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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 In case feasible deviations are proposed by the bidder and subsequently withdrawn, no commercial implications can be claimed by the bidder.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: Ramniwas Sangwa Designation: Deputy Manager Deptt: TC Engineering Phone: +91 40 2318 3548 Email: ramsangwa@bhel.in	
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<u>TECHNICAL ADDENDUM FOR DRY GAS SEAL SKIDS</u> <u>Project: RCF Thal ARC#4</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> </tr> </thead> <tbody> <tr> <td rowspan="2">RCF THAL ARC#4</td> <td>Seal Gas Skid</td> <td>TC9765156448</td> </tr> <tr> <td>Seal Gas Skid Spares</td> <td>TC9765156456</td> </tr> </tbody> </table>							Project	Description	Material Code	RCF THAL ARC#4	Seal Gas Skid	TC9765156448	Seal Gas Skid Spares	TC9765156456													
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RCF THAL ARC#4	Seal Gas Skid	TC9765156448																									
	Seal Gas Skid Spares	TC9765156456																									
3 <u>DESIGN</u> 3.1 The project specific requirements shall as per the following attachments: <table border="1"> <thead> <tr> <th>Sl. No.</th> <th>Description</th> <th>Document No.</th> </tr> </thead> <tbody> <tr> <td>a</td> <td>List of instruments</td> <td>As per this addendum</td> </tr> <tr> <td>b</td> <td>Checklist</td> <td>As per this addendum</td> </tr> <tr> <td>c</td> <td>Price schedule</td> <td>As per this addendum</td> </tr> <tr> <td>d</td> <td>TC55450-R03</td> <td>Attached</td> </tr> <tr> <td>e</td> <td>Seal Gas P&ID</td> <td>Attachment-1 of TC65156-44-R01</td> </tr> <tr> <td>f</td> <td>RCF technical Specification</td> <td>Attachment-2 of TC65156-44-R01</td> </tr> </tbody> </table> 3.2 Vendor shall include automatic change over arrangement from normal to emergency / start up seal gas supply and vice versa along with all the necessary instrumentation and controls required during start-up & emergencies. 3.3 Valve positioner shall be supplied along with valve diagnostic software. This software shall be integrated with customer control system for advance control valve diagnostics like seat ring condition, gland packing condition, actuator leakage etc. 3.4 The seal gas supply lines within the skid shall be 2" min. the gas velocity shall be limited to 30 m/s. 3.5 Vendor shall provide seal gas booster interface connection nozzles as indicated in the P&ID. 3.6 BHEL may decide to implement Primary, Secondary, Separation seal gas supply and vent monitoring as SINGLE or TWO separate skids. Vendor to consider this aspect during offer submission. Actual requirement shall be specified during detail engineering only. No implication shall be acceptable on account of single / two separate skids.							Sl. No.	Description	Document No.	a	List of instruments	As per this addendum	b	Checklist	As per this addendum	c	Price schedule	As per this addendum	d	TC55450-R03	Attached	e	Seal Gas P&ID	Attachment-1 of TC65156-44-R01	f	RCF technical Specification	Attachment-2 of TC65156-44-R01
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Ref.	Doc	Rev.No.	Revision	Prep.	Check	Appd.	Date																				
		01	Issued for RCF Thal ARC#4	IS	IS	Ram	15.06.18																				

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4 PROJECT SPECIFIC REQUIREMENT

4.1 For all other requirements, formats etc. refer Dry Gas Seal Skid specification TC55450-R03 along with the following project specific requirements.

Clause No	Existing	To be replaced with
2.1-a	Seal Gas P&I Diagram as per Variant Table-4 of this specification	Attachment-1 of TC65156-44-R03
2.1-c	List of Instruments, make & model as per Table-1 of this specification	As per this addendum.
3.3	NACE	NACE MR 0103
5.1	The Pipe sizes and terminal points shall be as per the Seal Gas P&ID indicated in variant table-4.	Refer 3.4 above. BHEL shall provide 2" connection or higher if required for primary seal gas. Vendor to provide matching size connection on the seal gas skids.
5.4	Flange connection.....	All flanges shall be WN RF.
5.5	PMI	PMI & IGC is applicable for all instrumentation items along with piping, fittings, valves etc.
6.5	All the instruments and quantity shall be as specified in Table-1.	As per this addendum.
7	Instrument installation	The instrument installation shall be piping standard. Primary inlet / vent / H ₂ S service shall be provided with double isolation valves. N ₂ Lines may be provided with tubing hookup.
6.6, 8.3	Foundation Fieldbus	Not Applicable.
9	Documentation	Vendor to include documents listed in this specification.
Fig-1 to 5	Typical P&ID	Attachment-1 of TC65156-44-R03
Table-1	List of Instruments, make & model	As per this addendum.
Table-4	List of variants	As per this addendum.
Table-5	Price Schedule	As per this addendum.
-	Cleanliness Test	No discoloration or hard articles found on 20 mesh screen after module blown for 5 minutes with 7 kg/cm ² g dry filtered gas.

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).

5.3 Vendor shall further try to reduce the above indicated dimensions based on its 3-D modeling of the skids.

6 DOCUMENTATION

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.

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e) Material test certificates.
 f) Filter degree of filtration test certificate.
 g) Explosion protection certificates for all electronic instruments.
 h) Terminal wiring details of Junction Box.
 i) Skid Photographs.
 j) Instruction, Service and Maintenance manual.
 k) 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 LIST OF INSTRUMENTS

SL No.	Instrument	Qty Note (2)	Minimum Specification	Vendor	Model
1	Differential Pressure Gauges	6	IP66; panel mount Range: as required Dial Size: 150mm Pr.Conn. : 1/4" NPTF Static Pr. : 210 kg/cm2(g)	Switzer, GIC, Wika	Switzer 109-V-E-2-6-0-S or eqv.
2	Pressure Gauges	18	IP67; panel mount Accuracy: ±1% of full scale, over range protection: 1.3 times of FS Dial Size: 150mm Pr.Conn.: 1/2" 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	8	Smart-HART / FF Protocol Intrinsic safe Ex-ia & flameproof Ex-d certified for Zone1, Gas IIA,B, C Min Load: 600 ohms All SS construction Pr.Conn.: 1/2" NPTF 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 3-way valve for DP and 2-way valve for pressure SIL certified for ESD / PLC Range : as required	Emerson	HART: 3051CD 3A 07 A1 J H2 B7 K8 L4 M4 Q4 QT D4 T1 DF D1 HR5
				Yokogawa	HART: EJA 110A E H S4 GU 2 CEB KU22 A D4 A1 M11
4	Pressure Transmitter	18		Emerson	HART: 3051CG * A 07 A1 J H2 B7 K8 L4 M4 Q4 QT D4 T1 DF D1 HR5 Note : * is as per range
				Yokogawa	HART: EJA 430A E * S4 GU 2 CEB KU22 A D4 A1 DG6 M11 Note : * is as per range

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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.								SL No	Instrument	Qty Note (2)	Minimum Specification	Vendor	Model
								5	SMART positioner for control valve.	For PDC V & On-Off valve partial stroke test	Positioner with Intrinsic safe Ex-ia & 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.
								6	Flow Meter	6	Internal magnetic float or Rota meter design or an integral orifice and differential-pressure (DP) cell or Thermal Mass flowmeter SMART-HART protocol Intrinsic safe Ex-ia & flameproof Ex-d certified for IEC Zone1, Gas IIA, B & C Pr.conn: Flanged	Krohne, Yokogawa, Emerson, FCI	The exact flow device type shall be provided during detail engineering and shall not have any delivery or commercial implication.
								7	Junction Box	5	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.		
								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.
								9	Pneumatic DP control valve	01 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	Note-6.	
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					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		
		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	
		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	Change over valve in startup gas (Not indicated in the P&ID)	1 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:	NOTE-6	
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SL No.	Instrument	Qty Note (2)	Minimum Specification	Vendor	Model
			Herion or ASCO, 02 nos for each valve Proximity type IS SIL certified limit switches, P&F make		
17	Canopy for all transmitters, positioners & junction boxes				As reqd
18	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
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.	

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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.	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): 5 Set (these spare elements are in addition to that specified in price schedule)	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 / Thermal Mass 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 2) 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 2) 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 % or minimum 1 no of each type, size, rating of Trim consisting of ball, plug with stem, cage (wherever applicable), packing material. ii. 10% (subject to minimum of 1) of partial stroke testing devices with links of each type and make. iii. 20% (subject to minimum of 1) of Air filter regulators. iv. 100% Seal kit consisting of O rings, gland packing, gaskets, etc. v. 20% (subject to minimum of 2) of proximity switches. vi. 20% (subject to minimum of 2) of solenoid valves of each type. vii. 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. 1/2", 3/4", 1", 1-1/2", 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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11 PRICE SCHEDULE:
 Enquiry ref. no.
 Offer ref no.

Date:
 Date:

Sl no.	DESCRIPTION	Qty	PRICE
1.	<u>Seal Gas Control system consists of the following:</u>		
a	Seal Gas Skid RCF Thal: TC9765156448	1 set	
b	Seal Gas Skid Spares RCF Thal: TC9765156456 (as per clause 10)	1 set	
c	Spare Seal Gas Filter Element: TC9765450206	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

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- 2.4 The project specific P&I diagram shall be provided after the placement of the order during the detailed engineering. The availability of the gas for start up in primary injection line and barrier seal shall be finalized as per P&I diagram.
- 2.5 The total design and selection of the equipment of Seal gas filter skid and seal gas control skid is the responsibility of the Vendor. The ranges and set values of the Instruments are to be furnished by Seal Gas Control Skid & Seal gas filter skid Vendor for BHEL/Customer's review during detailed engineering after the placement of the order.
- 2.6 The primary seal gas line within filter skid shall be steam traced and insulated. All Piping, Valves and fittings forming a part of steam tracing shall be IBR certified. The steam parameters shall be provided during detailed engineering.

3. General arrangement of the skid Assemblies

- 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



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- pressure transmitter shall be used. The Guided wave radar type level transmitter shall be with flange size and rating suitable for the design pressure of the system.
- b) The level transmitter using remote diaphragm sealed DP transmitter shall be with 3" flange size and rating suitable for the design pressure of the system. The suitable flushing rings along with drain & vent valves shall be provided.
- 3.8 Whenever, the condensate pot is provided, the following shall be provided.
- a) A solenoid valve operated drain control valve with proximity type limit switches designed for the condensate/oil flow envisaged for the project.
- b) A level transmitter specified in 3.7 above.
- c) A level gauge for local indication.
- 3.9 The Vendor shall note that the appearance engineering is one of the most important aspects. The whole Rack shall be very compact and shall give an aesthetically good look as this equipment is mounted on the operating floor of the compressor.
- 3.10 The Vendor shall take care of good accessibility for operation and maintenance of all parts. The Instruments and Components disposition /location on the rack and Piping/Tubing layout are paramount important aspect.
- 3.11 External paint shall be with the thickness 80-150 microns and internal paint shall be with the thickness 40-60 microns. The project specific painting specification, if applicable shall be provided during detailed engineering; vendor to carry out the same without any commercial implication.
- 3.12 The Skids shall be provided with lifting lugs for a 4-point lift.
- 3.13 Foundation holes shall be oval in shape to help in installation.

4. Seal Gas Duplex Filter (Coalescing)

- 4.1 The Duplex gas Filter shall be **coalescing** type as per design code ASME VIII div I, consisting of two filter bowls mounted in parallel with a change over valve. Each filter bowl is 100 % capacity. Clean Process gas is supplied to primary seal through a Duplex Filter with required filtration grade for liquids and solids as required for DGS.
- 4.2 The collapsible pressure for the cartridge is min. 10 kg/cm² (g) differential.
- 4.3 The Gas Pressure to Primary Seal is maintained 0.5 kg/cm² (g) more than Operating Gas by means of differential pressure controller and control valve.
- 4.4 While finalising the capacity (Flow) of Duplex Filter assembly, the maximum leakage through the labyrinth into the compressor and the primary seal leakage indicated in DGS specification shall be taken into account along with required margins.
- 4.5 The changeover valve is used for switching over from one filter bowl during operation so that one filter open to operating gas flow and other closed off for changing filter elements. There shall not be any reduction of flow during switching over operation. Arrows shall be provided on filter assembly to indicate the filter in operation. The change over valve shall be of Trans flow type. Double stage change over valve is preferred.
- 4.6 The filters shall be provided with drain and vent connections with valves.



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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	SS316
Flanges & Valves	SS 316L	SS 316	SS316
Fittings	SS 316L	SS 316	SS316
Manifolds	SS 316L	SS 316	SS316
Filters	SS 316L	SS 316	SS316

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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- 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.

- ~~a) Junction boxes shall be provided with wiring/ termination blocks.~~
- ~~b) Each Fieldbus junction box shall contain wiring terminal blocks for two Fieldbus segments. Wiring / termination block for each segment shall have four spur connections. However vendor shall use only three spur connections and one shall be kept as spare for future connection.~~



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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

- a) 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.
- b) Each assembly shall be marked with details like, drawing no, job number, PO No. etc. at a convenient location.
- c) Exterior carbon Steel surfaces shall be given at least two coats of Epoxy paint.
- d) Flanges openings shall be provided with metal closures.
- e) Pipe union openings shall be suitably closed with Swagelok (or Parker) fittings.
- f) Lifting Points and lifting lugs shall be clearly identified.
- g) 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.
- h) Adequate amount of silica gel or equivalent shall be provided in the box before despatch for the removal of moisture till installation.
- i) All safety instructions for storage and handling shall be indicated on external surface of the box.



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14. Guarantee

The Gas Seal Control System Skids and each component of the unit shall be guaranteed for 24 months of trouble free performance from the date of shipment or 18 months from the date of commissioning whichever is earlier

15. Bids

Technical bids and Price bids are to be submitted in separate sealed covers. Un-priced copy of the price bid shall be furnished along with Technical bid.

16. Services:

Vendor shall provide services of their engineers for commissioning of Gas Seal Systems at site for 7 working days per compressor train

17. Training:

Vendor shall at no extra cost to the purchaser, undertake to train 4 engineers selected by the purchaser for a period of 5 working days at BHEL Hyderabad or Vendors works or site

18. SPECIAL NOTES

18.1 Vendor should bring out in his offer clause wise deviations if any, with respect to proposed supply along with price adder for withdrawing the deviation to comply with specification. Failure to highlight the same will be construed as acceptance on the part of the vendor to meet the requirement of this specification totally.

18.2 Vendor shall provide the relevant technical information and supporting documents whenever asked for by the customer/ consultant.

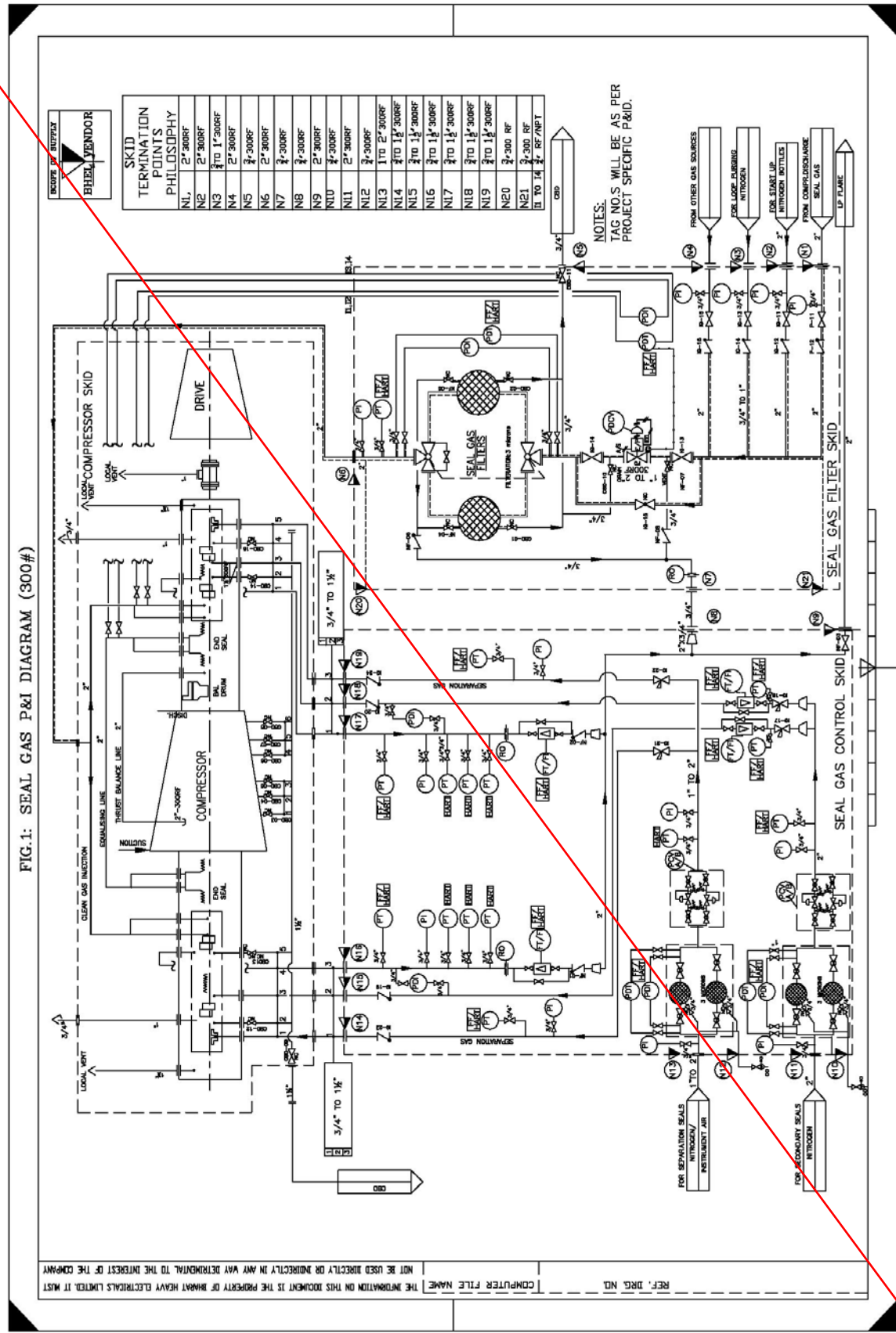
18.3 Vendor to clearly bring out any additional requirements which are essential for proper functioning of the dry gas seal system. This shall be included in the offer.



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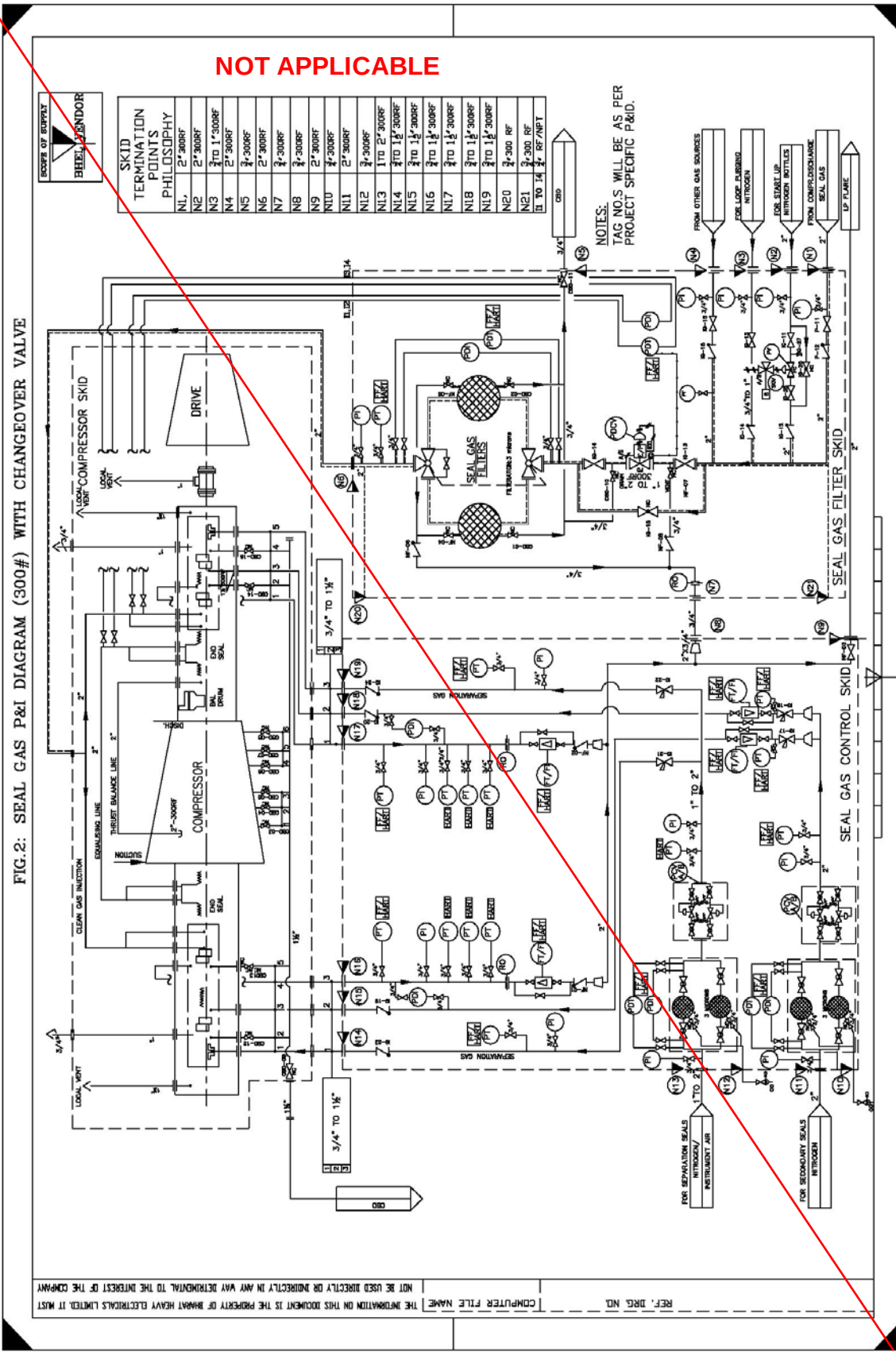
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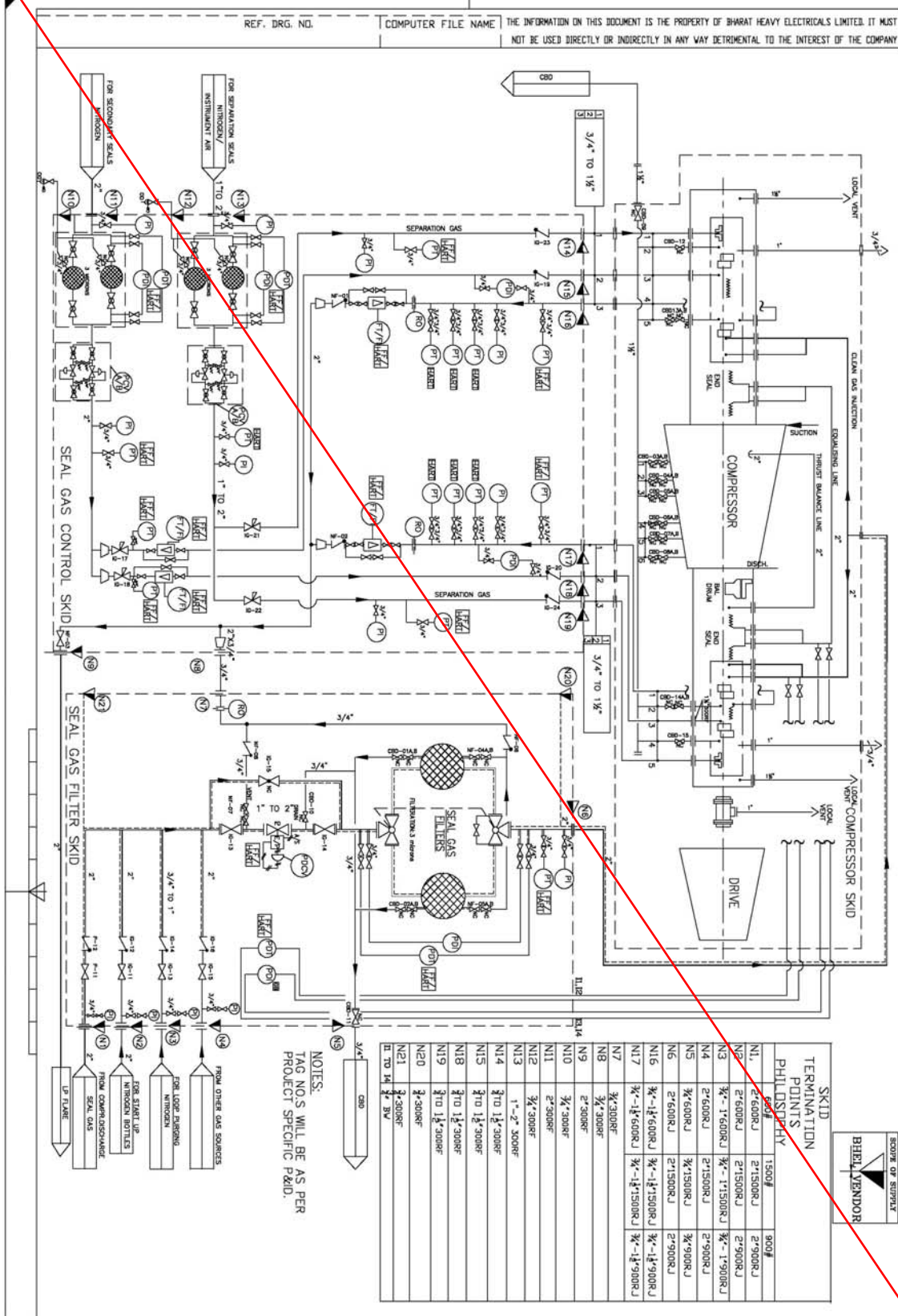


FIG. 3: SEAL GAS P&I DIAGRAM (600#, 900# & 1500#)



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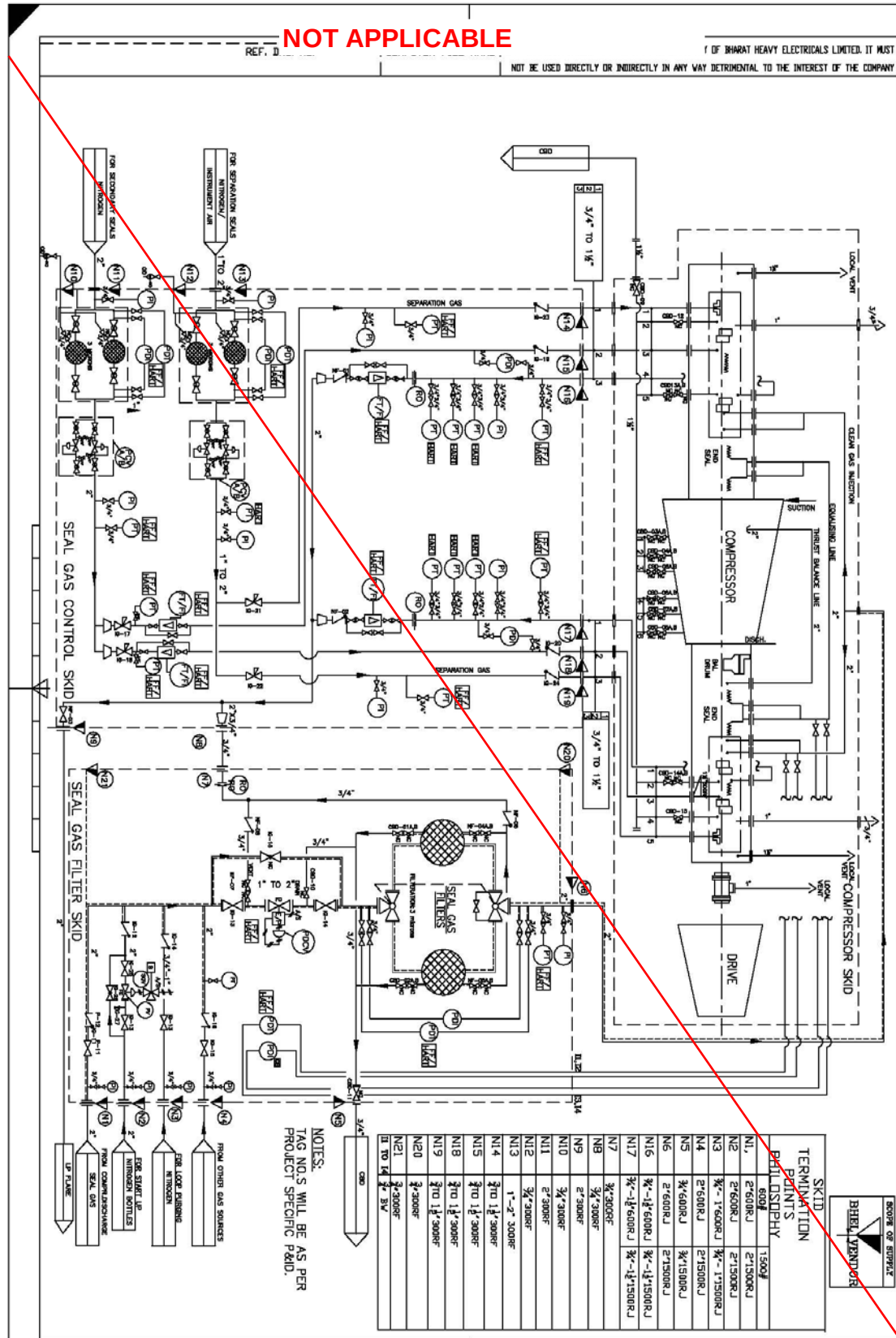


FIG. 5: SEAL GAS P&I DIAGRAM (1500#) WITH DRAIN ARRANGEMENT



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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: $\pm 1\%$ 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	

			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	Flowserve or IL, palghat or Koso, palghat or Tyco	
			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		
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 Boll & 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.	

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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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Table – 3: Quality Plan

Sl. No.	Description	Type of check Quantum of check 100%	Ref. Documents	Type of Inspection	Agency
1	Assembly of Skids	- Location of equipment - Correctness of flow Schematics - Overall dimensions	- Approved GA drg. of Skids	Physical check	BHEL/ CUSTOMER
2	Welding (if applicable)	Type	Manufacturing drawings.	-Review of Radiograph certificate -Welding efficiency of 1	--Do--
3	Duplex Filter	- Material Certification - Hydrostatic test - Degree of filtration-Type Test	-BHEL/ CUSTOMER Specification - Approved drg./docts.	Verification of test report certificate	--Do--
4	Control Valves	- Calibration test certificate -Seat leakage test certificate -100% radiography test certificate (two shall be taken from each area to be tested) -magnetic particle test certificate -hardening test certificate -charpy test -confirmity test certificate -Material Certification - Explosion proof/ Intrinsic safe certification - Hydrostatic test - Control valve functional test	--DO--	- Verification - Review of Certificates	--Do--
5	Valves	- Material Certification - Hydrostatic test - Control valve functional test	--DO--	- Verification - Review of Certificates	--Do--
6	Pressure Gauges, Diff. Pr. Gauges.	- Make, Model - Materials Certification	--DO--	--Do--	--Do--



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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--



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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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		HYDERABAD		Page 27 of 32																																																								
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Ref. Doc TC55450. DOC	COMP. FILE FILE NAME	<table border="1"> <tr> <td>37</td> <td>FILTER SKID- MRPL CHTU</td> <td>TC9755450378</td> <td>Item Same as M.code: TC9755450904</td> </tr> <tr> <td>38</td> <td>CONTROL SKID- MRPL CHTU</td> <td>TC9755450386</td> <td>Item Same as M.code: TC9755450912</td> </tr> <tr> <td>39</td> <td>FILTER SKID- MRPL PFCCU</td> <td>TC9755450394</td> <td>As per CCI-MCN-1001-27</td> </tr> <tr> <td>40</td> <td>CONTROL SKID- MRPL PFCCU</td> <td>TC9755450408</td> <td>As per CCI-MCN-1001-27</td> </tr> <tr> <td>41</td> <td>SGS SKID- TABRIZ</td> <td>TC9755450416</td> <td>As per CCI-CA217-27</td> </tr> <tr> <td>42</td> <td>SGS SKID- SPARES- TABRIZ</td> <td>TC9755450424</td> <td>As per CCI-CA217-27</td> </tr> <tr> <td>43</td> <td>Shifted to Table-4</td> <td></td> <td></td> </tr> <tr> <td>44</td> <td>Shifted to Table-4</td> <td></td> <td></td> </tr> <tr> <td>45</td> <td>Shifted to Table-4</td> <td></td> <td></td> </tr> <tr> <td>46</td> <td></td> <td></td> <td></td> </tr> <tr> <td>47</td> <td></td> <td></td> <td></td> </tr> <tr> <td>48</td> <td></td> <td></td> <td></td> </tr> <tr> <td>49</td> <td></td> <td></td> <td></td> </tr> <tr> <td>50</td> <td></td> <td></td> <td></td> </tr> </table>			37	FILTER SKID- MRPL CHTU	TC9755450378	Item Same as M.code: TC9755450904	38	CONTROL SKID- MRPL CHTU	TC9755450386	Item Same as M.code: TC9755450912	39	FILTER SKID- MRPL PFCCU	TC9755450394	As per CCI-MCN-1001-27	40	CONTROL SKID- MRPL PFCCU	TC9755450408	As per CCI-MCN-1001-27	41	SGS SKID- TABRIZ	TC9755450416	As per CCI-CA217-27	42	SGS SKID- SPARES- TABRIZ	TC9755450424	As per CCI-CA217-27	43	Shifted to Table-4			44	Shifted to Table-4			45	Shifted to Table-4			46				47				48				49				50			
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Table – 4: Variant Table					
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	Var No	Description	Requirements	Material code	Reference P&ID
	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	Startup Gas: 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	Startup Gas: 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	TC9755450637	Fig.1
64	Seal gas Control Skid	DCS Insts FF Instruments	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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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	TC9755450726	Fig.2
73	Seal gas Control Skid	DCS Insts	FF Instruments	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	TC9755450785	Fig.3
79	Seal gas Control Skid	DCS Insts	FF Instruments	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	TC9755450815	Fig.4
82	Seal gas Control Skid	DCS Insts	HART Protocol	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	TC9755450840	Fig.4
85	Seal gas Control Skid	DCS Insts	FF Instruments	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	TC9755450874	Fig.3
88	Seal gas Control Skid	DCS Insts	HART Protocol	TC9755450882	Fig.3
89	Spares for Seal gas filter skid and control skid			TC9755450890	Fig.3

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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:

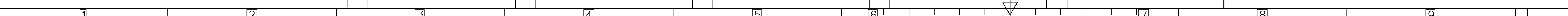
- (1) The individual prices for the spares and optional items against sl nos 02 and 03 above are valid for one year to order as and when the requirement arises.
- (2) Any additional requirements which are essential for proper functioning of the dry gas seal system but not indicated in specification are included in the offer.

Vendor's signature & seal

[illegible]

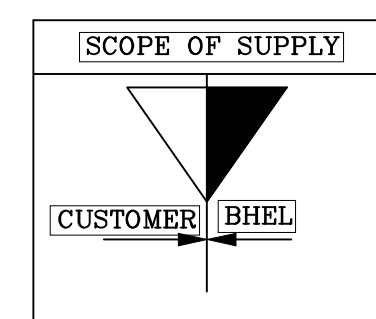
SIGN. AND DATE	REF. DRG. NO.	COMPUTER FILE NAME

INVENTORY NO

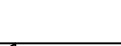
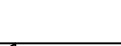
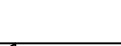


- 1) ALL INSTRUMENT TAG NO'S SHALL BE PREFIXED WITH UNIT NO. 46"
- 2) ALL PRESSURE INSTRUMENTS SHALL BE PROVIDED WITH 3/4" GATE VALVE AS ROOT VALVE. THERMOWELL CONNECTION FOR FLANGED.
- 3) SEAL GAS PIPING MATERIAL SHALL BE SS.
- 4) ALL INTERCONNECTING PIPING SHALL BE SUPPLIED BY BHEL.
- 5) ALL LOW POINT SHALL BE PROVIDED WITH DRAIN ARRANGEMENT.
- 6) FOR INTERLOCK DETAILS REFER LUBE OIL P&ID.
- 7) ALL LOCAL AND LCP MOUNTED INSTRUMENTS SHOWN IN THIS P&ID ARE IN BHEL SCOPE OF SUPPLY.

↑
VENT TO ATM AT SAFE LOCATION



CUSTOMER:	RASHTRIYA CHEMICALS AND FERTILIZERS LIMITED [THAL, MAHARASTRA]
PROJECT:	GTG HRSG PROJECT
PRODUCT:	AMMONIA REFRIGERATION COMPRESSOR
CONSULTANT :	PROJECT & DEVELOPMENT INDIA LIMITED PDI

भारत भारती  BHARAT HEAVY ELECTRICALS LTD. HYDERABAD				<table><tr><td>NAME</td><td>SIGN.</td><td>DATE</td></tr><tr><td>DRN. DEEPAK JHA</td><td></td><td>10.05.17</td></tr><tr><td>CHD. DEEPAK JHA</td><td></td><td>10.05.17</td></tr><tr><td>APPD. KV MURALIDHAR</td><td><i>KV</i></td><td>10.05.17</td></tr></table>		NAME	SIGN.	DATE	DRN. DEEPAK JHA		10.05.17	CHD. DEEPAK JHA		10.05.17	APPD. KV MURALIDHAR	<i>KV</i>	10.05.17	<table><tr><td>NO. OF VAL.</td><td>N.A.</td></tr><tr><td>NO. OF ITEMS</td><td>N.A.</td></tr></table>		NO. OF VAL.	N.A.	NO. OF ITEMS	N.A.
NAME	SIGN.	DATE																					
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<table><tr><td>DEPT. : SYNGG</td><td>UNTL. DMS.</td></tr><tr><td>DEL. : 1415</td><td><i>C.M.A.</i></td></tr></table>		DEPT. : SYNGG	UNTL. DMS.	DEL. : 1415	<i>C.M.A.</i>	<table><tr><td></td><td>SCALE :</td></tr><tr><td>N.T.S.</td><td></td></tr></table>			SCALE :	N.T.S.		<table><tr><td>WEIGHT (KG)</td><td>REF. TO ASSY. DRG.</td></tr><tr><td>-N.A.-</td><td></td></tr></table>		WEIGHT (KG)	REF. TO ASSY. DRG.	-N.A.-		<table><tr><td>ITEM NO.</td><td>N.A.</td></tr><tr><td></td><td>-N.A.-</td></tr></table>		ITEM NO.	N.A.		-N.A.-
DEPT. : SYNGG	UNTL. DMS.																						
DEL. : 1415	<i>C.M.A.</i>																						
	SCALE :																						
N.T.S.																							
WEIGHT (KG)	REF. TO ASSY. DRG.																						
-N.A.-																							
ITEM NO.	N.A.																						
	-N.A.-																						
TITLE				DRAWING NO.				REV.															
SEAL GAS P & I DIAGRAM				HY-DG-1-33600-40604				01															
				SHT No. 1				NO OF SHT 1															

 पी डी आई एल PDIL	DESIGN PHILOSOPHY – INSTRUMENTATION FOR AMMONIA REFRIGERATION COMPRESSOR	PNIN/EM-132/ARC-IV	0	 आर सी एफ
		DOCUMENT NO	REV	
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DESIGN PHILOSOPHY – INSTRUMENTATION **AMMONIA REFRIGERATION COMPRESSOR**

TABLE OF CONTENTS

Sl. No.	DESCRIPTION	SHEET NUMBER
1.0	INSTRUMENTATION AND CONTROLS	03
2.0	SCOPE	03
3.0	CONTROL PHILOSOPHY	05
4.0	BASIS OF DESIGN	07
5.0	INSTRUMENTATION CODE AND PRACTICES	08
6.0	HAZARDOUS AREA CLASSIFICATION & ELECTRICAL EXECUTION	10
7.0	ELECTRICAL SUPPLY	11
8.0	FIELD MOUNTED INSTRUMENTS	11
9.0	PNEUMATIC TRANSMISSION	17
10.0	ELECTRONIC INSTRUMENT SIGNAL WIRING	18
11.0	PROCESS CONNECTION	18

LIST OF ATTACHMENTS

A. List of Annexure:

ATTACHMENT NUMBER	DESCRIPTION	NUMBER OF SHEETS
ANNEXURE-1	SPECIFICATION OF SERVER GRADE COMPUTER	1
ANNEXURE-2	INSTRUMENT ACCURACIES	1
ANNEXURE-3	INSTRUMENT PROCESS CONNECTIONS	2

 पी डी आई एल PDIL	DESIGN PHILOSOPHY – INSTRUMENTATION FOR AMMONIA REFRIGERATION COMPRESSOR	PNIN/EM-132/ARC-IV	0	
		DOCUMENT NO	REV	
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and control signals shall be interfaced with DCS through serial communication and soft links.

- 3.16 Those parameters, which are directly or indirectly tripping the plant or may cause production loss, shall be wired with 2 out of 3 transmitter trip voting interlock in PLC. There shall be three separate analog input channels in three diff. AI cards shall be used for this purpose in PLC. Same thing is applicable to Digital inputs also.
- 3.17 OEM commissioning engineers shall be present for all the commissioning activities for specialized instrumentation systems like Performance controllers, Bentley Nevada Systems, PLC, anti-surge control, termination of fibre optic cables, integration with DCS etc.

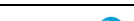
4.0 BASIS OF DESIGN

General

Instrumentation for the proposed Ammonia Refrigeration Compressor is to provide a highly reliable and comprehensive control and monitoring system. To facilitate these well proven techniques shall be adopted for measurement and control.

The following philosophy is to be adopted.

1. The input transmitters and the Final control elements being used for Control functions and Interlock functions shall be completely separate.
2. Same valve should not be used for both Control and ON-OFF actions. Separate Control valve and ON-OFF valve to be provided.
3. All control valves shall be provided with SMART valve positioner with valve position signal feedback connected to PLC system by 4 to 20 mA analog signal. It shall be HART compatible.
4. Universal HART Protocol with Latest Revision shall be used in all cases.
5. Wago / weidmuller / Phoniex / Klippon make screw less terminal shall be used with single tier only.
6. All limit switches shall be proximity sensor type.
7. Cable entry to local control room shall be through MCT blocks.
8. No head mounted temperature transmitters are to be used.
9. Turbine flow meter shall not be used.
10. All Contacts shall be Gold Plated 2 SPDT.
11. No Direct Process Switches (Pressure / Level/ Flow / Temp.) shall be used. However, if it's not possible to install transmitter for particular application online pressure/level switches (float type) may be used if the need arise.

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12. Execution type for all field transmitters in hazardous area shall be intrinsic safe. Flame / ex. proof enclosures shall be provided where intrinsic certifications are not available.
13. All field transmitters for pressure, d/p, level and flow shall be microprocessor based (dual compartment) SMART transmitters with “UNIVERSAL HART” protocol with latest revision. The transmitter selection shall be such that the operating maximum upper limit shall be around 70% of the total measurement range of the transmitter
14. All equipment/materials supply shall include spares required for 2 years operation and consumable for commissioning.
15. Inputs from thermocouples shall be provided with cold junction compensation and downscale burns out feature for high temperature shut downs and vice versa for low. A passive alarms shall warn about the burn-out.
16. Hardwired signals from MCC / Switchgear to interposing relays shall be potential free contacts.
17. The control system shall utilize Intrinsic Safety Barriers to meet hazardous area operation for all vibration, thermocouple, analog & digital etc. signals. All Non-Intrinsic safety circuits (e.g. Solenoids etc.) shall be segregated from the intrinsic safety wiring.
18. It is expected that for Safety and Availability reasons, all trip inputs shall be two out of three (2oo3) voting logic sensors / instruments connected to three independent nozzles / process tapings / pads.

5.0 INSTRUMENTATION CODE AND PRACTICES

IEC 13	Diagrams, Charts and Tables, Preparation of Logic Diagrams
IEC 534	Industrial - Process Control Valves
IEC 584	Thermocouples
IEC 605	Equipment Reliability Testing elements
IEC 611-12	Part 12 Graphical Symbols for Diagrams. Binary Logic
IEC 654	Measurement and Control equipment
IEC 751	Industrial Platinum Resistance Thermometer Sensor
IEC 801	Electromagnetic Compatibility for Industrial Process measurement and Control Eqpt.
IEC 848	Preparation of Function Charts for Control Systems
IEC 902	Industrial Measurement and Control Terms and Definitions
ISA S-5 .1	Instrumentation Symbols and Identification

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ISA S-5.2	Binary Logic Diagrams for Process Operation
ISA S-5 3	Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Symbols
ISA-S20	Instrumentation specification formats
ANSI/ISA S 5.1	Process Instrumentation Terminology
ANSI/ ISA S71.04	Environmental conditions
ANSI/ ISA S75.01	Control Valve Equations
ANSI/ ISA S75.02	Control Valve Procedure Capacity Test
ANSI/ ISA S75.03	Face-to-Face Dimensions for Flanged Globe Style Control Valve Bodies
ANSI/ FCI 70.02	Quality Control Standard for Control Valve Seat Leakage
BS 6020	Instruments for the Detection of Combustible Gases
DIN 3582	Screwed Plugs, Tapped Holes, with Whitworth Part 2 Pipe Threads: General Outlay of Types
DIN 43760	Measurement Standard for RTD.
DIN 19243	Measurement and Control Electrical Sensors, Electrical Position Sensors and Signal Converters used for Intrinsically safe two-wire DC System.
EN-50-014/020	Electrical Apparatus for Potentially Explosive Atmospheres
EN 54 Part I	Components of Automatic Fire Detection System Introduction.
EN 54 Part 5	Heat sensitive Detectors - Point Detectors containing a Static Element.
ISO 3511.1	Process Measurement Control Functions and Instrumentation Representation Part I: Basic requirements.
ISO 3511.2	Process Measurement Control Functions and Instrumentation Representation Part 2: Extension of Basic Requirements.
ISO 3511.4	Process Measurement Control Functions and Instrumentation Representation Part 4: Basic Symbol for Process Computer, Interface and shared Display/Control Systems.
ISO 4200	Plain End Steel Tubes, Welded and Seamless - General Table of Dimensions and Masses per Unit Length.
ISO 5167	Measurement of Fluid by Means of Orifice Plates, Nozzles and Venturi Tubes Inserted in Circular cross-section Conduits Running Full.

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API RP 520	Sizing, selection and Installation of Pressure relieving devices in Refineries
API RP 521	Guide for Pressure Relieving and Depressuring System
API S 670	Vibration, Axial-Position and Bearing-Temperature Monitoring Systems
API RP 2000	Venting Atmospheric and low pressure storage tanks
API- Chapter 5.4 :	Accessory equipment for liquid meters Manual of
Chapter 6.2	Loading rack and tank truck metering system
Chapter 6.6:	Pipeline Metering Systems Measurement
Chapter 12:	Calculation of Standards Petroleum Quantities
2.1 & 12.2	Part 1 and 2
API-RP-550	Manual on Installation of refinery Instruments Part I and Control System
ANSI - B 16.104	Control Valve seat leakage
ISA-S 75.01	Control Valve sizing
ISA S 18.1	Specifications and guides for the use of general Annunciators.
IEC 529	Environmental Protection of equipment
ANSI B 2.1	Pipe threads
ANSI B 16.5	Steel pipe flanges, flanged valves and fittings
IEC 79.11/	Intrinsic safety code and practice
IEC-79.14	International Boiler Regulation
IS 2148	Flameproof enclosure of electrical apparatus
IEC 61508	Functional Safety of Electrical, Electronic, Programmable Electronic Safety Related Systems
IEC 61511	Functional Safety of Safety Instrumented Systems for the Process Sector

6.0 HAZARDOUS AREA CLASSIFICATION & ELECTRICAL EXECUTION

6.1 The execution of instrumentation shall be as per area Zone 2, group IIC, T3, EExib and Protection.

Electrical / Electronic instruments	IP 67
Sensors; RTD, T/C, etc.	IP 65
Local Gauges; PG, etc.	IP 55
Pneumatic instruments	IP 54
Solenoid valves	IP 67
Local Panel / Skid Mounted Panels	IP 55

EMC compatibility and electrical safety as per latest IEC standard.

6.2 Electrical instrument equipment shall be designed for and supplied as intrinsic safe certified.

Analysers, solenoid valves and other equipment that cannot be classified intrinsic safe shall be ex-proof in accordance with the above mentioned electrical specification.

Certification for installation in hazardous areas in accordance with IEC 60079 series is shown below:

Separate trays shall be used for multi-conductor cables for thermocouple wiring, 4-20mA wiring and alarm system and power circuits, which also will ensure the required segregation between high and low energy level circuits.

Transmitters, positioners, I/P converters, etc.: Ex ib IIC T3

Switches: Ex de IIC T3

Analysers and Panels: Ex p IIC T3

Solenoid Valves: Ex d IIC T3(Ex md not allowed)

Junction Boxes and Cable Glands: Ex d IIC T3

7.0 ELECTRICAL SUPPLY

The electrical supply will be as follows:

Distributed Control System, trip system,

and Control Room Instruments : 115V AC

Solenoid Valves : 115V AC

Local Panels : 115V AC/24 V D.C

Local Illumination, equipment for air conditioning, space heaters, ventilation of local panels and similar purposes : 240V AC

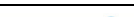
Field-mounted Transmitters and switches : 24V D.C. intrinsic safe

Safety Circuits : 115 V AC

The 115V AC supply will be an uninterrupted power supply (UPS) of 115V +/- 10%, 50Hz +/- 3%. The supply will be made available from two UPS sources. Individual clients from the redundant pairs utilizing 115V, AC shall be sourced from separated UPS sources. The system shall be configured / wired such that, any one UPS failure shall not affect operation of the compressor.

Where 24V DC is needed, it will be generated by local redundant rectifier units having high MTBF, which are part of the instrumentation supply. The power supply to these redundant units shall be taken from separate UPS sources.

8.0 FIELD MOUNTED INSTRUMENTS

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In general, all field mounted electronic instruments shall be provided with IP-66 weather-proof and dust proof enclosures in accordance with the IEC 529 notation.

8.1 ANALYSERS

The gas analysers for the measurement of CO, H₂, SO_x, NO_x, CH₄ etc., shall be Air/N₂ purged. The electronics shall be microprocessor based. The primary sampling system shall be near the tapping point. All analysers shall be grouped area-wise and housed in a pressurised and air conditioned prefabricated analyser shelter conforming to NAMUR recommendations.

All liquid analysers shall be of intrinsic safe design suitable for execution class specified for the area. Liquid analyser, sample conditioning unit and other accessories shall be mounted on rack.

8.2 FLOW INSTRUMENTS

8.2.1 Flow Transmitter

D/P cells shall have measuring methods on the floating differential capacitance/ inductance or piezoelectric principle or silicon resonator principle. Bodies shall normally be in stainless steel with AISI 316 internals. Pressure elements in austenitic stainless steel are a requirement in hydrogen service. The transmitter shall be furnished with an output meter or gauge with a sq. rt. scale. Smart type transmitters will be used with Hart Protocol. All flow transmitters shall have sq. root extraction function. Process connection size shall be 1/2" NPT through Oval flanges. Integral 3 valve manifold shall be used.

8.2.2 Rotameter Types

Rotameter types may be used in pipe sizes from 2" and smaller. The meter shall be selected for normal flow at 50 to 60 % of the span. In applications with toxic or inflammable fluids, glass tubes must not be used except for low-pressure analyser sample flows. They may be used for severe corrosive services and fluid of high viscosity. The metal tube meters shall be of stainless steel, PTFE lined or any other suitable lining for the service. The indicator assembly shall be magnetically coupled and mounted with rotameter body.

8.3 PRIMARY DIFFERENTIAL PRODUCERS

8.3.1 Orifice Plates

Orifice plates of the square edged concentric type shall be specified except where unsatisfactory for the application. Materials shall normally be AISI 316 SS unless special materials are required for the service.

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8.4.2 LEVEL GLASSES

8.4.2.1 Gauge Glasses

Glass type level gauges shall not be used. Magnetic type level gauges with hermetically sealed followers shall be used for level indications.

Level gauges shall be supplied with a pair of off-set shut off valves with ball check.

For cold services the temperature is below 0 deg C, a non-frosting extension will be used.

8.5 PRESSURE INSTRUMENTS

8.5.1 Pressure Transmitters

Pressure Transmitters and differential pressure transmitters shall be modern inherent motion-free type of the floating differential capacitance/piezoelectric/silicon measurement principle. **Bodies shall normally be in stainless steel** with pressure elements in AISI 316. Pressure elements in austenitic stainless steel is requirement in hydrogen service. Two valve integral manifold of 316 SS material in general shall be used with pressure transmitter. Smart type transmitters will be used HART protocol. Overall accuracy for Smart Transmitter shall be ± 0.075 % or better. Process connection shall be 1/2" NPT.

8.5.2 PRESSURE GAUGES

8.5.2.1 Gauge

Gauges for process and utility service shall be the modern industrial S.S. Bourdon gauge type with the case in stainless steel. The gauge shall preferably be a safety type with solid front where pointer and glass are partitioned off from the bourdon type by a solid disc as per IS. Pulsation dampeners shall be installed with the gauges where pulsating pressure occurs. Process connection shall be 1/2" NPT (M). Blow out disc shall be provided for all gauges except for Instrument Air service. Accuracy shall be ± 1 % or better. Dial size:150 mm. Vendor shall also provide the gauge valves.

8.5.2.2 Pressure Elements

Pressure elements shall normally be of low carbon stainless steel. Special elements such as diaphragms and bellows can be selected who are more suitable for the service than bourdon tubes.

8.5.2.3 Pressure Switch

Pressure switches shall be used for alarm, interlock, sequence system and will have electric switches DPDT with Hermatically sealed contacts rated for 1

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8.7 CONTROL VALVES

Valve types shall be selected, pneumatic diagram/piston operated globe, ball or butterfly shall be selected taking into account such factors as piping, operating and design conditions, fluid being handled, range ability required, allowable leakage, noise and other special requirements. The valves shall have electro-pneumatic positioners or pneumatic positioner with I/P converter. Valve seat leakage shall be in accordance with ANSI B16.104. Actuator shall be designed for Instrument air pressure of 3.5 Kg/cm²g. Volume Boosters (Fairchild / Fisher make) may be provided for ensuring faster response of the valve.

Air - Piping and Fittings.

Air piping and fittings shall be in stainless steel with a min. tube size of 1/4" OD. In case 1/4" OD tube is not adequate, 1/2" OD tubes shall be used.

Seat Leakage shall be leakage class-IV or better.

Seat Leakage shall be chosen in accordance with process demands and safe operation of the plant and in accordance with ANSI B16.104-1976/FCI-70.2. Safety shut off valves must not be used in throttling service during normal operation.

8.8 PRESSURE RELIEVING DEVICES

8.8.1 Pressure Relieving Devices

All pressure Relieving Devices shall be sized in accordance with applicable local and national code requirements. Formulas shall be in accordance with API RP 520, 1990 and ASME Codes section VIII and I.

8.8.2 Nomenclature

Nomenclature used shall be in accordance with API RP 520.

8.8.3 Safety and Relief Valves

Safety and Relief Valves shall normally be direct spring loaded types. Balanced bellows valves shall normally be furnished for relief into closed flare and blow down systems, if the developed back-pressure exceeds 10% of the set pressure.

8.8.4 Rupture Discs

Rupture Discs may be used in lieu of or in combination with safety and relief valves, where applicable or required.

8.8.5 Pressure and Vacuum Relief Valves

Pressure and Vacuum Relief Valves for storage tanks shall normally be of the weight loaded or pilot operated type, and sized in accordance with API RP 2000 Tank Venting Code, or Local Codes if they govern.

8.8.6 Centre-to-Face

Centre-to-face dimensions shall be in accordance with API 526.

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8.9 SWITCHES AND SOLENOID VALVES

8.9.1 Level Switches

Level switches shall normally be the external float cage type. Body material and rating shall conform to piping specifications. Internal trim shall be stainless steel unless other materials are required for service.

8.9.2 Pressure Switches

Pressure switches for direct connected process and utility service shall normally be diaphragm or bourdon tube type with materials suitable for the service. Connections shall normally be 1/2" NPT male. Micro switches shall be hermetically sealed.

8.9.3 Temperature Switches

Temperature switches mounted in the control room and in the locals panels shall be thermocouple actuated and be completely adjustable.

8.9.4 Flow Switches

Flow switches for direct operation by process fluids may be of the rotameter or paddle type for low accuracy requirements. Orifice plate and differential pressure type transmitter shall be used for high accuracy requirements and the switch shall be an electric analog switch. For alarm purpose, the switching shall be through DCS/PLC software.

8.9.5 Solenoid Valves

Solenoid valves shall normally be used as pilots to actuate other instruments/valves connected to the process. Protective enclosure shall be IP65. The coil insulation shall be of Class –H suitable for continuous operation in 85 deg. C ambient temperature (max. surface temperature in sun) for outdoor service. Body material shall normally be stainless steel & Orifice size shall be 9mm. Solenoid valves will be powered by 110V AC +/- 10%, 50 Hz +/- 3%

All switches and solenoid valves shall be ex-proof and shall meet the classification of the area in which they are installed and be fitted with 1/2" NPT (F) cable gland connection.

Solenoids used for trip applications shall be at least SIL-3 certified and dual redundant (increased reliability mode)

9.0 PNEUMATIC TRANSMISSION

9.1.1 Output Signal

Output signal from all pneumatic transmitters shall be 0.2-1.0 kg/cm²g.

9.1.2 Pneumatic Receiver Instruments

Pneumatic Receiver Instruments shall have receiver elements design for 0.2-1 kg/cm²g input signal.

9.1.3 Pneumatic Transmission Tubing

Pneumatic Transmission Tubing for local transmission shall be 1/4" OD Stainless Steel tubing with stainless steel fittings.

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9.1.4 Instrument Air

Instrument Air required is available at 6.5kg/cm²g and max. 70 deg C. However, the air pressure can be down to 4.5 kg/cm²g for remote consumers. Design pressure is 10kg/cm²g.

Dew Point is - 40 deg. C at line pressure.

The air is oil and dust free.

Air distribution Headers shall be of SS 304.

10.0 ELECTRONIC INSTRUMENT SIGNAL WIRING

Electronic Instrument Signal Wiring shall be twisted pairs - 15 twists or more per meter. Conductors shall be 1.5mm² for one and two pairs and 0.75 mm² for multi-conductor cable and shall be stranded, tinned copper. Insulation shall have a minimum radial thickness of 0.25mm. Insulation of core to core shall withstand a r.m.s. AC test voltage of min. 2000V.

All cables shall be galvanised steel wire armoured under the PVC outer cover of a flame retardant, low smoke type (FRLS) in accordance with IEC 227.

Multi pairs shall be shielded with braided tinned copper wire. The temperature rating shall be min. 85 deg C. Each core shall be colour coded and/or numbered.

Cable and Multicore Cables for Solenoids etc.

Cables and multicore cables for such items as solenoid valves and flame detectors shall normally have a conductor size of 1.5mm². However, conductor size for power cables shall be co-ordinated with the Electrical Group to avoid too many different cable types.

10.1 Thermocouple Extension Wires

Thermocouple Extension Wires shall be twisted pairs - 15 twists or more per meter. Conductors shall be 16 AWG for one and 20 AWG for two pairs and multi-conductor cables. Conductors shall be solid and shall be galvanised steel wire armoured under the outer FRLS PVC cover. Individual pair cables and the individual pairs in multicore cables shall be shielded with braided tinned copper wire. Multicore cables shall also have a similar common shield.

Standard insulation is PVC with minimum temperature rating of 85 deg. C.

Each core shall be colour coded and numbered.

11.0 PROCESS CONNECTION (Refer Annexure- 3)

11.1 First tapping points for all pressure, d/p signals shall be 3/4" NPT. Mechanical piping scope shall be up to 1st isolation valve(s). Subsequent reduction to 1/2" size and impulse piping and connection shall be under the scope of instrumentation.

11.2 Wherever diaphragm seals have been used, the vessel or piping nozzle shall be 3" flanged. Flange rating shall conform to piping index.

11.3 All vessel or piping nozzles for temperature instruments shall be 1 1/2" flanged or 1" NPT (F) threaded.

ANNEXURE -2
INSTRUMENT ACCURACIES

The instrument reference accuracies shall be as per the table below. Any deviation shall have prior approval of the Owner.

SR.NO.	DESCRIPTION	ACCURACY
1	Gas Monitors all types	5 %FS
2	Conductivity, pH meters	0.5 % value
3	Belt weighers	0.5 % range
4	Pressure, DP Transmitter	0.075 % of span (for 10:1 turndown)
5	Pressure, DP Transmitter rangeability	100:1
6	Pressure Gauges	1 % of span for Burdon type, 1.5 % of span for Diaphragm type.
7	Tank Gauging (Custody Transfer)	± 1 mm with ± 1 mm resolution
8	Other Tank Gauging	± 5 mm
9	Displacer Transmitter	± 10 mm
10	Temperature Gauge bimetallic	± 1 %
11	TT for Thermocouple, RTD	± 0.12°C
12	Orifice Plate: Normal Application	± 2 % of flow rate
13	Orifice Plate: Special Application	± 1.5 % of flow rate
14	Annubar, lines<10"	± 1 % of flow rate
15	Rotameters	± 2 % of flow rate
16	Vortex Meter	± 0.7 % of flow rate
17	Magnetic Flow Meter	± 0.5 % of flow rate
18	Positive Displacement Meter	± 0.25 % of flow rate
19	Ultrasonic Flow Meter	± 0.5 % of flow rate
20	Mass Flow Meter	± 0.25 % of rate
21	All Utility flows for guarantee runs	± 1 % or better

ANNEXURE-3
INSTRUMENT PROCESS CONNECTIONS

Instrument Devices	Vessel Or Tank	Piping Scrwd. Spec	Piping Flgd Or Sw	1st Block Valve	Instrument Connection	Vent And Drain Inst Connection	Remarks
Flow Instrument							
Flow dP Cells		1/2 Inch NPT	1/2 inch *	1/2 inch to Pipe Spec	1/2 inch NPT	1/2 inch NPT	* piping to provide 1/2"NPT M when valve is SW
dP Cells with remote chemical seals	2 inch Flanged	2 inch Flanged	2 inch Flanged	2 inch Flanged	1/2" to 3" Flanged		
Variable Area Meter		Line Size	Line Size				
Averaging Pilot		1 1/2 inch	1 1/2 inch	see Remarks			When hot tap is used use full sized ball valve
Flow Glasses		Line Size	Line Size				
Level Instrument							
Stand Pipes	2 inch Flanged			2 inch Flanged		3/4 inch NPT	Stand pipe size 2" or 3"
External Displaces / Guided Wave Radar	2 inch Flanged			2 inch Flanged	2 inch Flanged	3/4 inch NPT	
Internal Displacers	4 inch Flanged			4 inch Flanged	4 inch Flanged		
Internal Ball Floats	4 inch Flanged				4 inch Flanged		
Gauge Glasses	2 inch Flanged.			1 inch 2 inch*	1 inch 2 inch*	1/2 inch NPT	* For Magnetic type
Level Instrument with Remote Chemical seals	2 inch or 3 inch flanged	2 inch or 3 inch Flanged	2 inch or 3 inch Flanged	2 inch or 3 inch Flanged			
Pressure Instruments							
Pressure Gauges	2 inch Flanged	3/4 inch NPT	3/4 inch	3/4 inch	1/2 inch NPT	1/2 inch NPT	Except where 1" to Pipe Specification
Transmitters	2 inch Flanged	3/4 inch NPT	3/4 inch	3/4 inch to Pipe Spec	1/2 inch NPT	1/2 inch NPT	Except where 1" to Pipe Specification

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Instrument Devices	Vessel or Tank	Piping Scr. Spec	Piping Fig or SW	1st Block Valve	Instrument Connection	Vent and Drain Inst connection	Remarks
dP Cells	2 inch Flanged	3/4 inch NPT	3/4 inch	3/4 inch to pipe Spec	1/2 inch NPT	1/2 inch NPT	Except where 1" to Pipe Specification
Pressure Instrument with Remote Chemical seals	2 inch or 3 inch flanged	2 inch or 3 inch Flanged	2 inch or 3 inch Flanged	2 inch or 3 inch Flanged			
Thermowell	2 inch flanged	1 ½ inch Flanged	1 ½ inch Flanged		1/2 inch NPT		
Analyzers	2 inch Flanged	2 inch Flanged	2 inch Flanged		Seller's std	Seller's std	

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VENDOR LIST

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Flue Gas Analyser (ZrO₂ type)		
1.	ABB Ltd (BU – Analytical &Adv)	India
2.	Emerson Process Management (I) Pvt. Ltd	India
3.	Ametek Inc	U.S.A
4.	GE Panametrics	Ireland
H₂S/ Total Sulphur Analysers		
1.	Barton Instrument Systems Limited	U.K
4.	ABB India Ltd.	India
System House Analysers		
1.	ABB Ltd (BU – Analytical &Adv)	India
2.	Chemtrols Industries Limited	India
3.	Emerson Process Management (I) Pvt. Ltd	India
4.	Intech	Italy
5.	Adage Automation Pvt Ltd.	India
Density Analysers		
1.	Emerson Process Management (I) Pvt. Ltd (coriolis type)	India
2.	Bopp & Reuther MesstechnikGmbh (coriolis type)	Germany
3.	SolartronMobrey	U.K
Moisture Analysers		
1.	GE Panametrics	Italy
2.	AmetekInc	U.S.A
Gas & Fire Detection System		
1.	Andrew Yule & Company Ltd. (Fire)	India
2.	Honeywell Automation India Limited (Gas)	India
3.	J B Boda And Brothers Pvt. Ltd. (Gas Make-International Sensor Technology)	India
4.	Pollution Protection System Mumbai Pvt Ltd (Gas)	India
5.	Teledyne Fluid Systems (Gas)	Thailand
6.	General Monitors (Gas)	U.K
Air Quality Monitoring System		
1	Chemtrol industries Ltd.	India
Flow Element: Orifice/ Venturi/ Flow Nozzle		
1.	Baliga Lighting Equipments Limited (Only Orifice)	India
2.	General Instruments Consortium (Only Orifice)	India
3.	Instrumentation Ltd, Palakkad	India
4.	Micro Precision Products Private Ltd.	India
5.	Eureca Industrial Equipments Pvt Ltd.	India
6.	Unicontrols Instruments Pvt. Ltd.	India
7.	Bopp & Reuther MesstechnikGmbh	Germany
8.	Technomatic Spa	Italy
9.	ISA Controls Limited	U.K
10.	Daniel Measurement & Control	U.S.A
11.	Flowtech Instruments services (Orifice/Venturi)	India
12	Chemtrol Industries Ltd	India
Pitot Tube/ Annubar		
1.	Control Engineers	India
2.	Emerson Process Management (I) Pvt. Ltd.	India
3.	Micro Precision Products Private Ltd.	India
4	ABB India Limited	India
5.	Unicontrols Instruments Pvt. Ltd.	India
6.	Technomatic Spa	Italy

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7.	ISA Controls Limited	U.K
8	Daniel Measurement & Control	U.S.A
Rotameters		
1.	Instrumentation Engineers Pvt. Ltd.	India
2.	Krohne Marshall Pvt. Ltd.	India
3.	Placka Instruments & Controls Pvt. Ltd. (Purge Rotameter Only)	India
4.	Rota Instrumentation	India
5.	Eureca Industrial Equipments Pvt Ltd.	India
6.	ABB India Ltd.	India
7	Krohne	Germany
8	Rota Yokogawa Gmbh& Co. Kg	Germany
9	Tokyo Keiso Co. Ltd.	Japan
10.	Yamatake Corporation	Japan
11	Emerson Process Mgt	U.S.A
12	Flowtech Instruments services	India
13	Chemtrol Industries Ltd	India
Mass Flow Meter (Coriolis Type)		
1.	Emerson Process Management (I) Pvt. Ltd.	India
2	SIEMENS Ltd.	India
3.	ABB India Limited	India
4	Bopp & Reuther MesstechnikGmbh	Germany
5	Endress + Hauser Gmbh& Co.	Germany
6.	Krohne	Germany
7.	Schlumberger Resource Management Ltd.	U.S.A
8.	Chemtrol Industries Ltd	India
Turbine Flowmeter		
1.	FmcSanmar Ltd.	India
2.	ABB India Ltd.	India
3.	Bopp & Reuther MesstechnikGmbh	Germany
4.	Instromet International N.V	Holland
5.	Itochu Corporation (Rep.KubotaCorpn.)	Japan
6.	Yamatake Corporation	Japan
7.	Oval Asea Pacific Pte Ltd	Singapore
8.	Barton Instrument Systems Limited	U.K
9.	Emerson Process Mgt	U.K
10.	Emerson Process Mgt	U.S.A
11.	Rockwell International Corpn.	U.S.A
12.	Chemtrol Industries Ltd	India
Vortex meter		
1.	Krohne Marshall Pvt. Ltd.	India
2.	Yokogawa Limited	India
3.	Siemens Ltd.	India
4	ABB India Ltd.	India
5.	Emerson Process Management (I) Pvt. Ltd.	India
6	Bopp & Reuther MesstechnikGmbh	Germany
7.	Endress + Hauser Gmbh& Co.,	Germany
8.	Krohne	Germany
9	Itochu Corporation (Rep.KubotaCorpn.)	Japan
10	Schlumberger Resource Management Ltd.	U.S.A
PD Meter		
1.	Rockwin Flow Meters (I) Pvt. Ltd.	India

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2.	Bopp & Reuther MesstechnikGmbh	Germany
3.	Oval Asea Pacific Pte Ltd	Singapore
4.	Emerson Process Mgt	U.S.A
5.	Schlumberger Resource Management Ltd.	U.S.A
6.	Chemtrol Industries Ltd	India
Magnetic Flow meter		
1.	Emerson Process Management (I) Pvt. Ltd.	India
2.	ABB India Ltd.	India
3.	Endress + Hauser (India) Pvt. Ltd.	India
4.	Krohne Marshall Pvt. Ltd.	India
5.	Siemens Ltd.	India
6.	Bopp & Reuther MesstechnikGmbh	Germany
7.	Krohne	Germany
8.	Yamatake Corporation	Japan
9.	Chemtrol Industries Ltd	India
Insertion Type Flow Meter		
1	Siemens Ltd.	India
Ultrasonic Flow Meter		
1	Endress + Hauser (India) Pvt. Ltd.	India
2.	Siemens Ltd.	India
3.	Chemtrol Industries Ltd	
Orifice Meter		
1	Chemtrol Industries Ltd	India
Metering Skid		
1	Chemtrol Industries Ltd (for liquid & Gas)	India
Pressure Gauges		
1.	A N Instruments Pvt. Ltd.	India
2.	General Instruments Consortium,	India
3.	H.Guru Industries	India
4.	Manometer (India) Pvt. Ltd	India
5.	PeejeeEngg. Works	India
6.	Precision Industries Ltd. (standard normal type)	India
7.	Premium Inst. & Controls Ltd.	India
8.	Walchandnagar Industries Ltd.	India
9.	Ashcroft India(P) Ltd. (standard normal type)	India
10.	Dresser Europe S.A	Germany
11.	WikaAlexanderWiegandGmbh& Co.	Germany
12.	Spriano Spa	Italy
13.	Nagano Keiki Seisakusho	Japan
14.	Rueger SA	Switzerland
15.	Budenberg Gauge Co. Ltd	U.K
Vol. Seal Pr. Gauges		
1.	A N Instruments Pvt. Ltd. (=<600# Except Urea Service)	India
2.	Dresser Europe S.A.	Germany
3.	WikaAlexanderWiegandGmbh& Co.	Germany
4.	Spriano Spa	Italy
5.	Nagano Keiki Seisakusho	Japan
6.	Rueger Sa	Switzerland
7.	Budenberg Gauge Co. Ltd.	U.K
Local D/P Indicators		
1.	Switzer Instrument Co.	India

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2.	Barton Instrument Systems Limited	U.K
3.	Delta Controls Ltd.	U.K
Pressure & D/P Transmitters		
1.	Emerson Process Management (I) Pvt. Ltd.	India
2.	Honeywell Automation India Limited	India
3.	Yokogawa Limited	India
4.	Siemens Ltd.	India
5.	Endress + Hauser (India) Pvt.Ltd.	India
6.	Siemens Ag, Germany	Germany
7.	Yamatake Corporation	Japan
8.	Yokogawa Electric Corporation	Japan
9.	Emerson Process Mgt Singapore Ltd	Singapore
10.	SmarSingaporePte. Ltd.	Singapore
11.	Honeywell Inc.	U.S.A
12.	Moore Products Company	U.S.A
Vol. Seal Pr./Dp Transmitter		
1.	Honeywell Automation India Limited	India
2.	Yokogawa Limited	India
3.	Siemens Ltd.	India
4.	ABB India Limited	India
5.	Emerson Process Management (I) Pvt. Ltd.	India
6.	Endress+ Hauser (India) Pvt. Ltd.	India
7.	Fuji Electric Systems Co., Ltd. (Except Urea Service)	Japan
8.	Yamatake Corporation	Japan
9.	Yokogawa Electric Corporation	Japan
10.	Emerson Process Mgt Singapore Ltd	Singapore
11.	Moore Products Company	U.S.A
Pressure & D/P Switches Including Vol. Seal		
1.	Indfos Industries Ltd. (Except Vol.Seal)	India
2.	Switzer Instrument Co., (Except Vol.Seal)	India
3.	Kaustubha Udyog (pressure switch & D/P switches except volumetric seal)	India
4.	Endress + Hauser(India) Pvt. Ltd.	India
5.	Nagano Keiki Seisakusho	Japan
6.	Yamatake Corporation	Japan
7.	Delta Controls Ltd.	U.K
8.	Sor Inc.	U.S.A
9.	United Electric Controls Co.	U.S.A
Vol. Seal Pressure.&Dp Switches (Urea Service)		
1.	Spriano Spa	Italy
2.	Delta Controls Ltd.	U.K
3.	Endress + Hauser(India) Pvt. Ltd.	India
4..	Sor Inc.	U.S.A
Transparent/ Reflex / Bicolor Mag.Level Gauges		
1.	Chemtrols Samil(India) Pvt Ltd.	India
2.	Pune TechtrolPvt.Ltd. (<=300# Rating Only)	India
3.	Tecnomatic (India) Pvt. Ltd.	India
4.	V-Automat & Inst. (P) Ltd., (Upto 300#)	India
5.	Nisan Scientific Process Equipments Pvt. Ltd.	India
6.	ABB India Ltd.	India
7.	Bliss Anand Private Ltd.	India

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3.	H.Guru Industries	India
4.	PeejeeEngg. Works	India
5.	Waaree Instruments Ltd	India
6.	Walchandnagar Industries Ltd.	India
7.	Ashcroft India(P) Ltd.	India
8.	Goa Instruments Industries Ltd(Liquid filled, Gas filled Mercury in steel)	India
Radiation Pyrometer		
1.	Siemens Ag, Germany	Germany
2.	Tempsens Instruments (I) Pvt. Ltd.	India
3.	C.C.R. Technico	Italy
4.	ChinoCorp.	Japan
5.	Land Infrared	U.K
6.	Wahl Instruments	U.S.A
Temperature Transmitters		
1.	ABB India Limited	India
2.	Endress+ Hauser (India) Pvt. Ltd.	India
3.	Siemens Ltd.	India
4.	Siemens Ag, Germany	Germany
5.	M-System	Japan
Temperature Switches		
1.	Goa Instruments Industries Ltd	India
Gate/Plug Valves		
1.	Audco India Limited(L&T Valves Divn.)	India
2.	BHEL(Valves Division)	India
3.	Chemtrols Engineering Limited (Plug Valves)	India
4.	Ksb Pumps Limited (Valves Divn)	India
5.	Flowserve India Control Pvt. Ltd.(Plug Valve upto 12"300# upto 6" 600#)	India
6.	Velan Inc.	Canada
7.	MalbrangueS.A.	France
8.	CesareBonetti	Italy
9.	Fasani S.P.A.	Italy
10.	Petrol Valves S.R.L	Italy
11.	Matsura H. P Machine Works Co.Ltd.	Japan
12.	Bel Valves	U.K
Globe / Angle Valves		
1.	Dresser Masoneilan (GE)	India
2.	Emerson Process Management India Ltd (Fisher)	India
3.	Instrumentation Ltd. (Palakkad) (= <2500#, Except Slurry, Noise, Cavitation)	India
4.	Mil Controls Limited (= <600#, Except Slurry, Noise, Cavitation)	India
5.	Flowserve india control pvt. Ltd. (globe valve upto 30" 600# upto 24" 900#, upto 16" 2500# upto 4" 4500#)	India
6.	Koso fluids controls pvt. Ltd. (globe valves: upto 8" 2500# 10 to 18" 300# angle valves upto 8" 300#)	India
7.	Severn glocon (I) pvt. Ltd. (1 to 8 " rating 2500# (except noise, cavitation); 1 to 12 " rating 600# (except noise, cavitation)	India
8.	Dresser Masoneilan (= <2500#, Urea Service Also)	France
9.	Arca-ReglerGmbH (= < 2500#)	Germany
10.	Parcol Spa (= <2500#, Urea Service Also)	Italy

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11.	Nippon Fisher Co. Ltd. (= < 2500#)	Japan
12.	Yamatake Corporation (= < 2500#)	Japan
13.	Fisher Xomox (= < 2500#)	Singapore
14.	Flowserve (= < 2500#)	U.S.A
15.	Chemtrol Industries Ltd. (for water & steam)	India
Ball Valves		
1.	Tyco Valves & Controls (I) Ltd (= < 150 #)	India
2.	Virgo Engineers Ltd. (= < 600# With Maccair Actuators)	India
3.	Flowserve India controls Pvt. Ltd. (upto 16" 600#)	India
4.	Koso Fluid Controls pvt. Ltd. (upto 8 " , 2500# , 10" to 18" 900#)	India
5.	Metso Automation (= < 2500#)	India
6.	Velan Inc. (ball valves on/off size: 1/4" to 6" (rating upto 2500#) size 8" to 16" (rating upto 900#) size 18" to 30 " (rating upto 300#)	canada
7.	Perrin GmbH (SIZE 1/2" TO 12 " & Rating 150# to 2500# , size 14" to 18" & rating 150# to 1500#)	Germany
8.	Metso Automation (= < 2500#)	Italy
9.	Petrol Valves S.R.L	Italy
10.	Pibiviesse S.P.A. (Rating Upto 2500 #)	Italy
11.	GTC Italia	Italy
12.	Metso Automation (= < 2500#)	Singapore
13.	Orbit Valves (= < 2500#)	Singapore
14.	M/s Bray Control Pvt Ltd (upto 4" 300#)	India
Butterfly Valves		
1.	Instrumentation Ltd. (Palakkad) (= < 300#)	India
2.	Tyco Valves & Controls (I) Ltd (= < 150 #)	India
3.	Virgo Engineers Ltd. (= < 300#)	India
4.	Flowserve india control pvt. Ltd. (upto 30" , 300# upto 12" 600#)	India
5.	Koso fluid controls (pvt.) ltd. (= < 150#)	India
6.	Korea Unicom valves co. Ltd.(for rating = < 300#)	Korea
7.	Parcol Spa (= < 2500# Urea Service Also)	Italy
8.	Orton s.r.l (Upto 2500#)	Italy
9.	Bray Controls (= < 300#)	U.S.A
10.	Keystone (Upto 2500#)	Singapore
11.	Metso Automation (Upto 2500#)	Singapore
12.	Leeds Valve Ltd	U.K
13.	EMET Control Pvt Ltd (upto 4" 900#, 6" 150# to 16" 150#, double eccentric)	India
Saunders (Pinch) Valves		
1	Weir BDK VALVES(a unit of weir india pvt. Ltd.) upto 1500#	India
Solenoid Valves		
1.	Asco (India) Limited	India
2.	IMI Norgren (add)	India
3.	IMI Norgren-Herion Fluidtronic GmbH & Co.	Germany
4.	Alexander Controls Ltd.	U.K
5.	Asco Joucomatic Ltd.	U.K
Prds & Spray Nozzle, Vent Valves Upto 2500#		
1.	Cci Valve Technology Ab	Sweden
2.	ABB	U.K
3.	Control Components Inc.	India
4.	Spx Valves & Controls (Copes-Vulcan Ltd)	U.S.A

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5.	Control Components Inc.	India
6.	Chemtrol Industries Ltd (PRDS Combine & Split)	India
Air Filter Regulator		
1.	Asea Brown Boveri Ltd.	India
2.	Divya Control Elements Pvt. Ltd.	India
3.	Mil Controls Limited	India
4.	Placka Instruments & Controls Pvt. Ltd.	India
5.	Shavo Norgren(India) Pvt Ltd.	India
6.	ABB India Limited	India
Pressure Regulator		
1	Chemtrol Industries Ltd	India
Limit/Proximity Switches		
1.	Osna Electronics Pvt. Ltd. (Intrinsically Safe Proximity Switches)	India
2.	Pepperl + Fuch	India
3.	EL-O Matic India Pvt Ltd(for non critical apps)	India
4.	Rotex Manufacturers & Engineers Pvt Ltd(for non critical apps)	India
5.	Protocontrol Instruments (I) Pvt. Ltd. (for non critical applications)	India
6	Pepperl + Fuch	Germany
7.	Pepperl + Fuchs Pte Ltd.	Singapore
8.	Honeywell Inc.	U.S.A
Valve actuator (Pneumatic/ Rotary)		
1.	EL-O-Matic India private limited (for non- critical applications)	India
2.	Bray Control Pvt Ltd.	India
3.	XOMOX SANMAR LTD.	India
Self actuated pressure control valve		
1	Fisher / Emerson	USA / India
Slam Shut off valve		
1.	Fisher / Emerson	USA/ India
2.	Flowserve	USA / India
3.	Virgo	USA / India
Electroneumatic Positioner		
1.	Siemens Limited	India
2	OEM of the control valves (Add Fisher, Yamatake, Severn, Dresser, etc.)	
Turbine Bypass valves		
1.	Circor Flow Technologies India Pvt. Ltd. (2 to 24" upto 2500#)	India
Desuperheater		
1.	Cicor Flow technologies India Pvt. Ltd (upto 24" 300# upto 28" 1500 # Multi nozzle 3" to 4 " upto 2500#)	India
2.	EMET Control Pvt Ltd (1 ½" 600# X 3" 2500#)	India
Pressure reducing station		
1.	Cicor Flow technologies India Pvt. Ltd. (1 to 20" upto 1500#, 1 to 10" upto 1500 # 1"to 8" upto 2500#)	India
Safety Valves & Thermal Relief Valves Upto 2500#		
1.	Fainger Leser Valves (P) Ltd. (Upto 600#, ½" To 6")	India
2..	Instrumentation Ltd. (Palakkad)	India
3.	Tyco Sanmar Ltd.	India
4.	Bliss anand private limited (8" * 10" 300#, 6" * 8 " 600# ,4 * 6" 1500#)	India
5.	Mekaster engg. Ltd (upto 600# safety – 4"* 6" , thr relief ¾" * 1")	India
6.	Dresser Valve & Controls	Canada

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Speed Indicator		
1.	Pepperl + Fuch	Germany
2.	Shinkawa Electric Co.	Japan
3.	Pepperl + Fuchs Pte Ltd.	Singapore
4.	Jacquet	Switzerland
5.	Bentley NevadaLlc	U.S.A
Anti Surge Controller		
1.	Compressor Control Corporation	Singapore
Burner Management System		
1.	DuragIndustrieElektronikGmbh& Co Kg	India
2.	Siemens Ag, Germany	Germany
3.	Mitsubishi Heavy Industries Ltd.	Japan
4.	Omron Corporation	Japan
5.	Yamatake Corporation	Japan
6.	Honeywell Inc.	U.S.A
Furnace Camera, Heater, Thermal Imager		
1.	Tempsens instruments (I) Pvt. Ltd.	India
Terminal Automation System		
1.	Asea Brown Boveri Ltd.	India
2.	Emerson Process Management (I) Pvt. Ltd.	India
3.	Honeywell Automation India Limited	India
4.	Chemtrol Industries Ltd	India
I/P Converter		
1.	Emerson Process Management (I) Pvt. Ltd.	India
2.	Invensys (Foxboro)	India
3.	Yokogawa Limited	India
4.	Yokogawa Electric Corporation	Japan
5.	Emerson Process Management Ltd	U.S.A.
Instrument Power & Control Cables		
1.	Associated Cables Ltd.	India
2.	Associated Flexibles & Wires Pvt. Ltd.	India
3.	Cords Cable Industries Ltd.	India
4.	Delton Cables Ltd	India
5.	Insucon Cables & Conductors (P) Ltd. (For Smaller Non-Critical Projects)	India
6.	J K Cables Limited	India
7.	Kei Industries Limited	India
8.	Paramount Cable Corporation	India
9.	T C Communications Pvt Ltd	India
10.	Thermo Cables Limited	India
11.	Toshniwal Cables	India
12.	Udey Pyro Cables Pvt Ltd	India
13.	Polycab Wires	India
Extension & Compensating Cables		
1.	Associated Cables Ltd.	India
2.	Associated Flexibles & Wires Pvt. Ltd.	India
3.	Cords Cable Industries Ltd.	India
4.	Delton Cables Ltd	India
5.	General Instruments Consortium,	India
6.	J K Cables Limited	India
7.	Kei Industries Limited	India

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8.	Paramount Cable Corporation	India
9.	Thermopads Pvt. Ltd.	India
10.	Toshniwal Cables	India
Cable Trays & Accessories (Al./Gi)		
1.	Globe Electrical Industries	India
2.	Indiana Engg Works Pvt Ltd	India
3.	Metalite Industries,	India
4.	Parekh Engineering Company	India
5.	Sadhana Engineering Corporation	India
6.	Steelite Engineering Limited	India
Multi Transit Inlet System		
1.	MctBrattberg Aktiebolag	Sweden
2.	Roxtec Ab	Sweden
3.	Hawke International	U.K
Junction Box & Cable Gland		
1.	Baliga Lighting Equipments Limited	India
2.	Ceag Flameproof Control Gears Pvt.Ltd.	India
3.	Flameproof Equipments Pvt. Ltd.	India
4.	Flexpro Electicals Pvt. Ltd.	India
5.	Trinity Touch Pvt. Ltd. (Only cable Glands upto size 25M)	India
6.	Stahl-Und Apparatebau Hans Leffer GmbH	Germany
7.	TAN SWA technologies Inc (Junction Box)	India
CS Seamless Pipes		
1.	Indian Tube Co(Tata Div. Of Tubes & Pipes)	India
2.	Ismt Limited	India
3.	Maharashtra Seamless Ltd.	India
4.	Ets Trouvay & Cauvin	France
5.	Phoceenne	France
6.	Horst Kurvers GmbH	Germany
7.	Mannesmann Handel Ag	Germany
8.	Dalmine Spa	Italy
9.	Ibf Seamless Pipes Spa	Italy
10.	Marubeni Itochu Steel	Japan
11.	Nippon Steel Corporation	Japan
12.	Nissho Iwai Corporation	Japan
13.	Okura & Co. Ltd.	Japan
14.	Sojitz Corporation CS Seamless Pipes	Japan
15.	Sumitomo Metal Industries Ltd.	Japan
16.	Hyundai Corporation	Korea
17.	Vomal International Limited	U.K
SS Seamless Pipes		
1.	Choksi Tube Company Ltd.	India
2.	Nuclear Fuel Complex	India
3.	Rajendra Mechanical Industries Ltd.	India
4.	Ratnamani Metals & Tubes Limited	India
5.	Matix Tubes Company Pvt. Ltd.	India
6.	Phoceenne	France
7.	Tps-Technitube Rohrenwerke GmbH	Germany
8.	Dalmine Spa	Italy
9.	T.T.I- Tubacex Tubos Inoxidables, SA(1/2" NB SS pipe)	Spain

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SS Tubes		
1.	Choksi Tube Company Ltd.	India
2.	Nuclear Fuel Complex	India
3.	Ratnamani Metals & Tubes Limited	India
4.	Matix Tubes Company Pvt. Ltd.	India
5.	Itochu Corporation (Rep.KubotaCorpn.)	Japan
6.	Nishitani& Co. Ltd.	Japan
7..	Sumitomo Metal Industries Ltd.	Japan
Pipe Fittings		
1.	Eby Industries	India
2.	Excel Hydro-Pneumatics Pvt Ltd,	India
3.	Micro Precision Products Private Ltd.	India
4.	Precision Engineering Industries	India
5.	Tecnomatic (India) Pvt. Ltd.	India
6.	Wesmec Engineers Pvt. Ltd.	India
7.	CellierS.A.	France
8.	Siemens Ag Pgi	Germany
9.	Thyssen-Krupp StahlunionGmbh	Germany
10.	CesareBonetti	Italy
11.	Technomatic Spa	Italy
12.	Sumitomo Metal Industries Ltd.	Japan
13.	Dewrance& Co. Ltd.	U.K
14.	Hopkinsons Limited	U.K
15.	Thompson Valves Ltd.	U.K
16.	Velan Engineering Co. Limited	U.K
17.	Anderson Greenwood & Co.	U.S.A
18.	Crane Company Intl. Sales	U.S.A
Compression Fittings		
1.	Aura Inc	India
2.	Baldota Valve & Fitting Co.Pvt.Ltd.	India
3.	Excel Hydro-Pneumatics Pvt Ltd,	India
4.	Excelsior Engg Works	India
5.	Panam Engineers	India
6.	Precision Engineering Industries	India
7.	Reliance Engg. & Electrical Corpn.	India
8.	Vikas Industrial Products	India
9.	Arya Crafts & Engineering Pvt Ltd.	India
10.	Fluid Controls Pvt Ltd	India
11.	Wesmec Engineers Pvt. Ltd.	India
12.	Parker Hannifin SingaporePte. Ltd.	Singapore
13.	Swagelock Company/Creximco	U.S.A
Instrument Miniature Valves		
1.	Audco India Limited(L&T Valves Divn.)	India
2.	Aura Inc	India
3.	BHEL (Valves Division)	India
4.	Chemtrol Industries Ltd	India
5.	Excel Hydro-Pneumatics Pvt Ltd,	India
6.	Chemtrols Samil(India) Pvt Ltd	India
7.	Hyd- Air Engineering works Lonavla	India
8.	Excelsior Engg Works	India
9.	Ksb Pumps Limited (Valves Divn)	India

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10.	Panam Engineers	India
11.	Tecnomatic (India) Pvt. Ltd.	India
12.	Wesmec Engineers Pvt. Ltd	India
13.	CellierS.A.	France
14.	BfeBonney Forge Valve Licensee	Italy
15.	Euromisure Cremona	Italy
16.	Technomatic Spa	Italy
17.	Kosei Sangyo Ltd	Japan
18.	Sumitomo Metal Industries Ltd.	Japan
19.	Dewrance & Co. Ltd.	U.K
20.	Hopkinsons Limited	U.K
21.	Velan Engineering Co. Limited	U.K
22.	Anderson Greenwood & Co.	U.S.A
23.	Crane Company Intl. Sales	U.S.A
24.	Swagelock Company/Creximco	U.S.A
Purge Rotameter		
1.	Instrumentation Engineers Pvt. Ltd.	India
2.	Placka Instruments & Controls Pvt. Ltd.	India
3.	Eureca Industrial Equipments Pvt Ltd	India
Self Actuated Pressure Control Valves		
1.	Nirmal Industries Control Pvt Ltd (1/2" to 6" &<300#)	India
Slam Shut Off Valve		
1.	Nirmal Industries Control Pvt Ltd (1/2" to 6" &<300#)	India
AIR HEADER/ADPOT		
1	Wesmec engineering pvt. Ltd.	India
Condensate pot		
1	Wesmec engineering pvt. Ltd.	India
Valve manifolds		
1	Wesmec engineering pvt. Ltd.	India
Calibration equipment & services		
1	Tempsens instruments (i) pvt. Ltd.	India
Enclosures		
1	Trinity touch pvt. Ltd. (weatherproof size 80 * 80 mm)	India
Instrument contractor for inst. Construction /erection works		
1	ANI instrument (upto 0.5 crores	India
2.	Instrocon engineers and controls (I) Pvt. Ltd (upto 0.5 crores)	India
3.	Jasubhai engineering pvt. Ltd.	India
4.	Koso india pvt. Ltd. (kent introl control valve divn.)	India
5.	L&T (construction contracts Divn.)	India
6.	Miraj instrumentation service (upto 0.5 crores)	India
7.	Narayan engineering (< Rs. 5 lacs (small project))	India
8.	Pace process control pvt. Ltd.	India
9.	Peron engg. Construction ltd.	India
10.	Protect control pvt. Ltd.	India
11	Technimont ICB ltd.	India
12.	M/s Godrej & Boyce mfg. co. ltd	India