMALL BORE LINES

S.No.	Project Philosophy
1	Adequate care shall be taken for small bore (1.5" and below) branch from piping. As a rule, for all lines in 600# & above classes, lines having two phase flow and lines having Pulsating flow such as discharge of reciprocating compressors & reciprocating pumps, all small bore branches, e.g. vents, drain, orifice taps, pressure tappings, temperature tapings, sample connections, PSV inlet, TSV inlet etc. shall be provided with 2 number stiffeners at 90° to each other from the main pipe to impart adequate stiffness to the branch connection. The stiffeners shall be made of 6mm thick flats of material equivalent to the pipe material. Further, irrespective of line rating, the stiffeners shall be provided for all orifice taps, all small bore tappings from PSV inlet / outlet lines and all small bore tappings from Control Valve manifolds.

3.7.7 SUPPORTING OF COLD INSULATED LINES

S.No.	Project Philosophy
1	High density PUF blocks shall be considered for cold piping supports. Wooden supports not acceptable.

3.7.8 ANALYSIS TEMPERATURE

S.No.	Project Philosophy
1	All lines shall be analysed at analysis temperature. In the absence of analysis temperature, lines shall be analysed at operating temperature if difference between operating & design temperatures is less than or equal to 30 deg.C, otherwise it shall be analysed at design temperature. However, analysis of flare line & calculation of thermal growth of tall equipments shall be done as per Process input. All hydrocarbon lines shall be analysed at Steam out temperature. Steam out temperature shall be taken as per the line list. In case of non-availability of line-list, it shall be taken as 30 deg.C less than the saturation temperature of type of steam.

3.7.9 LINES REQUIRING MANDATORY FORMAL ANALYSIS

S.No.	Project Philosophy
1	All process lines to and from fired heaters and steam generators
2	All process lines to and from centrifugal compressor and blower
3	All lines to and from turbines
4	All pump lines (6" & above and analysis temp > 120°C & less than -60°C) & air cooler lines.
5	Reboiler piping, Flare header/sub headers, Jacketed lines, Non metallic Piping
6	All other lines as below: 6" to 8" with analysis temp above 300°C & less than -100°C 10" to 14" with analysis temp above 150°C & less than -80°C 16"& above with analysis temp above 100°C & less than -80°C

S.No.	Project Philosophy
7	Lines requiring composite stress analysis (Piping along with Structure and Equipments), Dynamic/Wind/Seismic analysis
8	Lines requiring Flange leakage check, i.e. 26" & above except air & water lines (upto 600 rating) 4" & above, all lines (900 rating and above)
9	All other critical lines (connecting to sensitive equipments). Such as Platefin exchangers, Cold boxes (sizes 6" and above and analysis temp. > 120°C & less than -60°C)
10	For lines involving pulsating flow such as those connected to reciprocating pumps & compressors, in addition to thermal analysis, analog study for acoustic & mechanical vibration shall be done along with equipments, by approved vendor / Agency.
11	Dynamic analysis shall be performed as per Clause 5.0 S.No. 43. The fundamental frequency of the piping system shall be well above the imposed frequencies, if any, to avoid resonance. The minimum acceptable frequency for transfer lines shall be 7 Hz and for remaining lines with slug flow, it shall be 6 Hz.
12	Seismic Analysis shall be performed as per Engineering Technology Development Department Seismic analysis Design Basis.
13	Wind Analysis shall be performed as per Engineering Technology Development Department Wind analysis Design Basis.

3.7.10 ADDITIONAL REQUIREMENTS

S.No.	Type	Description
1	Software	As per Clause 5.0 S.No. 34.

3.8 MATERIALS

S.No.	Type	Description
1	Basic Material of Construction	Basic material selection of particular line depending on its service, temperature and corrosivity shall be as spelt out in process package. Detailed material specification shall follow the requirements stated herewith, except wherever specified as per Licensor's requirement. GI (hot dipped) pipe shall be used for instrument air up to 6".

3.8.1 PIPE

3.8.1.1 THICKNESS

S.No.	Project Philosophy
1	Calculation of pipe thickness and branch reinforcement shall be based on requirements of ASME B31.3 / IBR as applicable. Proper corrosion allowance and mill tolerance shall be considered while selecting nominal thickness.

S.No.	Project Philosophy
2	For carbon steel and low alloy steel pipes minimum pipe thickness shall be as follows: 'S160' up to 0.75"NB(except steam tracing), 'XS' up to 0.75"NB(for steam tracing), 'XS' for 1" to 2"NB, 'STD' for above 2NB.
3	For stainless pipes minimum pipe thickness shall be as follows: '80S' up to 0.75"NB, '40S' for 1"NB to 2"NB, '10S' for above 2"NB
4	The philosophy of minimum thickness / schedule is applicable for both seamless and welded pipes but is not applicable to category -D classes (for services in A3A, A3Yspecs etc) & firewater service(A33A), where IS pipes are being used.
5	All pipes (seamless & welded) shall have uniform negative wall thickness tolerance of 12.5% for wall thickness calculations purpose.
6	For thicknesses exceeding minimum thickness/schedule criteria, schedule XS shall be selected for CS & AS classes (for 2" & above). Intermediate schedules between STD & XS shall be ignored. Similarly for SS classes (2" & above) S10, S20, S30 & 40S may be selected beyond minimum thickness/schedule criteria.
7	Maximum 10% of corrosion allowance may be reduced in special cases, to optimize the pipe schedules.
8	For Cat-D classes, for aboveground applications, 'D/t' ratio shall be taken as 120(max.). For other than Cat-D services, 'D/t' ratio shall be generally restricted to 100 (except for Flare, Cooling water, Vacuum, O/H Vapour and Transfer lines. For these lines minimum thickness specified in clause 3.8.1(2) shall be followed). 'D' is nominal dia. and 't' is nominal thickness.
9	Pipe wall thickness shall be calculated at Class condition except as defined in Clause 3.8.1.2
10	Raw water shall be unlined carbon steel having the minimum corrosion allowance of 4.5 mm.
11	For fire water piping CS with cement lining as per BPCL-KR requirement as in JOB NO: A307 IREP.

3.8.1.2 BASIS FOR WALL THICKNESS CALCULATION

In general, the pressure-temperature combination to calculate wall thickness shall be as given. Deviation to this clause can be permitted with specific permission from HOD-Piping and Client.

Material For Groups

Group A

- (1) C.S. (A106 GR.B, A672)
- (2) LTCS (A333 GR.6)
- (3) Low Alloys
- (4) 1.25% Cr-0.5% Mo
- (5) 2.25% Cr-1.0% Mo
- (6) 5%Cr-0.5% Mo
- (7) 9%Cr-1.0% Mo
- (8) 9%Cr-1.0% Mo-V

Group B

- (1) SS (A312 TP304, 304L, 316L, 321,347)
 (2) SS (A358 TP304, 304L, 316, 316L, 321, 347)

Group C

- (1) Higher Alloys
 (2) Hastelloy

S.No.	GROUP	CLASS	SIZE	DESIGN CONDITION
1	A	150	upto 24"	Class condition
2	A	150	above 24"	Line condition (Note-1)
3	A	300	upto 14"	Class condition
4	A	300	above 14"	Line condition (Note-1)
5	A	600	upto 8"	Class condition
6	A	600	above 8"	Line condition (Note-1)
7	A	900	upto 8"	Class condition
8	A	900	above 8"	Line condition
9	A	1500, 2500	upto 4"	Class condition
10	A	1500, 2500	above 4"	Line condition
11	B	150	up to 24"	Class condition
12	B	150	above 24"	Line condition (Note-2)
13	B	300	upto 14"	Class condition
14	B	300	above 14"	Line condition (Note-2)
15	B	600	upto 6"	Class condition
16	B	600	above 6"	Line condition (Note-2)
17	B	900, 1500	upto 4"	Class condition
18	B	900, 1500	above 4"	Line condition
19	B	2500	upto 2"	Class condition
20	B	2500	above 2"	Line condition
21	C	150	upto 6"	Class condition
22	C	150	above 6"	Line condition
23	C	300 to 2500	all sizes	Line condition

NOTES:

1. Only If the thickness / schedule as per class condition exceeds XS the thickness shall be calculated based on actual design service conditions subject to a minimum of 80% class rating upto 20mm thickness. Above 20 mm thickness, it should be based on actual/design service conditions subject to minimum 20mm.

2. Only If the thickness / schedule as per class condition exceeds 40S The thickness shall be calculated based on actual design service conditions subject to a minimum of 80% class rating upto 20mm thickness. Above 20 mm thickness, it should be based on actual/design service conditions subject to minimum 20mm.

3.8.1.3 PIPE SIZE

S.No.	Project Philosophy
1	Pipe sizes shall normally be 0.5", 0.75", 1.0", 1.5", 2.0", 3", 4", 6", 8", 10", 12", 14", 16", 18", 20", 24", 26", 30", 36", 40", 44", 48", 52", 54", 56", 60", 64", 72", 78", 80"

3.8.1.4 TYPE

S.No.	MATERIAL	SIZE	TYPE
1	CS, LTCS, AS (except for Cat 'D' fluids)	Upto 14"	Seamless

S.No.	MATERIAL	SIZE	TYPE
2	CS, LTCS, AS (except for Cat 'D' fluids)	16" and Above	E.F.S.W.
3	SS (Process lines)	Upto 12"	Seamless
4	SS (Process lines)	14" and Above	E.F.S.W.
5	SS (Non process lines)	Upto 12"	Seamless
6	SS (Non process lines)	14" and Above	E.F.S.W
7	CS (Cat 'D' fluids & Fire water service except Raw water service)	ALL	Welded
8	Hastelloy, DSS	Upto 12"	Seamless
9	Hastelloy, DSS	14" & Above	E.F.S.W

3.8.2 FITTINGS

S.No.	Type	Description
1	Material	
2	Type	Type of Fittings shall be equivalent to pipe type
3	Thickness / Rating	Thickness of fittings at ends to match pipe thickness for BW fittings SW fittings shall be 3000#, 6000# or 9000# depending on the pipe thicknesses S80, S160 and above S160 respectively.
4	Branch Connections	
4.1	Upto 600#	1.5" NB and below : Half Couplings/Tees 2" and above : Tees/Pipe to Pipe with or without reinforcement
4.2	900# and above	Equal tee/unequal tee shall be used for all sizes. In case of non availability of unequal tees, o-lets may be used. Usage of sweepo-let shall be avoided due to poor availability globally.
5	Mitres	Mitres shall be used in Category 'D' service above 6"NB. Elbows(seamless/welded) are acceptable in place of mitres, however, thickness of elbows shall be same as mitres. Seamless elbows are acceptable in place of welded elbows. For other than Category 'D' fluid in 150# and 300# Class mitres can be permitted for sizes above 48". Mitres to be designed as per ASME B31.3. However, use of mitres shall be minimum.
6	Unions	Union shall not to be used in lines other than Cat-D water lines.

3.8.3 FLANGES

S.No.	Type	Description
1	Type	

S.No.	Type	Description
1.1	For 150 class rating	Upto 1.5" : SW RF (with Non-metallic Gasket), WN RF (with metallic/Spiral Wound gasket) 2" and above : WN RF for CS (other than Cat.D), AS & SS (Cryo) ; LJ FF+Stub Ends for SS other than Cryo(LJ flanges shall be avoided on vertical portion of SS pipeline) SO RF for Cat.D service up to 24" and SO FF for Cat.D service 26" and above
1.2	For 300,600 class rating	Upto 1.5" : SW RF 2" and above : WN RF
1.3	For 900 class rating and above	All sizes : WN RTJ
2	Hydraulic Bolt Tensioning	Shall be performed to the extent and as defined in 6-76-0002

3.8.4 GASKETS

S.No.	RATING	MATERIAL/SERVICE	TEMPERATURE	TYPE	GASKET OR STRIP MATL+FILLER MATL/RTJ GASKET MATL
1	150	CS & SS(utilities & except steam)	up to 371 Deg.C	PLAIN	BS 7531 Gr. X
2	150	CS & LTCS (Process and steam)	up to 371 Deg.C	Spiral wnd	SS316+Grafoil
3	150	AS (all services)	up to 371 Deg.C	Spiral wnd	SS316+Grafoil
4	300 & 600	CS	up to 427 Deg.C	Spiral wnd	SS316+Grafoil
5	300 & 600	AS	All	Spiral wnd	SS316+Grafoil
6	150, 300, 600	SS (other than utilities)	All	Spiral wnd	SS316+Grafoil (where trim material is SS304/316) SS316L+Grafoil (where trim material is SS304L/316L)
7	300(*), 600(*), 900, 1500, 2500	CS	All	Octagonal RTJ	Soft Iron
8	300(*), 600(*), 900, 1500, 2500	AS	All	Octagonal RTJ	5Cr-Alloy steel

S.No.	RATING	MATERIAL/SERVICE	TEMPERATURE	TYPE	GASKET OR STRIP MATL+FILLER MATL/RTJ GASKET MATL
9	300(*), 600(*), 900, 1500 2500	SS	All	Octagonal RTJ	SS

(*) Only if RTJ is specially mentioned in PMS.

3.8.5 VALVES

S.No.	Type	Description
1	SW Valves	Upto 1.5 inch, for 150#, 300#, 600# (except ball & plug valves).
2	Flanged Valves	Above 2.0 inch for 150#, 300#, 600#. Ball & Plug valves shall be flanged for all sizes.
3	BW Valves	900# and above
4		Metal to metal seated ball valve shall be used on all flow, pressure and level tapings as per P&ID requirement.

3.8.6 STRAINERS

S.No.	Type	Description
1	Y-Strainers	As per Clause 5.0 S.No. 42.1.
2	T-Strainers	As per Clause 5.0 S.No. 42.2.

3.8.7 TRAPS

S.No.	Type	Description
1	Main line drains up to 600# Rating / Steam Supply Manifold	Pre-fabricated Compact Steam Trapping assemblies with thermodynamic Steam traps
2	Main line drain for 900# and above	Thermodynamic/Bimetallic Steam traps with conventional fabricated Steam Trap Assembly.
3	Traps in Steam Tracing Lines	As per Clause 5.0 Point 28
4	Process Traps	As per Process Data Sheets

3.8.8 NDE REQUIREMENTS (IF NOT SPECIFIED IN PMS)

S.No.	Type	Description
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S.No.	Type	Description
1	General	Extent of NDE in all cases shall depend on severity of application. In case of any conflict in NDE specifications, more stringent NDE shall apply. Radiography to be minimised at site due to proximity with existing plants . If at all required ,proximity radiography to be taken . TOFT/PAUT to be considered to the extent possible.
2	No radiography	Category 'D' service as per B31.3
3	5% Radiography of Butt welds and DP/MP testing of Fillet welds	150#, 300#, 600# Normal Hydrocarbon service, CS & SS & LTCS
4	10% Radiography of Butt welds and DP/MP testing of Fillet welds	150#, 300#, 600# in IBR, Firewater
5	20% Radiography of Butt welds and DP/MP testing of Fillet welds	150#, 300#, 600# up to 3% Cr AS - General Services. 150#, 300#, 600# NACE, Caustic - CS& SS. 150#, 300# Hydrogen & Oxygen- CS.
6	100% Radiography of Butt welds and DP/MP testing of Fillet welds	All ratings for Cryo, 5%Cr and above AS, High temp. applications (>500 deg.C), severe cyclic Piping. 900# and above for all services . 600# and above for hydrogen& oxygen in CS. NACE, Oxygen, Hydrogen, Caustic for all ratings for up to 3% Cr AS.

In case of any conflict amongst the radiography requirements above or any other specifications, the more stringent requirement shall be followed.

3.9 THERMAL INSULATION OF PIPING, EQUIPMENT & VESSELS

S.No.	Type	Description
1	Hot Insulation	As per 6-44-0002
2	Cold Insulation	As per 6-44-0003

3.10 PAINTING

S.No.	Type	Description
1	Shop and Field Painting	As per Clause 5.0 S.No. 23.
2	Colour Coding requirements	As per Clause 5.0 S.No. 24.
3	Environment	As per Clause 5.0 S.No. 21.

3.11 WELDING

S.No.	Type	Description
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S.No.	Type	Description
1	Applicable Codes & Stds.	Process Piping - B31.3 (all requirements) Indian Boiler Regulations (all requirements) ASME BPV Sec. IX(Welding and Brazing Qual.) ASME BPV Sec.V (Non Destructive Examination) ASME BPV Sec.II Pt.C (Welding rods, electrodes & filler materials)
2	Welding Specification	As per 6-77-0001

3.12 MISCELLANEOUS

S.No.	Type	Description
1	Positive Material Identification	Positive material identification (PMI) test shall be done as per EIL specifications for positive material identification(PMI). PMI shall be carried out for all AS/SS piping and NACE and H2 piping. Other CS piping - for all piping with rating 600 & above. PMI shall be done for pressure balancing lines of all valves above category.

4.0 SPECIFIC DESIGN REQUIREMENTS

4.1 HYDROGEN SERVICE REQUIREMENTS

4.1.1 PIPES, FITTINGS AND FLANGES

S.No.	Project Philosophy
1	All carbon steel pipes, fittings and flanges having wall thickness 9.53 mm and above shall be normalised. Cold drawn pipes and fittings shall be normalised after the final cold draw pass for all thicknesses. In addition, fittings made from forgings shall have Carbon - 0.35% max. and Silicon - 0.35% max. The normalising heat treatment shall be a separate heating operation and not a part of the hot forming operation.
2	All alloy steel (Cr-Mo) pipes, forgings and fittings shall be normalised and tempered. The normalising and tempering shall be a separate heating operation and not a part of the hot forming operation. The maximum room temperature tensile strength shall be 100,000 psi.
3	For carbon steel pipes, fittings and flanges, hardness of weld and HAZ shall be 200 BHN (max.). For alloy steel, hardness of weld and HAZ shall be 225 BHN (max.).

S.No.	Project Philosophy
4	For all Carbon steel and Alloy steel pipes, fittings and flanges with wall thickness over 20mm, Charpy-V Notch impact testing shall be carried out in accordance with paragraph UG-84 of ASME Section VIII, Div-1 for weld metal and base metal from the thickest item per heat of material and per heat treating batch. Impact test specimen shall be in complete heat treated condition and accordance with ASTM A370. Impact energies at 0°Celsius shall average greater than 27J (20 ft-lb) per set of three specimens, with a minimum of 19J (15 ft-lb). If welding is used in manufacture, impact testing of Heat Affected Zone(HAZ) & weld metal shall also be carried out.

4.1.2 VALVES

4.1.2.1 GENERAL

S.No.	Project Philosophy
1	All valve castings shall be of radiographic quality. All cast valve flanges & bodies with flange rating of class 900 or greater shall be examined in accordance with paragraphs 7.2 through 7.5 of Appendix-7 of ASME SEC-VIII, DIV.1, regardless of casting quality factor. Only Normalized and Tempered material shall be used in the following specifications: Castings : A217 Gr.WC1, A217 Gr.WC4, A217 Gr.WC5, A217 Gr.WC6, A217 Gr.WC9, A217 Gr.C5, A217 Gr.C12 Forgings : A182 Gr.F11 Cl.2 PMI shall be executed & documented for all alloy steel and SS valves including bypass piping, valves & internals. Also PMI is required for pressure balancing line/600 & above CS piping/For all piping of AS/SS/NACE/H2.

4.1.2.2 HELIUM LEAK TEST

Body / bonnet / cover joints & stuffing box of all valves shall have low emission. One valve per metallurgy, per rating, per size shall be helium leak tested as per ASME Sec.V, Subsection A, Article 10 (Detector Probe Technique), Appendix IV at a minimum of 25% of the allowable (rated) cold working pressure. Selection of valves for helium leak test shall be at random. Test duration shall be as follows :

S.No.	PRESSURE CLASS	NOMINAL SIZE	TEST DURATION(in Minutes)
1	Upto 300	Upto 2"	3
2	Upto 300	3" to 6"	6
3	Upto 300	8" to 16"	9
4	Upto 300	18" to 24"	9
5	600	Upto 2"	6
6	600	3" to 6"	9
7	600	8" to 16"	9
8	600	18" to 24"	12

S.No.	PRESSURE CLASS	NOMINAL SIZE	TEST DURATION(in Minutes)
9	800 & 900	Upto 2"	9
10	800 & 900	3" to 6"	12
11	800 & 900	8" to 16"	12
12	800 & 900	18" to 24"	15
13	1500	Upto 2"	12
14	1500	3" to 6"	15
15	1500	8" to 16"	15
16	1500	18" to 24"	18
17	2500	Upto 2"	12
18	2500	3" to 6"	18
19	2500	8" to 16"	18
20	2500	18" to 24"	21

The valve shall show no leakage. No leakage is defined as a total leakage rate of less than 0.0001 ml/s of helium.

4.1.2.3 CS & AS VALVES

S.No.	Project Philosophy
1	Bend test and Magnetic Particle inspection of the entire surface of body and bonnet casting shall be in accordance with ASTM A217. Supplementary requirement S3 & S4 evaluation of magnetic particle, inspection shall be in accordance with MSS-SP-53 except that no linear discontinuities shall be allowed. The Brinell hardness of heat treated casting shall not exceed 200 BHN for carbon steel & 225 for alloy steel. Repair of defective casting shall be outlined in writing to the purchaser before repair starts. Repair method to be approved prior to welding. Casting shall be preheated to a minimum of 400°F prior to welding and all Chromium-Molybdenum alloys shall be postweld heat treated after welding is complete. Stress relieving is essential for welds. Carbon steel shall be normalized and alloy steels shall be normalized & tempered. Dye Penetrant test of welds shall be in accordance with ASTM B165 Procedure B-2. Interpretation as per Appendix-8 of ASME-VIII Div.1. The tensile stress for AS shall be less than 100,000 psi. Charpy V-notch impact testing is to be done for valve material (average 20 ft-lb for set of 3 [minimum value 15 ft-lb] at 30 F). For radiography and acceptance criteria of Valve castings, refer Paragraph 2 of Clause 4.1.2.4(1)

4.1.2.4 SS VALVES

S.No.	Project Philosophy
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S.No.	Project Philosophy
1	Casting and test bar shall be heat treated together. Valve casting shall be in solution heat treated and pickled condition. Critical body and bonnet casing section typically defined by ASME B16.34 shall be radiographed and shall meet ASTM E446 (upto 2" thick) Category A,B & CA Level 2, Category CB, OC & CD Level 3, Category D,B & F Level 0. For wall thickness 2" to 4.5" comparable plates of ASTM E186 shall be used. ASTM E94 and ASTM E142 shall be used for recommended practice & controlling quality of radiography as guide. The entire surface of all castings shall be dye-penetrant inspected after pickling. Repair welds shall be 100% radiographed and evaluated in accordance with paragraph 344.5 of ASME B31.3 with a minimum casting quality factor of 0.95. Dye Penetration test shall be as per ASTM E165 Procedure B-2, Interpretation as per Appendix-8 of ASME-VIII Div.1.

4.2 TECHNICAL REQUIREMENTS FOR PIPING MATERIAL

This is applicable over and above the requirements specified in Clause 3.8.

4.2.1 GENERAL

S.No.	Type	Description
1	Ends : Unless otherwise specified, the ends shall be to the given standard	SW/SCRD : ASME B16.11 BW : ASME B16.25 FLANGED : ASME B16.5 and ASME B16.47 SERIES 'B' and MSS SP-44 for 22" THREADING : ASME/ANSI B1.20.1 (NPT, Taper threads) up to 1.5" and IS-554 for 2" to 6"
2	Face Finish shall be to MSS-SP-6/ASME B46.1 / ASME B16.5 / B16.47. The interpretation shall be as given	Stock Finish : 250-1000 μ in AARH Serrated Finish /Smooth Finish/125 AARH : 125-250 μ in AARH Extra Smooth Finish/63 AARH : 32-63 μ in AARH
3	Austenitic Stainless Steel requirements	
3.1		All items/parts shall be supplied in solution annealed condition
3.2		For all Austenitic Stainless steels, Intergranular Corrosion (IGC) Test shall be conducted as per following : ASTM A262 Practice 'B' with acceptance criteria of 60 mils/year (max.) for casting. OR ASTM A262 Practice 'E' with acceptance criteria of 'No cracks as observed from 20X magnification' & microscopic structure to be observed from 250 X magnification" for other than casting. For IGC test, two sets shall be drawn from each solution annealing lot; one set corresponding to highest carbon content and other set corresponding to the highest rating/thickness.

S.No.	Type	Description
3.3		For all items of stabilised SS grades (SS321, SS347), stabilizing heat treatment shall also be done. It shall be carried out subsequent to normal solution annealing. Soaking temperature and holding time shall be 900°C and 4hrs respectively
4	Threaded joints	Upto 204 deg.C, threaded joints shall be made with 1" width PTFE joining tape. Above 204 deg.C, threaded joints shall be seal welded with a full strength fillet weld. All threaded joints, irrespective of pressure and temperature, for critical services including toxic fluid, hydrogen etc shall be seal welded with a full strength fillet weld. Threaded joints shall be avoided in hydro carbon services, to the extent feasible.
5	Piping used in fire fighting system	Piping used in fire fighting shall be marked as such.

4.2.2 PIPES

Unless specifically exempted, welded pipes shall be acceptable only with longitudinal weld made employing automatic welding.

S.No.	Project Philosophy
1	Spiral Weld pipes shall be acceptable only for Category D and Fire Water services.
2	Unless mentioned otherwise in the material code, double seam 180 deg. apart is allowed for sizes 36" and larger only.
3	Galvanised Pipes shall be only Hot Dip galv. to ASTM A53.

4.2.3 FITTINGS

S.No.	Project Philosophy
1	All fittings shall be seamless in construction unless otherwise specified.
2	For reducing BW fittings having different wall thickness at each end, the greater one shall be employed and the ends shall be matched to suit respective thickness.
3	All welded fittings shall have maximum negative tolerance equivalent to pipe selected.
4	All welded fittings shall be double welded. Inside weld projection shall not exceed 1.6mm, and the welds shall be ground smooth at least 25mm from the ends.
5	For fittings made out of welded pipe, the pipe itself shall be of double welded type, manufactured with the addition of filler material and made employing automatic welding only.
6	All welded fittings shall be normalized for CS, normalized & tempered for AS; and 100% radiographed by X-ray for all welds made by fitting manufacturer as well as for welds on the parent material.
7	Bevel ends of all BW fittings shall undergo 100% MP/DP test.
8	Those used in fire fighting facilities shall be marked.

4.2.4 FLANGES

S.No.	Project Philosophy
1	Bore of weld neck flange shall correspond to the inside diameter of pipe for specified schedule/thickness. Ends shall be beveled to suit the specified schedule / thickness.
2	For RTJ flanges, only octagonal section ring joint flanges shall be used.

S.No.	Project Philosophy
3	Minimum Hardness of groove of RTJ flanges of given materials, blinds and spacers shall be as given : Carbon Steel : 140BHN 1% Cr to 5%, 9% Cr : 150BHN Type 304, 316, 321, 347 : 160BHN Type 304L, 316L : 140BHN
4	For RTJ flanges, blinds & spacers, the hardness of the groove shall be specified on the test report.

4.2.5 VALVES

4.2.5.1 GENERAL

S.No.	Type	Description														
1		Valves of Class 900 & above shall be pressure-seal type. Threaded and seal welded or welded bonnet may be employed upto sizes 1.5".														
2		All flanged valves (except forged) shall have flanges integral with the valve body. Weld-on flanges shall be made by full penetration joints and 100% radiographed.														
3		Forgings are acceptable in place of Castings but not vice-versa.														
4		No cast iron valves to be used in firewater or any other service except in drinking water service. Valves used in drinking water service shall be of ductile cast iron.														
5		Valve under LTCS (Low temperature Carbon Steel temperature below -29°C to -45°C) and cryogenic service (below -45°C) shall meet the requirements of BS-6364 and shall be procured from pre-qualified vendor. Pre-qualification test as per BS-6364 is mandatory regardless of intended service.														
6		Face-to-Face/End-to-End dimension shall be as per ANSI B16.10. In case the same is not covered under B16.10, the dimension shall be as per BS 2080/Manufacturer’s Std.														
7	By pass arrangement															
7.1	A globe type valve shall be provided as bypass for the given sizes of gate valves. Size of bypass valve shall be 0.5" for main valve up to 4", 0.75" for main valve of 6" and 8" size and 1" for main valves 10" and above.	<table><tr><td>Class Rating</td><td>Size of valve requiring bypass</td></tr><tr><td>150</td><td>26" and above</td></tr><tr><td>300</td><td>16" and above</td></tr><tr><td>600</td><td>6" and above</td></tr><tr><td>900</td><td>4" and above</td></tr><tr><td>1500</td><td>4" and above</td></tr><tr><td>2500</td><td>3" and above</td></tr></table>	Class Rating	Size of valve requiring bypass	150	26" and above	300	16" and above	600	6" and above	900	4" and above	1500	4" and above	2500	3" and above
Class Rating	Size of valve requiring bypass															
150	26" and above															
300	16" and above															
600	6" and above															
900	4" and above															
1500	4" and above															
2500	3" and above															

S.No.	Type	Description
7.2		Bypass piping, fittings and valves shall be of compatible material and design. By-pass attachment to the main valve body shall not be screwed. All fillet welds for by-pass installation shall be 100% examined by DP/MP test and Butt-weld joints shall be 100% examined by radiography. NDT of bypass valve shall be in line with main valve.
8	Radiography of castings	All casting shall be of radiographic quality. This requirement to be ensured by sample radiography before proceeding with the actual production. Radiography procedure, areas of casting to be radiographed, and the acceptance criteria shall be as per ASME B16.34. Percentage of radiography shall be as given below.
8.1	Hydrogen/Hydrogen bearing hydrocarbons, oxygen, NACE service, stress relieved classes	Class 150 : 50% up to 24" and 100% for 26" & above Class 300 : 50% up to 16" and 100% for 18" and above
8.2	LT/Cryo services	Class 150 : 20% up to 24" and 100% for 26" & above Class 300 : 20% up to 16" and 100% for 18" and above
8.3	Stabilized grades of SS	100% radiography irrespective of size or rating
8.4	All services other than those mentioned at 5.8.1, 5.8.2, 5.8.3, Category-D services, Fire water	Class 150 CS : 5% up to 24" and 100% for 26" and above Class 150 AS & SS : 10% up to 24" and 100% for 26" & above Class 300 : 10% up to 16" and 100% for 18" and above
8.5	All services	Class 600 & above : 100% radiography for all sizes
8.6	Category 'D' , Fire water	NIL
9	Ball/Plug /Butterfly valve requirements	
9.1		Each valve shall be supplied with a lever / wrench except for gear operated / motor operated valves
9.2		Soft-seated ball, plug & butterfly valves shall be supplied with antistatic devices.
9.3		The ball of ball valve shall not protrude outside the end flanges of valve.
9.4	Ball valves shall be of floating ball / trunnion mounted type as given:	150# : Up to 8"-Floating ball;10" & above- Trunnion mounted 300# : Up to 4"- Floating ball; 6" & above- Trunnion mounted 600# and above : Up to 1.5"- Floating ball; 2" & above- Trunnion mounted
9.5		Use of soft seated ball/plug/butterfly valves shall be suitably selected based on temperatures handled.
9.6		Butterfly valves shall be suitable for throttling application.

S.No.	Type	Description
9.7		For Process (Hydrocarbon) services butterfly valve shall be triple offset, high performance type.
9.8		Quarter-turn valves shall have "open" position indicators with limit stops.
9.9		Fire safe valves shall be used for all Hydrocarbon services.

4.2.5.2 VALVE OPERATION REQUIREMENT

Manual mode of operation shall also be provided for all MOVs. Requirement of Gear operator for manual mode of operation shall be defined below.

Gear operation shall be provided as given. For sizes lower than these ranges, hand wheel / lever / wrench shall be provided. For pressure balance plug valves manufacturer's recommendation shall be acceptable. Hand wheel diameter shall not exceed 750mm and lever length shall not exceed 500mm on either side. Effort to operate shall not exceed 35 Kg at hand wheel periphery. However, failing to meet the above requirements, vendor shall offer gear operation.

Group Valve Type

- A Gate Valve, Globe Valve & Diaphragm Valve
- B Ball Valve / Plug Valve (Other than pressure balance plug valves)
- C Butterfly Valve

S.No.	VALVE GROUP	CLASS	SIZE REQUIRING GEAR-OPERATOR
1	A	150 Class	12" and larger
2	A	300 Class	12" and larger
3	A	600 Class	10" and larger
4	A	900 Class	6" and larger
5	A	1500 Class	3" and larger
6	A	2500 Class	3" and larger
7	B	150 Class	6" and larger
8	B	300 Class	6" and larger
9	B	600 Class	4" and larger
10	B	900 Class	3" and larger
11	B	1500 Class	3" and larger
12	C	150, 300 Class	6" and larger

4.2.6 STRAINERS

S.No.	Project Philosophy
1	Allowable pressure drop when specified shall be certified by vendor along with the offer. If asked specifically, vendor shall furnish pressure drop calculations.
2	All 2" & higher sized Y type strainers shall be provided with 0.75" flanged drain connection on the blind flange/as per P&ID. For less than 2", this shall be 0.5" size/as per P&ID. All connections shall be flanged type (threaded connections in strainers are not allowed).
3	Bottom flange of Y-type strainer shall not have tapped hole. Full length standard size studs shall be used for joining blind flange.

S.No.	Project Philosophy
4	For fabricated strainers, all BW joints shall be fully radiographed and fillet welds shall be 100% DP/MP.
5	All the strainers shall be hydrostatically tested at the lower of twice the design pressure and 1.5 times the class rating as per ASME B16.5 at ambient temperature.

4.2.7 TRAPS

S.No.	Project Philosophy
1	Vendor shall furnish the performance curve indicating the capacity in mass/hour at various differential pressures across the trap.
2	Parts subject to wear and tear shall be suitably hardened.
3	Traps shall function in horizontal as well as in vertical installation.
4	Traps shall have integral strainers.
5	All traps shall be hydrostatically tested to twice the design pressure. Air traps shall be tested at 1.5 times the design pressure.

4.2.8 HOSES

S.No.	Project Philosophy
1	Manufacturer shall guarantee suitability of hoses for the service and working conditions specified in the requisition, even if the material is not specified in the Material Requisition for any particular service.
2	All hoses shall be clearly marked with service and working pressure at both ends.
3	Hoses shall be resistant to ageing, abrasion and suitable for outdoor installations.
4	Complete Hose assembly shall be tested at two times the design pressure.
5	Rubber Steam hoses shall be subject to steam resistance test.

4.2.9 EXPANSION JOINTS

S.No.	Project Philosophy
1	The applicable codes are ASME B31.3 and EJMA (Expansion Joint Manufacturer's Association).
2	Bellows shall be formed from solution annealed sheet conforming to the latest ASTM Spec.
3	Any longitudinal weld shall be 100% radiographed. The finished longitudinal weld must be of the same thickness and same surface finish as the parent material. Circumferential welds are not permitted.
4	Bellows are to be hydraulically or expansion (punched) formed. Rolled formed bellows are not acceptable. Noticeable punch or die marks resulting from expansion operation are not acceptable.
5	No repairs of any kind are allowed on the bellows after forming. Deep scratches and dents are not acceptable.
6	The out of roundness shall be limited to $\pm 3\text{mm}$. This is the max. deviation between the max. & min. diameter.
7	The actual circumference of the welding end shall be maintained to $\pm 3\text{mm}$ of the theoretical circumference.
8	Apart from the usual requirements, the vendor shall also furnish Design calculations to justify stiffness and fatigue life, Axial, lateral stiffness, angular stiffness, effective pressure thrust area, Installation/maintenance manual and Moments & forces due to stiffness & pressure thrust due to expansion joint. List of expansion joints shall be submitted along with data sheet.

4.2.10 SUPPORTS AND SPRING ASSEMBLIES

S.No.	Project Philosophy
1	The Material, Design, Manufacture and Fabrication shall be generally as per MSS-SP-58/ MSS-SP-89 and/or BS 3974.
2	Testing of springs shall be as per BS1726

4.2.11 GASKETS

S.No.	Project Philosophy
1	Asbestos shall not be used for gaskets and fillers.
2	Full face gaskets shall have bolt holes punched out
3	Non-metallic ring gaskets as per ASME B16.21 shall match flanges to ASME B16.5 upto 24", and ASME B16.47 or AWWA for sizes > 24" unless otherwise specified.
4	Spiral wound gaskets as per ASME B16.20 shall match flanges to ASME B16.5 upto 24", and ASME B16.47 series 'B' for sizes > 24" unless otherwise specified.
5	Inner ring shall be provided for the following: a) As per code (B 16.20) requirement. b) For sizes 26" & above in all classes. c) For vacuum, cryo and hydrogen service. d) For SS321, SS347 and H-grade SS classes. e) For classes where temperature is higher than 427°C. f) For 900# rating and above classes.(If PMS specifies spiral wound gasket)
6	In case of RTJ gaskets, only octagonal section ring gaskets shall be used & shall have proper marking stamped. Material certificate shall be available for the gasket. Hardness of RTJ gaskets shall be 20 BHN(min) less than the corresponding flange groove hardness.

4.2.12 STUDS, BOLTS, NUTS

S.No.	Project Philosophy
1	All bolting shall be as per ASME B18.2.1 for Studs, M/C Bolts and Jack screws, and ASME B18.2.2 for nuts.
2	Threads shall be unified (UNC for $\leq 1"$ dia and 8UN for $> 1"$ dia) as per ANSI B1.1 with class 2A fit for Studs, M/C Bolts and class 2B fit for nuts.
3	Stud bolts shall be threaded full length with two heavy hex nuts. Length tolerance shall be in accordance with the requirement of ASME B16.5
4	The nuts shall be double chamfered, semi-finished, heavy hexagonal type and shall be made by the hot forged process.
5	All the stud/ bolt should have metallurgical certificates in case of alloy/ SS metallurgy with identified colour marking at the stud ends/ bolt side face.
6	Heads of jack screws and M/C bolts shall be heavy hexagonal type. Jack screw end shall be rounded.
7	Wherever bolt tensioning is specified stud bolt length shall be longer by minimum one diameter to suit bolt tensioner. Excess threads shall be protected by a threaded nut.

4.2.13 SPECIAL SERVICE REQUIREMENTS

S.No.	Type	Description
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S.No.	Type	Description
1	IBR	IBR stands for Indian Boiler Regulation. For steam services, it is statutory obligation to meet IBR requirements. For items under IBR material composition restrictions, test reports, painting, etc. shall be as per IBR's stipulations.
2	NACE & Sour Service	For items under this category EIL Standard Specification 'Material requirements for Carbon steel components used in sour service in Petroleum Refinery Environments, 6-79-0013' shall be followed.
3	CRYO & Fire-Safe	For items to be used under LTCS (low temperature Carbon Steel -29°C to -45°C) and cryogenic conditions, temp below -45 °C and those required to be fire-safe, special designs and tests would be applicable. Pre-qualification criteria need to be specified before execution of job.
4	Impact Tests	Welded Pipes and Fittings used below ASME Temp. -29 °C shall be impact tested as per requirement of ASME B31.3.

4.2.14 INSPECTION AND TESTING

S.No.	Project Philosophy
1	All items and their parts shall be subjected to all mandatory as well as supplementary (wherever specified) tests and checks called for in the respective codes/standards/data sheets.
2	The examining personnel shall have the requisite qualification and experience.
3	Client and its authorized representative reserve the right to vet and suggest changes in vendor's procedures.
4	Vendor's works and facilities shall be accessible to the Client/Representative at all reasonable times.
5	Test reports for all mandatory as well as supplementary tests wherever specified shall be furnished.
6	Positive material identification test at vendor's works shall be done as per 'Standard specification for positive material identification PMI at vendor's works, 6-81-0001'.

4.2.15 MARKING

S.No.	Project Philosophy
1	All items shall be marked (stamped/etched) in accordance with the applicable code/standard/specification. In addition, the item code, if available, shall also be marked.
2	For ease of identification, the colour of painted strip (wherever required) shall be as per the applicable standard.
3	Paint or ink for marking shall not contain any harmful metal or metal salts which can cause corrosive attack either ordinarily or in service. Special items/smaller items shall have attached corrosion resistant tag providing salient features.

4.2.16 DISPATCH

S.No.	Project Philosophy
1	All items shall be dry, clean and free from moisture, dirt and loose foreign material of all kinds.

S.No.	Project Philosophy
2	All items shall be protected from rust, corrosion, and mechanical damage during transportation, shipment and storage.
3	Rust preventive on machined surfaces to be welded shall not be harmful to welding and shall be easily removable with a petroleum solvent. Pipes shall be preserved with rust preventive oil.
4	Ends shall be suitably protected, and the protectors shall be securely and tightly attached.
5	Each variety and size of item shall be supplied in separate packaging marked with the purchase order no., item code (if available), and the salient specifications.
6	Carbon steel, LTCS and low alloy steel valves shall be painted with one coat of inorganic zinc silicate primer.

5.0 OWNER / CLIENT SPECIFIC REQUIREMENTS

S.No.	Description	Selected Option
1	Equipment spacing (ISBL)	Generally OISD norms / Licensor requirements
2	Minimum pipe rack width (Main Pipe Rack)	As per equipment layout
3	Spare capacity on Rack / Sleeper	10% for Units and 25% for Offsites.
4	Cooling water lines	On rack upto 30" Underground above 30"
4.1	FW lines (in Units)	As per General Civil Design Basis
5	Minimum height of sleeper	300mm (with pavement) or 600mm (without pavement/ gravel below pipe rack. Pipeline at grade level to be avoided, to the extent feasible. In the case of drains minimum height from drain - min 150 mm with pavement & min 300 mm with out pavement.
6	Air cooler location	On Pipe rack / Tech structure top
7	Location of pumps:	
7.1	In Units	Pump discharge 1m (MIN.) outside rack with motor towards rack
7.2	In Offsites	Cover shed
8	Requirements of monorail on pumps:	
8.1	Under pipe rack / shed	NONE
8.2	Open area	Where crane/hydra access is not possible.
9	Means for Exchanger bundle removal:	
9.1	In Open area at grade and on Tech Structures top floor open to sky	Hydro Extractor
9.2	On Tech Structures except top floor open to sky	Hydro Extractor (Provision shall be made for chain pulley block arrangement on both sides of heat exchanger for handling floating head, channel covers, etc.)
10	Offsites Piping (On sleepers / Pipe Rack)	Generally Pipe Rack, however, sleepers may be considered in localized areas
11	Battery limit valves' operation:	
11.1	OSBL Piping on sleepers	Operable from ground / platform at grade level

S.No.	Description	Selected Option
11.2	OSBL/ISBL Piping on Piperack	
11.2.1	Valves at grade level	Operable from ground / platform at grade level
11.2.2	Valves at Piperack level	Operable from platform
12	Pipe way road crossing	Culvert / Overhead pipe bridges(pipe bridges to the extent possible)
13	Electrical cable routing underground / above ground	As per Electrical Design Basis
14	Instrument cable routing underground / above ground	As per Instrumentation Design Basis
15	Any requirement of statutory approval.	IBR regulations for projects in India
16	Safety shower / eye wash	As per P & ID, Equipment Layout
17	Requirement of elevators	As per Specific requirement of Client/Licensors
18	Compressor house for ISBL & OSBL:	
18.1	Location	Under shed
18.2	Maintenance requirement	E.O.T(ISBL) H.O.T(OSBL)
19	Instrument Air Drier Shed	Required
20	Insulation material: Hot Cold Safety Electrical heat tracing	Material selection and thickness as per agreed Process Design Basis and in place of safety insulation Wire mesh cages/ protection guards as per EIL specification A307-000-16-43-SP-0002 shall be provided.
21	Type of environment for selection of painting system	Industrial Marine (As per EIL Painting spec 6-79-0020/ agreed job specification.)
22	Method of surface preparation: Mechanical tools Power tool cleaning Blast cleaning	Blast cleaning (Grit blasting) No sand blasting is permitted. Power tool cleaning for repair painting.
23	Corrosion protection below insulation:	
23.1	CS Pipe (upto 125 DEG C operating temperature)	As per EIL Painting spec 6-79-0020/ agreed job specification.
23.2	SS Pipe: Cold Insulated Hot insulated	As per EIL Painting spec 6-79-0020/ agreed job specification.
24	Specific colour coding requirements	As per BPCL-KR Color Code/agreed job specification.Color coding for all pipes/ fittings shall be implemented.
25	Usage of IS grade material	Limited to Cat-D services as per ASME B31.3 & Fire water service
26	Usage of asbestos sheet gasket	Not permitted
27	Provision for high settlement in tank farm: Usage of dresser coupling in tank farms Flexibility of piping	Flexibility of piping. (if required, Bellow to be used instead of dresser coupling)

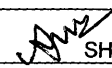
S.No.	Description	Selected Option
28	Steam tracing	Conventional 1/2" NB CS pipe tracing with balanced pressure thermostatic steam traps. Bought out Standard modules of Steam distribution & Condensate Recovery with "integral glandless piston valves" for Steam Station and "integral glandless piston valves and trap valve station" for Condensate recovery. Condensate Return station shall have Balanced pressure thermostatic steam traps. All steam tracing piping shall be hydro tested. Outlets of steam traps shall be routed away from the pipe rack.
29	Bulk Material Supplier	Project Vendor list approved BPCL
30	Engineering Drawing mode	Electronic - ISBL/OSBL
31	Specific software package for engineering drawings:	PDS/PDMS for Units and Offsites. Isometric drawings to include Design pressure, Temperature, NDT requirement & hydro test pressure.
32	Material Control System	EIL in-house software package
33	Item Coding system	EIL practice
34	Stress analysis package	CAESAR-II All inputs data shall be submitted to BPCL-KR in soft format (.C2) for future modification of the existing line.
35	Access to nozzles of columns	Platform for 'manholes, nozzles with valves, spectacle blinds and instruments' (However, ladder access may be provided for Instrument connections including root valves)
36	Staircase / Ladders for tall columns	Ladder
37	Provision of breakup flanges for removal of tube bundles of heat exchangers	Required / To be established during 3D model review.
38	Height of pipe support pedestals	300 mm
39	Mandatory Bulk Material Escalation	EIL Standard
40	Cathodic Protection of Tankage and U/G Piping	As per SED (Static Eqpt. Dept.) Design Basis
41	Cast iron valves	None, except in drinking water service for sizes 2" NB and above
42	Strainers:	
42.1	Y Type	Upto 1.5" irrespective of service 2" & above in steam service
42.2	T type	2" & above in services other than steam
43	Dynamic stress analysis	Required for: Two phase flow lines with slug/plug flow, Transfer lines and Lines identified by Licensor
44	Piping isolation valve for instruments/ Stand Pipes	As per P&ID/ Process Design Basis

S.No.	Description	Selected Option
45	Disposal of nonrecoverable condensate in units & offsites: Through U/G header to storm water sewer Soak Pit	As per Process Design Basis
46	Sequence of burner piping near peep-doors	Valves to be operable while viewing from peepholes
47	Sea Water Piping	-
48	Spiral Weld pipes	IS pipes for Category D services & Fire Water service.
49	Corrosion Pad on bare pipe	For 2" NB and above on pipe rack/sleeper
50	Special requirements for Hydrogen service	As per Clause 4.1

Annexure-5

वाल्वों के लिए तकनीकी टिप्पणियाँ

TECHNICAL NOTES FOR VALVES

7	13.07.17	REVISED AND ISSUED AS STANDARD SPECIFICATION	 PK	 SH	 MI	 RN
6	04.08.10	REVISED AND ISSUED AS STANDARD SPECIFICATION	RN	ATD	SC	DM ND
5	04.07.08	REVISED AND ISSUED AS STANDARD SPECIFICATION	RN	SC	DM	VC
4	15.11.00	REVISED AND ISSUED AS STANDARD SPECIFICATION	RN	BRB	NS	MI
3	04.04.94	ISSUED IN LINE WITH GENERAL REVISION	AKG	NS	GRR	AS
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

AARH :	Arithmetic Average Roughness Height
ANSI :	American National Standards Institute
API :	American Petroleum Institute
ASME :	American Society of Mechanical Engineers
ASTM :	American Society for Testing & Materials
BGO :	Bevel Gear Operator
BHN :	Brinell Hardness Number
BIS :	Bureau of Indian Standards
BS :	British Standard
BVIS :	Bureau Veritas Industrial Services
BW :	Butt Weld
CAT :	Category
CEIL :	Certification Engineers International Limited
CS :	Carbon Steel
DFT :	Dry Film Thickness
DNV :	Det Norske Veritas
DP :	Dye-Penetrant
eDMS :	Electronic Document Management System
IBR :	Indian Boiler Regulations
IGC :	Inter Granular Corrosion
IS :	Indian Standard
LT :	Low Temperature
LTCS :	Low Temperature Carbon Steel
MOV :	Motor Operated Valve
MP :	Magnetic Particle
MR :	Material Requisition
NDT :	Non Destructive Testing
PMI :	Positive Material Identification
PO :	Purchase Order
PR :	Purchase Requisition
RFQ :	Request for Quotation
SCRD :	Screwed
SS :	Stainless Steel
SW :	Socket Weld

Piping Standards Committee

Convenor : Mr M. Ismaeel

Members : Mr. Amrendra Kumar
Mr. G. Balaji
Mr. Udayan Chakravarty
Mr. K.J. Harinarayanan (S&ME)
Mr. S. Ghoshal (Process-2)
Mr. G.K. Iyer (Projects)
Mr. Pankaj Kumar Rai (Construction)

CONTENTS

1.0	GENERAL	4
2.0	DOCUMENTATION.....	4
3.0	DESIGN AND CONSTRUCTION.....	5
4.0	OPERATION	9
5.0	INSPECTION AND TESTING	9
6.0	RADIOGRAPHY OF CAST VALVES.....	10
7.0	IBR CERTIFICATION.....	11
8.0	MARKING.....	11
9.0	DESPATCH.....	11
10.0	ATTACHMENTS	12
11.0	REFERENCES.....	12

1.0 GENERAL

- 1.1 Vendor shall supply valves in accordance with the valve specification sheets along with auxiliaries, if any, such as gear operator, bypasses, drains, locking arrangements etc. wherever specified in the specification sheets, subject notes and other enclosures to the material requisition (MR).
- 1.2 Vendor shall quote in strict accordance with the valve data / specification sheets, subject technical notes and all other enclosures to the MR. For 'Cat-I valves', no deviations whatsoever shall be accepted. Post Order Waiver/ Deviation format 5-0000-0180-F1 as mentioned in Cl. 5.17 of specification for Quality Management System Requirements from Bidder (6-78-0001) is not applicable for Cat-I valves. For Cat-II Valves, if exceptions/ deviations become absolutely must, the same shall be requested as explained in clause 2.3.6 giving reasons for seeking such exceptions/ deviations.
- 1.3 All codes and standards for manufacture, testing, inspection etc. shall be of latest editions as on issue date of RFQ.

2.0 DOCUMENTATION

- 2.1 All document submissions to EIL shall be through EIL eDMS.
- 2.2 For 'Cat-I' valves, no documents shall be submitted with the offer.
- 2.3 For 'Cat-II' valves, vendor shall submit the following documents with the offer:
- 2.3.1 Manufacturer's complete descriptive and illustrative catalogue / literature.
- 2.3.2 Detailed dimensioned cross section drawing with parts / material lists, weight etc.
- 2.3.3 Drawings for valves with accessories like gear operator, hydraulic / pneumatic operator, motor, extension bonnet, extended stems with stands, bypass etc. giving major salient dimensions.
- 2.3.4 One copy of the valve specification sheets signed as "Accepted" by the manufacturer. Deviations, if any shall be marked as applicable on the valve specification sheet.
- 2.3.5 If the valve is regretted or has no deviation, the manufacturer shall write clearly on valve specification sheets as "Regret" or "No Deviation".
- 2.3.6 For 'CAT-II' valves, if there is any deviation, the same shall be listed clausewise.
- 2.3.7 On failure to submit documents as specified in clauses 2.1.1 to 2.1.6 above, the offer is likely to be rejected.
- 2.4 The following documents shall be submitted through eDMS of EIL after placement of the order:
- 2.4.1 For Cat-I valves to manufacturers' standard specified in MR/valve specification sheet, detailed dimensioned cross section drawing with parts, materials, weight, etc. shall be submitted for records/information.

- 2.4.2 For 'Cat-II' valves, Vendor shall submit for review drawings mentioned in clauses 2.1.2 & 2.1.3 before start of manufacture. No other drawings shall be submitted for review.
- 2.4.3 Test report shall be supplied for all mandatory tests as per the applicable code. Test reports shall also be furnished for any supplementary tests as specified in clauses 3.13, 3.14 & 3.15.
- 2.4.4 Material test certificates (physical properties, chemical composition & heat treatment report) of the pressure containing parts shall be furnished for the valves supplied. Material test certificates for the other parts shall also be furnished for verification during inspection.
- 2.5 In addition to submissions through EIL eDMS, Catalogues/Drawings shall be in submitted in hard copies (6 sets) and soft copies (2 CDs/DVDs) along with delivery for Purchaser's record for all categories/types of valves.

3.0 DESIGN AND CONSTRUCTION

- 3.1 Valve shall be designed, manufactured, tested, inspected and marked as per the manufacturing standards, design codes and standards indicated in the respective valve specification sheets. Any conflict between the requisition, enclosures, specification sheets and referred standards/codes shall be brought to the notice of the purchaser for clarifications and resolution, before proceeding with the manufacture. The purchaser's decision shall be final and binding to the vendor. The drawings submitted for review shall not include any deviations except as communicated in writing in Deviation permits. The Drawings shall be reviewed only for design and construction features.
- 3.2 All flanged valves shall have flanges integral (except forged valves) with the valve body. Flange face finish shall be normally specified in the valve specification sheet as 125 AARH etc. The interpretation for range of face finish shall be as follows:

Stock Finish	: 1000 μ in AARH max.
125 AARH	: Serrations with 125 to 250 μ in AARH
63 AARH	: 32 to 63 μ in AARH

- 3.3 For all weld end valves with bevel end as per ASME B16.25, the contour of bevel shall be as follows:

Material	Wall Thickness	Weld Contour
Carbon Steel (Except Low Temp. Carbon Steel)	Upto 22 mm	Figure 2 Type A
	> 22 mm	Figure 3 Type A
Alloy Steel, Stainless Steel & Low Temp. Carbon Steel	Upto 10 mm	Figure 4
	> 10 mm & Upto 25 mm	Figure 5 Type A
	> 25 mm	Figure 6 Type A

Valve ends shall match thickness of the connecting pipe. Sloping of inside contour of valves shall be done wherever necessary to achieve this.

3.4 For flanged valves with ring joint flanges the hardness shall be as follows:

Flange Material	Min. Hardness of Groove (BHN)
Carbon Steel	140
1% Cr to 5% Cr, 9% Cr	150
Type 304, 316, 321, 347	160
Type 304L, 316L	140

3.5 Following requirements for check valves shall be met over and above the valve specification sheet requirements:

3.5.1 Unless specified otherwise in the data sheet all check valves 3" & above (except in 900#, 1500# & 2500# rating) shall have a drain boss at location "G" (Refer Fig.No.1 of ASME B16.34) where pocket is formed in valve body. A tapped drain hole with plug shall be provided as per ASME B16.34. Threads shall be as per ASME B1.20.1 (Taper) NPT.

3.5.2 For heavy check valves, provisions shall be available for lifting by way of lugs, eye bolts and other such standard devices.

3.6 If an overlay weld-deposit is used for the body seat ring seating surface, the corrosion resistance of the seat ring base material shall be at least equal to the corrosion resistance of the material of the shell.

3.7 Following valve bypass requirements shall be met:

3.7.1 By-pass requirement for Gate valves shall be as follows unless otherwise mentioned.

ASME 150 Class	On sizes 26" and above
ASME 300 Class	On sizes 16" and above
ASME 600 Class	On sizes 6" and above
ASME 900 Class	On sizes 4" and above
ASME 1500 Class	On sizes 4" and above
ASME 2500 Class	On sizes 3" and above

3.7.2 The by-pass piping arrangement shall be such that clearance between main valve body and by-pass assembly shall be the minimum possible for layout reasons. Vendor shall follow the sketch enclosed in Specification No. 6-44-0052-A1.

3.7.3 By-pass valve shall be a globe valve. The sizes shall be as under:

On main valve $\leq$ 4"	:	1/2"
On main valve 6" to 8"	:	3/4"
On main valve 10" & above	:	1"

By-pass piping shall be of same metallurgy as main valve. The by-pass piping, fittings and valve tag numbers shall be as specified in Specification No. 6-44-0052-A2. In case details of by-pass arrangement for any Valve tag number is missing, Vendor shall bring the same to notice of EIL and provide by-pass as per details specified.

3.7.4 Vendor shall supply the by-pass valve duly tested and fitted to the main valve. Valves with by-pass shall have the direction of flow marked on the main valve. By-pass attachment to the

- main valve body shall not be screwed. All fillet welds for by-pass installation shall be 100% examined by DP/MP test and Butt-weld joints shall be 100% examined by radiography.
- 3.8** Valve body / bonnet shall be forged / cast as specified. Forgings are acceptable in place of casting but not vice-versa.
- 3.9** Stem shall be forged or machined from forged / rolled bar. No casting is permitted. However, integral stem of cast material is acceptable for Plug valves.
- 3.10** Stellite / hardfacing by deposition, shall be minimum 1.6 mm.
- 3.11** Renewable seat rings shall be seal welded for valves of size 3" and above to prevent loosening in service.
- 3.12** For Low Temperature & Cryogenic valve requirements, refer Specification.No.6-44-0052-A3 unless otherwise specified.
- 3.13** For Hydrogen service valve requirements, refer Specification.No.6-44-0052-A4 unless otherwise specified.
- 3.14** Valves under 'NACE' category shall meet the requirements specified in MR-0103 unless otherwise specified.
- 3.15** For all austenitic stainless steel valves Inter Granular Corrosion (IGC) test shall be conducted as per the following:
- 3.15.1 ASTM A262 Practice 'B' with acceptance criteria of '60 mils/year (max.)' for all materials - forged, rolled, wrought and casting.
- Or
- ASTM A262 Practice 'E' with acceptance criteria of 'No cracks as observed from 20X magnification' for all materials other than castings. 'Microscopic structure to be observed from 250X magnification' in addition.
- 3.15.2 When specifically asked for in MR for high temperature application of some grades of austenitic stainless steel (eg. SS309, 310, 316, 316H etc.) ASTM A262 Practice 'C' with acceptance criteria of '15 mils/year (max.)' shall be conducted.
- 3.15.3 For the IGC test as described in Clauses 3.15.1 & 3.15.2, two sets of samples shall be drawn from each solution annealing lot. One set shall correspond to the highest Carbon content and the other to the highest pressure rating. When testing is conducted as per practice 'E', photograph of the microscopic structure shall be submitted for record.
- 3.16** All types of 321 or 347 stainless steel valves shall be in a stabilised heat treated condition. Stabilising heat treatment shall be carried out subsequent to the normal solution annealing. Soaking temperature and holding time for stabilising heat treatment shall be 900°C and 4 hours respectively.
- 3.17** Spiral wound bonnet gaskets are to be provided with inner/outer ring except when encapsulated gaskets type body-bonnet joints are employed. Outer ring may be avoided in case of non-circular spiral wound gasket used in 150# valve provided the outermost layer of spiral touches the bolts ascertaining the centering.
- 3.18** All Stainless Steel Castings shall be solution heat treated.

3.19 Only normalized and tempered material shall be used in the following specifications :

Castings : A217 Gr.WC1, A217 Gr.WC4, A217 Gr.WC5, A217 Gr.WC6, A217 Gr.WC9, A217 Gr.C5, A217 Gr.C12

Forgings : A182 Gr.F11 Cl.2, A182 Gr.F12 Cl.2

3.20 Ball / Plug / Butterfly Valves

3.20.1 As a prequalification, fire safe test as per API 607 / API 6FA / BS EN ISO 10497 (Supersedes BS 6755 Part II) shall be carried out on soft seated ball, plug & butterfly valves and also on lubricated plug valves. The test shall be witnessed and certified by a third party inspection agency like Lloyds, BVIS, DNV or EIL/ CEIL unless otherwise specified. The vendor has to submit test certificate for the particular design of the valve offered, if fire safe design is required as per the Valve Material Specification sheet..

3.20.2 Each valve shall be supplied with a lever / wrench except for gear operated / motor operated valves.

3.20.3 Soft-seated ball, plug & butterfly valves shall be supplied with antistatic devices.

3.20.4 BW / SW end ball valves shall have a 100 mm long seamless pipe nipple welded to each end of the valve. Nipples are to be welded prior to assembling Teflon seats / seals. Specifications of the nipples shall be as indicated in the MR.

3.20.5 The face-to-face dimensions of all ball valves shall be same as those of gate valves of the corresponding ANSI class (except 10" onwards in Class 150 where the face-to-face dimensions shall be as per API 6D long pattern).

3.20.6 The ball of ball valve shall not protrude outside the end flanges of valve.

3.20.7 Ball valves shall be of floating ball/trunnion mounted type as per following:

150#	8" & below	Floating ball
	10" & above	Trunnion mounted
300#	4" & below	Floating ball
	6" & above	Trunnion mounted
600# & above	1.5" & below	Floating ball
	2" & above	Trunnion mounted

3.20.8 Unless otherwise specified in the data sheets, bore of all reduced bore ball valves shall be limited to one size lower than the nominal bore.

3.21 The MOVs are to be installed in an open area and the actuators shall be suitable for all weather conditions. The testing of complete assemblies of MOVs along with the actuators shall be done by the supplier at his works.

3.22 Ends of flanged valves of 22" size shall match corresponding flanges to MSS-SP44 unless otherwise specified.

3.23 Yoke material shall be same as bonnet material where maximum temperature specified is more than 427°C.

4.0 OPERATION

4.1 Gear operation shall be provided as under:

Valve Type	Class	Size Requiring Gear-Operator
Gate Valve, Globe Valve & Diaphragm Valve	150 Class	12" and larger
	300 Class	12" and larger
	600 Class	10" and larger
	900 Class	6" and larger
	1500 Class	3" and larger
	2500 Class	3" and larger
Ball Valve / Plug Valve (Other than pressure balance plug valves)	150 Class	6" and larger
	300 Class	6" and larger
	600 Class	4" and larger
	900 Class	3" and larger
	1500 Class	3" and larger
Butterfly Valve	150, 300 Class	6" and larger

For sizes lower than these ranges, hand wheel / lever / wrench shall be provided. For pressure balance plug valves manufacturer's recommendation shall be acceptable provided the requirements specified in clause 4.6 are met.

- 4.2 Gear operator shall be provided, with position indicators for open / close positions and with limit stops. (Limit stops are not applicable for gate and globe valves).
- 4.3 Where gear operator is not called for as per Clause 4.1 but vendor recommends a gear operator, the same shall be highlighted.
- 4.4 Gear operator shall be so designed as to operate effectively with the differential pressure across the closed valve equal to the cold non-shock pressure rating.
- 4.5 Ball, plug and butterfly valves, shall have "Open" position indicators with limit stops.
- 4.6 Hand wheel diameter shall not exceed 750mm and lever length shall not exceed 500mm on either side. Effort to operate shall not exceed 35 Kg at handwheel periphery. However, failing to meet the above requirements, vendor shall offer gear operated valve and quote as per clause 4.3.

5.0 INSPECTION AND TESTING

- 5.1 Every valve shall be subjected to all the mandatory tests and checks called in the respective codes / data sheet by EIL inspection or any third party as approved by the purchaser. For IBR valves refer clause 7.0.
- 5.2 Every valve, its components and auxiliaries must be subjected to all the mandatory tests and checks called for in the respective codes, data sheets etc. by the manufacturer.
- 5.3 Though the extent of inspection shall be as under, exact extent with hold points shall be decided by EIL regional inspection office and recorded in the form of inspection plan. In case of third party inspection, the inspection plan shall be approved by the purchaser.

Forged Valves:

1. Visual and dimensional inspection.
2. Review of material test certificates.
3. Any mandatory or supplementary test.
4. Hydrostatic test on 10% valves selected on random basis.
5. Strip check is required for 1% of total ordered quantity of Gate & Globe valves (min. 1 No.) for each Valve sheet no., however, strip check is not required for CS/ Brass/ Bronze material valves with 13% Cr/ Brass/ Bronze trims.

Cast Steel Valves:

1. Visual and dimensional inspection.
2. Review of material test certificates.
3. Review of radiographs/radiographic reports or any other NDT tests wherever applicable as per data sheet.
4. Any mandatory or supplementary test.
5. Hydrostatic test 100% for body, 10% other test.
6. Strip check is required for 1% of total ordered quantity of Gate & Globe valves (min. 1 No.) for each Valve sheet no., however, strip check is not required for CS/ Brass/ Bronze material valves with 13% Cr/ Brass/ Bronze trims.

Samples for strip check shall be selected at random and shall generally be in the highest size in the lot.

- 5.4** In case of motor operated or actuator operated valves, functional / operational checks as per the requirements of the specifications shall be made on each valve.

6.0 RADIOGRAPHY OF CAST VALVES

- 6.1** Valve castings shall undergo radiographic examination as specified below.

Material	Rating	Size Range	Radiography
All	150#	24" and below	NIL**
		26" and above*	100%
	300#	16" and below	NIL**
		18" and above	100%
	600# & above	All sizes	100%

* No radiography is required for valves of size 26" and above in cooling water service.

**For sizes 24" & below in 150# and 16" & below in 300#, radiography percentage if specifically mentioned in individual valve material spec sheet shall govern.

Radiography specified as random 10% or 20% etc. in the respective valve data sheet implies 10% or 20% etc. of number of valves ordered against each item number with a minimum of one valve against each item.

- 6.2 Radiography procedure, areas of casting to be radiographed shall be as per ASME B16.34 and acceptance criteria shall be as per ASME B16.34 Annexure-B. However for areas of casting to be radiographed for types of valves not covered in ASME B16.34, vendor shall radiograph castings in line with ASME B16.34.
- 6.3 For random radiography wherever specified in individual data sheets, the sampling shall be per size of the quantity ordered for each foundry.
- 6.4 Radiography wherever specified in the data sheets or as per clause 6.1 shall be done by X-ray / γ -ray to get the required sensitivity.

7.0 IBR CERTIFICATION

- 7.1 For valves described "IBR", valves shall be in accordance with the latest IBR (Indian Boiler Regulation) including the requirements specified in the specification.
- 7.2 For SW / BW end carbon steel valves under IBR, the chemical composition shall conform to the following:
- | | | |
|-------------------|---|------------|
| Carbon (Max) | : | 0.25% |
| Others (S, P, Mn) | : | As per IBR |
- 7.3 Valves coming under the purview of "IBR"(Indian Boiler Regulations) shall each be individually accompanied by IBR certificate original in Form III-C duly approved by IBR authority / local authority empowered by the Central Boiler Board of India. Photocopy of original certificate duly attested by the local boiler inspector where the supplier is located is the minimum requirement for acceptance.
- 7.4 All "IBR" valves shall be painted red in body-bonnet / body-cover joint.

8.0 MARKING

- 8.1 Valve markings, symbols, abbreviations etc. shall be in accordance with MSS-SP-25 or the standard referred in specification sheet as applicable. Vendor's name, valve rating, material designation, nominal size, direction of flow (if any) etc. shall be integral on the body.
- 8.2 Each valve shall have a corrosion resistant tag giving size, valve tag / code no., securely attached to the valve body.
- 8.3 Paint or ink for marking shall not contain any harmful metal or metal salts such as zinc, lead or copper which cause corrosive attack on heating.
- 8.4 Carbon Steel / Alloy Steel valves shall be painted with one coat of inorganic zinc silicate (minimum DFT 65 to 75 microns).

9.0 DESPATCH

- 9.1 Valve shall be dry, clean and free from moisture, dirt and loose foreign materials of any kind.
- 9.2 Valves shall be protected from rust, corrosion and any mechanical damage during transportation, shipment and storage.

9.3 Rust preventive on machined surfaces to be welded shall be easily removable with a petroleum solvent or shall not be harmful to welding.

9.4 Each end of valve shall be protected with the following materials:

Flange Face	:	Wood or Plastic Cover
Bevelled End	:	Wood or Plastic Cover
SW & SCRD. End	:	Plastic Cap

9.5 End protectors of wood / plastic to be used on flange faces shall be attached by at least three bolts and shall not be smaller than the outside diameter of the flange. However, plastic caps for SW & SCRD end valves shall be press fit type.

9.6 End protectors to be used on bevelled end shall be securely and tightly attached.

9.7 For special service valves additional requirement for despatch shall be as prescribed in data sheet.

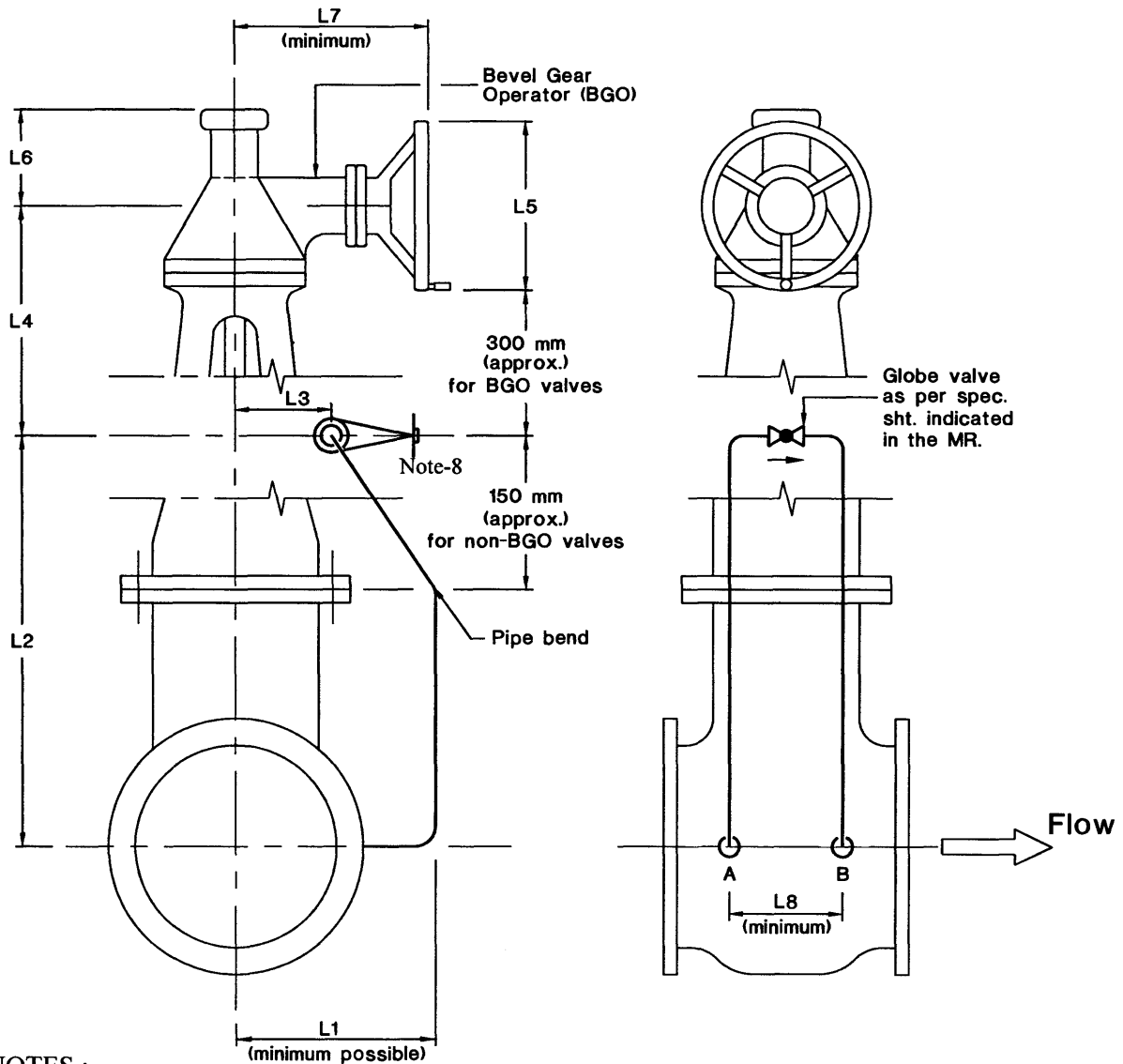
10.0 ATTACHMENTS

6-44-0052-A1	:	Bypass Piping Arrangement
6-44-0052-A2	:	Specifications for Bypass Piping, Fittings and Valves
6-44-0052-A3	:	Special Requirements for Low Temperature and Cryogenic Valves
6-44-0052-A4	:	Special Requirements for Hydrogen Service Valves

11.0 REFERENCES

6-78-0001	:	Specification for Quality management system requirements from bidders
6-78-0003	:	Specification for documentation requirements from suppliers
6-81-0001	:	Specification for Positive Material Identification (PMI) at Supplier's Works
6-81-0004	:	Inspection and Test plan for Valves

BYPASS PIPING ARRANGEMENT



NOTES :

1. The orientation & location of handwheel of bevel gear operator & the bypass arrangement shall be strictly as per this sketch.
2. The bypass connection ends shall be socket welded upto 600# and butt welded for 900# and above rating.
3. The bypass arrangement shall be properly clamped to & supported by the body of the main valve.
4. Basic design of bypass shall be to MSS-SP-45.
5. Material of bypass pipe & 90° elbows shall be same or equivalent to the body material as indicated in Specification No. 6-44-0052-A2.
6. This sketch is applicable for both BGO & NON-BGO Valves.
7. Vendor shall furnish dimensions L1 to L8.
8. Stem shall not be horizontal in the case of CRYO Valves

SPECIFICATIONS FOR BYPASS PIPING, FITTINGS AND VALVES

Class (Main Valve Sht.no.)	Pipe	Fittings	Bypass Valve Sht.no.
A1A(51301), A3A(51321), A9A(51301), A10A(51301), A11A(51301), A33A(51301), B1A(51401), B9A(51401), D1A(51501), D9A (51501)	ASTM A106 Gr.B (SMLS) 0.5"-0.75": S160 1.0"-1.5" : XS	ASTM A105 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52001
A6A(51301), B6A(51401)	ASTM A106 Gr.B (SMLS) 0.5"-0.5" : XXS 0.75"-1.5": S160	ASTM A105 0.5"-0.5" : SW 9000# 0.75"-1.5": SW 6000#	52001
A13A(51301), B13A(51401)	ASTM A106 Gr.B (SMLS) 0.5"-1.5" : XXS	ASTM A105 0.5"-1.5" : SW 9000#	52001
A2A(51302), B2A(51402), D2A (51502)	ASTM A106 Gr.B (SMLS)- IBR 0.5"-0.75": S160 1.0"-1.5" : XS	ASTM A105 - IBR 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52002
A4A (51303), B4A (51403), D4A (51503)	ASTM A333 Gr.6 (SMLS)- LT 0.5"-0.75": S160 1.0"-1.5" : XS	ASTM A350Gr.LF2- LT 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52003
A5A (51304), B5A (51404), D5A (51504)	ASTM A106 Gr.B (SMLS) -H2 0.5"-0.75": S160 1.0"-1.5": XS	ASTM A105 - H2 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52004
A7A (51307)	ASTM A106 Gr.B (SMLS) 0.5"-0.75" : S160 1.0"-1.5": XS	ASTM A105 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52007
A16A (51311), B16A (51411), D16A (51511)	ASTM A106 Gr.B (SMLS) - NACE 0.5"-0.5" : XXS 0.75"-1.5": S160	ASTM A105 - NACE 0.5"-0.5" : SW 9000# 0.75"-1.5": SW 6000#	52011
A19A (51313), B19A (51413), D19A (51513)	ASTM A106 Gr.B (SMLS) 0.5"-0.75" : S160 1.0"-1.5": XS	ASTM A105 0.5"-0.75": SW 6000# 1.0"-1.5" : SW 3000#	52013
E1A (51601), F1A (51701)	ASTM A106 Gr.B (SMLS) 0.5"-1.5" : S160	ASTM A234 Gr.WPB/ ASTM A105 0.5"-1.5" : BW, S160	52101
E2A (51602), F2A (51702)	ASTM A106 Gr.B (SMLS) - IBR 0.5"-1.5" : S160	ASTM A234 Gr.WPB/ ASTM A105 - IBR 0.5"-1.5" : BW, S160	52102
E5A (51604), F5A (51704)	ASTM A106 Gr.B (SMLS) - H2 0.5"-1.5" : S160	ASTM A234 Gr.WPB/ ASTM A105 - H2 0.5"-1.5" : BW, S160	52104
E9A (51605), F9A (51705)	ASTM A106 Gr.B (SMLS) 0.5"-1.5" : SCH XXS	ASTM A234 Gr.WPB/ ASTM A105 0.5"-1.5" : BW, SCH XXS	52105
E19A (51613), F19A (51713)	ASTM A106 Gr.B (SMLS) 0.5"-1.5" : SCH XXS	ASTM A234 Gr.WPB/ ASTM A105 0.5"-1.5" : BW, SCH XXS	52113

Class (Main Valve Sht.no.)	Pipe	Fittings	Bypass Valve Sht.no.
A5Y (51384), A33Y (51384)	ASTM A106 Gr.B (SMLS) 0.5"-1.5" : S160	ASTM A105 0.5"-1.5" : SW 6000#	52085
A1D (51330), B1D (51430), D1D (51530)	ASTM A335Gr.P11(SMLS) 0.5"-0.75" : S160 1.0"-1.5" : XS	ASTM A182 Gr.F11Cl.2 0.5"-0.75" : SW 6000# 1.0"-1.5" : SW 3000#	52030
D2D (51531)	ASTM A335Gr.P11 (SMLS) - IBR 0.5"-0.75" : S160 1.0"-1.5" : XS	ASTM A182 Gr.F11Cl.2 - IBR 0.5"-0.75" : SW 6000# 1.0"-1.5" : SW 3000#	52031
B5D (51432), D5D (51532)	ASTM 335Gr.P11(SMLS)- H2 0.5"-0.75" : S160 1.0"-1.5" : XS	ASTM A182 Gr.F11Cl.2 - H2 0.5"-0.75" : SW 6000# 1.0"-1.5" : SW 3000#	52032
B1E (51433)	ASTM A335Gr.P22(SMLS) 0.5"- 0.75" : S160 1.0"-1.5" : XS	ASTM A182 Gr.F22Cl.3 0.5"-0.75" : SW 6000# 1.0"-1.5" : SW 3000#	52033
D5E (51534)	ASTM A335Gr.P22(SMLS) - H2 0.5"-0.75" : S160 1.0"-1.5" : XS	ASTM A182 Gr.F22Cl.3 - H2 0.5"-0.75" : SW 6000# 1.0"-1.5" : SW 3000#	52034
A4F (51336), B4F (51436)	ASTM A335 Gr.P5(SMLS) 0.5"-0.75" : S160 1.0"-1.5" : XS	ASTM A182 Gr.F5 0.5"-0.75" : SW 6000# 1.0"-1.5" : SW 3000#	52036
B3F (51436)	ASTM A335 Gr.P5(SMLS) 0.5"-1.5" : XXS	ASTM A182 Gr.F5 0.5"-1.5" : SW 9000#	52036
A4G (51339), B4G (51439)	ASTM A335 Gr.P9(SMLS) 0.5"-0.75" : S160 1.0"-1.5" : XS	ASTM A182 Gr.F9 0.5"-0.75" : SW 6000# 1.0"-1.5" : SW 3000#	52039
F2D (51731)	ASTM A335 Gr.P11 (SMLS) - IBR 0.5"-1.5" : S160	ASTM A234Gr.WP11Cl.1/ A182 Gr.F11Cl.2 - IBR 0.5"-1.5" : BW, S160	52131
E5E (51634)	ASTM A335 Gr.P22(SMLS) - H2 0.5"-0.75" : S160 1.0"-1.5" : XS	ASTM A234Gr.WP22Cl.1/ A182 Gr.F22Cl.3 - H2 0.5"-0.75" : BW, S160 1.0"-1.5" : BW, XS	52134
A1K (51345), A3K (51345), B1K (51445), D1K (51545)	ASTM A312 TP304(SMLS) 0.5"-0.75" : 80S 1.0"-1.5" : 40S	ASTM A182 Gr.F304 0.5"-1.5" : SW 3000#	52045
A2K (51346), B2K (51446), D2K (51546)	ASTM A312 TP304(SMLS) - CRYO 0.5"-0.75" : 80S 1.0"-1.5" : 40S	ASTM A182 Gr.F304 - CRYO 0.5"-1.5" : SW 3000#	52046
B4K (51448), B5K (51448)	ASTM A312 TP304H (SMLS) 0.5"-1.5" : 80S	ASTM A182 Gr.F304H 0.5"-1.5" : SW 3000#	52048

Class (Main Valve Sht.no.)	Pipe	Fittings	Bypass Valve Sht.no.
A6K (51350), B6K (51450)	ASTM A312 TP304L (SMLS) 0.5"-0.75" : 80S 1.0"-1.5" : 40S	ASTM A182 Gr.F304L 0.5"-1.5" : SW 3000#	52050
A1M (51361), B1M (51461)	ASTM A312 TP316(SMLS) 0.5"-0.75" : 80S 1.0"-1.5" : 40S	ASTM A182 Gr.F316 0.5"-1.5" : SW 3000#	52061
B5M (51462)	ASTM A312 TP316H (SMLS) - H2 0.5"-0.75" : 80S 1.0"-1.5" : 40S	ASTM A182 Gr.F316H - H2 0.5"-1.5" : SW 3000#	52062
B3M (51463)	ASTM A312 TP321(SMLS) 0.5"-0.75" : 80S 1.0"-1.5" : 40S	ASTM A182 Gr.F321 0.5"-1.5" : SW 3000#	52063
A1N (51366), B1N (51466)	ASTM A312 TP 316L (SMLS) 0.5"-0.75" : 80S 1.0"-1.5" : 40S	ASTM A182 Gr.F316L 0.5"-1.5" : SW 3000#	52066
B6N (51471)	ASTM A312 TP316L (SMLS) 0.5"-0.75" : 80S 1.0"-1.5" : 40S	ASTM A182 Gr.F316L 0.5"0.5"-1.5" : SW 3000#	52071

SPECIAL REQUIREMENTS FOR LOW TEMPERATURE & CRYOGENIC VALVES

1.0 SCOPE

All valves of Low Temperature Carbon Steel (LTCS) and all grades of austenitic SS (CRYO) material are categorized as cryogenic valves. All these valves shall have extended bonnet as per BS 6364 except check valves.

Following qualification criteria shall be met by the valve vendors to quote valves for cryogenic services:

2.0 QUALIFICATION CRITERIA

- i) Both cryogenic test (clause 2.1) and reference list (clause 2.2) together shall be considered for vendor qualification and vendor shall furnish the same, along with his offer.
- ii) Vendors who do not have cryogenic test reports and reference list covering valves of all sizes, materials and ratings required by MR, should confirm / furnish the following for consideration of their offer:
 - a. Evidence of having conducted successfully at least one cryogenic test as per BS 6364. Test certificate shall be furnished with the offer.
 - b. Vendor shall confirm to conduct cryogenic test per clauses 2.1 & 2.3 for the remaining valves not later than 12 weeks from the date of purchase order.
 - c. Vendor shall also furnish reference list for valves supplied for non-cryo service if reference list referred in 2.2.1 does not cover all the sizes of MR.

Offers of vendors who do not comply with above requirements would be rejected.

2.1 Cryogenic Test

Vendors to furnish copies of cryogenic test certificate for tests conducted as per details given below:

- 2.1.1 Test shall be as per BS 6364.
- 2.1.2 Test temperature, unless specifically called for otherwise in the individual MR, shall be -45°C for LTCS and -196°C for all grades of austenitic stainless steel.
- 2.1.3. Tests carried out on a particular size of one type of valve, pressure rating and material shall qualify all sizes equal to and below the test valve size for the same type, pressure rating and material. In case of austenitic SS any one grade would qualify for all other grades of austenitic SS.
- 2.1.4. Tests should have been witnessed and certified by any one of the following third party inspection agencies; M/s Lloyd, BV, DNV, TUV or EIL/ CEIL.
- 2.1.5. Cryogenic test need not be conducted for every order. Test conducted previously and witnessed by inspection agencies listed above shall be considered acceptable and need not be repeated.

2.2 Reference List

Vendor shall furnish reference list for valves supplied for cryogenic service indicating the name of client, year of supply, size, material, pressure rating, type of valve and quantity.

2.3 Post Order Testing Procedure

2.3.1. Before conducting post order testing, vendor shall submit the following for approval:

- a. Test procedure (as per BS 6364).
- b. Cross-section drawing of the valve with material of construction.
- c. Schematic of test rig (as per BS 6364) with complete details.

2.3.2. Test has to be conducted irrespective of the service on largest size for each type of valve and for each material and class rating. Vendor shall offer one, two or three valves for selection of test valve by inspector depending upon whether quantity of largest valve in the order is one, two or three and more than three respectively.

In the event of failure of the test valve to meet the specification requirements, the vendor shall conduct test on two more valves. These two valves which pass test successfully, are of lower size, then the qualification will be valid only to sizes upto which test has been conducted successfully.

2.3.3. In case of non-conductance of cryogenic test(s) within 12 weeks or failure in the test(s) conducted after receipt of order, the owner reserves the right to invoke any of the provisions of the purchase order including cancellation of the purchase order at the risk and cost of vendor.

3.0 Bonnet extension, wherever specified in the valve sheet to BS 6364 shall be for “non cold box application” unless otherwise specified in the MR. Even if not called for in valve sheet, valves indicated as “LT” or “CRYO” shall be supplied with bonnet extension.

4.0 Bonnet and Gland extension joints shall be of butt welded/integrally cast construction.

5.0 Repair welding procedure for austenitic stainless steel valves in “CRYO” service shall have to be qualified for impact test as per ASME B31.3. Minimum acceptable impact energy shall be 20 J or lateral expansion of 0.38 mm at temperature of -196°C.

6.0 Wherever impact test of SS studs / nuts is called for in the data sheet, the impact value shall be 27 J at the intended service temperature specified in the data sheets.

SPECIAL REQUIREMENTS FOR HYDROGEN SERVICE

1.0 GENERAL

- 1.1 These requirements are applicable for valves used in Hydrogen service. These are in addition to the requirements described in "Technical Notes for Valves" Spec. No. 6-44-0052, and shall be read in conjunction with this specification.
- 1.2 All cast valve flanges & bodies with flange rating of Class 900 or greater shall be examined in accordance with paragraphs 7.2 through 7.5 of Appendix-VII of ASME SEC-VIII, DIV.1, regardless of casting quality factor.
- 1.3 Body / bonnet / cover joints & stuffing box of all valves shall have low emission. One valve per metallurgy, per rating, per size shall be helium leak tested as per ASME Sec.V, Subsection A, Article 10 (Detector Probe Technique), Appendix IV at a minimum of 25% of the allowable (rated) cold working pressure. Selection of valves for helium leak test shall be at random. Test duration shall be as follows:

Test Duration in Minutes					
Nominal Size	Pressure Class				
	Upto 300	600	800 & 900	1500	2500
Upto 2"	3	6	9	12	12
3" to 6"	6	9	12	15	18
8" to 16"	9	9	12	15	18
18" to 24"	9	12	15	18	21

The valve shall show no leakage. No leakage is defined as a total leakage rate of less than 0.0001 ml/s of helium.

- 2.0 Only normalized and tempered material shall be used in the following specifications:

Castings : A217 Gr.WC1, A217 Gr.WC4, A217 Gr.WC5, A217 Gr.WC6, A217 Gr.WC9, A217 Gr.C5, A217 Gr.C12

Forgings : A182 Gr.F11 Cl.2

3.0 CS & AS VALVES

- 3.1 Bend test and Magnetic Particle inspection of the entire surface of body and bonnet casting shall be in accordance with ASTM A217. Supplementary requirement S3 & S4 evaluation of magnetic particle, inspection shall be in accordance with MSS-SP-53 except that no linear discontinuities shall be allowed.
- 3.2 The Brinell hardness of heat treated casting shall not exceed 200 BHN for carbon steel & 225 for alloy steel.
- 3.3 Repair to defective casting shall be outlined in writing to the purchaser before repair starts. Repair method to be approved prior to welding.
- 3.4 Casting shall be preheated to a minimum of 400°F prior to welding and all Chromium-Molybdenum alloys shall be postweld heat treated after welding is complete. Stress relieving is essential for welds.

- 3.5 Carbon steel shall be normalised and alloy steels shall be normalised & tempered.
- 3.6 Dye Penetrant test of welds shall be in accordance with ASTM B165 Procedure B-2. Interpretation as per Appendix-8 of ASME-VIII Div.1.
- 3.7 The tensile stress for AS shall be less than 100,000 psi.
- 3.8 Charpy V-notch impact testing is to be done for valve material (average 20 ft-lb for set of 3 [minimum value 15 ft-lb] at 30°F).
- 3.9 For radiography and acceptance criteria for valve castings, refer Cl. 4.2.
- 4.0 SS VALVES**
- 4.1 Valve casting shall be in solution heat treated and pickled condition.
- 4.2 Critical body and bonnet casing section typically defined by ASME B16.34 shall be radiographed and shall meet ASTM E446 (upto 2" thick) Category A, B & CA Level 2, Category CB, OC & CD Level 3, Category D, B & F Level 0. For wall thickness 2" to 4.5" comparable plates of ASTM E186 shall be used. ASTM E94 and ASTM E142 shall be used for recommended practice & controlling quality of radiography as guide. The entire surface of all castings shall be dye-penetrant inspected after pickling.
- 4.3 Welds shall be 100% radiographed and evaluated in accordance with paragraph 344.5 of ASME B31.3 with a minimum casting quality factor of 0.95. Dye Penetration test shall be as per ASTM E165 Procedure B-2, Interpretation as per Appendix-8 of ASME-VIII Div.1.

- 4.9.8 Vortex meter shall be considered where high rangeability is the prime requirement.
- 4.9.9 Differential Pressure type flow transmitter shall meet all the requirements specified in clause 2.16.
- 4.9.10 Wedge flow meter shall be considered in slurry services or where powder deposits may form. However, Diaphragm seal type DP transmitter shall be provided along with wedge flow meter duly calibrated with both sensor and the transmitter.

4.10 Control Valves

- 4.10.1 Control valves shall normally be globe type. Other valve types like butterfly, ball, rotary plug, angle or 3way etc., shall be selected as per service and process requirements.
- 4.10.2 Control valve sizing shall be carried out as per ISA S75-01. The valve shall permit upto 150% of normal flow or 110% of maximum flow, whichever is higher. In general, control valves shall be sized so that the valve opening is as noted below:
- | | | |
|-----------------|---|-----------------|
| At max. flow | : | about 90% open |
| At normal flow | : | about 75% open |
| At minimum flow | : | about 20% open. |
- 4.10.3 Flanged control valves shall be used. Body material, body rating and flange rating shall be as per piping specifications. However body and flange rating shall be minimum 300#.
- 4.10.4 Minimum control valve body size shall be 1" in general. Reduced trims can also be considered.
- 4.10.5 For globe valves trim characteristics shall be equal percentage type unless required otherwise. Control valve plugs shall be heavy top guided for single seated valves. Cage guiding may be used in clean applications.
- 4.10.6 Anti-cavitation trim shall be selected wherever cavitation is expected in the valve. For flashing services and hardened trim shall be used and anti-cavitation trim shall not be provided.
- 4.10.7 Noise from control valve during operation shall be limited to OSHA specified level or better. The maximum allowable noise is 85 dBA SPL (Sound Pressure Level). Source treatment for noise may be performed by using special trims like low noise trims, in case noise exceeds the specified level. Other methods based on merit are also permissible.
- 4.10.8 Valve seat leakage shall be minimum class IV as per ANSI/FCI 70.2 unless tight shutoff requirement is required as per the P&ID.
- 4.10.9 Flanged bolted type gland packing boxes shall be used. Packing shall normally be PTFE on liquid and gas service up to 200°C (design). Graphite/graphite foil shall be used above 200°C (design) temperature. Asbestos based packing material shall not be used.
- 4.10.10 Bellows seal shall be used where it is required to isolate the packing from the process fluid or where no leakage to atmosphere can be tolerated like toxic, explosive and precious fluids.
- 4.10.11 Material used for trim shall be minimum SS 316, with guide bushing of hardened stainless steel like 440 C, 17-4 PH. For higher pressure drops (more than 10 kg/cm²) or erosive and slurry services and in general for all steam services, flashing and cavitating services, plug and seat shall be stellite.

Special cases may require 17-4 PH seat ring and 440 C solid plugs or other materials like Hastelloy, Monel etc.

- 4.10.12 Valve actuator shall be pneumatic spring opposed diaphragm type, in general. Piston type actuators may be used for very high shut off pressure requirements. Additional equipment including volume bottle necessary to meet fail safe condition shall also be included in case double acting piston type actuator is selected. In either case, actuator shall be able to withstand maximum shut-off pressure (1.5 times of design pressure) with the minimum instrument air pressure specified.
- 4.10.13 Whenever limit switches are specified as inductive proximity type, these shall meet NAMUR (DIN-19234) requirements.
- 4.10.14 Solenoid valves, wherever used, shall be universal and continuous rated type with class H coil insulation. These shall be SS body as a minimum.
- 4.10.15 Self-actuating regulators for flow, pressure and temperature shall be used where loads are constant and requirements of precision and accurate controls are not stringent.
- 4.10.16 The actuator shall be painted as below:

Direct action (open on air failure) valves	-	Green
Reverse acting (close on air failure) valve	-	Yellow
Actuator for shutdown valves	-	Red

Items like air volume tanks etc., supplied as an accessory along with the actuators, shall be painted as per corresponding actuator.

4.11 ON-OFF VALVE

- 4.11.1 On-off valves shall have flanged end connections integral to the valve body. Top entry valve design shall not be offered unless specifically indicated. Body rating of valve shall be minimum 300#.

Whenever flangeless on-off valve body design is specified, following shall apply:

- Wafer type or lug type body design for butterfly type on-off valves body size up to 6 inches.
- Lug type body design for butterfly type of on-off valve body size more than 6 inches.

- 4.11.2 For on-off valves with fire safe design, flanged body construction shall only be acceptable.

- 4.11.3 For all services where full port valves are specified, following shall apply:

- Port size shall be equal to line size for rating up to ASME Class 1500.
- Port size shall not be less than one size than the line size for rating ASME Class 2500 and above.

- 4.11.4 For steam jacketed valves, the body and port size shall be one size lower than the on-off valve end connections.

- 4.11.5 On-off valve body, bonnet, bottom flange, line flanges and other pressure containing assemblies shall be of the same material of construction as specified for valve body.

- 4.11.6 In case of ball-type of on-off valves;
- The valve design shall ensure valve seat and body protection against thermal expansion of the entrapped fluid when the on-off valve is fully close.
 - For size up to 4" and rating up to ASME Class 300, the on-off valve shall have floating ball design. For ratings ASME Class 600 and above, floating ball is acceptable for sizes less than 2". For higher sizes trunion mounted ball design shall be provided.
- 4.11.7 Rotary type on-off valves like Ball valves, butterfly valves etc. shall have blow out proof shaft guiding design.
- 4.11.8 Guide bushing shall be of a sufficiently hard material to resist side thrust on the plug or shaft.
- 4.11.9 Vendor shall be responsible for trim design and selection of the on-off valve. However, it must meet the following minimum requirements:
- The valve characteristics shall be quick-opening (on-off) type.
 - Vendor shall select proper material pairs, surface finish, hardness and clearances to avoid galling.
 - Valves operating under extreme temperature conditions, vendor shall consider increased clearances at room temperature and seal welding of threaded seat rings etc whenever required. Hard facing of trim including guide bushing shall be considered for all valves operating at high temperatures (i.e. temperature more than 200°C). For very low temperature application, material used shall have adequate cold impact strength.
 - For all on-off valves including 3-way type of valves, stem and plug shall be detachable and shall be attached together by suitable threaded design secured with a pin to avoid plug rotation during operation.
- 4.11.10 Trim material and actuator colour shall be as specified for the control valve.
- 4.11.11 Leakage class of on-off valves shall be as specified in data sheet, where no class is specified it shall be Class IV.
- 4.11.12 For on-off valves specified with Class VI / bubble tight (as per API) leakage class, vendor shall select the soft seat (elastomer) material suitable for the process conditions i.e., shut off pressure, maximum temperature and process fluid. Metal seated on-off valves meeting the leakage class shall also be acceptable.
- 4.11.13 For application in vacuum service, vendor to provide inverted packing design suitable for vacuum service. For pressure-cum-vacuum service, the on-off valve shall have dual packing design suitable for the application. Dual packing design shall also be provided for on-off valves in toxic service, with a facility to connect inert fluid between the packings.
- 4.11.14 Valve actuator shall be designed to move the valve to the failure position as specified. For failure position specified as 'fail-locked', vendor shall provide air reservoir with all required accessories to meet the fail lock position of the valve.
- 4.11.15 Whenever double acting springless type of actuator is unavoidable, all accessories like pilot valves, booster relays, non-return valve, pressure gauge, volume tank etc. shall be provided to ensure desired action on air failure.

- 4.11.16 The volume tank shall be of carbon steel construction and sized as per ASME Section VIII with design pressure of $10\text{kg/cm}^2\text{g}$ as a minimum. Each volume bottle shall be sized for a minimum of 3 valve strokes
- 4.11.17 The actuator casings and diaphragms shall be designed for minimum twice the maximum pneumatic operating pressure of the on-off valve.
- 4.11.18 Vendor shall be fully responsible for sizing and selection of correct actuator, while sizing the actuator vendor shall consider minimum actuator thrust equal to two times (2) the total force induced by shut off condition and the force required to overcome packing friction.
- 4.11.19 Wherever the valves are indicated as fire safe, they shall be tested for fire safe as per BS 6755 (Part-2) when the valves are supplied with metal-to-metal seats and shall be tested as per API 607 latest edition when the valves are provided with soft seats.
- 4.11.20 Wherever fire safe actuator and controls have been asked for, actuators and all accessories such as solenoid valves, air volume bottles etc. shall meet the fire proof requirement to ensure normal valve operation even during and after exposure to fire. Vendor shall clearly define the schemes they propose to achieve the above requirements and ensure that the proposed schemes shall meet the requirement in terms of type of exposure and exposure time of the testing procedure given in BS 6755/API 607.
- 4.11.21 Vendor shall furnish type test certificate duly witnessed by third party inspection agency like M/S LRIS, BV, DNV, TUV etc. for fire safe testing of valve, actuator and controls for the offered models.

4.12 Smart Type and Field Bus Type Positioners

Digital smart positioners or field bus type of positioners with diagnostic capabilities shall be provided as per job specific requirement. These shall meet the following minimum requirements:

- a) The positioner sensor and sensing mechanism shall be rugged and shall not be affected by the line/valve vibration. The performance of the positioners shall be immune to above vibration.
- b) The positioner's output and input range shall be field adjustable without any hardware modification. The output from the positioners shall be available for both single acting as well as double acting actuator.
- c) Each positioner shall be operable, configurable and accessible through HART compatible hand held configurator/field bus configurator as applicable. Smart positioners shall also have dedicated buttons for the above functions.
- d) Control valve's operating signatures in the form of hard copy and soft copy for each control valve provided with smart positioners shall be supplied. The necessary software for advanced control valve diagnostics like seat ring condition, gland packing condition, actuator leakage etc. shall also be included.
- e) Fieldbus positioner shall have the capability to perform functions like PID etc.
- f) All positioners shall have metallic casing and cover.

4.13 Pressure Relief Valves and Rupture Discs



PROJECT SUPPLIER LIST

JOB NO – B034

PROJECT :- MSBP

CLIENT :- BPCL-KR

Item Code : 04MH		Item Description : MECH.SEAL FOR PUMPS/AGITATORS		
1	E153	EAGLEBURGMANN INDIA PRIVATE LIMITED	INDIA	MSL
2	F149	FLOWERVE SANMAR LTD	INDIA	MSL
3	J078	JOHN CRANE SEALOL (I) LTD	INDIA	MSL

Item Code : 04DA		Item Description : PUMP-ROTARY.SCREW		
1	A185	ALEKTON ENGG INDUSTRIES PVT. LTD	INDIA	MSL
2	F635	FLOWERVE CORPORATION (FORMERLY I571)	U.S.A.	MSL
3	N151	NETZSCH TECHNOLOGIES INDIA PVT.LTD	INDIA	MSL
4	P564	POMPE VERGANI SPA	ITALY	MSL
5	P660	PLENTY MIRRLESS PUMPS	U.K.	MSL
6	R035	ROTO PUMPS LTD	INDIA	MSL

Item Code : 04DB		Item Description : PUMP-ROTARY.GEAR		
1	D033	DEL PD PUMPS & GEARS PVT. LTD.	INDIA	MSL
2	F635	FLOWERVE CORPORATION (FORMERLY I571)	U.S.A.	MSL
3	M580	MAAG PUMPS SYSTEMS AG	SWITZERLAND	MSL
4	S565	SHIMADZU CORPORATION	JAPAN	MSL
5	T194	TUSHACO PUMPS PVT. LTD	INDIA	MSL
6	V524	VIKING PUMP INC	U.S.A.	MSL
7	W599	WITTE PUMPS & TECHNOLOGY GMBH	GERMANY	MSL

Item Code : 04AB		Item Description : PUMP-CENT.HOR(SPP)		
1	A550	ARAI PUMP MANUFACTURING COMPANY LTD	JAPAN	MSL
2	C725	CLYDE UNION LIMITED (FRMLY T722 & W518)	U.K.	MSL
3	D501	DMW CORPORATION	JAPAN	MSL
4	E501	EBARA CORPORATION (JAPAN)	JAPAN	MSL
5	F156	FLOWERVE INDIA CONTROLS PVT LTD	INDIA	MSL
6	F635	FLOWERVE CORPORATION (FORMERLY I571)	U.S.A.	MSL
7	G510	GOULDS PUMPS INC	U.S.A.	MSL
8	I198	ITT CORPORATION INDIA PVT LTD	INDIA	MSL
9	K018	KSB PUMPS LTD (POONA)	INDIA	MSL
10	K087	KIRLOSKAR EBARA PUMPS LTD	INDIA	MSL
11	R611	RUHRPUMPEN GMBH(FORMERLY THYSENT509)	GERMANY	MSL
12	S401	SULZER PUMPS INDIA LIMITED	INDIA	MSL
13	S744	SULZER PUMPS (US) INC	U.S.A.	MSL

Instrumentation Items:

Item Code : 15AA		Item Description : TUBE FITTINGS		
1	A240	ASTEC VALVES & FITTINGS PVT. LTD.	INDIA	MSL
2	A345	ARYA CRAFTS & ENGINEERING PVT LTD	INDIA	MSL
3	A701	AUTOCLAVE ENGINERS FLUID COMPONENTS	U.S.A.	MSL
4	C220	COMFIT & VALVES PVT. LTD.	INDIA	MSL
5	C714	CIRCOR INSTR. TECHNOLOGIES INC-FORM.H608	U.S.A.	MSL
6	E008	EXCELSIOR ENGG. WORKS	INDIA	MSL
7	E104	EXCEL HYDRO PNEUMATICS PVT LTD	INDIA	MSL
8	F146	FLUID CONTROLS PVT LTD	INDIA	MSL
9	H634	HAM-LET (ISRAEL-CANADA) LTD.	ISRAEL	MSL
10	M058	MULTIMETAL INDUSTRIES	INDIA	MSL
11	P240	PRECISION ENGINEERING INDUSTRIES	INDIA	MSL
12	P303	PRIME ENGINEERS	INDIA	MSL
13	P307	PANAM ENGINEERS	INDIA	MSL
14	P671	PARKER HANNIFIN CORPORATION	U.S.A.	MSL
15	R002	RELIANCE ENGINEERING & ELECTRICALS CORPN	INDIA	MSL
16	S146	SEALEXCEL (INDIA) PVT. LTD.	INDIA	MSL
17	S303	SWASTIK ENGINEERING WORKS	INDIA	MSL
18	S773	SWAGELOK CO.	U.S.A.	MSL
19	S816	SSP FITTINGS CORPORATION	U.S.A.	MSL
20	T761	TK FUJIKIN CORPORATION	SOUTH KOREA	MSL
Item Code : 15AB		Item Description : INSTRUMENT TUBING		
1	H086	HEAVY METALS & TUBES LIMITED(MEHSANA)	INDIA	MSL
2	J110B	JINDAL SAW LTD (NASHIK WORKS)	INDIA	MSL
3	R066	RATNAMANI METALS AND TUBES LTD	INDIA	MSL
4	R127	REMI EDELSTAHL TUBULARS LTD (FORM RMIL)	INDIA	MSL
5	T761	TK FUJIKIN CORPORATION	SOUTH KOREA	MSL
Item Code : 15BA		Item Description : AIR FILTER REGULATORS		
1	D077	DIVYA CONTROL ELEMENTS PVT LTD	INDIA	MSL
2	J092	JANATICS INDIA PVT LTD	INDIA	MSL
3	M710	MARSH BELLOFRAM	U.S.A.	MSL
4	P293	PLACKA INSTRUMENTS INDIA P LTD	INDIA	MSL
5	S035	SHAVO NORNGREN (I) PVT LTD	INDIA	MSL
6	S091	SCHRADER DUNCAN LIMITED	INDIA	MSL
7	S242	SHAH PNEUMATICS	INDIA	MSL
8	T745	THOMPSON VALVES LTD	U.K.	MSL
9	V019	VELJAN HYDRAIR PVT LTD	INDIA	MSL
Item Code : 15BB		Item Description : MACHINE MONITORING SYSTEMS		

1	G147A	GE INDIA INDUSTRIAL PVT LTD	INDIA	MSL
2	R178	ROCKWELL AUTOMATION INDIA PVT LTD	INDIA	MSL
3	S814	SHINKAWA ELECTRIC COMPANY LTD.	JAPAN	MSL
Item Code : 15CB Item Description : SIGNAL CABLES				
1	A132	ASSOCIATED FLEXIBLES & WIRES [P] LTD	INDIA	MSL
2	C019	CMI LIMITED	INDIA	MSL
3	C145	CORDS CABLE INDUSTRIES LTD	INDIA	MSL
4	D012	DELTON CABLES LIMITED	INDIA	MSL
5	E063	ELKAY TELELINKS LTD.-	INDIA	MSL
6	K082	KEI INDUSTRIES LIMITED	INDIA	MSL
7	P254	POLYCAB WIRES PVT LTD	INDIA	MSL
8	R203	RALLISON ELECTRICALS PVT. LTD.	INDIA	MSL
9	S304	SUYOG ELECTRICALS LTD	INDIA	MSL
10	T212	THERMO CABLES LTD (FORM. T-150)	INDIA	MSL
11	U015	UDEY PYROCABLES PVT. LTD.	INDIA	MSL
Item Code : 15EA Item Description : SOLENOID VALVES				
1	A052	AVCON CONTROLS PVT. LTD.	INDIA	MSL
2	A167	ASCO NUMATICS (INDIA) P. LIMITED	INDIA	MSL
3	A555	ASCO JOUCOMATIC LTD	U.K.	MSL
4	A588	ALCON ALEXANDER CONTROLS LIMITED	U.K.	MSL
5	A721	ASCO JOUCOMATIC SA	FRANCE	MSL
6	H554	HERION WERKE	GERMANY	MSL
7	P217	PRECISION INSTRUMENT COMPANY	INDIA	MSL
8	R021	ROTEX AUTOMATION LTD.	INDIA	MSL
9	S091	SCHRADER DUNCAN LIMITED	INDIA	MSL
10	T745	THOMPSON VALVES LTD	U.K.	MSL
11	V542	VERSA BV		NETHERL
Item Code : 15EB Item Description : CONTROL VALVES				
1	A529	ARCA REGLER GMBH	GERMANY	MSL
2	A761	AST APPARECCHI DI SICUREZZA E TENUTA SPA	ITALY	MSL
3	C032	CONTINENTAL VALVE LTD	INDIA	MSL
4	C731	CCI VALVE TECHNOLOGY GMBH	CZECH REPUBLIC	MSL
5	D127	DRESSER VALVE INDIA PVT LTD	INDIA	MSL
6	D649	DRESSER PRODUITS INDUSTRIELS	FRANCE	MSL
7	E179A	EMERSON PROCESS MANAGEMENT CHENNAI LTD.	INDIA	MSL
8	F151	FORBES MARSHALL ARCA P LTD.(FORMRLY A214	INDIA	MSL
9	F176	FLOWERVE INDIA CONTROL PVT LTD-BANGALOR	INDIA	MSL
10	F636	FLOWERVE PTE LTD	SINGAPORE	MSL
11	I586	ITALVALV S.N.C	ITALY	MSL

12	K179A	KOSO INDIA PVT LTD (FORM.K176)	INDIA	MSL
13	K624	KENT INTROL UK LTD (FORM. A-718)	U.K.	MSL
14	M055	MIL CONTROLS LIMITED	INDIA	MSL
15	M561	MOTOYAMA ENGG WORKS LTD	JAPAN	MSL
16	M700	METSO AUTOMATION OY	FINLAND	MSL
17	S023	SEVERN GLOCON INDIA PVT LTD	INDIA	MSL
18	S442	SAMSON CONTROLS PVT LTD	INDIA	MSL
19	S505	SEVERN GLOCON LTD	U.K.	MSL
20	S510	SAMSON AG MESS-UND REGELTECHNIK	GERMANY	MSL
21	S793	SPX VALVES & CONTROLS (FORMERLY DEZURIK)	U.S.A.	MSL
22	W5941	WEIR VALVES & CONTROLS UK LTD	U.K.	MSL
Item Code : 15EC Item Description : PRESSURE RELIEF VALVE				
1	A710	ANDERSON GREENWOOD CROSBY	U.S.A.	MSL
2	A761	AST APPARECCHI DI SICUREZZA E TENUTA SPA	ITALY	MSL
3	B015	BHEL (TRICHY)	INDIA	MSL
4	B110	BLISS ANAND PVT LTD	INDIA	MSL
5	C700	CURTISS WRIGHT FLOW CONTROL CORPORATION	CANADA	MSL
6	D101	DARLING MUESCO (INDIA) PVT. LTD.	INDIA	MSL
7	D523	DRESSER INC.	U.S.A.	MSL
8	I172	INSTRUMENTATION LTD. (PALGHAT)	INDIA	MSL
9	L569	LESER GMBH & CO. KG	GERMANY	MSL
10	N541	NAKAKITA SEISAKUSHO CO LTD	JAPAN	MSL
11	T181	TYCO SANMAR LTD	INDIA	MSL
Item Code : 15ED Item Description : INSTRUMENT VALVES& MANIFOLDS				
1	A240	ASTEC VALVES & FITTINGS PVT. LTD.	INDIA	MSL
2	A345	ARYA CRAFTS & ENGINEERING PVT LTD	INDIA	MSL
3	A701	AUTOCLAVE ENGINERS FLUID COMPONENTS	U.S.A.	MSL
4	A710	ANDERSON GREENWOOD CROSBY	U.S.A.	MSL
5	B213	BAUMER TECHNOLOGIES INDIA PVT.LTD.(W058)	INDIA	MSL
6	C015	CHEMTROLS INDUSTRIES LTD	INDIA	MSL
7	C220	COMFIT & VALVES PVT. LTD.	INDIA	MSL
8	C714	CIRCOR INSTR. TECHNOLOGIES INC-FORM.H608	U.S.A.	MSL
9	E008	EXCELSIOR ENGG. WORKS	INDIA	MSL
10	E104	EXCEL HYDRO PNEUMATICS PVT LTD	INDIA	MSL
11	F146	FLUID CONTROLS PVT LTD	INDIA	MSL
12	H634	HAM-LET (ISRAEL-CANADA) LTD.	ISRAEL	MSL
13	M010	MICRO PRECISION PRODUCTS PVT LTD	INDIA	MSL
14	P240	PRECISION ENGINEERING INDUSTRIES	INDIA	MSL
15	P303	PRIME ENGINEERS	INDIA	MSL

16	P307	PANAM ENGINEERS	INDIA	MSL
17	P671	PARKER HANNIFIN CORPORATION	U.S.A.	MSL
18	S303	SWASTIK ENGINEERING WORKS	INDIA	MSL
19	S773	SWAGELOK CO.	U.S.A.	MSL
20	T047	TECNOMATIC INDIA PVT LTD	INDIA	MSL
21	T761	TK FUJIKIN CORPORATION	SOUTH KOREA	MSL
Item Code : 15EE Item Description : TANK PR. PROTECT. DEVICES / FLAME ARRSTR				
1	A710	ANDERSON GREENWOOD CROSBY	U.S.A.	MSL
2	A733	ANDERSON GREENWOOD VAREC	U.S.A.	MSL
3	B537	BRAUNSCHWEIGER FLAMMENFILTER	GERMANY	MSL
4	G568	GROTH CORPORATION	U.S.A.	MSL
5	L562	L & J TECHNOLOGIES	U.S.A.	MSL
6	P205	PROTEGO INDIA PVT LTD	INDIA	MSL
7	P318	PRESSURE & FLOW CONTROL INDUSTRIES	INDIA	MSL
8	S797	SAFETY SYSTEMS UK LTD	U.K.	MSL
Item Code : 15EF Item Description : ON-OFF VALVES				
1	C032	CONTINENTAL VALVE LTD	INDIA	MSL
2	C718	CAMERON ITALY SRL (FORM. D659)	ITALY	MSL
3	E141	EL-O-MATIC INDIA (PVT) LTD.	INDIA	MSL
4	F636	FLOWSERVE PTE LTD	SINGAPORE	MSL
5	I586	ITALVALV S.N.C	ITALY	MSL
6	K511	KITAMURA VALVE MANUFACTURING CO LTD	JAPAN	MSL
7	K620	KITZ CORPORATION OF EUROPE S.A.	SPAIN	MSL
8	M561	MOTOYAMA ENGG WORKS LTD	JAPAN	MSL
9	M700	METSO AUTOMATION OY	FINLAND	MSL
10	P544	PIBIVIESSE S. R. L.	ITALY	MSL
11	P689	PERRIN GMBH	GERMANY	MSL
12	R199	ROTEX MANUFACTURERS & ENGINEERS P LTD.	INDIA	MSL
13	S510	SAMSON AG MESS-UND REGELTECHNIK	GERMANY	MSL
14	S793	SPX VALVES & CONTROLS (FORMERLY DEZURIK)	U.S.A.	MSL
15	T198	PENTAIR VALVES & CONTROLS INDIA PVT LTD	INDIA	MSL
16	T733	TYCO VALVES & CONTROLS	U.S.A.	MSL
17	V088	VIRGO VALVES & CONTROLS PVT LTD.	INDIA	MSL
18	W5941	WEIR VALVES & CONTROLS UK LTD	U.K.	MSL
Item Code : 15EG Item Description : SELF ACTUATED PR.CONTROL VALVES				
1	D127	DRESSER VALVE INDIA PVT LTD	INDIA	MSL
2	D649	DRESSER PRODUITS INDUSTRIELS	FRANCE	MSL
3	E179A	EMERSON PROCESS MANAGEMENT CHENNAI LTD.	INDIA	MSL
4	E534	ESME VALVES LTD.	U.K.	MSL

5	E6231	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	MSL
6	E626	ELSTER-INSTROMET NV-FORMER. I563	BELGIUM	MSL
7	G603	GORTER CONTROLS B.V.	NETHERLANDS	MSL
8	N088	NIRMAL INDUSTRIAL CONTROL PVT. LTD.	INDIA	MSL
9	P538	PIETRO FIORENTINI SPA	ITALY	MSL
10	R539	RMG REGEL+MESSTECHNIK GMBH	GERMANY	MSL
11	R610	RICHARDS INDUSTRIES (FORMERLY TRELOAR)	U.S.A.	MSL
12	S442	SAMSON CONTROLS PVT LTD	INDIA	MSL
13	S510	SAMSON AG MESS-UND REGELTECHNIK	GERMANY	MSL
Item Code : 15EN Item Description : SPECIAL CONTROL VALVES-MIXED				
1	D127	DRESSER VALVE INDIA PVT LTD	INDIA	MSL
2	D649	DRESSER PRODUITS INDUSTRIELS	FRANCE	MSL
3	E179A	EMERSON PROCESS MANAGEMENT CHENNAI LTD.	INDIA	MSL
4	E6232	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	MSL
5	F636	FLOWERVE PTE LTD	SINGAPORE	MSL
6	I586	ITALVALV S.N.C	ITALY	MSL
7	K511	KITAMURA VALVE MANUFACTURING CO LTD	JAPAN	MSL
8	M561	MOTOYAMA ENGG WORKS LTD	JAPAN	MSL
9	M700	METSO AUTOMATION OY	FINLAND	MSL
10	S510	SAMSON AG MESS-UND REGELTECHNIK	GERMANY	MSL
11	S793	SPX VALVES & CONTROLS (FORMERLY DEZURIK)	U.S.A.	MSL
12	T198	PENTAIR VALVES & CONTROLS INDIA PVT LTD	INDIA	MSL
13	T733	TYCO VALVES & CONTROLS	U.S.A.	MSL
14	W5941	WEIR VALVES & CONTROLS UK LTD	U.K.	MSL
Item Code : 15EO Item Description : PILOT OPERATED SAFETY VALVES				
1	A710	ANDERSON GREENWOOD CROSBY	U.S.A.	MSL
2	A761	AST APPARECCHI DI SICUREZZA E TENUTA SPA	ITALY	MSL
3	B110	BLISS ANAND PVT LTD	INDIA	MSL
4	C700	CURTISS WRIGHT FLOW CONTROL CORPORATION	CANADA	MSL
5	C720	CAMERON LTD.	U.K.	MSL
6	D523	DRESSER INC.	U.S.A.	MSL
7	T181	TYCO SANMAR LTD	INDIA	MSL
8	W597	WEIR POWER & INDUSTRIAL FRANCE-FORM S791	FRANCE	MSL
Item Code : 15GA Item Description : ORIFICE PLATES & FLANGES				
1	B024	BALIGA LIGHTING EQUIPMENTS (P) LIMITED	INDIA	MSL
2	C220	COMFIT & VALVES PVT. LTD.	INDIA	MSL
3	C720	CAMERON LTD.	U.K.	MSL
4	D509	DANIEL MEASURMNT & CONTROL ASIA PACIFIC	U.S.A.	MSL
5	E022	EUREKA INDUSTRIAL EQUIPMENTS (P) LTD.	INDIA	MSL

6	G016	GURU NANAK ENGG WORKS	INDIA	MSL
7	I172	INSTRUMENTATION LTD. (PALGHAT)	INDIA	MSL
8	M010	MICRO PRECISION PRODUCTS PVT LTD	INDIA	MSL
9	M045	MINCO (INDIA) PVT LTD (GEN. INST.)	INDIA	MSL
10	P514	PETROL VALVES SRL	ITALY	MSL
11	P538	PIETRO FIORENTINI SPA	ITALY	MSL
12	S286	STAR-MECH CONTROLS (INDIA) PVT LTD	INDIA	MSL
13	T516	TM TECNOMATIC SPA	ITALY	MSL
Item Code : 15GC Item Description : FLOW ELEMENTS:(VENTURI, FLOW NOZZLES)				
1	M010	MICRO PRECISION PRODUCTS PVT LTD	INDIA	MSL
2	M313	MINCO (I) FLOW ELEMENT P. LTD. (GIC CO.)	INDIA	MSL
3	S286	STAR-MECH CONTROLS (INDIA) PVT LTD	INDIA	MSL
4	T516	TM TECNOMATIC SPA	ITALY	MSL
Item Code : 15HD Item Description : TEMP.ELEMENTS, THERMOWELLS				
1	A206	ALTOP INDUSTRIES LTD.	INDIA	MSL
2	A682	ABB AUTOMATION LTD	U.K.	MSL
3	D004	DETRIV INSTRUMENTATION & ELECTRONICS LTD	INDIA	MSL
4	D677	DAILY THERMETRICS CORPORATION	U.S.A.	MSL
5	G622	GAYESCO LLC	U.S.A.	MSL
6	P190	PYRO-ELECTRIC INSTRUMENTS GOA PVT LTD	INDIA	MSL
7	T146	TEMPSENS INSTRUMENTS INDIA PVT LTD	INDIA	MSL
8	T232	TECHNO INSTRUMENTS	INDIA	MSL
9	T241	THERMAL INSTRUMENT (I) P LTD (GEN.INST.)	INDIA	MSL
10	T514	THERMO ELECTRIC CO. INC.	U.S.A.	MSL
11	T516	TM TECNOMATIC SPA	ITALY	MSL
12	T705	THERMO-COUPLE PRODUCTS CO	U.S.A.	MSL
13	T734	THERMO-ELECTRA B.V	NETHERLANDS	MSL
14	W589	WIKA ALEXANDER WIEGAND & CO GMBH	GERMANY	MSL
Item Code : 15KA Item Description : PRESSURE GAUGES				
1	A053	AN INSTRUMENTS PVT LTD	INDIA	MSL
2	A362	ASHCROFT INDIA PVT LTD	INDIA	MSL
3	B213	BAUMER TECHNOLOGIES INDIA PVT.LTD(W058)	INDIA	MSL
4	B561	BAUMER BOURDON HAENNI SAS	FRANCE	MSL
5	B618	BUDENBERG GAUGE CO. LTD	U.K.	MSL
6	B696	BADOTHERM PROCESS INSTRUMENTS B.V.	NETHERLANDS	MSL
7	G115	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	INDIA	MSL
8	H081	H GURU INSTRUMENTS(SOUTH INDIA)PVT. LTD	INDIA	MSL
9	H099	H.GURU INDUSTRIES	INDIA	MSL
10	M029	MANOMETER (INDIA) PVT. LTD.	INDIA	MSL

11	N577	NAGANO KEIKI SEISAKUSHO LTD	JAPAN	MSL
12	W061	WIKA INSTRUMENTS INDIA PVT LTD	INDIA	MSL
13	W064	WALCHANDNAGAR INDUSTRIES LTD(TIWAC DIVN)	INDIA	MSL
14	W589	WIKA ALEXANDER WIEGAND & CO GMBH	GERMANY	MSL
Item Code : 15KD Item Description : DIFFERENTIAL PRESSURE GAUGES				
1	A053	AN INSTRUMENTS PVT LTD	INDIA	MSL
2	B213	BAUMER TECHNOLOGIES INDIA PVT.LTD(W058)	INDIA	MSL
3	G115	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	INDIA	MSL
4	H139	HIRLEKAR PRECISION ENGINEERING PVT LTD	INDIA	MSL
5	S087	SWITZER PROCESS INSTRUMENTS PVT. LTD.	INDIA	MSL
6	W061	WIKA INSTRUMENTS INDIA PVT LTD	INDIA	MSL
Item Code : 15LA Item Description : TEMP.GAUGES(BI METALLIC,FILLED SYSTEM)				
1	A053	AN INSTRUMENTS PVT LTD	INDIA	MSL
2	A362	ASHCROFT INDIA PVT LTD	INDIA	MSL
3	B213	BAUMER TECHNOLOGIES INDIA PVT.LTD(W058)	INDIA	MSL
4	B561	BAUMER BOURDON HAENNI SAS	FRANCE	MSL
5	B696	BADOTHERM PROCESS INSTRUMENTS B.V.	NETHERLANDS	MSL
6	G115	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	INDIA	MSL
7	G192	GOA INSTRUMENTS INDUSTRIES PVT. LTD.	INDIA	MSL
8	H081	H GURU INSTRUMENTS(SOUTH INDIA)PVT. LTD	INDIA	MSL
9	H099	H.GURU INDUSTRIES	INDIA	MSL
10	W061	WIKA INSTRUMENTS INDIA PVT LTD	INDIA	MSL
11	W064	WALCHANDNAGAR INDUSTRIES LTD(TIWAC DIVN)	INDIA	MSL
12	W589	WIKA ALEXANDER WIEGAND & CO GMBH	GERMANY	MSL
Item Code : 15MB Item Description : VARIABLE AREA FLOW METERS(I,T)				
1	A172	ALFLOW GLASS EQUIPMENTS	INDIA	MSL
2	A623	ASA SPA	ITALY	MSL
3	A682A	ABB AUTOMATION PRODUCTS GMBH	GERMANY	MSL
4	B510	BROOKS INSTRUMENT	U.S.A.	MSL
5	E022	EUREKA INDUSTRIAL EQUIPMENTS (P) LTD.	INDIA	MSL
6	H626	HEINRICHS MESSTECHNIK GMBH	GERMANY	MSL
7	I030	INSTRUMENTATION ENGINEERS PVT. LTD.	INDIA	MSL
8	K105	KROHNE MARSHALL PVT. LTD	INDIA	MSL
9	K582	KROHNE MESSTECHNIK GMBH & CO KG	GERMANY	MSL
10	P293	PLACKA INSTRUMENTS INDIA P LTD	INDIA	MSL
11	R515	ROTA YOKOGAWA GMBH & CO. KG	GERMANY	MSL
12	T530	TOKYO KEISO CO LTD	JAPAN	MSL
13	Y006	YOKOGAWA INDIA LIMITED	INDIA	MSL
Item Code : 15NA Item Description : MAGNETIC FLOW METERS				

1	A682A	ABB AUTOMATION PRODUCTS GMBH	GERMANY	MSL
2	E179	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	MSL
3	E187	ENDRESS+HAUSER (I) PVT. LTD.	INDIA	MSL
4	E525	ENDRESS + HAUSER FLOWTEC AG	SWITZERLAND	MSL
5	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	MSL
6	H626	HEINRICHS MESSTECHNIK GMBH	GERMANY	MSL
7	I030	INSTRUMENTATION ENGINEERS PVT. LTD.	INDIA	MSL
8	I590	INVENSYS SOFTWARE SYSTEMS (S) PTE LTD	SINGAPORE	MSL
9	K105	KROHNE MARSHALL PVT. LTD	INDIA	MSL
10	K582	KROHNE MESSTECHNIK GMBH & CO KG	GERMANY	MSL
11	Y006	YOKOGAWA INDIA LIMITED	INDIA	MSL
12	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	MSL
Item		Item Description : VORTEX FLOW METER		
1	A682A	ABB AUTOMATION PRODUCTS GMBH	GERMANY	MSL
2	B617	BOPP & REUTHER MESSTECHNIK GMBH	GERMANY	MSL
3	E179	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	MSL
4	E187	ENDRESS+HAUSER (I) PVT. LTD.	INDIA	MSL
5	E525	ENDRESS + HAUSER FLOWTEC AG	SWITZERLAND	MSL
6	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	MSL
7	K582	KROHNE MESSTECHNIK GMBH & CO KG	GERMANY	MSL
8	O523	OVAL CORPORATION	JAPAN	MSL
9	R539	RMG REGEL+MESSTECHNIK GMBH	GERMANY	MSL
10	Y006	YOKOGAWA INDIA LIMITED	INDIA	MSL
11	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	MSL
Item Code : 15NI Item Description : MASS FLOW METERS				
1	A682A	ABB AUTOMATION PRODUCTS GMBH	GERMANY	MSL
2	B510	BROOKS INSTRUMENT	U.S.A.	MSL
3	B621	BRONKHORST HIGH TECH BV	NETHERLANDS	MSL
4	E179	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	MSL
5	E187	ENDRESS+HAUSER (I) PVT. LTD.	INDIA	MSL
6	E525	ENDRESS + HAUSER FLOWTEC AG	SWITZERLAND	MSL
7	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	MSL
8	F576	FLUID COMPONENTS INTERNATIONAL LLC	U.S.A.	MSL
9	F641	FOX THERMAL INSTRUMENT INC.	U.S.A.	MSL
10	H626	HEINRICHS MESSTECHNIK GMBH	GERMANY	MSL
11	K582	KROHNE MESSTECHNIK GMBH & CO KG	GERMANY	MSL
12	K616	KURZ INSTRUMENTS INC	U.S.A.	MSL
13	M508	MAGNETROL INTERNATIONAL N.V	BELGIUM	MSL

14	R515	ROTA YOKOGAWA GMBH & CO. KG	GERMANY	MSL
15	R604	RHEONIK MESSGERATE GMBH	GERMANY	MSL
16	Y006	YOKOGAWA INDIA LIMITED	INDIA	MSL
Item Code : 15OA Item Description : GAUGE GLASSES & COCKS				
1	A221	ASIAN INDUSTRIAL VALVES & INSTRUMENTS	INDIA	MSL
2	B110	BLISS ANAND PVT LTD	INDIA	MSL
3	C201	CHEMTROLS SAMIL (INDIA) PVT LTD	INDIA	MSL
4	C716	CESARE BONNETTI S.P.A.	ITALY	MSL
5	G115	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	INDIA	MSL
6	J543	JERGUSON GAUGE & VALVE	U.S.A.	MSL
7	K637	KLINGER SPA	ITALY	MSL
8	L009	LEVCON INSTRUMENTS PVT LTD	INDIA	MSL
9	N520	NIHON KLINGAGE CO LTD	JAPAN	MSL
10	P017	PRATOLINA INSTRUMENTS PVT LTD	INDIA	MSL
11	P239	PUNE TECHTROL PVT LTD	INDIA	MSL
12	S036	SIGMA INSTRUMENTS CO	INDIA	MSL
13	T047	TECNOMATIC INDIA PVT LTD	INDIA	MSL
Item Code : 15OF Item Description : MAGNETIC LEVEL INSTRUMENTS				
1	A759	ABB INC (FORMLY K622)	U.S.A.	MSL
2	B110	BLISS ANAND PVT LTD	INDIA	MSL
3	C015	CHEMTROLS INDUSTRIES LTD	INDIA	MSL
4	C716	CESARE BONNETTI S.P.A.	ITALY	MSL
5	G115	GAUGES BOURDON (I) PVT. LTD. (GEN.INST)	INDIA	MSL
6	K582	KROHNE MESSTECHNIK GMBH & CO KG	GERMANY	MSL
7	K637	KLINGER SPA	ITALY	MSL
8	L009	LEVCON INSTRUMENTS PVT LTD	INDIA	MSL
9	M508	MAGNETROL INTERNATIONAL N.V	BELGIUM	MSL
10	N520	NIHON KLINGAGE CO LTD	JAPAN	MSL
11	P017	PRATOLINA INSTRUMENTS PVT LTD	INDIA	MSL
12	P239	PUNE TECHTROL PVT LTD	INDIA	MSL
13	S036	SIGMA INSTRUMENTS CO	INDIA	MSL
14	T047	TECNOMATIC INDIA PVT LTD	INDIA	MSL
Item Code : 15OG Item Description : SPL. LEVEL INSTRUMENTS-GUIDED WAVE RADAR				
1	A759	ABB INC (FORMLY K622)	U.S.A.	MSL
2	E179	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	MSL
3	E187	ENDRESS+HAUSER (I) PVT. LTD.	INDIA	MSL
4	E657	ENDRESS+HAUSER GMBH+CO. KG	GERMANY	MSL
5	K582	KROHNE MESSTECHNIK GMBH & CO KG	GERMANY	MSL
6	L562	L & J TECHNOLOGIES	U.S.A.	MSL

7	M508	MAGNETROL INTERNATIONAL N.V	BELGIUM	MSL
8	V518	VEGA GRIESHABER KG	GERMANY	MSL
Item Code : 15RD Item Description : FIELD INSTRUMENTS (P,DP,F,L,T,TD)				
1	A200	ABB INDIA LTD (BANGALORE)	INDIA	MSL
2	A682A	ABB AUTOMATION PRODUCTS GMBH	GERMANY	MSL
3	E179	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	MSL
4	E623	EMERSON PROCES MGMT ASIA PACIFIC PTE LTD	SINGAPORE	MSL
5	E641	ENDRESS+HAUSER WETZER GMBH+ CO.KG	Germany	MSL
6	E657	ENDRESS+HAUSER GMBH+CO. KG	GERMANY	MSL
7	F644	FUJI ELECTRIC SYSTEMS CO. LTD	JAPAN	MSL
8	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	MSL
9	H621	HONEYWELL INC.	U.S.A.	MSL
10	I177	INVENSYS INDIA PRIVATE LIMITED	INDIA	MSL
11	Y006	YOKOGAWA INDIA LIMITED	INDIA	MSL
12	Y501	YOKOGAWA ELECTRIC CORPORATION	JAPAN	MSL
Item Code : 15TE Item Description : SPEED TANSMITTERS				
1	A661	ASEA BROWN BOVERY LTD (ABB LTD)	SWITZERLAND	MSL
2	H620	HANS TURCK GMBH & CO. KG	GERMANY	MSL
3	J531	JAPAN SERVO CO LTD	JAPAN	MSL
4	P649	PEPPERL + FUCHS GMBH	GERMANY	MSL
Item Code : 15UA Item Description : CONTROL PANEL & ACCESSORIES				
1	A212	ACCUSONIC CONTROLS PVT LTD	INDIA	MSL
2	E004	ELECTRONIC CORPORATION OF INDIA LTD.	INDIA	MSL
3	E184	ELECTRONIC INSTRMNTATION & CONTROL P LTD	INDIA	MSL
4	I004	INSTRUMENTATION LTD	INDIA	MSL
5	I010	INDUSTRIAL CONTROLS & APPLIANCES PVT LTD	INDIA	MSL
6	I206	IRIS AUTOMATION PVT LTD	INDIA	MSL
7	K048	KERALA STATE ELECT DEV CORP LTD (ARoor)	INDIA	MSL
8	P134	POSITRONICS PVT LTD	INDIA	MSL
9	P213	PRIMA AUTOMATION INDIA PVT LTD	INDIA	MSL
10	P214	PYROTECH ELECTRONICS PVT LTD	INDIA	MSL
11	R084	RADHA KRISHNA CONTROLS	INDIA	MSL
Item Code : 15YA Item Description : ALARM ANNUNCIATORS				
1	E004	ELECTRONIC CORPORATION OF INDIA LTD.	INDIA	MSL
2	I083	INSTALARM INSTRUMENTS PVT LTD.	INDIA	MSL
3	I545	IDEC IZUMI CORPORATION	JAPAN	MSL
4	M154	MTL INSTRUMENTS PVT LTD	INDIA	MSL
5	M171	MINILEC (INDIA) PVT LTD	INDIA	MSL
6	P014	PROCON INSTRUMENTATION PVT LTD	INDIA	MSL

7	R540	RONAN ENGINEERING COMPANY	U.S.A.	MSL
Item Code : 15ZA Item Description : RUPTURE DISCS				
1	B017	BS & B SAFETY SYSTEMS (INDIA) LTD	INDIA	MSL
2	F575	FIKE CORPORATION-USA	U.S.A.	MSL
3	R519	REMBE GMBH SAFETY+CONTROL	GERMANY	MSL
Item Code : 15RA Item Description : LOOP POWERED INDICATORS				
1	B713	BEKA ASSOCIATES LTD	U.K.	MSL
2	E179	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	MSL
3	E641	ENDRESS+HAUSER WETZER GMBH+ CO.KG	Germany	MSL
4	H150	HONEYWELL AUTOMATION INDIA LTD.	INDIA	MSL
5	I177	INVENSYS INDIA PRIVATE LIMITED	INDIA	MSL
6	M154	MTL INSTRUMENTS PVT LTD	INDIA	MSL
7	Y006	YOKOGAWA INDIA LIMITED	INDIA	MSL
Item Code : 15CD Item Description : FIELD BUS SIGNAL CABLES				
1	A132	ASSOCIATED FLEXIBLES & WIRES [P] LTD	INDIA	MSL
2	B735	BELDEN INC	U.S.A.	MSL
3	C145	CORDS CABLE INDUSTRIES LTD	INDIA	MSL
4	L612	LEONI KERPEN GMBH	GERMANY	MSL
Item Code : 15UB Item Description : PREFABRICATED INSTRUMENT HOOKUPS				
1	A240	ASTEC VALVES & FITTINGS PVT. LTD.	INDIA	MSL
2	C220	COMFIT & VALVES PVT. LTD.	INDIA	MSL
3	E179	EMERSON PROCESS MANAGEMENT INDIA PVT LTD	INDIA	MSL
Item Code : 15UC Item Description : ACCESS CONTROL SYSTEM				
1	T242	TRANSIT ELECTRONICS PVT. LTD.	INDIA	MSL
Item Code : 15EL Item Description : DESUPERHEATERS & PRDS				
1	A529	ARCA REGLER GMBH	GERMANY	MSL
2	C015	CHEMTROLS INDUSTRIES LTD	INDIA	MSL
3	C226	CIRCOR FLOW TECHNOLOGIES INDIA PVT LTD	INDIA	MSL
4	C706	CCI VALVE TECHNOLOGY AB(FORMERLY B-706)	SWEDEN	MSL
5	F151	FORBES MARSHALL ARCA P LTD.(FORMRLY A214	INDIA	MSL
6	H610	HOLTER REGELARMATURE N GMBH &CO.KG(HORA)	GERMANY	MSL
7	I593	IMTECH SYSTEMS BV (FORMERLY K-611)	NETHERLANDS	MSL
8	S510	SAMSON AG MESS-UND REGELTECHNIK	GERMANY	MSL
9	S7931	SPX VALVES & CONTROLS	U.K.	MSL
10	W5941	WEIR VALVES & CONTROLS UK LTD	U.K.	MSL
11	Y509	YARWAY CORPORATION	U.S.A.	MSL
Item Code : 15CC Item Description : OPTICAL FIBRE CABLE & ASSOC.ITE 1				
1	A400	AKSH OPTIFIBRE LIMITED	INDIA	MSL
2	A714	ABB INDUSTRI AS	NORWAY	MSL

3	B155	BIRLA ERICSSON OPTICAL LIMITED	INDIA	MSL
4	F013	FINOLEX CABLES LTD.	INDIA	MSL
5	H138	HIMACHAL FUTIRISTIC COMMUNICATIONS LTD.	INDIA	MSL
6	K190B	KEC INETRNLATIONAL - MYSORE	INDIA	MSL
7	K615	KABEL RHEYDT	GERMANY	MSL
8	P610	PIRELLI CAVI SPA	ITALY	MSL
9	S100	STERLITE OPTICAL TECHNOLOGIES LTD	INDIA	MSL
10	U099	U M CABLES LTD	INDIA	MSL
11	V092	VINDHYA TELELINKS LIMITED	INDIA	MSL
Item Code : 15AB Item Description : INSTRUMENT TUBING				
1	H086	HEAVY METALS & TUBES LIMITED(MEHSANA)	INDIA	MSL
2	J110B	JINDAL SAW LTD (NASHIK WORKS)	INDIA	MSL
3	R066	RATNAMANI METALS AND TUBES LTD	INDIA	MSL
4	R127	REMI EDELSTAHL TUBULARS LTD (FORM RMIL)	INDIA	MSL
5	T761	TK FUJIKIN CORPORATION	SOUTH KOREA	MSL

Electrical Item:

Item Code : 13GB Item Description : CONTROL STATIONS-FLAME PROOF				
1	B024	BALIGA LIGHTING EQUIPMENTS (P) LIMITED	INDIA	MSL
2	F024	FLEXPRO ELECTRICALS PVT LTD	INDIA	MSL
3	F036	FLAMEPROOF EQUIPMENTS PVT.LTD	INDIA	MSL
4	F141	FCG POWER INDUSTRIES PVT LTD	INDIA	MSL
5	F165	FCG FLAMPROOF CONTROL GEARS P. LTD(C-157	INDIA	MSL
6	G159	PETROLEUM SAFETY PRODUCTS IND. PVT. LTD.	INDIA	MSL
7	K173	KAYSONS TECHNO EQUIPMENT P LTD.		MSL
8	S158	SUDHIR SWITCHGEARS PVT LTD	INDIA	MSL
Item Code : 13JF Item Description : MOTOR-INDUCTION-M.V (FLAME PROOF)				
1	B048	BHARAT BIJLEE LIMITED	INDIA	MSL
2	C010	CROMPTON GREAVES LTD.	INDIA	MSL
3	K005	KIRLOSKAR ELECTRIC CO LTD	INDIA	MSL
4	L065	LAXMI HYDRAULICS PVT LTD	INDIA	MSL
5	M282	MARATHON ELECTRIC MOTOR I LTD-FORM A350	INDIA	MSL
Item Code : 13JK Item Description : MOTORS - IMPORTED				
1	A661	ASEA BROWN BOVERY LTD (ABB LTD)	SWITZERLAND	MSL
2	A717	NIDEC ASI SPA	ITALY	MSL
3	C730	GE ENERGY POWER CONVERSION FRANCE SAS	FRANCE	MSL
4	C736	CEMP SRL	ITALY	MSL
5	G632	GENERAL ELECTRIC CANADA	CANADA	MSL

6	H510	HITACHI LTD	JAPAN	MSL
7	H641	HYUNDAI HEAVY INDUSTRIES CO. LTD	KOREA	MSL
8	J511	JEUMONT SA / FRAMATONE ANP	FRANCE	MSL
9	L575	LOHER GMBH	GERMANY	MSL
10	L603	LLOYD DYNAMOWERKE GMBH & CO. KG	GERMANY	MSL
11	S524	SIEMENS AG	GERMANY	MSL
12	T597	TOSHIBA CORPORATION	JAPAN	MSL
13	W598	WEG EQUIPAMENTOS ELETRICOS S.A.	BRAZIL	MSL
14	W598A	WEGEURO - INDUSTRIA ELECTRICA S.A.	PORTUGAL	MSL
Item Code : 14CA Item Description : CABLE GLANDS (HAZARDOUS AREA)				
1	B024	BALIGA LIGHTING EQUIPMENTS (P) LIMITED	INDIA	MSL
2	C195	COMET BRASS PRODUCTS	INDIA	MSL
3	C205	COMET INDUSTRIES	INDIA	MSL
4	F024	FLEXPRO ELECTRICALS PVT LTD	INDIA	MSL
5	F036	FLAMEPROOF EQUIPMENTS PVT.LTD	INDIA	MSL
6	F141	FCG POWER INDUSTRIES PVT LTD	INDIA	MSL
7	F165	FCG FLAMPROOF CONTROL GEARS P. LTD(C-157	INDIA	MSL
8	K173	KAYSONS TECHNO EQUIPMENT P LTD.		MSL
9	S158	SUDHIR SWITCHGEARS PVT LTD	INDIA	MSL
10	S375	STANDARD METAL INDUSTRIES	INDIA	MSL
Item Code : 13WB Item Description : A.C. VARIABLE SPEED DRIVE				
1	A200B	ABB LTD	INDIA	MSL
2	A661	ASEA BROWN BOVERY LTD (ABB LTD)	SWITZERLAND	MSL
3	B054	BHEL (BANGALORE)	INDIA	MSL
4	B727	BALDOR ELECTRIC COMPANY (FORMLY. R564)	U.S.A.	MSL
5	C730	GE ENERGY POWER CONVERSION FRANCE SAS	FRANCE	MSL
6	E140	EUROTHERM DEL INDIA LIMITED	INDIA	MSL
7	H510	HITACHI LTD	JAPAN	MSL
8	K636	KARL E BRINKMANN GMBH	GERMANY	MSL
9	L001A	LARSEN & TOUBRO LTD-MAHAPE	INDIA	MSL
10	M593	MEIDENSHA CORP	JAPAN	MSL
11	R178	ROCKWELL AUTOMATION INDIA PVT LTD	INDIA	MSL
12	S003A	SIEMENS LTD - NASHIK	INDIA	MSL
13	S450	SCHNEIDER ELECTRIC INDIA PVT LTD	INDIA	MSL
14	S524	SIEMENS AG	GERMANY	MSL
15	T597	TOSHIBA CORPORATION	JAPAN	MSL
16	V593	VACON OYJ	FINLAND	MSL

Note:

1. VENDOR shall necessarily procure all the material forming permanent part of the unit / plant from OWNER / PMC approved vendors only. This shall include subordered items / components also. The "Approved Vendors" shall be item specific.
2. OWNER / PMC approved vendor list for the various items is enclosed in this section.
- 3.
4. VENDOR may procure material from any of OWNER / PMC approved vendors. However, current validity, holiday status and range of approval as per EIL enlistment letter, workload, stability and solvency need to be verified by the VENDOR with vendor before placement of order. VENDOR is also required to ensure that equipment qualification criteria, specified elsewhere in the bid document, are also simultaneously met.
- 5.
6. Vendors on OWNER / PMC holiday list shall not be considered for ordering. VENDOR shall comply with this requirement without any time or cost implication to the OWNER. If a vendor is put on OWNER / PMC's holiday list subsequent to VENDOR placing an order, it shall be VENDOR's responsibility to ensure quality work and timely supply from the vendor.
- 7.
8. VENDOR may consider additional / alternate vendors not included in "OWNER / PMC approved Vendors" list, with prior approval of OWNER / PMC. "Approval status" documents / credentials to be furnished by the vendors in such cases shall solely be the responsibility of the VENDOR. OWNER / PMC's decision on approval shall be final and non negotiable. Non-acceptance of a particular proposed vendor due to any reasons whatsoever shall not be a cause of schedule and cost implication.
- 9.
10. For items where there is no vendor list of OWNER/PMC, the vendors suggested by VENDOR shall be approved by OWNER / PMC prior to placement of order by VENDOR. VENDOR shall list down the proposed suppliers / vendors for such items and submit the same for OWNER / PMC's review / approval along with necessary documents / credentials. "Approval status" documents / credentials to be furnished by the vendors in such cases shall solely be the responsibility of the VENDOR. OWNER / PMC's decision on approval shall be final and non negotiable. Non-acceptance of a particular proposed vendor due to any reasons whatsoever shall not be a cause of schedule and cost implication.
- 11.
12. VENDOR shall make an independent assessment of capability of all the vendors for timely deliveries of material / equipment. Any delays in deliveries by vendor(s) shall not be a cause of schedule and cost implication.
- 13.
14. At any stage of the project, if it comes to the notice of OWNER / PMC that VENDOR has procured material / equipment, intentionally or unintentionally whatsoever, from an unapproved vendor and/or items not falling in approved range of vendor(s), the same shall be rejected forthwith and VENDOR shall be liable to replace such material / plant / machinery without any schedule and cost implication to the OWNER.
- 15.
16. List of vendors appearing anywhere else in the contract document in case of duplication of the items at two or more places shall not be considered by VENDOR and shall be superseded by the vendor list enclosed herewith.
- 17.
18. It is understood that should the name of Vendor be changed due to change in their Company or

Corporate share holding, OWNER may accept such Vendors under its new name with prior approval.

19.

20. Any such approval shall however, not absolve the VENDOR from any of his obligations under the contract; neither shall any such approval signify nominations or instruction to use such a vendor. All approved vendors are deemed to have been freely chosen by the VENDOR at his own risk