BHARAT HEAVY ELECTRICALS LIMITED

HEAVY POWER EQUIPMENT PLANT

RAMACHANDRAPURAM, HYDERABAD-502032 (INDIA)

NOTICE INVITING

EXPRESSION OF INTEREST (EOI)

FOR SUPPLY OF

DRY GAS SEALS AND SEAL GAS CONTROL & FILTER SKIDS FOR CENTRIFUGAL COMPRESSORS

EOI REFERENCE NUMBER : HYD/T&C/DGSEOI/2014/02

Turbines & Compressor Division of Bharat Heavy Electricals Limited, Hyderabad,

Invites

Expression Of Interest (EOI) from Reputed Dry gas Seal Manufacturers (OEMs) and DGS Skid manufacturers (OEMs)

For supply of Dry gas Seals and its control and filter skids for Centrifugal compressors as per the housing dimensions and specifications attached to this EOI.

CONTACT PERSON AT BHEL:

S.DURAIRAJ

ADDITIONAL GENERAL MANAGER / COMPRESSOR DESIGNS DEPARTMENT

NEW ENGINEERING BUILDING, SECOND FLOOR,

BHARAT HEAVY ELECTRICALS LIMITED,

RAMACHANDRAPURAM, HYDERABAD -502032, INDIA

PHONE: +91 40 23183423 (office), 9010339111 (mobile)

E-MAIL ID: durairaj@bhelhyd.co.in

EOI RESPONSE SCHEDULE

Last date for receipt of any queries on EOI: 31st May 2014

Replies to all queries/clarifications by BHEL: 15th June 2014

Last Date for receipt of Response to EOI at BHEL: 30th June 2014

MODE OF SUBMISSION OF RESPONSE TO EOI

Response should be sent in a sealed cover to the above address by courier mail. The cover shall be super scribed with EOI Reference number and the words "Expression of Interest – Dry gas Seals "

Alternately, same may be e-mailed to the e-mail ID given above, so as to reach BHEL on or before the last date mentioned above. In case of submission of response through e-mail to the e-mail ID, hard copy of the same shall be enclosed along with printout of e-mail and sent by courier mail to the above person so as to reach BHEL on or before 30th June 2014.

Notice Inviting Expression Of Interest (EOI) from Reputed Dry gas Seal and DGS Skid Manufacturers

For supply of Dry gas Seals and its control and filter skids for Centrifugal Compressors, as per the housing dimensions and Specifications attached to this EOI.

EOI REFERENCE NUMBER: HYD/T&C/2014/01

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SECTION – 1: SUMMARY OF REQUIREMENT

1.1 ABOUT BHEL

Bharat Heavy Electricals Limited (BHEL) (web site: www.bhel.com), a Government of India Undertaking, is a major electrical equipment manufacturer for both the Indian and export markets. It is one of the largest engineering and manufacturing enterprises in India and is one of the leading international companies in the field of power generating equipment with an annual revenue of over INR 275 Billion (US$ 5.5 Billion).

BHEL offers a wide spectrum of products and services for core sectors like Power, Transmission, Industry, Transportation, Oil & Gas, and Non-Conventional Energy Systems etc.

1.2 ABOUT HYDERABAD UNIT OF BHEL

The Hyderabad unit (www.bhelhyderabad.com) of BHEL was formed in 1976 mainly for the design and manufacture of Steam Turbine, Generator, Heat Exchangers and Pumps required for thermal power plants and Centrifugal Compressors for Fertilizer and refinery applications.

1.3 COMPRESSOR DIVISION OF BHEL HYDERABAD

BHEL is manufacturing centrifugal compressors of horizontally split design (MCL series) and vertically split design (BCL series) as per GENP technology for handling various gases in Refinery, Petro chemical and Fertilizer and natural gas application. The design pressure of Compressors is up to 300 bar.

1.4 OBJECTIVE TO SEEK EXPRESSION OF INTEREST (EOI)

This EOI is published for seeking response from qualified and experienced Original Equipment Manufacturers (OEMs) who are willing to be associated with BHEL for supply of Dry gas seals and its control and filter skids for Centrifugal Compressors as per the standard specifications attached to this EOI. However, the sizes and process gas sealing requirements may vary depending on customer process gas parameters and control system requirements specific to the projects. Job specifications will be provided at the time of Request For Quotation (RFQ) specific to the project that is under execution by BHEL.

1.5 RESPONSE TO THE "EXPRESSION OF INTEREST" – (EOI)

BHEL will shortlist prospective partners based on the responses received to this EOI request and register them as its approved vendor for supply of DGS / DGS Skids.

A separate RFQ will be issued to the shortlisted prospective partners for submitting their formal quotations as and when the requirement arises.

1.6 TECHNICAL AND QUALIFYING REQUIREMENTS

Only OEMs meeting both the Technical Requirements (TR) as described in Section-2 and the Qualifying Requirements (QR) as described in Section–3, will be considered for sending of RFQ.

1.7 CHECKLIST OF DOCUMENTS TO BE ATTACHED TO THE E.O.I. RESPONSE

The check-list of information required to be submitted along with the EOI by the interested Dry gas Seal manufacturers, is given at Section–5 of this document.

SECTION – 2: TECHNICAL SPECIFICATIONS

DESIGN AND CONSTRUCTION: The Dry gas Seals shall meet the design requirements as specified in the standard specification TC5 2357 (Annex 1) and the housing dimensions indicated in the specification TC5 2508 (Annex 2) for varying sizes.

Similarly Dry gas Seal control and filter skids shall meet the Specification TC5 2540 (Annex 3).

Short listed partners will be provided with the job specification along with RFQ as applicable to specific Compressor projects that will be executed by BHEL.

SECTION – 3: QUALIFYING REQUIREMENTS

3.1 TECHNICAL CAPABILITY FOR DRY GAS SEALS

The respondent shall be a reputed Dry gas seal manufacturer (OEM) who should have manufactured and supplied Dry Gas Seals similar in terms of specified shaft diameter and housing dimensions configuration of compressors for various process gases. As a reference, un-priced copy of the customer purchase order for such items, the relevant Dry gas seal drawing and specification along with copies of the test certificates of that supply are to be furnished for our review. Product catalogues may be provided for better appreciation of configurations and applications. The summary of the data is to be furnished as per the format indicated below:

PROFORMA FOR FILLING UP THE QUALIFYING REQUIREMENT DATA

SL. NO. :

CUSTOMER NAME:

CUSTOMER PURCHASE ORDER REFERENCE & DATE:

YEAR OF SUPPLY:

SEAL MODEL NO.:

PROCESS GAS SERVICE:

SHAFT DIAMETER:

SPEED:

PRIMARY SEALING GAS:

SEALING PRESSURE:

CONFIGURATION:

UNI/Bi DIRECTIONAL

TOTAL NUMBER OF HOURS THE SEAL IS UNDER CONTINUOUS OPEARTION:

CUSTOMER'S (END USER REPRTESENTATIVE) CONTACT DETAILS:

- NAME
- DESIGNATION & ADDRESS
- CONTACT TELEPHONE NUMBER
- E-MAIL ID

NOTE:

Dry gas Seals Drawings, copies of un-priced purchase order and test certificates to be attached for each reference.

3.2 TECHNICAL CAPABILITY FOR DRY GAS SEALS SKIDS

The respondent shall be a reputed Dry gas seal skid manufacturer (OEM), who should have manufactured and supplied Dry Gas Seals skids of various operating pressures up to 300 bar at least five units designed, manufactured, tested and supplied by the proposed manufacturer and at least two of these units shall have completed atleast one year of satisfactory operation without any major overhaul as on the EOI due date.

PROFORMA FOR FILLING UP THE QUALIFYING REQUIREMENT DATA

SL. NO. :

CUSTOMER NAME:

CUSTOMER PURCHASE ORDER REFERENCE & DATE:

YEAR OF SUPPLY:

PROCESS GAS SERVICE:

PRIMARY SEALING GAS:

SEALING PRESSURE:

DESIGN PRESSURE:

DESIGN TEMPERATURE:

TOTAL NUMBER OF HOURS THE SEAL SKID IS UNDER CONTINUOUS OPEARTION:

CUSTOMER'S (END USER REPRTESENTATIVE) CONTACT DETAILS:

- NAME
- DESIGNATION & ADDRESS
- CONTACT TELEPHONE NUMBER
- E-MAIL ID

NOTE:

Dry gas Seal Skid Drawings, copies of un-priced purchase order and test certificates to be attached for each reference.

SECTION – 4 COMPANY PROFILE OF THE OEM

CONTACT DETAILS:

NAME OF COMPANY:

DETAILS OF HEAD OFFICE:

ADDRESS:

TELEPHONE:

FAX:

E-MAIL:

WEB SITE:

DETAILS OF FACTORY / WORKS:

ADDRESS:

TELEPHONE:

FAX:

E-MAIL:

DETAILS OF CHIEF EXECUTIVE OF THE COMPANY:

NAME(S):

DESIGNATION:

ADDRESS:

TELEPHONE:

FAX:

E-MAIL:

DETAILS OF MARKETING REPRESENTATIVE (OUTSIDE INDIA):

ADDRESS:

TELEPHONE:

FAX:

E-MAIL:

DETAILS OF INDIAN REPRESENTATIVE, IF AVAILABLE (in case of non –Indian vendor):

ADDRESS:

TELEPHONE:

FAX:

E-MAIL:

CONTACT PERSON FOR FURTHER INTERACTION REGARDING THIS EOI:

NAME(S):

DESIGNATION:

ADDRESS:

TELEPHONE:

FAX:

E-MAIL:

DETAILS OF THE COMPANY TO BE FURNISHED AS PER FOLLOWING POINTS:

YEAR OF ESTABLISHMENT OF THE COMPANY:

ANNUAL PRODUCTION CAPACITY:

PARTICULARS OF PRODUCT RANGE OF THE COMPANY:

(Please attach brochures and catalogues)

COUNTRY OF ORIGIN FOR OFFERED DESIGN AND TECHNOLOGY:

FINANCIAL INFORMATION:

ANNUAL TURN OVER AND PROFIT AFTER TAX FOR LAST 3 YEARS: (2011, 12 & 13)

(Please attach copies of audited Balance Sheet and P&L Account)

DUN AND BRADSTREET REPORT FOR THE COMPANY

QUALITY AND ENVIRONMENTAL MANAGEMENT SYSTEM:

IS THE COMPANY ISO: 9001 CERTIFIED? : YES / NO.

(IF YES, ENCLOSE COPY OF CERTIFICATE)

IS THE COMPANY ISO: 14001 CERTIFIED? : YES / NO.

(IF YES, ENCLOSE COPY OF CERTIFICATE)

IS THE COMPANY OHSAS 18001 CERTIFIED? : YES / NO.

(IF YES, ENCLOSE COPY OF CERTIFICATE)

EXPERIENCE LIST OF SIMILAR DRY GAS SEALS AND ITS SKIDS SUPPLIED SO FAR:

DETAILS OF INSPECTION AND TESTING FACILITIES:

MAXIMUM SIZE AND SEALING PRESSURE OF DRY GAS SEALS AND ITS SKIDS SUPPLIED:

ANY OTHER INFORMATION LIKED TO BE SHARED BY OEM (OPTIONAL)

SECTION – 5: CHECKLIST OF DOCUMENTS TO BE ATTACHED TO THE EOI RESPONSE

Following documents are to be provided along with the Expression of Interest:

Covering Letter expressing their interest to supply such Dry gas seals and its control and filter skids to BHEL, on their Company letterhead, along with following Enclosures:

1 Filled-up format of Qualifying Requirement Criteria – Section–3

2 Filled-up format of Company Profile – Section–4

3 Un-priced Purchase Order copy of similar Dry gas Seals and its skids supplied earlier

4 Dry gas Seals and its skids drawings of the previous supply as per above cited P.O.

5. Test Certificate copies pertaining to the supply of Dry gas seals and its skids as per above P.O.

6. Product brochures and catalogues

STANDARD SPECIFICATION FOR DRY GAS SEALS

1. INTRODUCTION

This General Specification covers the requirement of Dry gas seals of following types used both in Low Pressure and High Pressure applications for Centrifugal Compressors

a. Single / Double / Tandem / Triple

b. Unidirectional / Bidirectional

c. With / without intermediate Labyrinth

Dry gas seals shall be provided to restrict or prevent process gas leaks to the atmosphere or seal gas leaks in to the process gas stream over the range of specified operating conditions. Seal shall be suitable for specified variations in seal operating conditions that may prevail during start-up, shut down or settling out and during other specified conditions. When toxic or inflammable gases are used, an isolating seal is required to prevent uncontrolled leaks to the atmosphere or the bearing housing. This isolating seal shall be capable of acting as a backup seal if the primary seal fails during operation. Dry gas seal shall be provided with connections to inject filtered gas and to protect against reversal of differential pressure during sub atmospheric operation. Each dry gas seal assembly shall be cartridge mounted, located and attached to the compressor shaft. For unidirectional seals, cartridges shall be designed such that incorrect installation of the cartridges is impossible

2. SCOPE

Vendor shall offer for the dry gas seal as per this specification, job specification and the standards indicated elsewhere in the specifications. All test requirements as per this specification, international standards and special tests indicated in the job specification, if any, shall be considered in the offer. Special tools and Commissioning spares shall be included in the offer. The type of seal required, Gas Composition at different operating points and Shaft and housing dimensions are indicated in job specification. Scope of supply of supporting seal gas system (along with filter skid) is covered under a separate specification as indicated in Job Specification.

Rev. No.	Revisions	Prepared	Approved	Date
02	Refer to record of revisions	SDR	PNR	17.02.10

3. BRIEF DESCRIPTION OF DRY GAS SEALING SYSTEM

Offered configuration for Dry Gas Seals shall be of type Single or Tandem or triple or double configuration as indicated in the Job Specification to prevent leakage of process gas. A barrier seal (separate cartridge) – Carbon Ring Tertiary / Labyrinth seal as per Job Specification shall be provided to prevent entry of lube oil from the bearings into the seal zone. Dry, filtered clean gas (Process gas / Nitrogen / Sweet Gas as indicated in job specification) shall be filtered and throttled with the help of DPCV in compressor to the corresponding primary seal gas pressure and routed to the primary seals. Primary seal leakage shall be routed to the flare. A restriction orifice in the flare-line shall maintain a backpressure of about 0.3-0.4 kg/cm^2-g. **The leakages of the in-board seal & intermediate Labyrinth seal shall be estimated based on this back-pressure. Nitrogen shall be supplied** to the secondary seal with the secondary seal leakage routed to safe atmospheric height **or** it shall be **plugged** as indicated in the job specification. Both primary and secondary seals shall be capable of handling the entire pressure difference from clean (seal) gas pressure to flare pressure. Nitrogen or Instrument Air shall be supplied as barrier/separation gas as indicated in the job specification.

4. Applicable Standards / Codes

1. API 617
2. API 614
3. NACE Standard MR0175 (for Petroleum production, drilling, gathering and flow line equipment)
4. NACE Standard MR0103 (For sour Petroleum refining and related processes)

Please refer Job specification for applicable edition / NACE code

5. CHECKLIST

The offer will be considered complete in all respects and will be scrutinized only after the vendor confirms each of the requirements as per the checklist in **Page Nos. 4 to 7** of this specification.

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6. Technical Data

Vendor shall furnish all the technical inputs / data in the specified format as per **Page Nos. 8 and 9** of this specification. Any other data given elsewhere will not be considered for evaluation / scrutiny.

7. Acceptance Criteria and Performance Track Record

As on the date of issue of this enquiry, at least TWO sets (validly similar in terms of specified process gas service, shaft diameter, speeds, sealing pressures and configuration etc.,) shall have been designed, manufactured, tested and supplied from the proposed manufacturing plant and at least ONE of these units shall have been successfully operated in the field for at least 8000 hours without any major overhaul. Vendor shall furnish the Performance Track Record as per **Page No.10** of this specification.

8. Comments and Deviations

Any comments or deviations with respect to this General Specification, Job Specification, API and NACE standards shall be provided separately clearly indicating the clause no, deviation sought for and the technical justification. Any deviation indicated elsewhere in the offer will not be considered during evaluation. All the deviations shall be discussed and settled upon before placement of the purchase order. If the Comments and Deviations are not provided separately, it will be presumed that the vendor is accepting for these specifications and standards without any deviations.

CHECK LIST

(To be completed by Vendor)

Sl.No	Detail	Y/N
1)	A typical Dry Gas Seal data sheet is furnished in Job Specification. It should be completely filled.	

	Vendor to furnish the below inputs along with **offer for the seal**	
2)	Geometrical and mechanical data of the dry gas seal	
3)	Dimensioned seal cross sectional drawing – with required connections – along with B.O.M	
4)	Acceptance to submit the seal cross sectional drawings (final) for **approval** – within a week after placement of order – in hard copy as well as in digital form (Auto Cad file)	
5)	Conformance to total requirements of BHEL specifications	
	Dynamic performance of Primary and secondary seals at the specified operating conditions The Leakage rates for the following shall be furnished at **Page No. 8 & 9** to facilitate validation.	
6)	The guaranteed primary (in board) seal leakage;	
7)	The guaranteed secondary (out board) seal leakage (N_2) for the specified pressure & temperature at inlet to secondary seal;	
8)	The guaranteed consumption to barrier seal (for $N_{2/}$Instrument Air) for the specified pressure & temperature at inlet to barrier seal	
9)	The guaranteed N_2 leakage across intermediate labyrinth seal (for a specified ΔP between secondary inlet and flare line)	
10)	Mechanical loss per seal @ MCS	

11)	Experience record as per the ACCEPTANCE CRITERIA (to be furnished as per Page No. 10 of this specification)	

12)	Acceptance to submit Quality plan & testing procedures within a week of placement of order.	

	MATERIAL Vendor shall confirm conformance to the following criteria.	
13)	The material of all the components exposed to process gas (viz. housing, ring faces, O rings/gaskets, springs, loose parts etc.,) shall be NACE compliant	
14)	For High Pressure Applications, that is, above **80 kg/cm²**, all gaskets shall be PTFE based, with circumferential spring backing	
15)	The sealing face shall be shrouded for containment	

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Sl.No	Detail	Y/N
	SPECIAL POINTS	
16)	Dry gas seal shall be designed for Guarantee case as indicated in Job specification and the seal performance for this case shall be demonstrated during testing	
17)	Performance of seal shall be satisfactory for all the other operating conditions of job specification.	
18)	**If the job gas is Hydrogen Rich, the seal shall be tested for performance with hydrogen or helium. Otherwise the gas shall be tested with Air / Nitrogen**	
19)	a) For Low Pressure Applications (<**80 kg/cm^2**), the clean gas pressure of 0.3 ~ 0.5 kg/cm^2 above equalizing line pressure is considered. b) For High Pressure Applications (>**80 kg/cm^2**), the clean gas pressure of 0.5 ~ 0.8 kg/cm^2 above equalizing line pressure is considered. Vendor to provide recommendation for the same specific to the job	
20)	The sealing faces shall get separated with zero differential pressure above lift off speed (to be indicated in offer).	
21)	The dry gas seals shall be used during performance test of the compressor. (The performance test details will be furnished during detailed engineering)	
22)	Vendor to confirm suitability of the dry gas seals to operate during string test & MRT. (During string test & MRT, the machine performs under near vacuum conditions – 0.2 ata). Vendor to indicate the primary inlet pressure of filtered air	
	Seal vendor to check for possible condensation of any components of clean gas, due to throttling in the control valve / across the seal faces and suggest suitable changes in system viz.,	
23)	Confirmation to incorporate chilling/ heating wherever required.	
24)	Confirmation on the requirement of drain in the primary leakage port.	
25)	To furnish a support document (if drain is recommended) for such requirement vide operational experiences/references for similar H_2 service	
	GUARANTEE CERTIFICATE	
26)	Acceptance to provide a **guarantee certificate** – for trouble free performance of the dry gas seals – **for a period of 12 months from the date of successful commissioning or 18 months from the date of last despatch, whichever is earlier.**	
	FIXTURE FOR ASSEMBLY / DISASSEMBLY OF DRY GAS SEAL Acceptance to provide a fixture for assembly & disassembly of the DRY GAS SEAL.	
27)	Drawings of the fixture assembly, individual components and BOM	
28)	User instructions for assembly / disassembly of seal	

Sl.No	Detail	Y/N
	COMMISSIONING SPARES	
29)	One set of gaskets, 'O' Rings on the body of the seals and tolerance strips shall be offered along with mail seal	
	IDENTIFICATION	
30)	Each seal shall be marked with details like drawing no, job number, PO No. Direction of Rotation etc., at a convenient location on seal stationary part.	
	CHECK LIST FOR PRESERVATION, PACKING & DESPATCH OF DRY GAS SEALS	
31)	**Dry Gas seal against each code shall be packed in two separate transportable permanent air tight metallic boxes and shall be suitably packed and protected/preserved from damage due to weather, transportation, and handling / storage at workplace.**	
32)	**Ensure that the metallic boxes contain the following:-** a) In the first box- Dry gas Seal cartridge of primary and secondary seals along with locking mechanism to prevent relative movement between stator and rotor parts shall be packed.	
	b) In the second box- Barrier seal cartridge and the outer closing flange of the dry gas seal shall be packed. Barrier seal shall be positioned in the closing flange the way it is housed for normal assembly. Barrier seal stator and rotating parts shall be locked together with locking mechanism to prevent relative movement. The spare O- rings and fasteners, if any, pertaining to each dry gas seal shall be kept in the second box with sufficient independent packing to avoid mechanical damage to the barrier seal and loose components themselves.	
33)	The special tools shall be packed in a separate box. The machined surfaces of the tool components shall be suitably preserved and packed. The packing list of the tools shall be provided in the box.	
34)	**Each Metallic Box shall be designed with the following features:**	
	a) Each metallic Box shall be optimum in size in consideration to the seal size and weight. It shall be of air tight and reusable type suitable for transportation and storage built with a hinged lid and good locking arrangement.	
	b) The metallic sheet used for box making shall be of adequate thickness not to deform easily for mechanical loads/shocks during transportation and handling.	
	c) All the corners of the metallic box shall be sufficiently reinforced so that the box is sturdy enough to withstand the mechanical shocks during transportation.	
	d) The seals in the box shall be positioned centrally in the box and packed & covered with protective cushioning all around. The cushioning/packing material around the seal shall be dense enough and shall have good damping properties.	

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35)	Adequate amount of silica gel in the box shall be provided before closing for despatch.	
36)	Warnings/Cautions like "Fragile", "Handle with Care", "Upright positioning" and symbols indicating protection from rain / dust shall be marked on the boxes. Other markings for identification as per purchase order and seal identification particulars in line with packing list shall be provided on external surface of the box.	

INSPECTION & TESTING

Both the **operating** & **spare** seals shall have the following shop tests.

Vendor to confirm acceptance to carry out each of these tests.

37)	Cleanliness test (**for the dry gas seal filter and control system**) No discoloration or hard particles found on 20mesh screen after module blown for 5 minutes with 100 psig (7 kg/cm^2-g) dry filtered gas.	
38)	Test Medium shall be as indicated against Point No. 18. Conversion factors from test gas to Job gas shall be provided (during offer stage) to evaluate the performance test results	
39)	Gas leak test at a pressure equal to settling out pressure with a gas of M.W equal or less than the seal gas	
40)	Functional run for minimum of one hour at operating pressure and speed. Following the test, seal elements shall be examined for wear and general condition	
41)	Other tests as per Appendix-ID of API 617	
42)	Acceptance to include Third Party Inspection by customer approved TPI.	

	OFFER FOR SPARES	
43)	Supplier shall include in his offer separate item-wise prices for the following spares for two years operation	
44)	'O' Rings/gaskets and Tolerance rings	
45)	Barrier Seal	

Sl.No	Detail	Y/N
FINAL DELIVERABLES		
46)	The contents of each metallic box for the dry gas seal shall be as per clause 31), 32-a) & b). The metallic box shall be designed as per clause 34) to 36).	
47)	Commissioning spares (as per point no. 29)	
48)	Two year spares (if ordered)	
49)	Special tools and tackles packed in a separate box, along with relevant drawings/ instructions as per clause 33)	
50)	Each consignment shall accompany with the following for inwards goods inspection at BHEL works. a) **set of approved drawings** b) **Packing list**	
51)	Supplier to confirm to furnish 15 copies (hard) of Operation and Instruction Manual along with the seals and soft copy on a CD	
52)	Supplier to confirm to furnish 5 copies of Quality book including material test certificates, balancing and performance test reports	
53)	Supplier to confirm to provide assistance for assembly/disassembly - 2 visits for a period of 3 days each -**at shop.**	
54)	Supplier to confirm to provide assistance - 2 visits for a period of 3 days each - **at site** during Erection & commissioning.	

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TECHNICAL DATA / INFORMATION

Name of Vendor:

Sl.No	Parameters	Values	Remarks
	VENDOR SHALL NOT ALTER THIS FORMAT. JUST TO FILL & RETURN FOR VALIDATION.		
1	Dry gas seal model		
2	Drawing No		
3	Shaft dia (mm)		
4	Unidirectional or Bi directional		
5	Sealing Pressure		
6	Seal design pressure		
7	Speed		
8	**INBOARD SEAL (primary seal)**		Considering a delta-P of 0.5 kg/cm² between seal gas & Ref Gas
A	Leakage (Nl/min)		
i	Expected		
ii	Guaranteed		
B	Static Leakage (Nl/min)		
i	Expected		
ii	Guaranteed		
9	**OUTBOARD SEAL (secondary seal)**		Considering a delta-P of 0.3 kg/cm2 between inlet of sec seal & primary vent.
A	Leakage Outboard (Nl/min)		
i	Expected		
ii	Guaranteed		
B	Static Leakage (Nl/min)		
i	Expected		
ii	Guaranteed		
10	Intermediate Labyrinth (Nl/min)		Expected Leakage for a delta-P of 0.3 kg/cm² between inlet of sec seal & primary vent (to flare)
i	Expected		
ii	Guaranteed		

Sl.No	Parameters	Values	Remarks
11	Intermediate Labyrinth **(Nl/min)**		Expected Leakage for a delta-P of **0.2 kg/cm²** between inlet of sec seal & primary vent (to flare)
i	Expected		
ii	Guaranteed		
12	Intermediate Labyrinth **(Nl/min)**		Considering **controlled flow** to the seal at recommended velocity.
i	Expected		
ii	Guaranteed		
ii	Velocity (m/sec)		
13	**BARRIER SEAL**		Differential pressure (delta P) between seal & secondary vent to atmosphere shall be indicated.
i	Leakage **(Nl/min)**		
ii	Expected		
Iii	Guaranteed		
iv	Delta P		
14	Axial movement (mm)	+/- ___	
15	Radial movement (mm)		
16	Balancing		
17	Lift off speed (rpm)		
18	Test Gas (of equivalent MW)	To specify	
19	Conversion factor		Conversion factor for test gas to real gas to be indicated
20	Deviation from Sketch Dimensions	To specify, if any	
21	Set of commissioning spares		To confirm "Included in the offer"
22	Mass of rotor parts (kg)		
23	MI **(kgm²)**		
24	Power Loss (kw)		
25	Materials		
a	Face		
b	Seat		
c	rotor/stator		
d	Labyrinth		
e	Secondary seals		
f	Bolts		

Ref. Doc. COMP. FILE NAME

PERFORMANCE TRACK RECORD

	PARAMETER AS PER THE ACCEPTANCE CRITERIA	OFFERED SEAL	REFERENCE-1	REFERENCE-2	REFERENCE-3	REFERENCE-4
1.	Seal Model No.					
2.	The specified process gas service					
3.	Shaft diameter					
4.	Speed					
5.	Sealing pressure					
6.	Configuration					
7.	Uni / Bi-Directional					
8.	Location*					
*Both the seals referred are designed, manufactured, tested and supplied from the same manufacturing plant as that of the offered seal.						
9.	Total number of hours the seal is under continuous operation.					

RECORD OF REVISIONS

Rev. No.	Date	Revision Details	Revised	Approved
00	24/12/08	New Standard	SDR	PNR
01	17/02/10	Point nos. 51 & 52 in check list & PTR revised.	SDR	PNR
02	08/08/12	• Preservation & packing instructions revised as per clause nos 31) to 36). • Final deliverables as per clause 46) and 49) revised.	YVRL	PNR

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ANNEXURE-2

PRODUCT STANDARD
TURBINES & COMPRESSORS
HYDERABAD

TC 5 2508
Rev. No. 01
PAGE 1 OF 13

STANDARDISED DRY GAS SEAL HOUSING DIMENSIONS

VAR No.	DISCRIPTION
01	DGS DIA 80 MCL/BCL300 SERIES
02	DGS DIA 97 MCL/BCL400 SERIES
03	DGS DIA 112 MCL/BCL400 SERIES
04	DGS DIA 112 BCL400/A HIGH PRESSURE SERIES
05	DGS DIA 132 BCL400/A HIGH PRESSURE SERIES
06	DGS DIA 150 MCL/BCL500 SERIES
07	DGS DIA 180 MCL/BCL600 SERIES
08	DGS DIA 180 MCL/BCL600 SERIES (NP DESIGN) (END MOUNTED BRG DESIGN)
09	DGS DIA 97XP BCL300/A HIGH PRESSURE SERIES
10	DGS DIA 180XP BCL500/N HIGH PRESSURE SERIES
11	DGS DIA BCL400/A HIGH PRESSURE SERIES (END MOUNTED BRG DESIGN)

Ref. Doc.	Rev.No.	Revisions :	Prepared :	Approved :	Date :
COM TCS	01	Refer to record of revisions	SUGUNA	YVRL	08.03.2012

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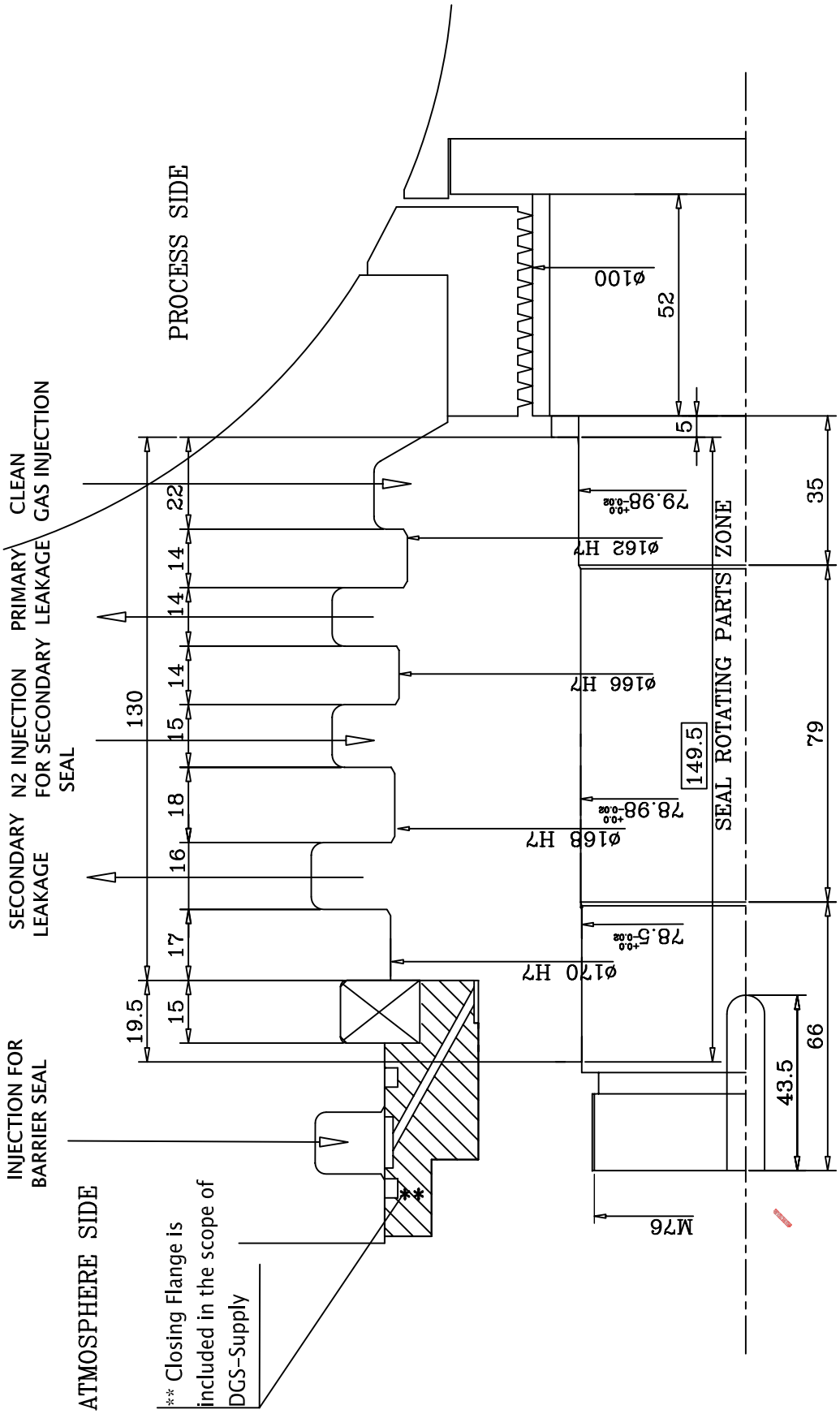
COM
TCS

DGS HOUSING DETAILS OF COMPRESSOR (SEAL DIA ø80) MCL/BCL300 SERIES VAR 01



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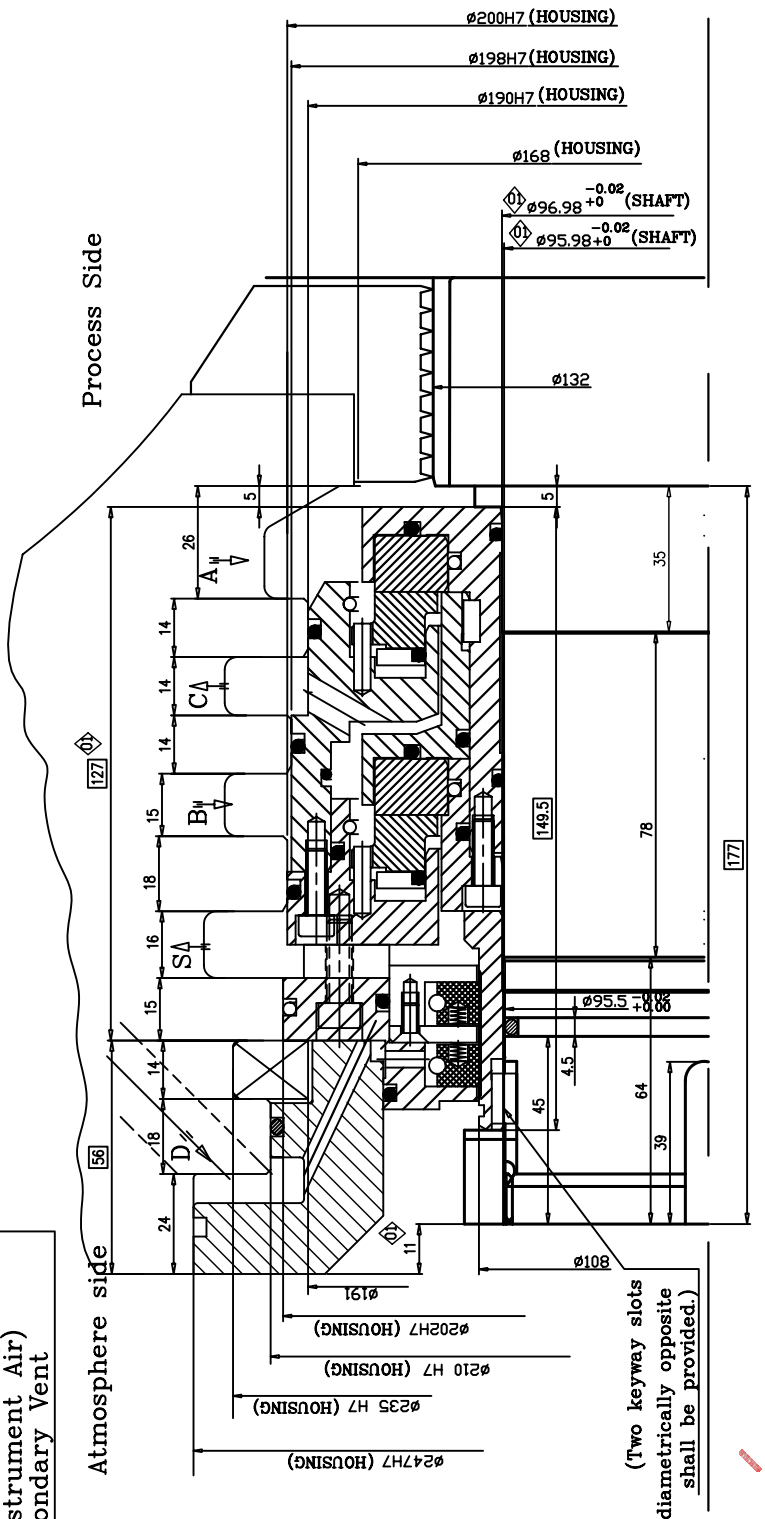
DGS HOUSING DETAILS OF COMPRESSOR (SEAL DIA ø97) MCL/BCL400 SERIES VAR 02



A= Clean Gas Inlet
B= Secondary Injection(N2)
C= Primary Vent
D= Barrier Seal Injection (Instrument Air)
S= Secondary Vent

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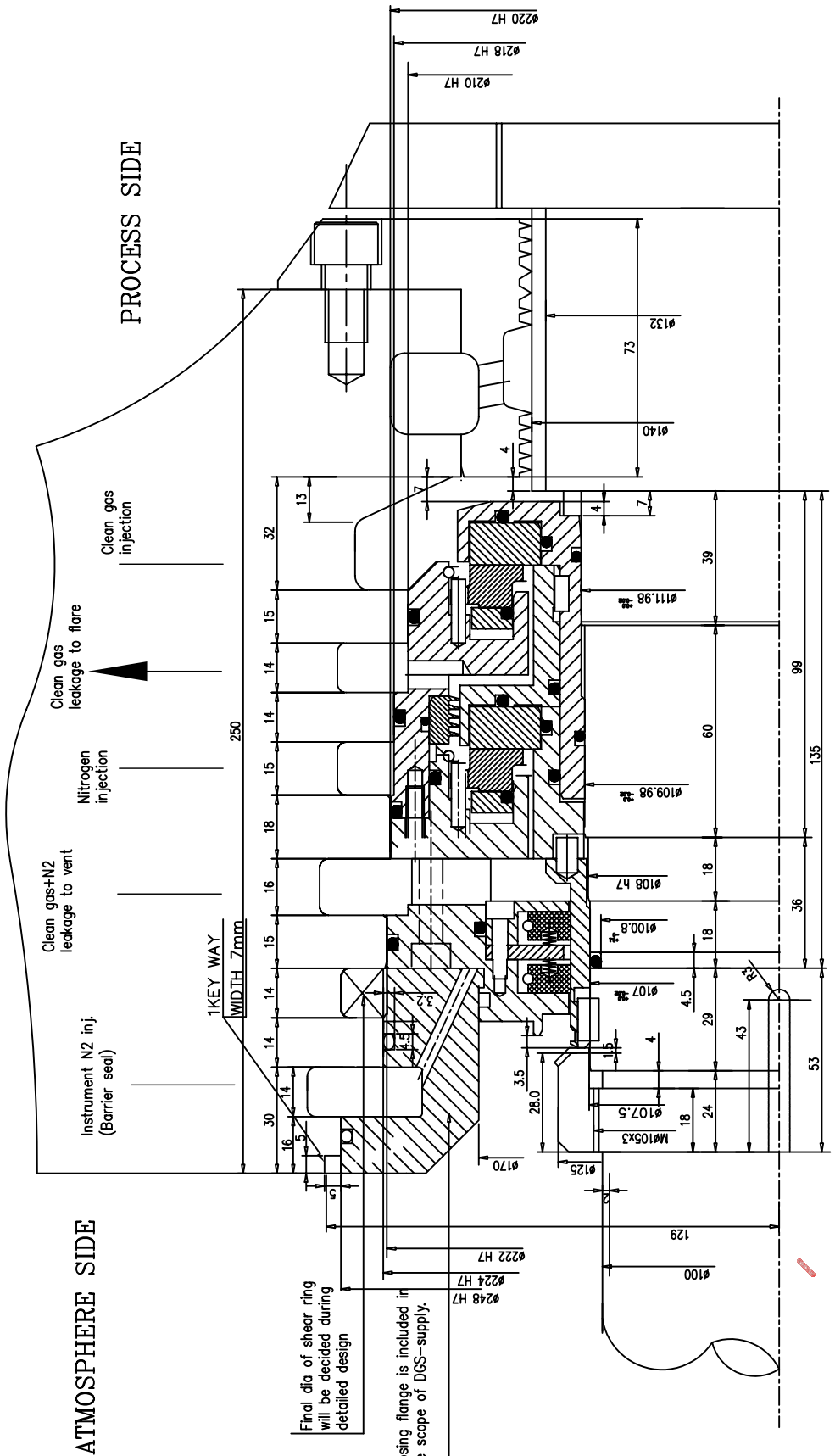
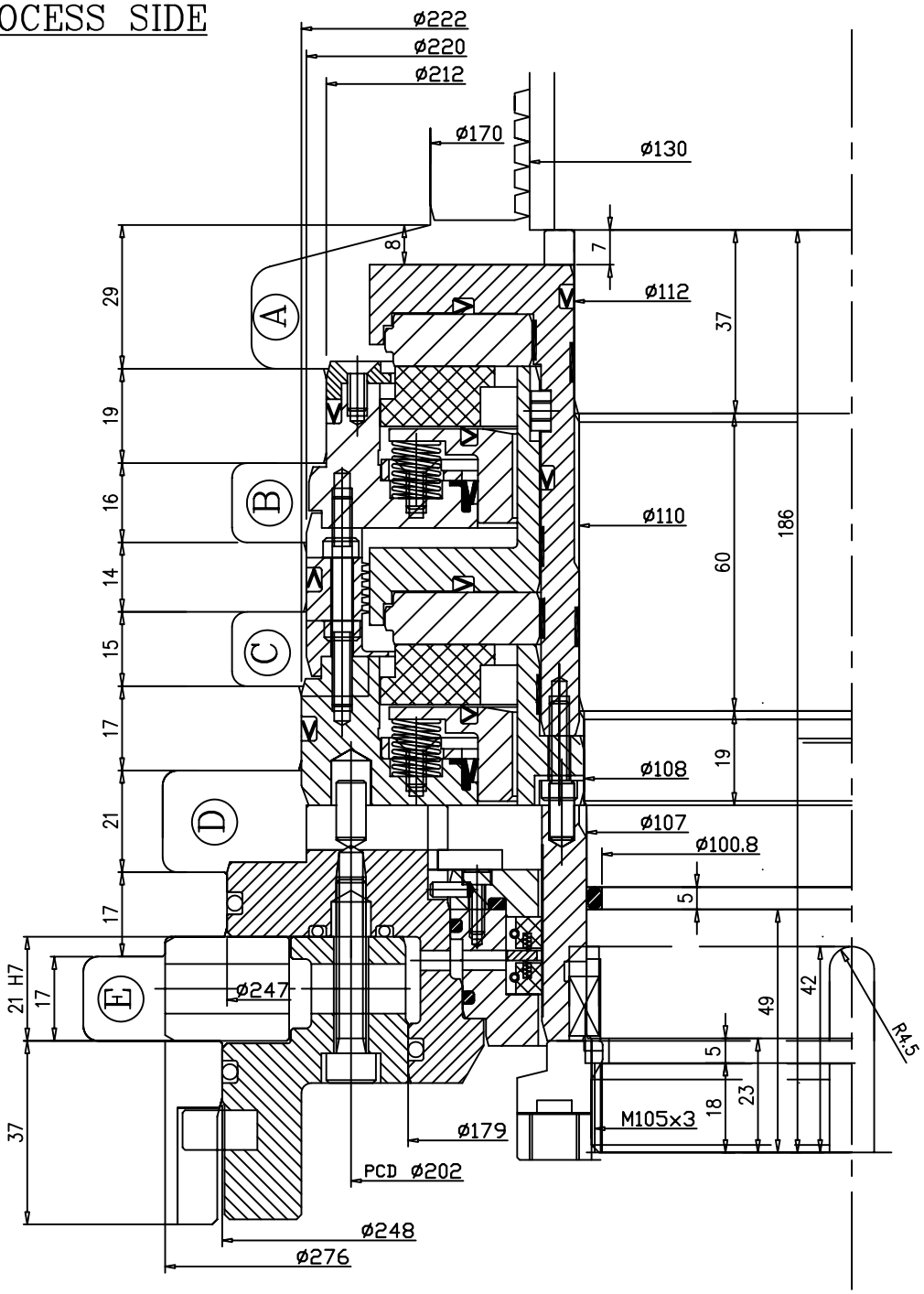
DGS HOUSING DETAILS OF COMPRESSOR (SEAL DIA ø112) MCL/BCL400 SERIES VAR 03



DGS HOUSING DETAILS OF COMPRESSOR SEAL DIA ø112 FOR HIGH PRESSURE BCL400/A SERIES) VAR 04

PROCESS SIDE



ATMOSPHERE SIDE

(A) CLEAN GAS INJECTION

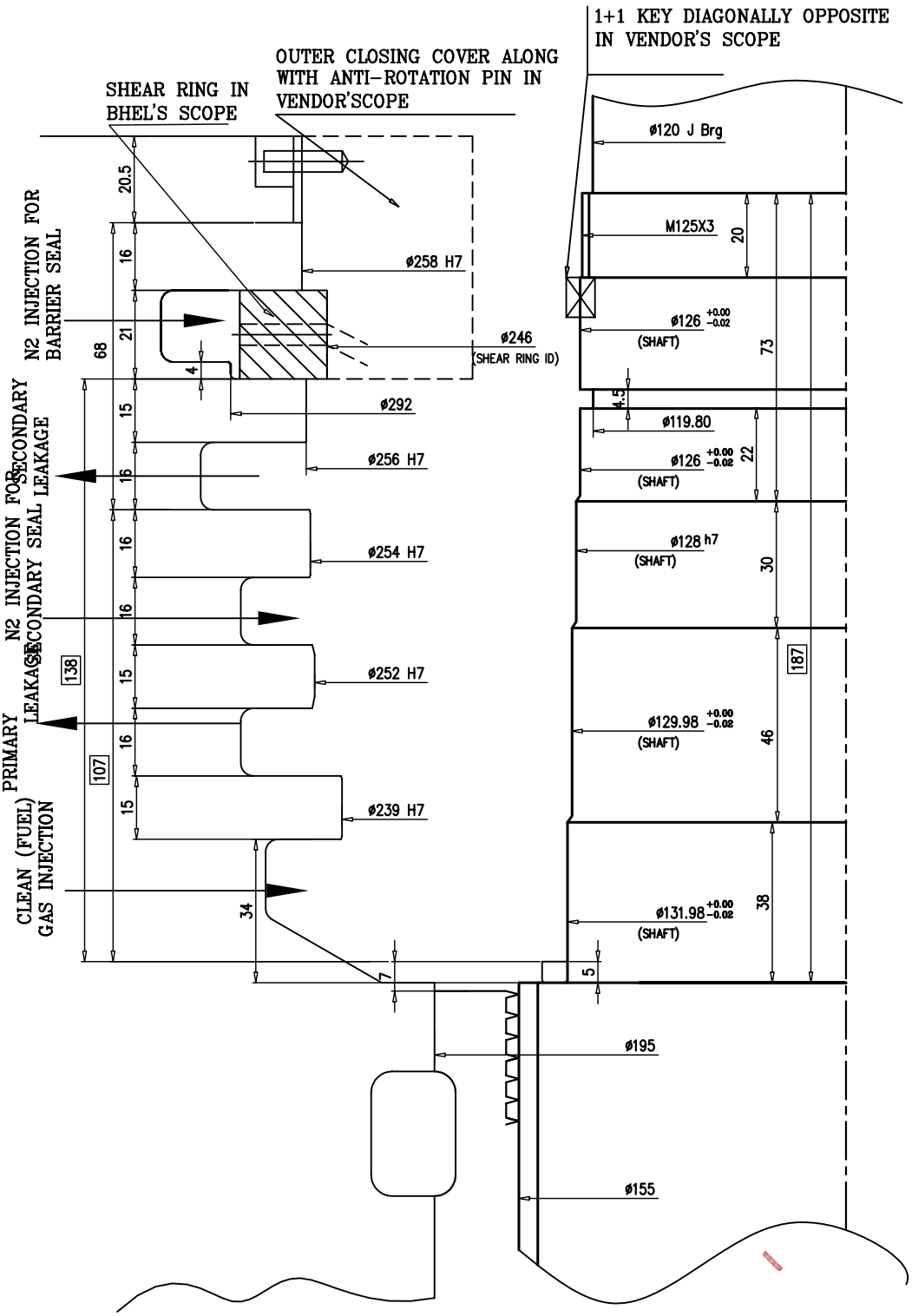
(B) PRIMARY LEAKAGE

(C) N2 INJECTION FOR SECONDARY SEAL

(D) SECONDARY LEAKAGE

(E) INJECTION FOR BARRIER SEAL

DGS HOUSING DETAILS OF COMPRESSOR
(SEAL DIA ø132 HIGH PRESSURE BCL400/A SERIES) VAR 05



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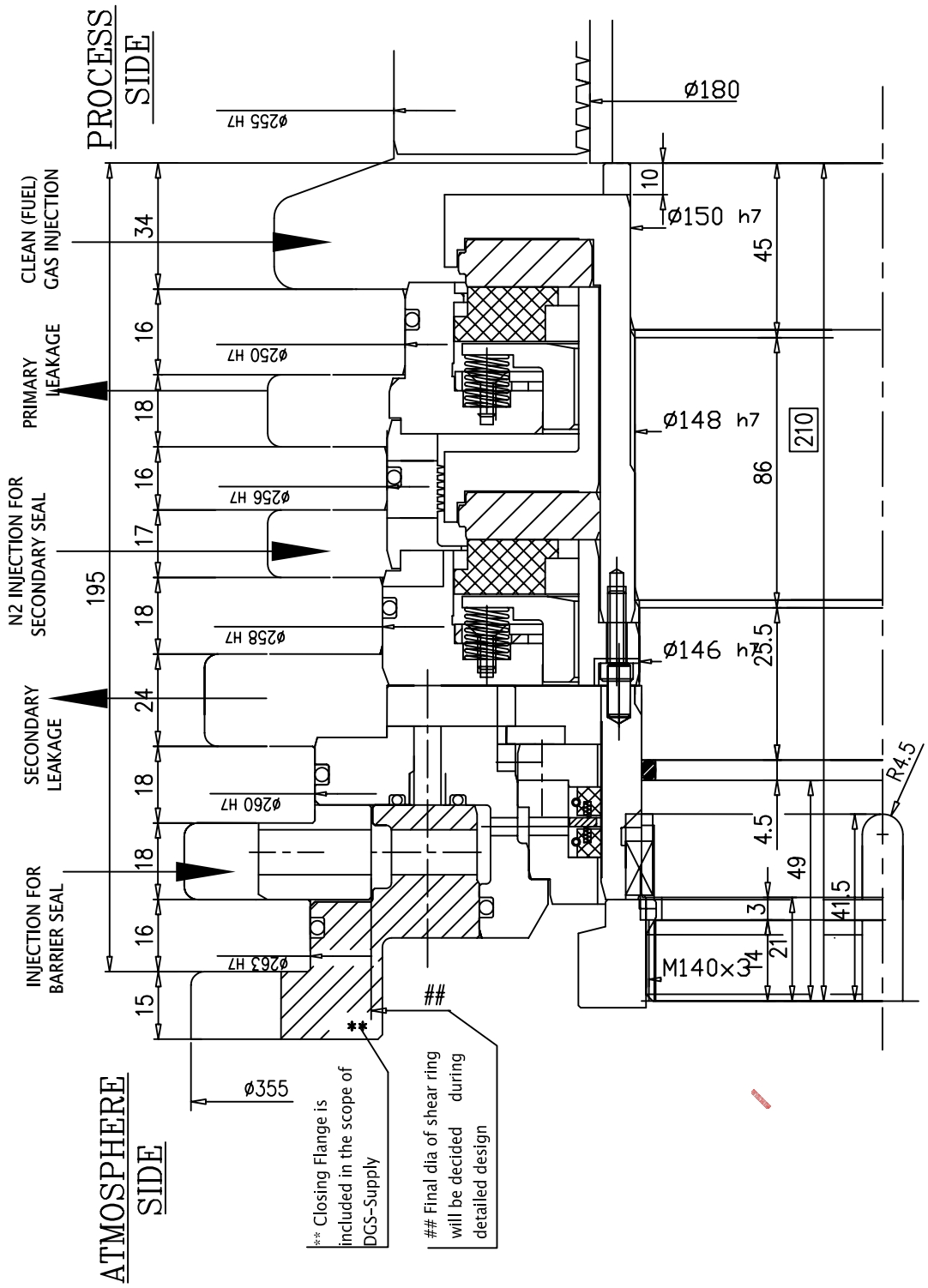
DGS HOUSING DETAILS OF COMPRESSOR
(SEAL DIA ø150 MCL/BCL500 SERIES) VAR 06



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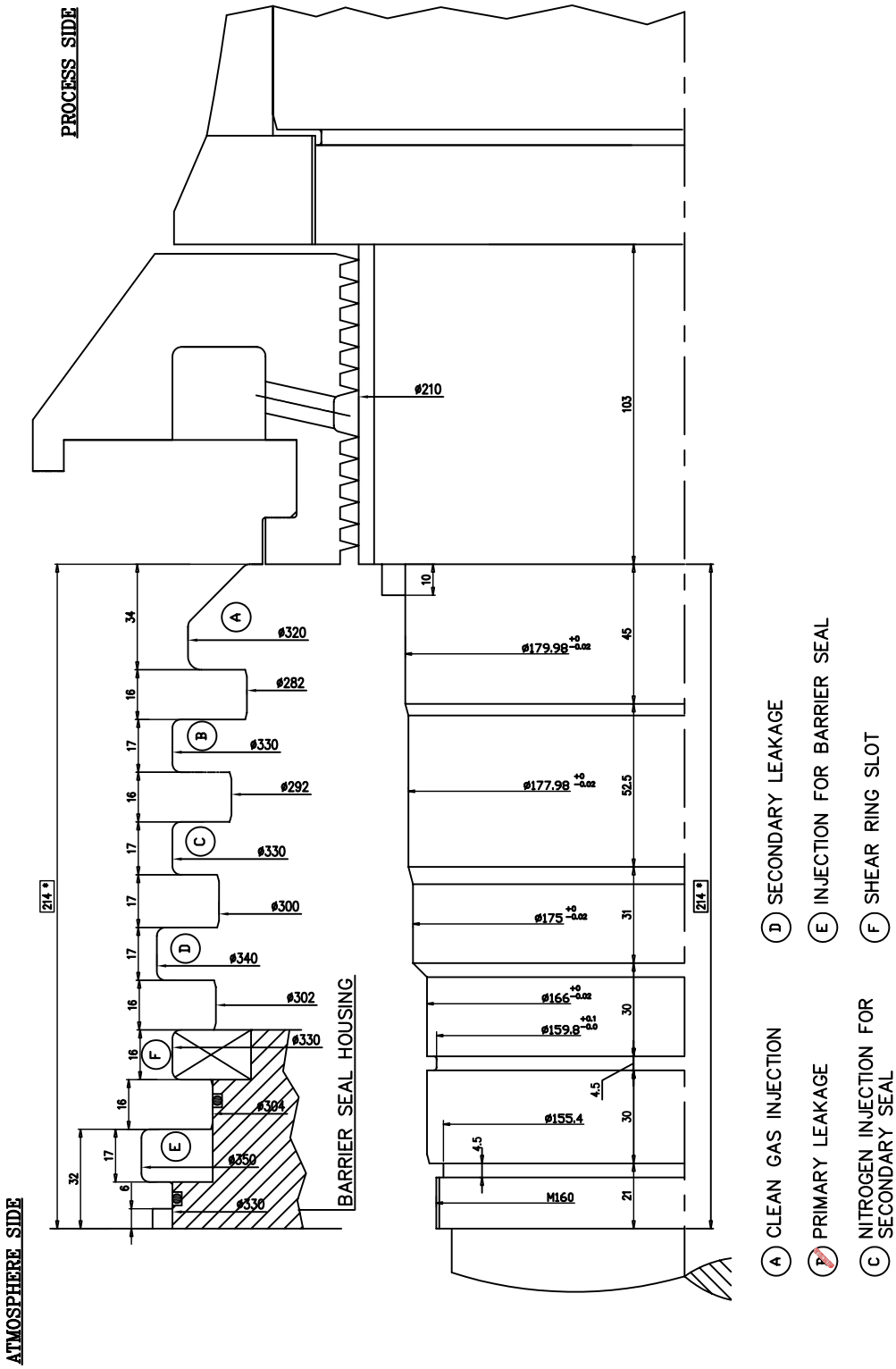
DGS HOUSING DETAILS OF COMPRESSOR (SEAL DIA ø180 MCL/BCL600 SERIES) VAR07



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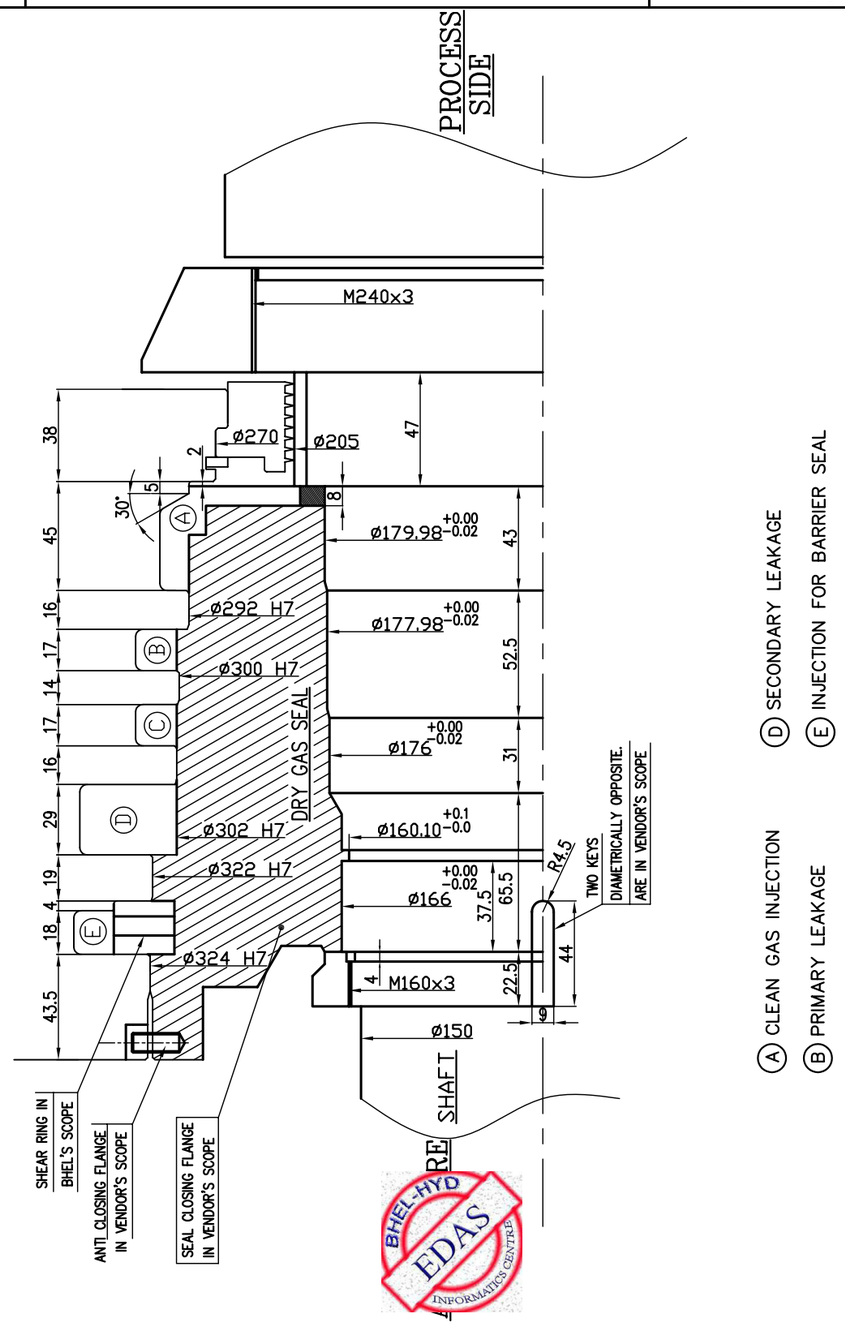
DGS DIA 180 MCL / BCL600 SERIES (NP DESIGN with END MOUNTED BEARING ARGMT) VAR 08

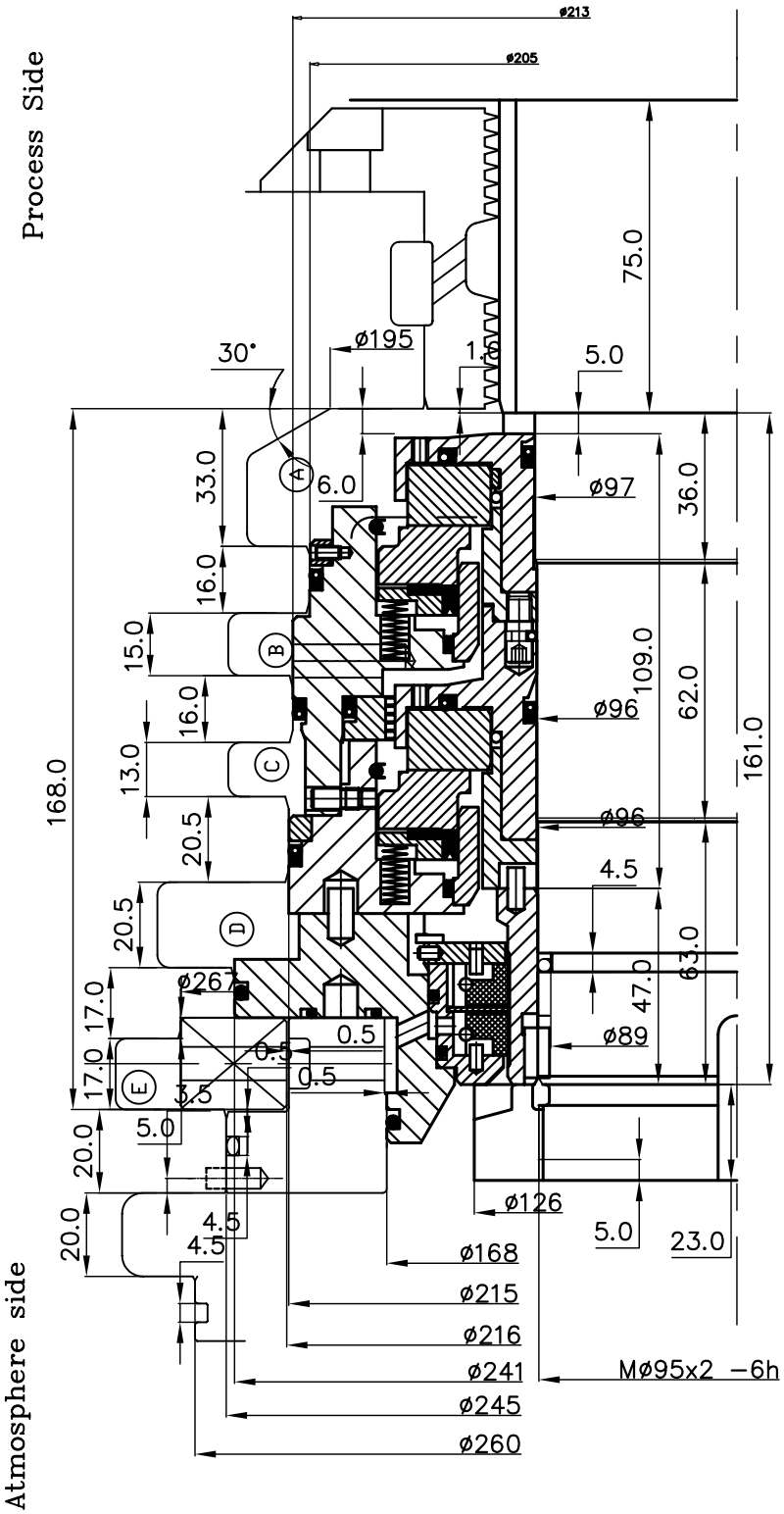


NOTE:

1. All hatched components of seal assembly as indicated in the above sketch, including O–rings, gaskets, tolerance strips, keys, locating pins, Outer closing Flange and retaining rings / circlips etc. are in Vendor's scope.

2. The dimensions indicated in the sketch shall be strictly adhered to.

DGS HOUSING DETAILS OF COMPRESSOR (SEAL DIA 97XP)
FOR BCL400/A HIGH PRESSURE SERIES VAR 09



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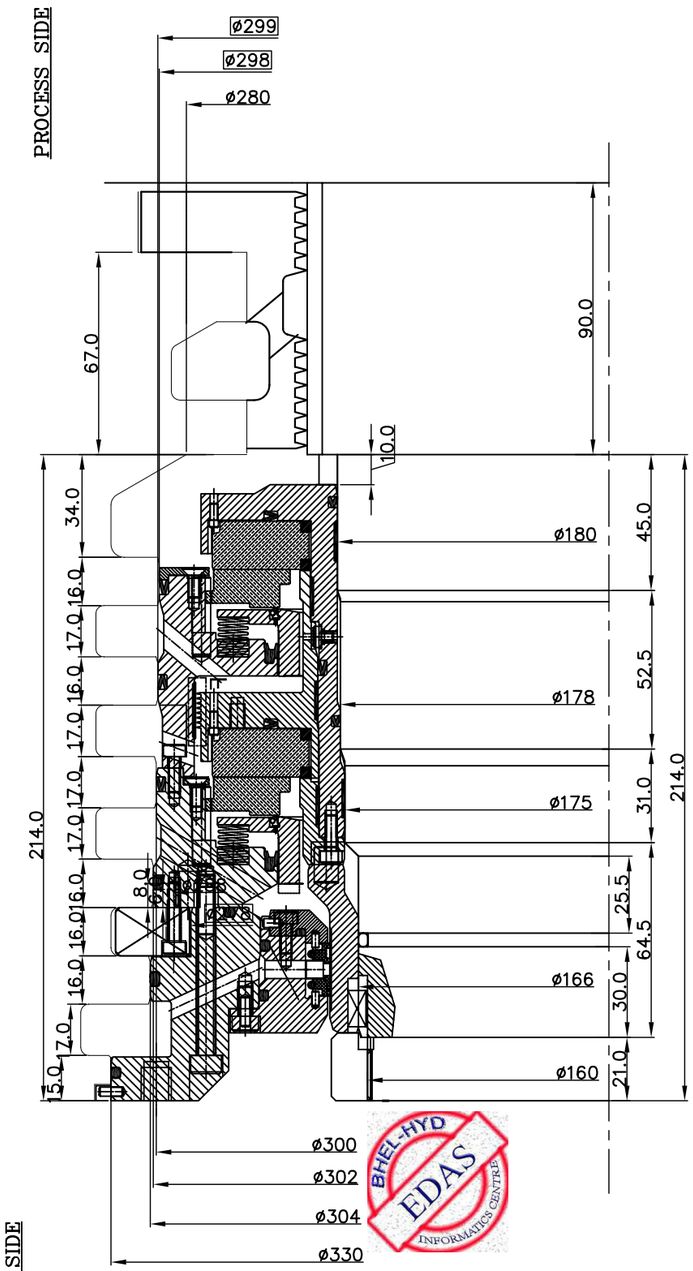
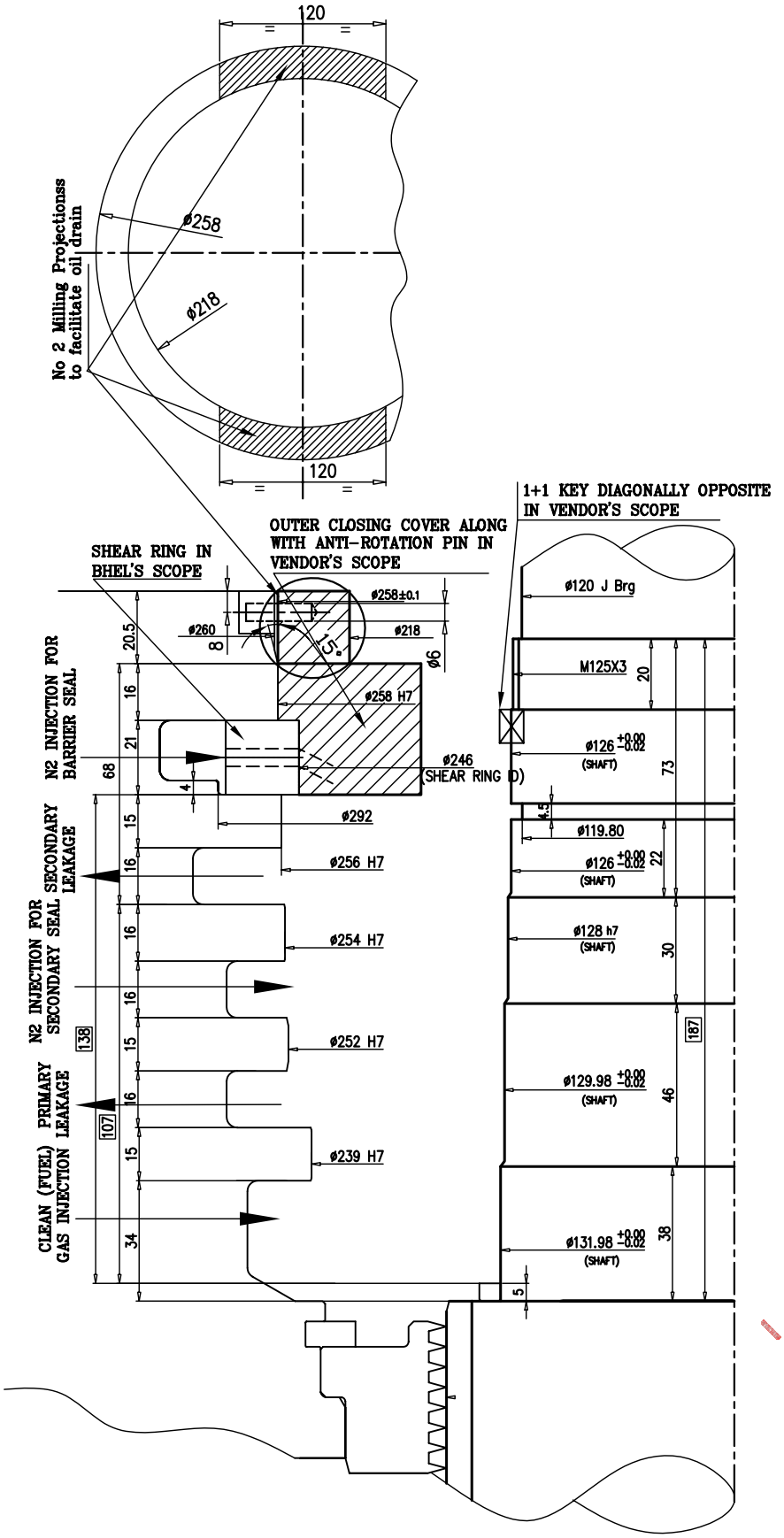
DGS HOUSING DETAILS OF COMPRESSOR
(SEAL DIA ø180XP BCL500/BCL600 HIGH SERIES VAR-10)



(A) CLEAN GAS INJECTION
(B) PRIMARY LEAKAGE
(C) NITROGEN INJECTION FOR SECONDARY SEAL
(D) SECONDARY LEAKAGE
(E) INJECTION FOR BARRIER SEAL
(F) SHEAR RING SLOT

DGS HOUSING DETAILS OF COMPRESSOR

DGS DIA 132 BCL400/A HIGH PRESSURE SERIES (END MOUNTED BRG DESIGN)



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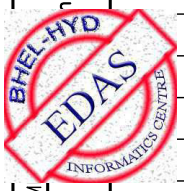
RECORD OF REVISIONS

REV.NO	DATE	REVISION DETAILS	REVISED	APPROVED
00	28.03.2009	Spec. Prepared	SUGUNA	YVRL
01	22.06.2013	Var09, Var10 & Var11 added	SUGUNA	YVRL



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COMP. FILE NAME: TC55450.DOC

SPECIFICATION FOR DRY GAS SEAL SKIDS FOR CENTRIFUGAL COMPRESSORS

1. Scope

This specification covers the minimum requirements of design, detail engineering, fabrication and supply of completely assembled Gas Seal Control System (with impulse piping, tubing and wiring) for a Centrifugal Gas Compressor consisting of (a) Seal Gas Filter Skid & (b) Seal Gas Control Skid compatible with Dry gas seals. The detail of the different operating cases, Gas composition, ambient conditions and design parameters of the different lines, etc are furnished in the project specific DGS specification which is a part of this enquiry.

2. Brief description of Seal Gas Filter Skid and Seal Gas Control Skid for Centrifugal Compressor:

2.1 The Vendors minimum Scope of Supply and Work shall be as indicated below.

a) Seal Gas P&I Diagram as per Variant Table-4 of this specification.
b) Latest edition of API 614.
c) List of Instruments, make & model as per Table-1 of this specification.

2.2 The scope of supply shall include the following for each compressor:

1) Seal Gas Filter Skid
2) Seal Gas Control Skid
3) Mating flanges with gaskets, bolts and nuts at terminal points
4) Spare filter cartridges – 05 sets (Each set consists of number of cartridges required for one Filter Bowl).
5) Loose supplied items like:
   i. Interconnection pipes and fittings between both assemblies.
   ii. Loose cable glands.
   iii. Foundation bolts and accessories
   iv. Instruments not mounted on the skids, etc.
   v. Any other item in Vendor's scope but not assembled on the skids

2.3 The function of the system is: -

- To supply and monitor process gas/ Nitrogen/ other gas, as applicable for primary injection to dry gas seals.
- To supply and monitor Nitrogen/ start up gas for purging
- To supply and monitor Inert gas (Nitrogen) for Secondary seals
- To supply and monitor Inert gas (Nitrogen)/ Instrument Air for barrier seals
- To monitor primary gas leakage and initiate Alarms/Shutdown in response to variation in leakage.

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

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

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.

4.7 Filtration grade:

a) Solids: Beta 75(98.7% efficient) on 2 microns or greater.

b) 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&I 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.

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.

c) All girth welded joints (longitudinal and circumferential) shall be 100% radiographed in accordance with UW-51 of ASME Section VIII, Div-1 and ASME Section V.

d) VALVES:

i. All valve castings shall be of radiographic quality.

ii. All cast valve flanges & bodies with flange rating of Class 1500 shall be examined in accordance with paragraphs 7.2 through 7.5 of Appendix-7 of ASME SEC-VIII, DIV.1, regardless of casting quality factor.

iii. Body / bonnet / cover joints & stuffing box of all valves shall have low emission and shall be helium leak tested as per ASME Sec.V, Subsection A, Article 10 (Detector Probe Technique), Appendix IV at a minimum of 25% of the allowable (rated) cold working pressure. Sampling for helium leak Test shall be one valve selected at random for each item of the material requisition. The failure of helium leak test shall call for testing of remaining valves of that item at vendor’s cost. The valve shall show no leakage. No leakage is defined as a total leakage rate of less than 0.0001 ml/s of helium. Test Duration shall be 12 Minutes

iv. Casting and test bar shall be heat treated together. Valve casting shall be in solution heat treated and pickled condition.

v. Critical body and bonnet casing section typically defined by ASME B16.34 shall be radiographed and shall meet ASTM E446 (upto 2" thick) Category A,B & CA Level 2, Category CB, OC & CD Level 3, Category D,B & F Level 0. For wall thickness 2" to 4.5" comparable plates of ASTM E186 shall be used. ASTM E94 and ASTM E142 shall be used for recommended practice & controlling quality of radiography as guide. The entire surface of all castings shall be dye-penetrant inspected after pickling.

vi. Repair welds shall be 100% radiographed and evaluated in accordance with paragraph 344.5 of ASME B31.3 with a minimum casting quality factor of 0.95. Dye Penetration test shall be as per ASTM E165 Procedure B-2, Interpretation as per Appendix-8 of ASME-VIII Div.1.

6. Instrumentation

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.

6.5 All the instruments and quantity shall be as specified in Table-1.The project specific requirements shall be finalised after the order placement. All the instruments shall be of Smart type and compatible to Hart communication until and unless specified otherwise.

6.6 In some specific projects **as indicated in variants of table-4**, the transmitters connected to DCS shall be of Foundation field bus type. The instruments and their accessories like field bus cables, connectors, junction boxes, etc shall be supplied compatible for FF Bus.(FNICO/FISCO)

6.7 Vendor to confirm compliance for the sub-vendors indicated as per Table-1. For the items, which are not covered in the list or vendors are not indicated, vendor has to procure from their standard sub-vendors

6.8 Vendor shall confirm that the bill of material furnished along with offer is only indicative and the final BOM, which shall be furnished during detailed Engineering (after order placement) for the approval of BHEL. The additional items, if any required for complying BHEL specification at later stage or for the satisfactory working of the seals shall be supplied by vendor without any price/delivery implications.

6.9 The body of the control valves shall be as per Piping Material Specification and as a minimum trim shall be with stelliting.

6.10 The vendor shall furnish the following test certificates for the instruments

a) Calibration/ test certificates
b) Material test certificates
c) Sub-vendor conformity certificates.
d) Third part statutory certificates

6.11 Vendor shall submit necessary statutory body certificates for the instruments & Junction Boxes, cable glands, etc from the following statutory authorities.

a) BIS (Bureau of Indian Standards)
b) CIMFR, Dhanbad
c) Petroleum and Explosives Safety Organization (PESO), Nagpur India (earlier CCOE)

Please note that the above are mandatory for all flame proof instruments of Indian origin.

6.12 Vendor shall submit necessary statutory body certificates for the instruments & Junction Boxes, cable glands, etc from Petroleum and Explosives Safety Organization (PESO), Nagpur India (earlier CCOE) in addition to the certificates from the country of origin for all flame proof items of foreign origin.

6.13 All the Device Description (DD) and common file format (CFF) files for all HART and FF instruments shall be supplied in CD/DVD for configuration.

6.14 The earth connections of all electrical components shall be brought to common bar for further connection to earth pit at site.

6.15 Electrical Junction Box shall be with LM-6 body, 2Nos of Outlet Connections of 1½” NPT at bottom and 12nos of Inlets of size ½” NPT. All inlets and outlets shall be complete with double compression cable glands. Blanking plugs shall be provided for all spare inlets/outlets. Material of cable gland shall be Nickel plated Brass material with PVC hood.

Cable glands, JB's and blanking plug shall be suitable for area Classification IEC Zone 1, Gas IIA, IIB and IIC "EExd" type Cable OD for outlet gland shall be furnished during detailed engineering. Telephone sockets and plugs shall be provided in JB. External paint shade Light Blue Shade 101 as per IS 5.

6.16 Signal cable shall be as follows:

6.16.1. Single pair 7 stranded/ 0.53 mm dia (1.5 mm2) annealed tinned copper conductors of electrolytic grade copper, PVC insulated.

6.16.2. FRLS type, armoured and of 1100V grade and shall meet insulation resistance, voltage and spark test requirements as per BS 5308 part-2.

6.16.3. Conductors as per BS6360

6.16.4. Pr. Insulation: Fire retardant (FR) shall be as per standard IEC 60332.Shall have mica insulation and shall be as per IEC-331 CAT –A type. Primary insulation and inner jacket of polyethylene with maximum capacitance of 80 pf/m.

6.16.5. Conductor DC resistance at 20° C : ≤ 12.3 ohms / km ; Inductance : ≤ 0.9 µ H /Km between conductors at 1000 HZ; Capacitance ≤0.06 µ F/ Km between conductors at 1000 Hz; Insulation resistance 100 M ohm / Km.

6.16.6. Color coding: Core insulation: Black & Blue; Inner Jacket: Black; Outer Jacket: Light blue for intrinsically safe application and black for others.

6.17 Spur cable between FF instruments and FF JB shall be Type A as per IEC61158 part2.

7. Instrument Installation Standards

7.1 The Pressure & DP Gauges shall be grouped as per operational requirement and mounted on the Gauge Board in the front side of the Skids.

7.2 All the instruments mounted on the skids shall be installed as per hook up diagrams (to be furnished during the detailed engineering). Based on these, Vendor shall develop & submit a tag number wise installation Standard (hook up) directory for all the instruments supplied/ mounted in the skids based on the above diagrams for BHEL/Customer approval.

7.3 The tubing for Control valves (from air filter regulator, I/P converter and control valve) shall be of stainless steel tubing and the same is in vendor's scope.

7.4 Integral manifolds shall be used if hook up is envisaged as tubing. Integral manifolds shall be used in piping hook-ups for 300#.

7.5 If hook up is specified as "piping" in the variant table-4, the piping hookup with welded joints shall be considered for primary seal gas inlet and vent lines. Installation of impulse lines shall be as per piping class.

7.6 Tubing for impulse line to instruments shall be made of SS 316L (for primary seal gas inlet and vent) or SS316 (for secondary seal inlet and vent, barrier seal inlet and vent) tube with double compression fittings of "Swagelok"/"Parker" make and of material SS 316L (for primary seal gas inlet and vent) or SS316 (for secondary seal inlet and vent, barrier seal inlet and vent).

7.7 Instead of union; flange to be used in all impulse pipes and tubes irrespective of class.

7.8 For pipe class 600# and above, the impulse piping shall be as per pipe class. In these cases no integral type manifold shall be used. 2-valve or 3-valve manifold shall be fabricated with gate valve and pipe. Equalization with globe valve only. Closed coupled installation shall be considered for high viscous services or hydrocarbons containing water for flow/pressure transmitter. The size (NB) of impulse pipe shall be ¾" for corrosive/congealing and high pressure services to avoid frequent chocking.

7.9 For pipe class below 600#, the impulse piping shall be as per pipe class. However small portion of tubing from impulse line to transmitter shall be made of tube with double compression fittings of "Swagelok"/"Parker" make. In those cases the tube material shall be suitable for that process fluid condition. In these cases the transmitter with integral manifold shall be used.

7.10 Bypass line with isolation valves must be provided for inline instruments like Rotameters, Integral orifice, Control/On-Off valves.

7.11 For impulse line with viscous / congealing services a tee off with blind flange shall be provided for cleaning purpose near to first isolation valve.

7.12 All the transmitters shall have horizontal impulse entry to have easy interchangeability.

7.13 The double valves (2 valves in series) shall be provided for all high-pressure (pressures more than 40 ata) isolation, vent & drain application.

7.14 The instruments shall not be mounted directly on its hook-up. The instruments shall first be mounted on gauge board / 2"pipe and then the hook-up shall be connected.

8. Electrical Installation

8.1 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, as specified in cause no 6.12.

8.2 Separate Junction box shall be provided for the following signals and grouping of instruments shall be carried out accordingly.

a) Analog Signals for DCS
b) Analog Signals for PLC
c) Field Bus Signals
d) Proximity signals
e) Digital signals
f) Solenoid valves
g) Intrinsic/Explosion proof signals

8.3 Field bus junction boxes (FNICO/ FISCO/HPT).

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.

c) In each Fieldbus segment, only one close loop can be connected (if applicable), remaining spur connection in the segment can be used for open loop.

d) Wiring/ termination blocks shall have built-in short circuit protectors.

e) Vendor shall provide field terminator for each segment inside Fieldbus junction box.

f) The junction boxes shall have metallic enclosure.

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

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

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

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

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

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

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

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

8.12 Inside each panel a SS bar measuring 16 mm^2, rectangular-sectioned shall be included for the connection of ground cables coming from the instruments or other.

9. The supplier shall furnish the following Documents

9.1 Along with offer:

a) Compliance for BHEL specification and its Annexures

b) Signed and stamped Filled up check-list (Table-2).

c) Price Schedule as per table-5.

d) Proven Track Record as indicated in Clause no 10.0.

e) Dew Point Curve.

9.2 Within 2 weeks of Placement of Order/ LOI:

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

b) Vendor shall submit following in 10 sets for approval for the documents as mentioned below within 2 weeks of Placement of PO /LOI:

i. General Arrangement drawing of Gas Seal Control System Skids giving overall dimensions. It shall show location /disposition of various equipments/Instruments on the Rack and location of customer termination connection.

ii. Bill of Material of all the equipments, instruments, components etc. The Bill of Material should clearly show the make and model of each component, which are subjected to BHEL/CUSTOMER approval.

iii. Instruments Data sheets as per ISA format.

iv. Filled in dry gas seal system data sheet as per API format.

v. Quality assurance plan.

vi. Spares list

9.3 Final Documentation: Vendor shall furnish (17 sets of hard copies for a) to c) below + 2 DVD's for all documents mentioned below)

a) Documents mentioned 9.2 above.

b) Terminal wiring details of Junction Box.

c) Instruction, Service and Maintenance manual

d) Test and Inspection reports : 3 copies

e) Guarantee Certificates : 3 copies

f) Photographs for all views : 2 sets (In DVD, the digital photos shall be provided).

10. Acceptance Criteria

10.1 The offered Dry Gas Seal system skids (Control system and filter) shall be proven and validly similar to the specified operating parameters, process gas service, pressures and configuration as compared to at least TWO UNITS designed, manufactured, tested and supplied from the proposed manufacturing plant and at least one of these units shall have been successfully operated in the field for at least 8000 hours of continuous operation without any major overhaul as on the date of issue of enquiry.

10.2 Vendor shall furnish complete reference list / details (Proven track record) along with the offer. These details shall include Plant name, year of commissioning, number of operating hours completed and name of contact person(s) etc. for the skids similar to one being offered.

11. Inspection and Tests

All the equipments shall be subject to inspection and witness tests by BHEL/CUSTOMER/CONSULTANT. The schedule of quality checks shall be furnished by the vendor in the quality plan which is subject to the approval of customer/consultant/ BHEL. The minimum shall be as indicated in clause 12.0 below and Table-3 Quality Plan.

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.

14. Guarantee

The Gas Seal Control System Skids and each component of the unit shall be guaranteed for 18 months of trouble free performance from the date of shipment or 12 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

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.

FIG.1: SEAL GAS P&I DIAGRAM (300#)

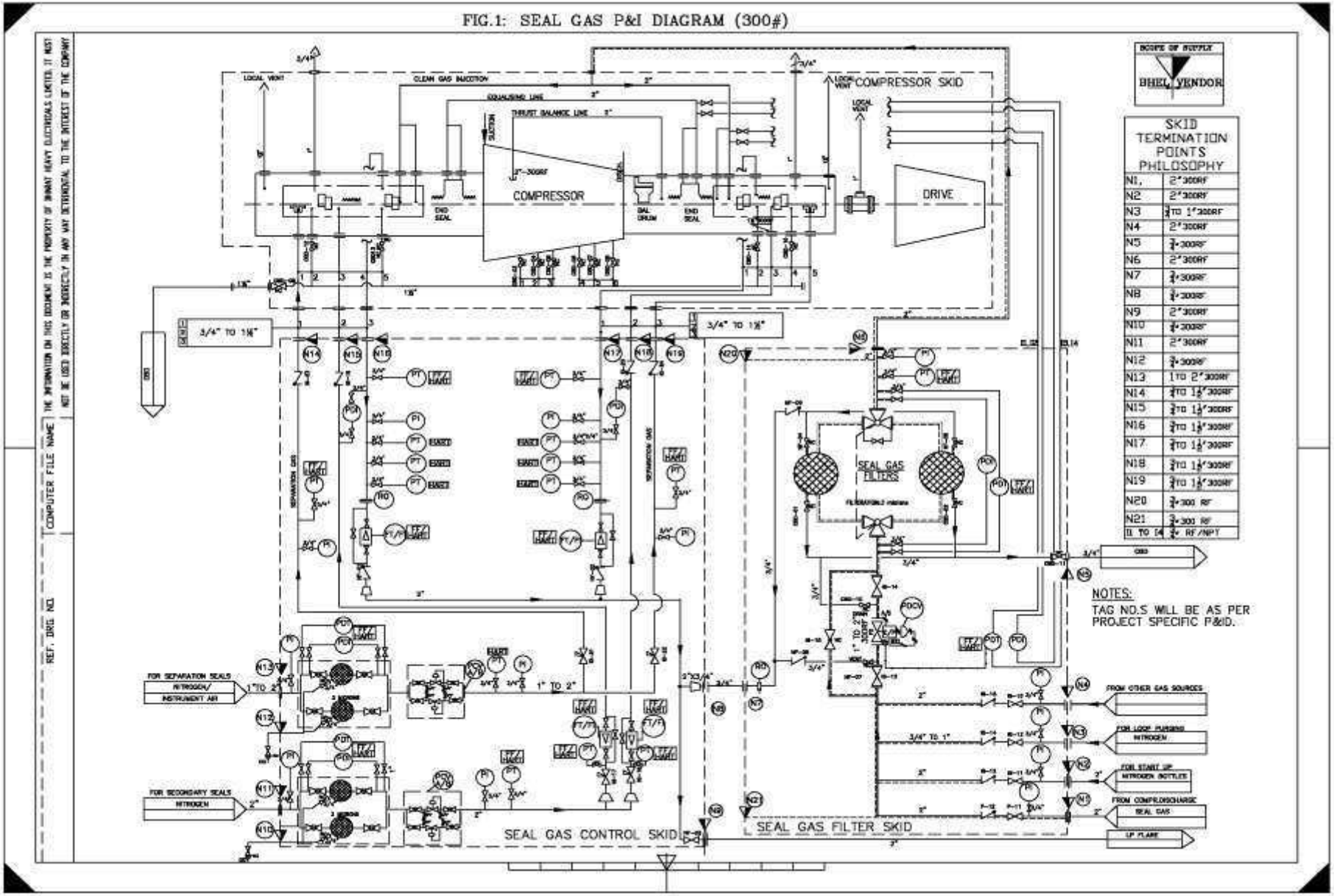
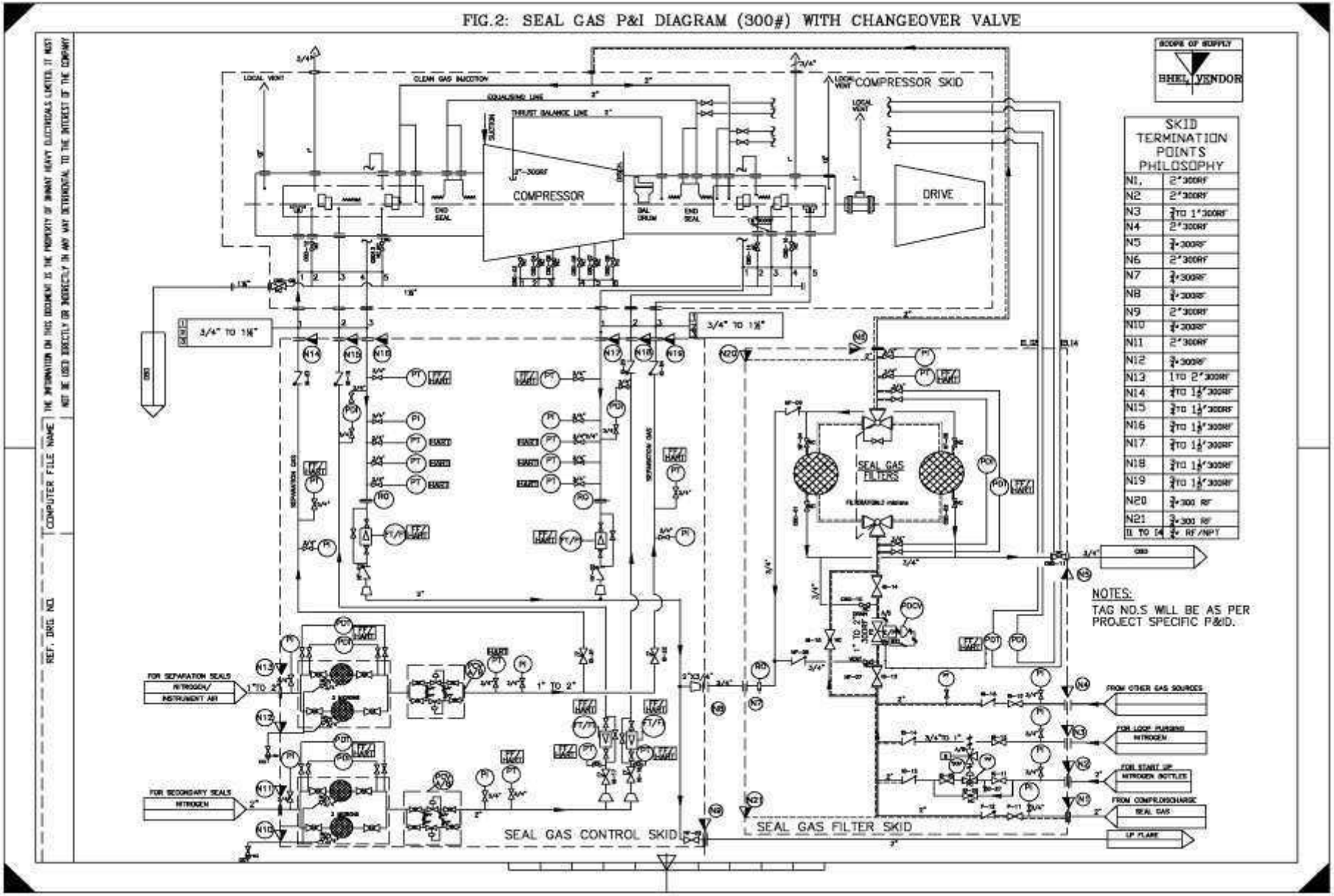


FIG.2: SEAL GAS P&I DIAGRAM (300#) WITH CHANGEOVER VALVE



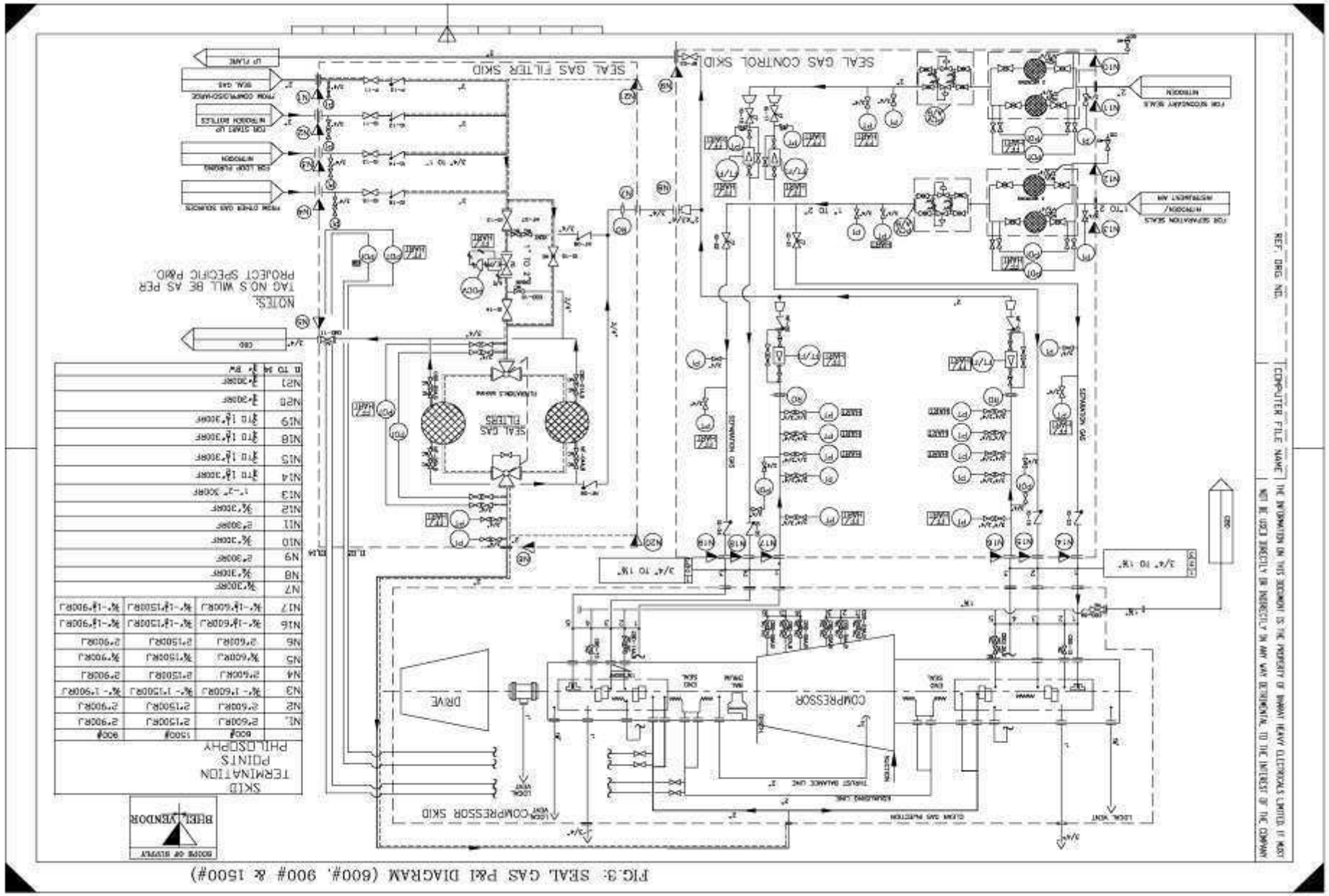


FIG.3: SEAL GAS P&I DIAGRAM (600#, 900# & 1500#)

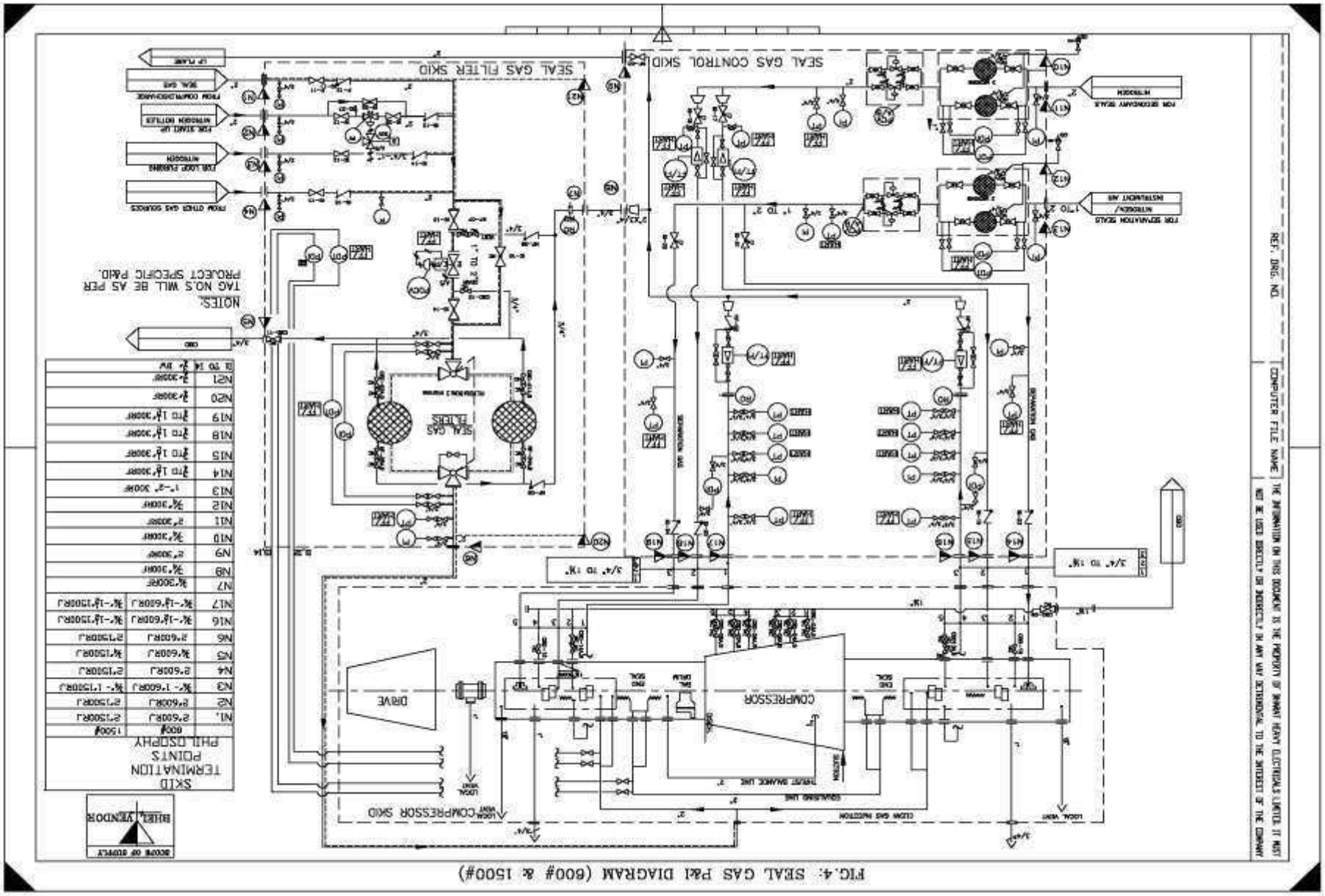
PRODUCT STANDARD

TURBINES AND COMPRESSORS

HYDERABAD

TC-55450

REV No.: **03**



PRODUCT STANDARD

TURBINES AND COMPRESSORS

HYDERABAD

TC-55450

REV No.: **03**

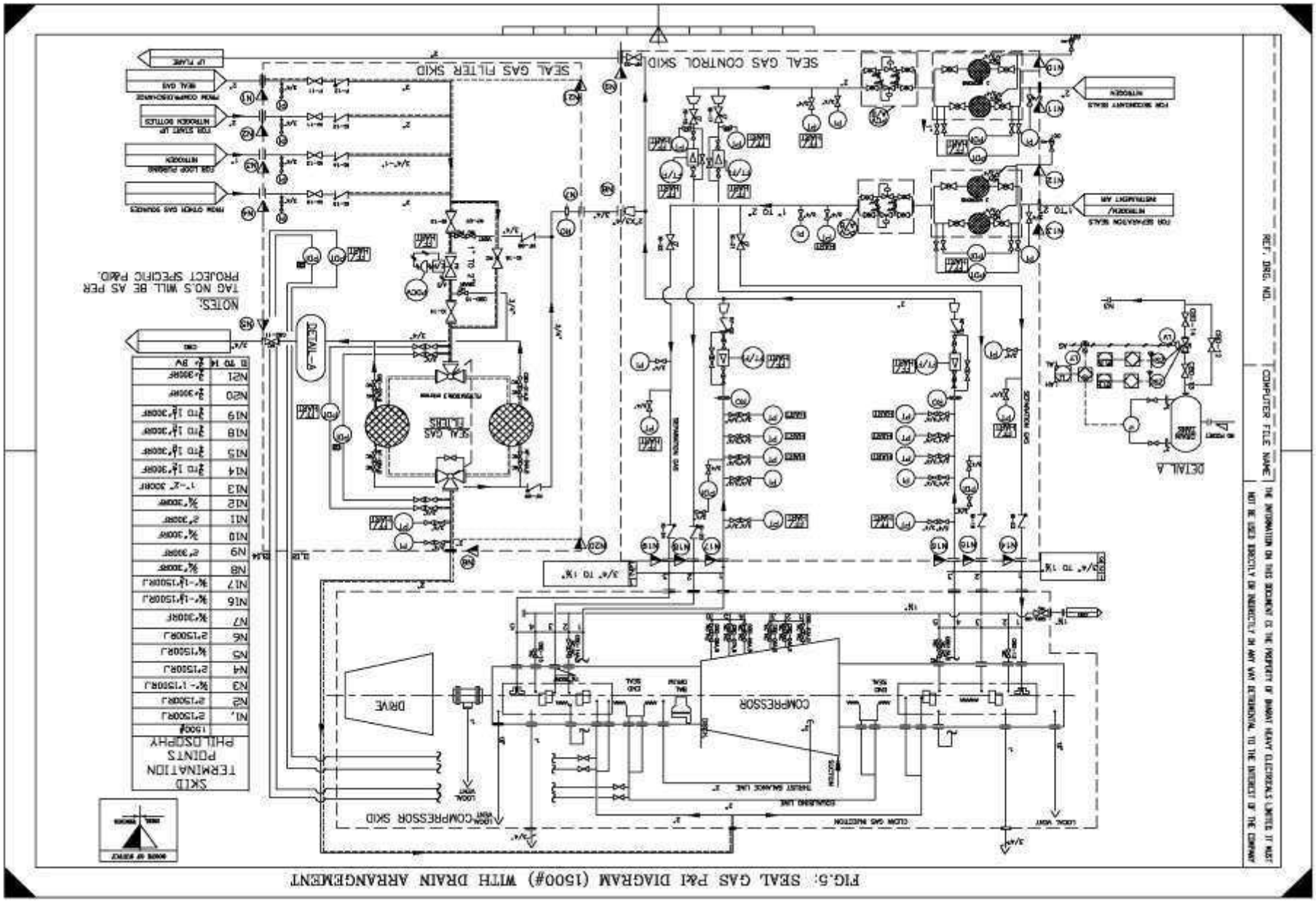


FIG.5: SEAL GAS P&I DIAGRAM (1500#) WITH DRAIN ARRANGEMENT

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

SL. No.	Instrument	Qty Note (2)	Minimum Specification	Vendor	Model
1	Differential Pressure Gauges	6 nos.	Differential Pressure Indicator	Switzer	109-V-E-2-6-0-S
			IP66; panel mount		
			Range : *		
			Dial Size : 150mm		
			Pr.Conn. : 1/4"PT-F		
			Static Pr. : 210 kg/cm2(g)		
2	Pressure Gauges	16 nos	Pressure gauge	GIC/ WIKA/ WAREE	
			IP67; panel mount		
			Accuracy: ± 1% of full scale		
			Range : *		
			Dial Size : 150mm		
			Pr. Connections: 1/2"NPT-M		
			Case and Bezel : All SS Construction Wetted parts : *		
			Gold plating for diaphragm seal type in seal gas line		
			Solid front type for seal gas line		
			Over range protection: SS316		
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 : *		
			intrinsic safe & explosion proof IEC Zone 1,Gas IIA, B & C		FF model: 3051CD 3F 07 A1 J D01 B7 IE(or IA) L4 M6 Q4 T1 DF
			Min Load: 600 ohms		
			All SS construction		
			Pr. Connections: 1/2"NPT-F		
			Accuracy: 0.075% of span	YIL	HART model: EJX 110A EH S4 GU 2 CEB/ V1U/A /D4/A1
			Min. Static Pr.: 210 kg/cm2(g)		
			LCD indicator		FF model: EJX 110A FH S4 GU 2 CDB/ D4/ A / A1/ FS1(or KS2) / LC1/ D46
			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) 17 nos (for fig. 1, 3 & 5)	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 : *		
			Others same as sl.no. 3		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

				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	Krohne	H250/RR/X/MX/EG/ESK/ EEx Note : X as per requirement
			SMART (HART protocol /FF)		
			Range : *		
			intrinsic safe & explosion proof IEC Zone 1,Gas IIA, B & C		
7	Guided wave radar LT for drain pot	1no.	Smart (Hart Protocol/ FF) Transmitters	Emerson or E&H or Magnetrol or Krohne	
			Pr.conn: Flanged		
8	Diaphram seal type LT for drain pot	1 nos	Smart (Hart Protocol/ FF) Transmitters	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
			Range : *		FF model: 3051CD 2F 02 A1 J D01 B7 IE(or IA) L4 M6 Q4 T1 DF + 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
			Others same as sl.no. 3		
			Pr. Connections: 3" Flanged	YIL	Equivalent models for HART and FF
			Flush flange with spacer ring minimum SS316 with Flushing / Filling Connection (1/2"size)		
9	Magnetic level gauge for drain pot	1no.	Body matl.: SS 316L	Levcon or Chemtrols or Technomatic or Krohne	
			Pr.conn: 1" Flanged		
			The maximum visible range of a single gauge shall not exceed 1470 mm		

			Ball check valve (offset design) required.		
10	Drain valve for drain pot	1no.	Smart/FF positioner as per sl.no 5 Others as per sl.no 15		
11	Change over valve in startup gas	1no.	On-off ball valve ANSI / FCI 70.2 Minimum class VI. the body as well as the actuator shall meet the testing requirements as per API 617 latest revision. Actuator: Pneumatic cylinder with spring return scotch yoke type SS, Universal type, IS or Exp.proof (as per project reqt.), Voltage (as per project reqt.) Solenoid valve : Make: Norgren or ASCO Proximity type IS SIL certified limit switches	Flowserve or IL, palghat or Koso, palghat or Tyco	
12	---	5 nos	Electrical Junction Box with LM-6 body	Baliga lighting or FCG flame proof control gears Or FCG Power Industries Or Flameproof Equipments P Limited	
13		2 nos	FF JB		FF JB Loose supply by BHEL. Vendor to make provision for mounting the same.
14	Duplex filter (Coalescing type) with change over transfer valve	1 nos	- Each filter 100% capacity with change over valve - Startup diff. Pr. : * - Max. Pr. For change over : * - Filter vessel : SS 316L - Change over valve : SS 316L	Forain Italy or Indfil Germany or 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.	

16	Duplex Filter, regulator with SS housing and changeover transfer valve	2 nos.	As per system requirement	Norgren or Parker or or Boll & kirch, or Hydac	
17	In line check valves		As per system requirement	Audco or BDK or ATIPL	
18	Needle valves		As per system requirement	Audco or BDK or ATIPL	
19	Instrument root & Isolation valves		As per system requirement	Audco or BDK or ATIPL	
20	Tubes, Tube fittings and manifolds		As per system requirement	Swagelok / Parker Hannifin corp.	
21	Instrument cable	As reqd	Single pair 1.5 mm2.		
22	Spur Cable for FF instr.	As reqd	Type A as per IEC 61158-2	Belden	

Notes:

(1) All instrument makes shall be as per this list. Any item not covered in this list shall be from a reputed manufacturer unless otherwise specified in this specification elsewhere. For the items, which are not covered in the list or vendors not indicated, vendor has to procure from their standard sub-vendors.

(2) If the quantity indicated above is more than the numbers required as per project specific P&I diagram, the additional quantity with ranges same as used within skid shall be supplied loose.

(3) All the items of the same type of instrument shall be of same make.

Table 2: Check List

(TO BE FILLED BY THE VENDOR AND SUBMITTED ALONG WITH THE OFFER WITH OUT WHICH OFFER WILL NOT BE CONSIDERED)

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.	

Vendor's Signature

Vendor's Company seal

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--

	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--	-Verifica-tion - 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--

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

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			

Table – 4: Variant Table

Var No	Description	Requirements		Material code	Reference P&ID
51	Seal gas Filter Skid	Rating: Insts Hookup: DCS Insts:	#300 Tubing HART Protocol	TC9755450513	Fig.1
52	Seal gas Control Skid			TC9755450521	Fig.1
53	Spares for Seal gas filter skid and control skid			TC9755450530	Fig.1
54	Seal gas Filter Skid	Rating: Insts Hookup: DCS Insts:	#300 Piping HART Protocol	TC9755450548	Fig.1
55	Seal gas Control Skid			TC9755450556	Fig.1
56	Spares for Seal gas filter skid and control skid			TC9755450564	Fig.1
57	Seal gas Filter Skid	Rating: Insts Hookup: DCS Insts: Startup Gas:	#300 Tubing HART Protocol With Changeover valve	TC9755450572	Fig.2
58	Seal gas Control Skid			TC9755450580	Fig.2
59	Spares for Seal gas filter skid and control skid			TC9755450599	Fig.2
60	Seal gas Filter Skid	Rating Insts Hookup DCS Insts Startup Gas:	#300 Piping HART Protocol With Changeover valve	TC9755450602	Fig.2
61	Seal gas Control Skid			TC9755450610	Fig.2
62	Spares for Seal gas filter skid and control skid			TC9755450629	Fig.2
63	Seal gas Filter Skid	Rating Insts Hookup DCS Insts	#300 Tubing FF Instruments	TC9755450637	Fig.1
64	Seal gas Control Skid			TC9755450645	Fig.1
65	Spares for Seal gas filter skid and control skid			TC9755450653	Fig.1
66	Seal gas Filter Skid	Rating Insts Hookup DCS Insts	#300 Piping 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 DCS Insts	#300 Tubing FF Instruments	TC9755450696	Fig.2
70	Seal gas Control Skid			TC9755450700	Fig.2

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

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

Table – 4-A: Variant Table

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

Ref. Doc.
COMP. FILE
FILE NAME TC55450. DOC

Table-5

PRICE SCHEDULE

SEAL GAS CONTROL SYSTEM

Enquiry ref. No: Date:
Offer ref no. Date:

Sl 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** The word "TYPE" means the make, model no, range, size/length, rating, material as applicable	
	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

Rev. No.	Date	Revision Details	Revised	Approved
00	03.03.2008	New Standard	--	AK
01	02.05.2009	Insulation requirement added	RAM	AK
02	13.12.2009	Generally revised and variants added	VJK	VVS
03	17.09.2010	Variants 43,44,45 added, Changes Highlighted	RAM	VVS

Form No. Rev. D-10 6-

Ref. Doc.
COMP. FILE C
FILE NAME TC55450.DOC