



PRODUCT STANDARD
TURBINES AND COMPRESSORS
HYDERABAD

TC-6-2668

REV No.: **01**

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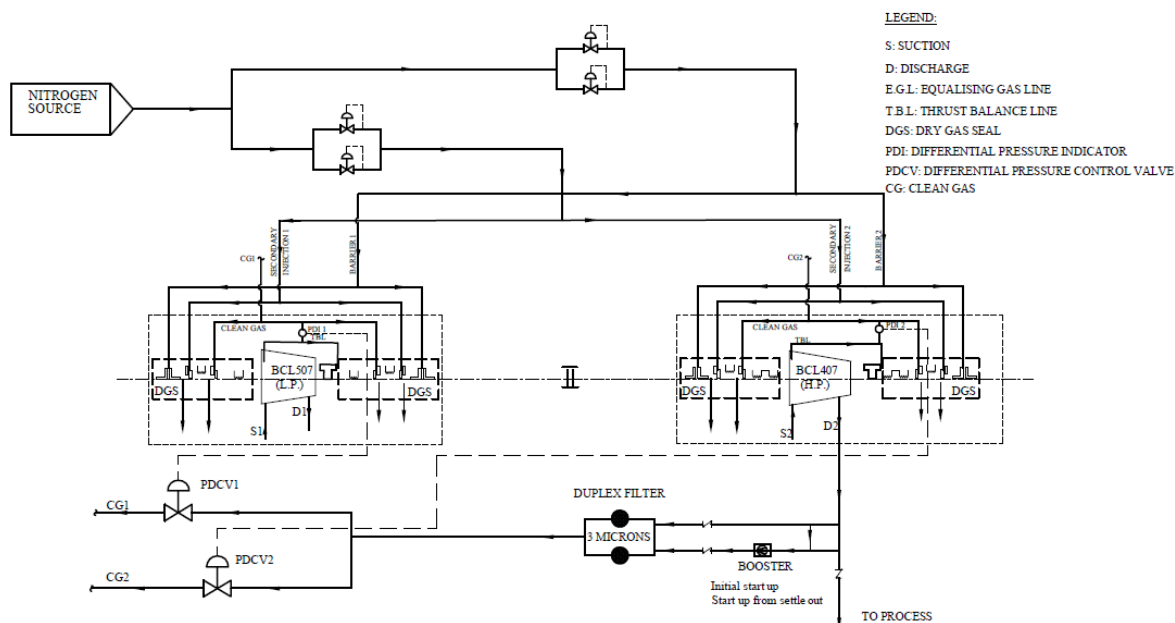
JOB SPECIFICATION OF DRY GAS SEALS

PROJECT: M/s HRRL DHDT (BCL 507+ ST+ BCL 407)

1. GENERAL SPECIFICATION:

For general details of dry gas seals, please refer General Specification No.TC52357
For Seal Shaft and Housing Dimensions, please refer Specification No.TC52508

2. SCHEMATIC OF GAS SEAL SYSTEM



For a detailed scheme, refer to Seal gas P&ID as provided in Dry Gas Seal skid specification

Scope of supply of supporting seal gas system (along with filter skid) is covered under a separate specification vide TC55450

Rev. No.	Revisions	Prepared	Approved	Date
01	Refer to record of revisions	SUGUNA	YVRL	14.02.20

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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. 3. SEAL PROCUREMENT DETAILS 3.1 DRY GAS SEAL CONFIGURATION SINGLE [] DOUBLE [] TANDEM [X] TRIPLE [] 3.2 DRY GAS SEAL TYPE: UNIDIRECTIONAL [] BIDIRECTIONAL [X] 3.3 INTERMEDIATE LABYRINTH: Yes / No Yes / No 3.4 BARRIER SEAL: CARBON RING TERTIARY [X] LABYRINTH SEAL [] 3.5 SEAL CODE DESCRIPTION: <table border="1" style="width: 100%;"> <thead> <tr> <th>Var</th> <th>Description</th> <th>BHEL Matl code</th> </tr> </thead> <tbody> <tr> <td>01</td> <td>Tandem type Bi directional Dry Gas Seal (Φ132) with Barrier seal</td> <td>TC9762668014</td> </tr> <tr> <td>02</td> <td>DGS Assy/Dis Assy. Fixture(Φ132)</td> <td>TC9762668022</td> </tr> <tr> <td>03</td> <td>Tandem type Bi directional Dry Gas Seal (Φ112) with Barrier seal</td> <td>TC9762668030</td> </tr> <tr> <td>04</td> <td>DGS Assy/Dis Assy. Fixture(Φ112)</td> <td>TC9762668049</td> </tr> </tbody> </table> 4. SEAL HOUSING & SHAFT DIMENSIONS Please refer Var No 11 (DGS DIA 132 BCL400/A & BCL500 SERIES for END MOUNTED BEARING DESIGN) and TC52508 Var No 14 (DGS DIA 112 BCL300A & BCL400 SERIES for END MOUNTED BEARING DESIGN) for Seal housing and shaft dimensions. All the interface assembly parts including outer closing cover with its pin, "O" rings, tolerance strips (as applicable), keys, locating/ anti-rotation pins, circlips etc. are in vendor scope. The outer closing cover shall be provided with the milled projections as shown in the sketch to facilitate free oil drain. The dimensions indicated in the sketch shall be strictly adhered to.					Var	Description	BHEL Matl code	01	Tandem type Bi directional Dry Gas Seal (Φ132) with Barrier seal	TC9762668014	02	DGS Assy/Dis Assy. Fixture(Φ132)	TC9762668022	03	Tandem type Bi directional Dry Gas Seal (Φ112) with Barrier seal	TC9762668030	04	DGS Assy/Dis Assy. Fixture(Φ112)	TC9762668049
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5. SEAL DESIGN INPUTS							
5.1. DATA FOR SEAL DESIGN							
OPERATING CONDITION		Design Case-1 SOR	Rated Case #	Design case-1 EOR	H2 rich case	Nitrogen case	Nitrogen case_5.5
PARAMETER DESCRIPTION							
Gas Composition		As per annexure-1					
Mol. wt.		2.96	3.4	3.51	2.030	28.010	28.010
Pr. in the Average Seal gas line upstream of filter (kg/cm ² -a)		56.3	61.5	57.5	47.8	12.2	10.7
Temp in Seal gas Line upstream of filter (°C)		110.90	126.10	110.53	90.0	140.6	139.9
Clean gas pressure (downstream of DPCV1) (kg/cm ² -a)		41.3	40.3	41.3	41.3	6.5	6.0
Clean gas temperature (downstream of DPCV1) (°C)		110.90	126.10	110.53	90.0	140.6	139.9
Clean gas pressure (downstream of DPCV2) (kg/cm ² -a)		49.10	50.90	49.60	44.90	9.20	8.30
Clean gas temperature (downstream of DPCV2) (°C)		110.90	126.10	110.53	90.0	140.6	139.9
Total clean gas leaking into Compr. through end labyrinth seals (both ends) Downstream of DPCV1 (into LP Compressor)	NOR (Kg/hr)	185	192	201	157	214	206
	NOR (Am ³ /hr)	49	47	45	58	41	43
	Max (Kg/hr)	277	288	302	236	322	309
	Max (Am ³ /hr)	74	71	68	87	62	64
Shaft Speed(rpm)		9220	10307	8768	7726	5199	5313
Total clean gas leaking into Compr. through end labyrinth seals (both ends) Downstream of DPCV2 (into HP Compressor)	NOR (Kg/hr)	130	139	143	106	166	158
	NOR (Am ³ /hr)	29	27	27	36	23	24
	Max (Kg/hr)	195	209	214	159	249	237
	Max (Am ³ /hr)	44	41	40	54	34	36
Shaft Speed(rpm)		9220	10307	8768	7726	5199	5313
System settling out press.(kg/cm ² -g)		52					
Rated Speed (rpm)		10307					
Min. mechanical design pressure for DGS		73 kg/cm ² g					
Mechanical design temperature for DGS		Min → 0 °C Max → 170 °C					
Back Pressure in Primary vent		Nor → 0.1kg/cm ² -g / Max → 1.7kg/cm ² -g					

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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. # Performance Guarantee case is <u>RATED CASE</u> - Rated Speed is 10307 RPM - Maximum Continuous Speed(MCS) is 10822 RPM - Minimum Speed is 5313 RPM - Trip Speed is 11905 RPM - Slow roll requirement: Not applicable/However, there will be tilting operation with 4 strokes per minute wherein each stroke rotation is 60 deg. 5.2. AMBIENT CONDITIONS <table border="1"> <tr> <td>Temperature</td> <td>:</td> <td>Min → 3.4 °C Nor → 28 °C Max → 48.2 °C</td> </tr> <tr> <td>Relative Humidity</td> <td>:</td> <td>Min → 3 Nor → 45 Max → 100</td> </tr> </table> 5.3. GAS COMPOSITION FOR VARIOUS CONTINUOUS OPERATING CONDITIONS: The gas composition for all the above operating conditions is furnished at Annexure-1 / 5.4. SEALING GAS <table border="1"> <tr> <td rowspan="3">Primary Seal</td> <td>For Normal Operation</td> <td>Dry and filtered process gas from HP Compressor discharge/Nitrogen/Sweet Gas</td> </tr> <tr> <td>During Starting</td> <td>Seal Gas (process gas / Nitrogen) from Seal Gas Booster</td> </tr> <tr> <td>During Settle Down</td> <td>Process gas from Seal Gas Booster</td> </tr> <tr> <td>Secondary Seal</td> <td colspan="2">Nitrogen / Plugged</td> </tr> <tr> <td>Barrier Seal</td> <td colspan="2">Nitrogen / Instrument Air</td> </tr> </table> <table border="1"> <thead> <tr> <th>Gas</th> <th>Parameter</th> <th>Min</th> <th>Nor</th> <th>Max</th> <th>Mech. Design</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Nitrogen</td> <td>Pressure Kg/Cm² g</td> <td>4.5</td> <td>6</td> <td>7</td> <td>10.5</td> </tr> <tr> <td>Temperature °C</td> <td></td> <td>40</td> <td></td> <td>65</td> </tr> <tr> <td rowspan="2">Sweet Gas</td> <td>Pressure Kg/Cm² g</td> <td colspan="4" rowspan="2">NA</td> </tr> <tr> <td>Temperature °C</td> </tr> <tr> <td rowspan="2">Instrument Air</td> <td>Pressure Kg/Cm² g</td> <td colspan="4" rowspan="2">NA</td> </tr> <tr> <td>Temperature °C</td> </tr> <tr> <td rowspan="2">MUG Compressor</td> <td>Disch. Pressure Kg/Cm² g</td> <td colspan="4">NA</td> </tr> <tr> <td>Disch. Temperature °C</td> <td colspan="4">NA</td> </tr> </tbody> </table>							Temperature	:	Min → 3.4 °C Nor → 28 °C Max → 48.2 °C	Relative Humidity	:	Min → 3 Nor → 45 Max → 100	Primary Seal	For Normal Operation	Dry and filtered process gas from HP Compressor discharge/ Nitrogen / Sweet Gas	During Starting	Seal Gas (process gas / Nitrogen) from Seal Gas Booster	During Settle Down	Process gas from Seal Gas Booster	Secondary Seal	Nitrogen / Plugged		Barrier Seal	Nitrogen / Instrument Air		Gas	Parameter	Min	Nor	Max	Mech. Design	Nitrogen	Pressure Kg/Cm ² g	4.5	6	7	10.5	Temperature °C		40		65	Sweet Gas	Pressure Kg/Cm ² g	NA				Temperature °C	Instrument Air	Pressure Kg/Cm ² g	NA				Temperature °C	MUG Compressor	Disch. Pressure Kg/Cm ² g	NA				Disch. Temperature °C	NA			
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6. SPECIAL POINTS

6.1 Checklist Clause 26 of TC52357 is not applicable. Please refer below clause for warranty as per the project requirement: –

Dry gas seals shall be guaranteed up to 31st August 2023. Warranty is applicable for inadequate design or of defective material or of poor workmanship. If any item is replaced during warranty period, such replaced item shall have another 12 months guarantee from the date of acceptance by Purchaser. However, extended guarantee period shall have an upper limit till 31st August 2024.

6.2 Sourcing of any raw material or finished goods, any testing and processing on product (e.g assembly) from China is not allowed.

6.3 The process gas will contain up to 4 vol% H₂S for about 24 hours every 3 year during sulphiding of catalyst. Material selection to be in accordance with NACE MR0103.

6.4 Maximum depressurization rate is 1.15kg/cm²/Minute. The material selection shall be suitably taken care of.

6.5 Make up gas compressor (which is reciprocating oil lubricated type compressor) is used to make-up the H₂ in closed recycle loop on continuous basis. Please note that maximum of 100 ppm of lube oil carryover in the process gas, due to the above. Dry gas seals and system shall be designed suitably.

6.5 MRT with dry gas seals is not applicable as per Clause 53 of TC52357. However, Supplier to confirm to provide assistance for assembly/disassembly – 2 visits for a period of 3 days each for each casing –**at shop**.

7. Applicable Standards / Codes

7.1. BHEL General Specification No. TC52357

7.2. BHEL Housing Dimension Specification No. TC52508

7.3. API 617 – 7th edition

7.4. API 614 – 5th edition

7.5. NACE MR0103

ANNEXURE - 1
GAS COMPOSITION

OPERATING CONDITIONS (Continued) (1-2.1.1.1) (1-3.1.2) (1-3.1.3)							
2	GAS ANALYSIS:		Normal		Other Conditions		
			Design case 1 & OR 2)	Rated 4)	Design case 1 EOR 3)	S/U H ₂ 6)	S/U N ₂ 8)
3	MOL %	MW					
4	AIR	28.97	0.00	0.00	0.00		
5	OXYGEN	32.00	0.00	0.00	0.00		
6	NITROGEN	28.02	0.68	0.48	0.51		
7	WATER VAPOR	18.02	0.47	0.46	0.50		
8	CARBON MONOXIDE	28.01	0.01	0.01	0.01		
9	CARBON DIOXIDE	44.01	0.00	0.00	0.00		
10	HYDROGEN SULFIDE 9)	34.08	0.01	0.01	0.01		
11	HYDROGEN	2.02	96.08	93.78	93.28		
12	METHANE	16.04	1.90	3.76	4.06		
13	ETHYLENE	28.00	0.00	0.00	0.00		
14	ETHANE	30.07	0.38	0.80	0.86		
15	PROPYLENE	42.08	0.00	0.00	0.00		
16	PROPANE	44.09	0.13	0.26	0.29		
17	ISOBUTANE	58.12	0.02	0.04	0.04		
18	n-BUTANE	58.12	0.03	0.06	0.07		
19	i-PENTANE	72.15	0.00	0.00	0.00		
20	n-PENTANE	72.15	0.00	0.00	0.00		
21	HEXANE PLUS		0.30	0.34	0.37		
	AMMONIA	17.03	0.00	0.00	0.00		
22	CORROSIVE AGENTS 12)		0.00	0.00	0.00		
23							
24	TOTAL		100.00	100.00	100.00		
25	AVG. MOL. WT.		2.96	3.40	3.51		

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