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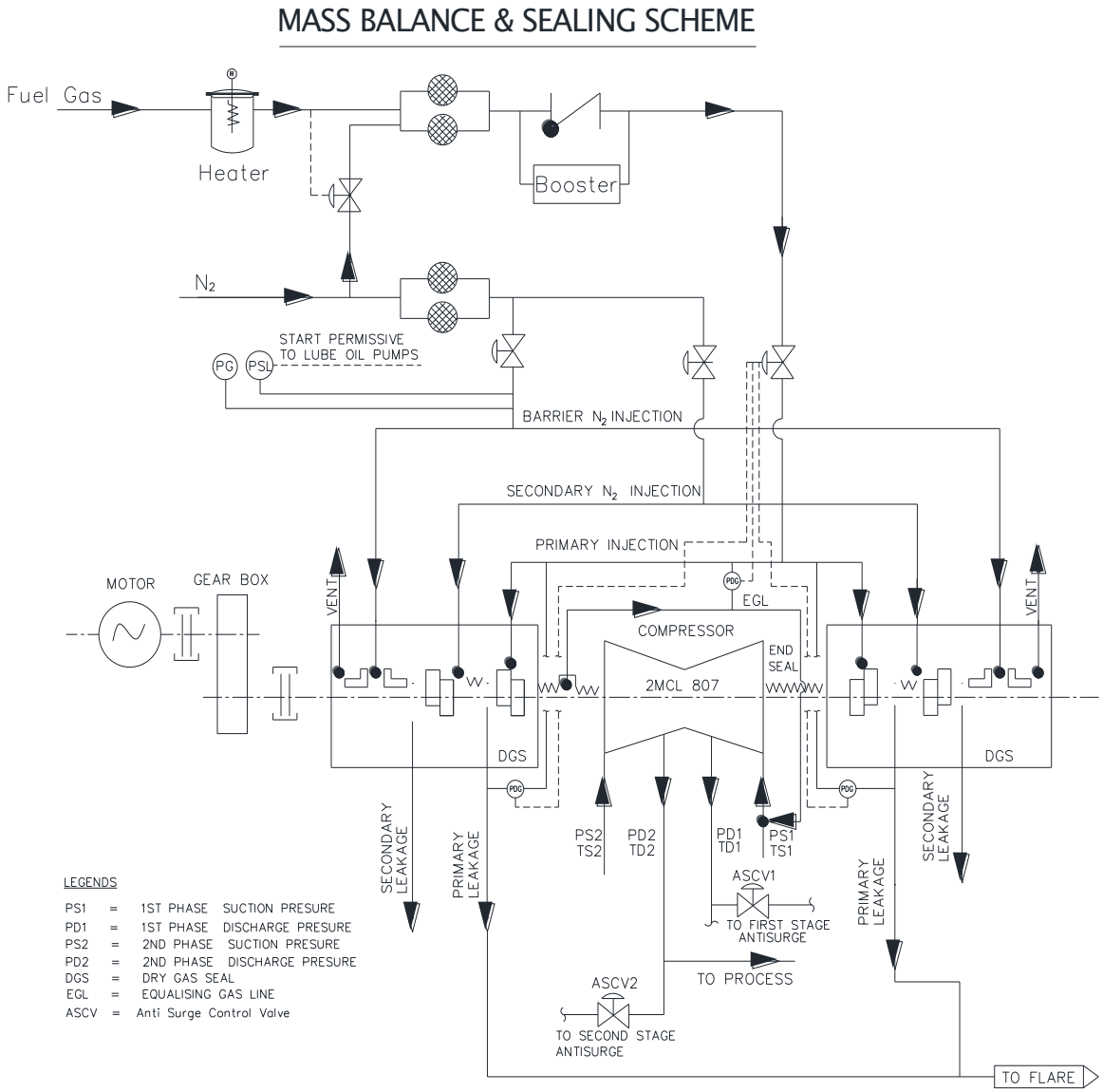
JOB SPECIFICATION FOR DRY GAS SEALS

PROJECT: HRRL DCU, Wet Gas Compressor

1. GENERAL SPECIFICATION:

For general details of dry gas seals, please refer Standard Specification No.TC52357
For seal housing and shaft dimensions please refer specification No. TC52508.

2. SCHEMATIC OF GAS SEAL SYSTEM



Scope of supply of supporting seal gas system (along with filter skid) is covered under a separate specification vide TC-5-5450.

Rev. No.	Revisions	Prepared	Approved	Date
00	Refer to record of revisions	KVS	YVRL	01.07.2020

COMP. FILE NAME

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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~~

3.4 BARRIER SEAL: CARBON RING TERTIARY [**X**] LABYRINTH SEAL [ ]

3.5 SEAL CODE DESCRIPTION:

(Vendor has the option to quote either of the two types if both the types are acceptable to customer)

Var	Description	BHEL Material code
01	Tandem type **Bi directional** Dry Gas Seal (Φ180) with Barrier seal	TC9762689011
02	DGS ASSY/DIS ASSY. FIXTURE	TC9762689020

4. SEAL HOUSING & SHAFT DIMENSIONS

Please refer **Var No. 15** of TC52508.

The components of seal assembly as indicated in the sketch i.e. O-rings, gaskets, tolerance strips, keys, locating pins, **Outer closing Flange** and retaining rings / circlips etc. are in Vendor's scope.
The dimensions indicated in the sketch shall be strictly adhered to.

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5. SEAL DESIGN INPUTS

5.1 DATA FOR SEAL DESIGN

OPERATING CONDITION		WET GAS	S/U	S/U VAPOURIZED LPG	SETTLE OUT
Pr. in the Equalizing gas Line (Kg/cm2-a)		1.328	1.730	1.630	6.500
Temp in the Equalizing gas Line (°C)		40.00	40.00	40.00	40.00
Clean gas presure at seal (Kg/cm2-a)		1.628	2.030	1.930	6.503
Clean gas temperature at seal (°C)		130.00	130.00	130.00	40.00
Shaft speed range (rpm)		5251 TO 8825			
Seal Gas		**Nitrogen (Mol. Wt. 28.0)**			
Total clean gas leaking into Compr. through end labyrinth seals (both ends)	Nor Kg/hr	280	317	308	60
	Nor Am^3/hr	163	148	152	9
	Max Kg/hr	421	476	463	89
	Max Am^3/hr	245	222	228	13
Seal Gas		**Fuel Gas (Max. Mol. Wt. 53.08)**			
Total clean gas leaking into Compr. through end labyrinth seals (both ends)	Nor Kg/hr	367	421	408	-
	Nor Am^3/hr	126	113	116	-
	Max Kg/hr	550	633	613	-
	Max Am^3/hr	189	170	174	-
Seal Gas		**Fuel Gas (Min. Mol. Wt. 14.03)**			
Total clean gas leaking into Compr. through end labyrinth seals (both ends)	Nor Kg/hr	186	214	207	-
	Nor Am^3/hr	242	218	223	-
	Max Kg/hr	279	321	311	-
	Max Am^3/hr	363	327	335	-

For settle out condition, leakages are calculated based on 5m/s gas velocity across end seals.

Suction pressure(Kg/cm2-a)	1.128
Suction temperature (°C)	40
Discharge pressure(Kg/cm2-a)	15.803
Discharge temperature (°C)	130
Minimum/Rated/MCS/Trip Speed (RPM)	5251/8405/8825/8825
Flare pressure (Kg/cm2-g)	Nor →0.1 / Max →1.5
Min. mechanical design pressure for DGS (kg/cm2-g)	19.0
Mechanical design Temperature for DGS (°C)	Min →-20 / Max →170
System settling out pressure (kg/cm2-g)	5.5
System settling out temperature (°C)	138

5.2 AMBIENT CONDITIONS

TEMPERATURE	MIN	NOR	MAX
AT SITE	3.4 °C	28 °C	48.2 °C
RELATIVE HUMIDITY	3%	45%	100%

5.3 GAS COMPOSITION FOR VARIOUS CONTINUOUS OPERATING CONDITIONS:

The Process gas composition of Wet Gas is furnished at **Annexure-1**

The Process gas composition of different types of the Fuel Gases which are to be used as seal gas is furnished at **Annexure-2**

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5.4 CORROSIVE ELEMENTS

Compressor is in H2S Service (up to 11.98 wt%)

Vendor to confirm the suitability of Vapourized LPG for safe operation of DGS

5.5 SEALING GAS

Primary Seal	For Normal operation	Fuel Gas/ Nitrogen.
	For Start-Up	Fuel Gas/ Nitrogen.
	For SOP condition	Nitrogen through Booster.
Secondary Seal		Nitrogen.
Barrier Seal		Nitrogen.

Note:

For heating fuel gas, Heater shall be provided.

5.6 Site Utility Data of the Seal Gas

GAS @user	PARAMETER	MIN	NOR.	MAX.	DESIGN
Nitrogen	Pressure (Kg/cm2-g)	3.5	5.0	7.0	10.5
	Temperature (Deg C)	-	40.0	-	65.0
Refinery Fuel Gas	Pressure (Kg/cm2-g)	1.8	2.0	4.5	8.1
	Temperature (Deg C)	35.0	37.0	55.0	65.0

6. Applicable Standards / Codes

6.1. BHEL General Specification No. TC52357.

6.2. BHEL General Specification for DGS Housing and shaft dimensions TC52508.

6.3. API 617 – 7th edition

6.4. API 614 – 5th edition

6.5. NACE Standard MR0103

7. Warranty

This clause overrides the Clause.26 of TC52357.

All equipment/goods supplied shall be warranted for 12 months from the date of commissioning or upto 31st December 2023 whichever is earlier.

Replaced/repaired equipment /material will be warranted for 12 months from the date of repair /replacement or 31st December 2024 whichever is earlier.

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ANNEXURE – 1 (Process Gas Composition)

Gas analysis ■ Mol % ☐ Wt%		Design Case-1		Design Case-2	
Constituent	MW	Stage 1	Stage 2	Stage 1	Stage 2
Air	28.966				
Oxygen	32.000				
Nitrogen	28.013				
Water	18.015	6.45	1.70	6.45	1.70
CO	28.011	0.35	0.40	0.36	0.41
CO_2	44.010	0.23	0.26	0.24	0.27
H_2S	34.079	9.78	10.99	7.59	8.51
Hydrogen	2.016	6.08	6.92	6.29	7.16
Methane	16.043	29.61	33.65	30.98	35.17
Ethylene	28.054	1.74	1.97	1.77	2.00
Ethane	30.070	13.97	15.77	13.97	15.76
Propylene	42.081	3.62	4.03	3.71	4.12
Propane	44.097	7.78	8.62	7.92	8.77
1 Butene	56.108	3.15	3.32	3.22	3.40
i-Butane	58.124	0.91	0.97	0.96	1.02
n-Butane	58.124	2.69	2.81	2.92	3.05
Cyclopentane	70.135				
Cyclopentene	68.120				
13Pentadiene	68.120				
1 Pentene	70.135				
i-Pentane	72.151				
n-Pentane	72.151				
Pentane Plus	81.86	13.64		13.62	
Pentane plus	76.71		8.59		8.66
Pentylene					
Total		100.0	100.0	100.0	100.0
Avg.Mol. Wt.		34.24	31.26	34.00	31.05

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ANNEXURE – 2 (Fuel Gas Composition)

Fuel Gas	Reinery Fuel Gas		Natural Gas		Vaporized LPG (NOTE 2)	Natural gas RDG Chhara Rich LNG
Composition Case	Rich Gas	Lean Gas	RDG Cairn	Chhara Lean LNG		
Component	Fuel Gas Composition, mole %					
H2	17.48	20.84	0.00	0.00	0.00	0
C1	32.01	74.33	83.53	95.40	0.00	87
C2	13.57	2.31	10.91	3.20	3.29	8.37
C2=	22.23	0.07	0.00	0.00	0.00	0
C3	1.20	0.57	2.98	0.00	29.24	3.00
C3=	6.50	0.00	0.00	0.00	0.00	0
i-Propane	0.00	0.00	0.00	0.00	0.00	Note 3
NC4	0.49	0.17	0.67	0.00	53.78	Note 3
IC4	0.23	0.21	1.16	0.00	13.25	0.00
C4=	0.10	0.00	0.00	0.00	0.00	0
NC5	1.49	0.19	0.15	0.00	0.03	0.23
iC5	0.01	0.00	0.23	0.00	0.27	0.00
C5=	0.02	0.00	0.00	0.00	0.00	0
C6	0.03	0.00	0.05	0.00	0.00	0
C6=	0.00	0.00	0.00	0.00	0.00	0
CO	0.14	0.09	0.00	0.00	0.00	0
O2	0.00	0.04	0.00	0.00	0.00	0
N2	3.46	1.15	0.31	1.40	0.00	0.2
H2S	< 100 ppmv	< 100 ppmv	0.00	0.00	Note 1	0
Cl	0.00	0.00	0.00	0.00	0.00	0
H2O	0.27	0.03	0.01	0.00	0.14	0.00
CO2	0.76	0.00	0.00	0.00	0.00	0
NH3	0.01	0.00	0.00	0.00	0.00	0
Fuel Gas Properties						
M.W	22.06	14.03	19.47	16.66	53.08	18.72
LHV (kcal/kg)	10940	12080	11677	11640	10970	-
			Total Sulphur: 10 ppm wt max			Total Sulphur: 10 ppm wt max

(**) This composition shall be considered as max Hydrogen stream.

Note 1:
Vaporized LPG Sulphur content is as follows:

Total sulphur, ppm wt (max)	150.00
Mercaptan sulphur, ppm wt (max)	20.00
H2S	Nil
Cu Strip Corrosion @ 38 deg C for one hour	Not worse than 1
Free Water Content	Nil

Note 3: i-Propane + n-Butane = 1.2 mol%

Note 2: The vaporized LPG shall be used as start-up fuel only for all heaters except for SRU Vaporized LPG can also be used for Wet gas compressor.

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RECORD OF REVISIONS

Rev. No.	Date	Revision Details	Revised	Approved
00	01.07.20	New Standard	KVS	YVRL

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