P.O. Box 81, Postal Code: 100, Muscat – Sultanate of Oman ص. ب ٨١، الرمز البريدي: ١٠٠، مسقط – سلطنة عُمان
تلكس: ٥٢١٢ بترو أو أن، فاكسميلي: ٢٤٦٧٧١٠٦، ٢٤٦٧٥٠٩٣ (٠٠٩٦٨)، هاتف: ٢٤٦٧٨١١١ (٠٠٩٦٨)، برقيا: بترو مسقط
Telex: 5212, Petro ON, Facsimile: (00968) 24677106, 24675093, Tel.: (00968) 24678111, Cable: Petro Muscat

شركة تنمية نفط عمان
Petroleum Development Oman

Date: 19-08-2024

Subject : Request for Information (RFI)
Project Name : South AP Flare Recovery Project

Dear Sir/Madam,

Petroleum Development Oman is carrying out an exercise to assess market capabilities in order to develop strategies as per below details:

1. Objective

The purpose of this Request for Information (RFI) is solely for information and planning purposes – it does not constitute a Request for Quotation (RFQ) or a Tender or a promise to issue a RFQ or Tender in the future.

2. Project Background

During the oil processing, a variable quantity of valuable natural gas is commonly released into the atmosphere. This associated gas is usually considered by oil companies as a by-product of oil, to be eliminated of by flare combustion.

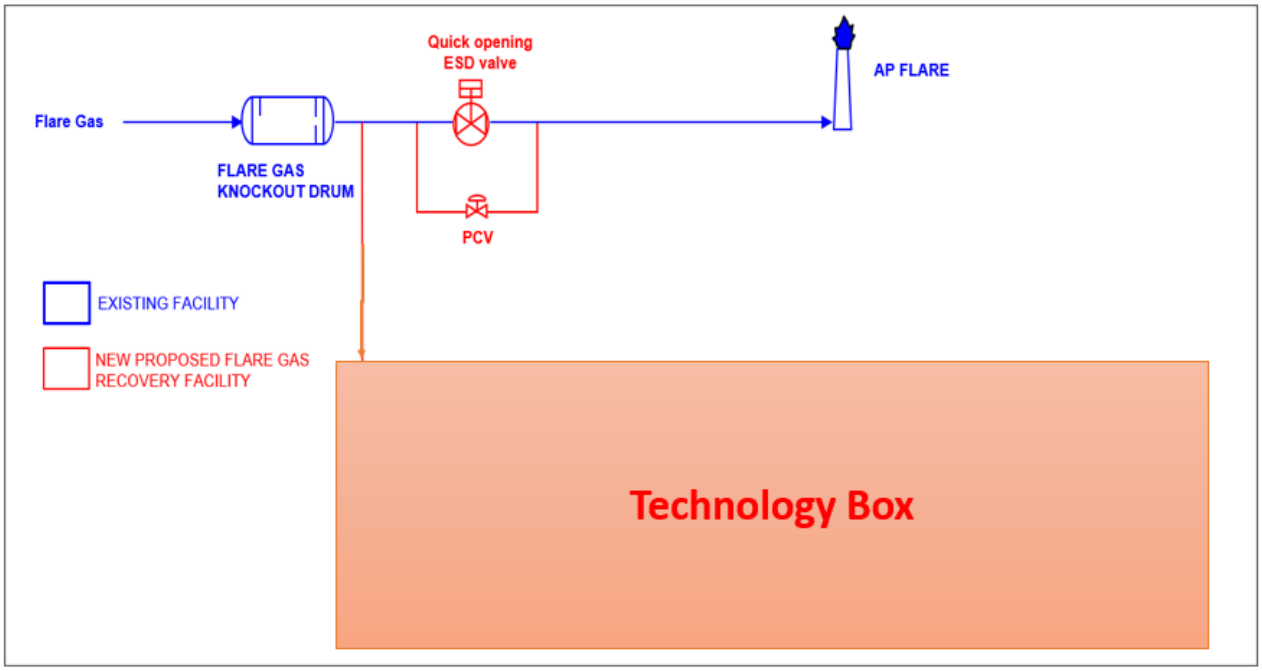
The 'South AP Flare Recovery Project' is one of the major PDO Projects intended for Greenhouse Gas Emissions [GHG] reduction. The ultimate project target is to eliminate routine flaring within the south of Oman conventional facilities.

This project scope includes selling the flared gas to the vendor where all environmental liabilities will be transferred to them. All those production stations are distributed in Bahja, Rima, Amal, Marmul and Nimr clusters. The flare source is associated gas from atmospheric dehydration tanks.

3. Scope of Work

The Company is exploring the option of recovering small scale flare gas in Oman south production stations. Total five stations have routine Atmospheric Pressure (AP) flare gas mostly coming from the Free Water Knock-Out FWKO, CWT and dehydration tank. Flow rates range from 3 ksm3/d to 80 ksm3/d (daily variations, such as higher levels during the day and lower levels at night) while H2S ranges from 0 PPM to 14000 PPM. Most of the south fields have low gas oil ratio (GOR). Also, all production stations are scattered with minimum 50 km distance between them which makes it difficult to gather them in one location. Detailed station values are provided in the following sections of this document.

The scope of this RFI is to provide for Budgetary Quotation to recover the routine flare gas using 'Flare Gas Purchase Agreement' approach where PDO intends to sell the flared gas in which all liability will be transferred to the vendor. All by-products to be commercialize by the vendor and PDO has no commitments to any party.



4. RFI Scope:

RFI should include detail clarifications of the below topic;

- Vendor to specify the proposed pricing model for purchasing flare gas (including any fixed or variable pricing components)
- Vendor to provide a detailed breakdown of all costs associated with the project, including initial setup, ongoing operation, and maintenance costs.
- Vendor to specify all the anticipated PDO Scope (Tie ins, power back up, any additional facility required etc)
- Vendor to clarify the proposed technology and the expected products and by-products. This may differ from one site to another.
- Vendor to specify the minimum contract duration required.
- Vendor to list all experience with similar projects.
- Carbon credit share (in %) to be included.

5. Technical Data

5.1 Nimr and Amal Thermal Scope

For Nimr and Amal thermal, the stations that will participate in the sales gas agreement are NRPS, Nimr – C, Amin, Al – Burj and Amal Thermal. As described in section 3 above, these gases come from FWKO's and Concentric wash tanks, therefore is a blend of associated gas and blanketing gas. The gases from these tanks are directly routed to the AP Flare system which is then burned. Below is the configuration for NRPS, a similar set up can be found for the other stations except that there is a difference in the number of tanks. Each station is having its own AP Flare system.

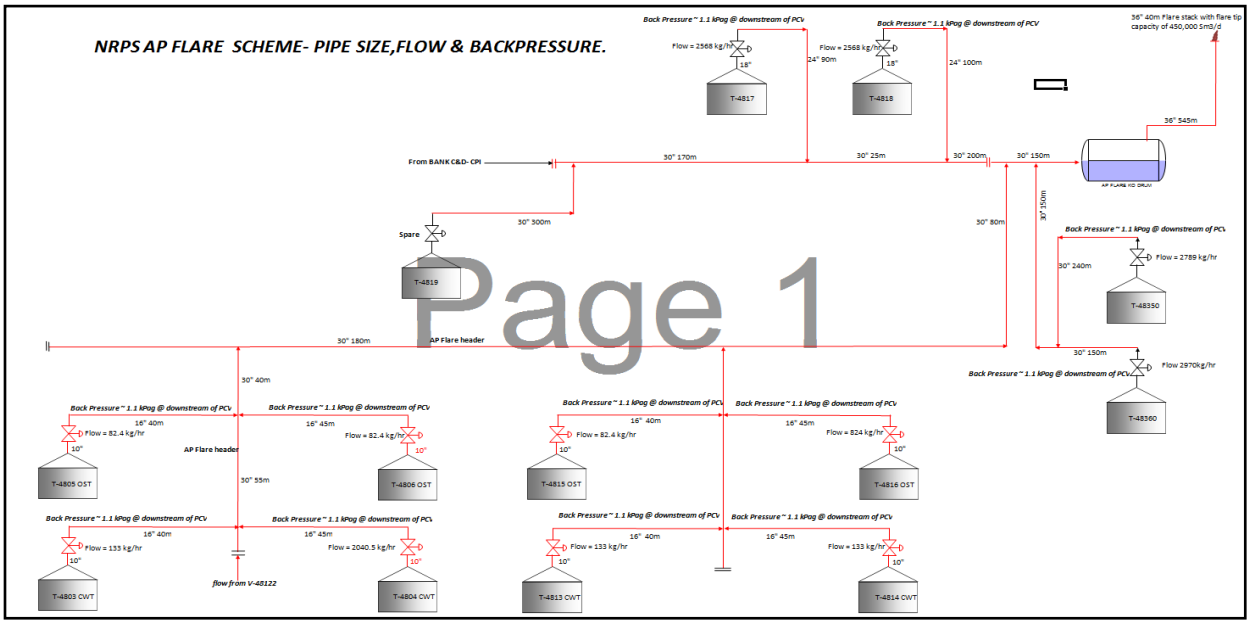


Figure 1: NRPS AP Flare System

5.1.1 Nimr and Amal Thermal AP Flare Gas composition

Composition (mol %)	NRPS	Amin	Nimr – C	Al -Burj	Amal Thermal
Nitrogen	2.647	9.041	11.065	4.409	3.608
CO2	6.500	10.000	0.761	0.500	44.936
Methane	30.562	56.177	64.851	65.038	17.220
Ethane	3.159	0.785	6.510	4.210	6.744
Propane	9.895	0.338	1.914	5.949	13.207
Iso-Butane	1.815	0.382	0.303	0.969	1.538
n-Butane	7.534	0.292	0.184	4.500	6.706
Iso-Pentane	1.950	0.207	0.018	0.886	1.114
n-Pentane	4.377	0.076	0.033	2.373	1.889

Composition (mol %)	NRPS	Amin	Nimr – C	Al -Burj	Amal Thermal
n-Hexane	0.038	8.863	0.026	1.318	1.601
H2S	1.400	1.400	0.200	0.075	1.127
H2O	22.790	12.086	12.063	8.674	8
m-Cyclopentane	0.000	0.006	0.004	0.099	0.000
Benzene	0.000	0.001	0.000	0.000	0.000
Cyclohexane	0.000	0.007	0.0037	0.075	0.000
n-Heptane	0.000	0.009	0.003	0.510	0.000
m-Cyclohexane	0.000	0.004	0.005	0.061	0.000
Toluene	0.000	0.0014	0.001	0.004	0.000
n-Octane	0.000	0.0015	0.000	0.205	0.000
e-Benzene	0.000	0.000	0.000	0.005	0.000
m-Xylene	0.000	0.000	0.000	0.000	0.000
p-Xylene	0.000	0.000	0.000	0.006	0.000
o-Xylene	0.000	0.000	0.000	0.000	0.000
n-Nonane	0.000	0.000	0.000	0.008	0.000
n-Decane	0.000	0.000	0.000	0.034	0.000
n-C11	0.000	0.000	0.000	0.012	<0.001
n-C12	0.000	0.000	0.000	0.004	<0.001
n-C13	0.000	0.000	0.000	0.002	<0.001
NBP36	0.000	0.000	1.399	0.000	0.000
NBP51	0.000	0.0942	0.000	0.000	0.000
NBP55	4.730	0.000	0.000	0.000	0.000
NBP58	0.000	0.000	0.282	0.000	0.000
NBP65	0.000	0.0622	0.000	0.000	0.000
NBP72	0.000	0.000	0.171	0.000	0.000
NBP79	0.000	0.0466	0.000	0.000	0.000
NBP86	0.000	0.000	0.086	0.000	0.000
NBP95	0.000	0.0387	0.000	0.000	0.000

Composition (mol %)	NRPS	Amin	Nimr – C	Al -Burj	Amal Thermal
NBP100	2.036	0.000	0.000	0.000	0.000
NBP101	0.000	0.000	0.046	0.000	0.000
NBP109	0.000	0.0162	0.000	0.000	0.000
NBP115	0.000	0.000	0.027	0.000	0.000
NBP121	0.000	0.0175	0.000	0.000	0.000
NBP129	0.000	0.000	0.016	0.000	0.000
NBP137	0.000	0.0134	0.000	0.000	0.000
NBP148	0.427	0.000	0.000	0.000	0.000
NBP151	0.000	0.007	0.000	0.000	0.000
NBP160	0.000	0.000	0.009	0.000	0.000
NBP165	0.000	0.009	0.000	0.000	0.000
NBP175	0.000	0.000	0.004	0.000	0.000
NBP177	0.000	0.008	0.000	0.000	0.000
NBP186	0.117	0.000	0.000	0.000	0.000
NBP189	0.000	0.000	0.004	0.000	0.000
NBP193	0.000	0.002	0.000	0.000	0.000
NBP203	0.000	0.000	0.003	0.000	0.000
NBP207	0.000	0.002	0.000	0.000	0.000
NBP218	0.000	0.000	0.002	0.000	0.000
NBP221	0.000	0.001	0.000	0.000	0.000
NBP232	0.018	0.000	0.001	0.000	0.000
NBP272	0.003	0.000	0.000	0.000	0.000
MW (kg/kgmol)	35.65	27.52	20.69	25.18	40.50
LHV (KJ/kgmol) @15°C	1.31e6	8.63e5	7.40e5	1.06e6	1.626e+006
HHV (KJ/kgmol) @15°C	1.44e6	9.51e5	8.23e5	1.17e6	1.766e+006
HC dew point (°C)	70.20	44.30	34.66	35.97	256.6
Water dew point (°C)	63.33	49.89	49.87	43.43	57.53
Wobbe Index @ 15°C	55.36	41.47	41.29	53.06	60.13

Table 1: Nimr and Amal Thermal AP Flare Gas Composition (Rich Case)

Hypo Name	NBP [C]	Mol. Wt.	Liq Density [kg/m3]	Tc [C]	Pc [kPa]	Vc [m3/kgmole]	Accentricity
NBP36	36.14	67.91	718.37	211.60	3907.11	0.2800	0.2000
NBP51	50.64	72.37	724.63	227.16	3720.05	0.3000	0.2300
NBP55	55.47	86.88	753.27	236.72	3761.36	0.3100	0.2200
NBP58	57.74	67.92	718.39	233.55	3643.88	0.3100	0.2500
NBP65	65.15	75.45	728.93	242.85	3582.38	0.3200	0.2600
NBP72	71.88	73.50	727.11	249.55	3504.53	0.3300	0.2700
NBP79	79.29	78.84	734.20	258.34	3429.83	0.3400	0.2800
NBP86	85.86	78.54	736.05	265.50	3358.40	0.3500	0.2900
NBP95	95.43	81.73	741.89	275.90	3238.82	0.3700	0.3100
NBP100	99.77	111.48	786.91	290.13	3610.25	0.3400	0.2900
NBP101	100.62	82.95	743.93	281.45	3175.45	0.3800	0.3200
NBP109	108.96	87.37	750.11	290.52	3086.68	0.4000	0.3300
NBP115	114.90	87.87	751.82	296.59	3012.43	0.4100	0.3400
NBP121	121.47	94.24	759.56	304.29	2973.11	0.4200	0.3500
NBP129	129.10	94.57	760.93	311.71	2873.89	0.4400	0.3700
NBP137	136.76	105.04	773.61	321.56	2866.57	0.4400	0.3800
NBP148	147.72	139.06	817.54	342.69	3094.35	0.4300	0.3700
NBP151	150.60	116.02	787.14	337.31	2784.25	0.4700	0.4000
NBP160	159.59	115.16	786.79	345.25	2662.47	0.4900	0.4200

Table 2: Hypo-Components Data

5.1.2 Nimr and Amal Thermal AP Flare Gas Operating Conditions

The operating pressure and temperature for the different stations are shown in Table 3. These data are taken downstream of the AP Flare KOD.

Operating Condition	NRPS	Amin	Nimr – C	Al -Burj	Amal Thermal
Pressure (bara)	1.01	1.01	1.01	1.01	1.01
Temperature (°C)	8 – 63.3	8 – 50	8 – 50	8 – 50	8 - 50

Table 3: Nimr and Amal Thermal AP Flare Gas Operating Conditions

5.1.3 Nimr and Amal Thermal Gas Forecast

Station Name	Minimum (Sm3/d)	Maximum (Sm3/d)
NRPS	78,000	120,000
Amin	10,000	31,000
Nimr-C	3,900	9,100
Al-Burj	5,400	24,000
Amal	27,000	65,000

Table 4: Nimr and Amal Gas Flowrates

5.2 Bahja-Rima Scope

For Bahja-Rima, there are four stations which will participate in the sales gas agreement. These are Suwaihat, Sayyala, Sadad and Rima. The AP Flare gas from these facilities comes from FWKO's (similar to Nimr) and directly routed to the AP Flare system.

5.2.1 Bahja-Rima AP Flare Gas Composition

Below is the summary of the AP Flare gas composition for Bahja-Rima. These compositions are based from the latest sampling, taken at the AP Flare header after the KOD.

Composition	Rima	Suwaihat	Sayyala	Sadad
	Mole%	Mole%	Mole%	Mole%
CO2	4.13	1.41	3.42	0.92
N2	21.1	13.33	5.82	11.41
Methane	26.98	36.67	41.93	36.05
Ethane	18.07	9.18	2.52	8.34
Propane	19.69	15.92	15.77	19.76
Iso-Butane	1.31	6.39	9.10	3.35
n-Butane	3.48	8.10	10.21	11.95
Iso-Pentane	0.45	2.56	4.14	3.23
n-Pentane	0.7	2.77	3.11	2.57
n-Hexane	0.33	0.78	0.55	0.27
n-Heptane	0	0.00	0.00	0.00
n-Octane	0	0.00	0.00	0.00
H2S	1.00	1.01	1.00	0.00
H2O	2.76	1.88	2.42	2.15

Table 5: Bahja-Rima AP Flare Gas Composition

5.2.2 Operating Conditions

For all 4 stations, the routine flare gas is available at battery limit at atmospheric conditions i.e. 1 ATM pressure & 8-50 °C temperature.

Operating Condition	Rima	Suwaihat	Sayyala	Sadad
Pressure (bara)	1.01			
Temperature (°C)	8 - 50			

Table 6: Bahja-Rima AP Flare Gas Operating Conditions

5.2.3 Bahja – Rima Gas Forecast

Station Name	Minimum (Sm3/d)	Maximum (Sm3/d)
Rima	14,200	22,500
Suwaihat	4,000	15,000
Sayyala	4,000	18,000
Sadad	8,000	32,000

Table 7: Bahja-Rima Gas Flowrates

5.3 Marmul Scope

5.3.1 Marmul AP Flare Gas Composition

Component	Mole %
Nitrogen	0.6321
CO2	1.2611
Methane	42.7747
Ethane	8.4161
Propane	26.1469
i-Butane	3.4143
n-Butane	10.6998
i-Pentane	1.4334
n-Pentane	1.9125
n-Hexane	0.18
H2S	0.001
H2O	0.23
Benzene	0.004
Toluene	0.0067
n-Heptane	0.0134
n-Octane	0.001
n-Nonane	0.0001
Mcyclopentan	0.0064
Cyclohexane	0.0032
Mcyclohexane	0.0007
NBP[0]25*	1.9879
NBP[0]66*	0.1764
NBP[0]106*	0.0063
NBP[0]146*	0.0001
CP1A_5*	0.0018
CP1B_5*	0.0003
NBP[4]43_2*	0.0363
NBP[4]56*	0.0171
NBP[4]74*	0.005
NBP[4]87*	0.0015
NBP[4]100*	0.0009
NBP[4]116_1*	0.0002
NBP[5]40*	0.0338

Component	Mole %
NBP[5]58*	0.0045
NBP[5]73*	0.002
NBP[6]43*	0.0429
NBP[6]57*	0.0207
NBP[6]71*	0.0075
NBP[6]85*	0.0022
NBP[6]99*	0.0005
NBP[6]113*	0.0001
NBP[0]40*	0.0795
NBP[0]59*	0.0134
NBP[0]76*	0.0091
NBP[0]89*	0.0041
NBP[0]105*	0.001
NBP[0]121*	0.0002
NBP[0]136*	0.0001
NBP[1]44*	0.0573
NBP[1]56*	0.0192
NBP[1]72*	0.0069
NBP[1]89*	0.0023
NBP[1]101*	0.0011
NBP[1]116*	0.0002
NBP[1]130_1*	0.0001
CP2A_2*	0.0006
NBP[3]44*	0.2266
NBP[3]56*	0.0579
NBP[3]73*	0.0157
NBP[3]87*	0.0059
NBP[3]102*	0.0018
NBP[3]116*	0.0005
NBP[3]130*	0.0001
CP1A*	0.0024
CP1B*	0.0003
CP1A_3*	0.0016
CP1B_3*	0.0005

Table 8: Marmul AP Flare Gas Composition

Name	NBP [C]	MW	Liq Density [kg/m3]	Tc [C]	Pc [kPa]	Vc [m3/kgmole]	Acentricity
NBP[0]25*	25.3900	60.3038	719.3689	200.5043	3753.5002	0.2917	0.1462
NBP[0]66*	65.9844	70.6363	741.9461	246.0783	3609.3523	0.3210	0.2471
NBP[0]106*	106.1708	87.9014	771.4521	292.8169	3342.2427	0.3692	0.3149
NBP[0]146*	146.1305	107.6197	798.9704	336.4351	2953.4673	0.4405	0.3793
CP1A_5*	79.8360	89.7571	722.3269	256.1402	3278.8093	0.3564	0.2783
CP1B_5*	116.3695	107.6890	750.6866	297.9788	2905.9048	0.4252	0.3382
NBP[4]43_2*	43.3013	96.3806	714.2914	218.1852	3704.5735	0.2997	0.2109
NBP[4]56*	56.3046	104.4642	724.4887	232.9750	3632.5605	0.3118	0.2388
NBP[4]74*	73.5811	114.6045	736.4215	252.9517	3537.3809	0.3290	0.2719

Name	NBP [C]	MW	Liq Density [kg/m3]	Tc [C]	Pc [kPa]	Vc [m3/kgmole]	Acentricity
NBP[4]87*	87.0739	122.6846	745.3276	268.5390	3422.9639	0.3477	0.2925
NBP[4]100*	100.4734	133.3397	756.0253	283.8697	3290.4785	0.3694	0.3124
NBP[4]116_1*	115.7212	141.5231	763.4972	299.9436	3103.1685	0.3995	0.3387
NBP[5]40*	40.3654	115.0413	734.8727	217.8758	3837.3406	0.2908	0.1939
NBP[5]58*	57.6522	123.0427	743.6223	237.5295	3798.4595	0.3011	0.2365
NBP[5]73*	72.8160	134.5486	755.4345	255.8087	3731.6587	0.3147	0.2622
NBP[5]88*	88.1609	148.3362	768.5571	274.6082	3643.7014	0.3314	0.2828
NBP[5]101*	100.7325	159.5865	778.1940	289.1082	3505.8652	0.3514	0.3006
NBP[5]116*	115.7237	172.4682	788.3170	305.8354	3340.1653	0.3769	0.3234
NBP[6]43*	43.3469	145.5395	759.2501	224.1721	4035.6960	0.2796	0.1990
NBP[6]57*	56.9907	157.7950	770.1752	241.0560	4037.7949	0.2862	0.2261
NBP[6]71*	70.7729	170.2626	780.6132	258.3029	3998.2102	0.2965	0.2475
NBP[6]85*	84.7000	179.7710	788.1793	275.0996	3895.1985	0.3119	0.2669
NBP[6]99*	99.0062	191.5510	796.9357	291.6169	3724.3992	0.3338	0.2866
NBP[6]113*	113.4440	206.6510	807.1340	308.1030	3560.5518	0.3569	0.3070
NBP[0]40*	39.8392	162.7395	798.9142	224.7012	4248.5791	0.2679	0.1766
NBP[0]59*	59.4489	176.5257	810.5773	250.2338	4367.2402	0.2703	0.2162
NBP[0]76*	75.9003	197.7300	827.2716	272.9271	4396.5781	0.2784	0.2342
NBP[0]89*	89.4156	213.8361	838.9306	291.0163	4336.7632	0.2904	0.2456
NBP[0]105*	104.9285	231.7199	850.5839	309.7207	4141.2861	0.3123	0.2637
NBP[0]121*	120.5363	251.4197	862.3279	328.2032	3959.8096	0.3347	0.2828
NBP[0]136*	135.5911	269.5094	873.7599	345.7748	3798.5588	0.3568	0.3019
NBP[1]44*	43.8163	116.1942	730.0482	220.8647	3823.2815	0.2922	0.2084
NBP[1]56*	56.2533	124.7356	739.2217	235.3257	3762.4827	0.3029	0.2338
NBP[1]72*	72.4849	136.9396	751.4860	254.7054	3696.1038	0.3169	0.2631

Table 9: Marmul Hypo-Components Properties

5.3.2 Operating Conditions

Operating Condition	Marmul
Pressure (bara)	1.01
Temperature (°C)	8 - 50

Table 10: Marmul AP Flare Gas Operating Conditions

5.3.3 Marmul AP Flare Gas Forecast

Station Name	Minimum (Sm3/d)	Maximum (Sm3/d)
Marmul	12,600	43,400

Table 11: Marmul Gas Flowrates

Technology Provider response to RFI requirements
PDO request you to complete the RFI request with detail of the Technology and submit the same no later than **19th of September 2024** by email for the attention of the project team at the following email: **Deema.DM.Mahrouqi@pdo.co.om.**

Yours sincerely,

Deema AlMahrouqi, Contract Engineer FPD15