



तेल एवं गैस उत्पादन प्रौद्योगिकी संस्थान
Institute of Oil and Gas Production Technology

पनवेल, नवी मुंबई
Panvel, Navi Mumbai

Project Report

on

पलियाड जीजीएस, अहमदाबाद एसेट की भूतल सुविधाओं की पर्याप्तता जांच
Adequacy Check of Surface Facilities at Paliyad GGS, Ahmedabad Asset



जनवरी - 2023



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विषय: पलियाड जीजीएस, अहमदाबाद एसेट की भूतल सुविधाओं की पर्याप्तता जांच
Subject: Adequacy Check of Surface Facilities at Paliyad GGS, Ahmedabad Asset

" पलियाड जीजीएस, अहमदाबाद एसेट की भूतल सुविधाओं की पर्याप्तता जांच " रिपोर्ट की प्रति आपके अवलोकनार्थ एवं संदर्भ के लिए संलग्न की गई है।

Please find enclosed a copy of the report on "Adequacy Check of Surface Facilities at Paliyad GGS, Ahmedabad Asset" for your kind perusal.

नितिन . बी . जोशी

Nitin. B. Joshi

Head of Department, SF & PE

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Executive Summary

This pertains to the project titled “**Adequacy Check of Surface Facilities at Paliyad GGS, Ahmedabad Asset**” taken up by IOGPT as an unscheduled project under AWP 2022-23.

Paliyad GGS is presently processing ~ 380 m³/day liquid; 1.75 LSCMD total gas including lift gas from 26 flowing wells. Also, it handles injection of water to 16 water injection wells.

The GGS is a non-processing installation, i.e., only gas-liquid separation takes place and its facilities comprise of group header, 3 bath heaters, 3 group separators, gas KOD, lift gas compressors, liquid storage and pumping facilities, utilities such as test facilities, fuel gas system, flare system and off-sites etc. The separated gas is dispatched to local consumers and also utilized for gas lift purpose. The liquid emulsion is dispatched through existing pipeline to CTF (Kalol).

Asset informed that 14 new wells are planned to be drilled in Wadu-Paliyad field and will be connected to Paliyad GGS. As per long term profile, the peak production is expected to be around 475 m³/day liquid, 205 m³/day crude oil and 2.06 LSCMD total gas including lift gas. Further, Asset desires crude oil-water separation and effluent handling facilities at GGS. Accordingly, Asset has requested to check the adequacy of the existing facilities at Paliyad GGS.

Based on the input data such as long term production profile, gas composition, crude oil analysis etc., simulation model was developed in Aspen HYSYS for reviewing adequacy of various equipment.

The study concludes that the existing bath heaters, group separators, lift gas compression system, crude oil pumping facilities, test facilities are adequate; while group and test manifold, gas KOD, crude oil storage, enclosed ground flare system, instrument air system and fire water pumping system are inadequate. Further for crude oil – water separation, new facilities such as heater treater, effluent storage and pumping facilities are envisaged.

Accordingly, new facilities required to address the inadequacy and additional facilities needed for crude oil-water separation are brought out in the report.

Rajiv Nischal

Rajiv Nischal
GGM-HOI IOGPT

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1.0 Background

The Wadu-Paliyad field located contiguously towards north of Kalol field in Ahmedabad-Mehsana block of Cambay basin was discovered in 1983 and put on production in 1989. Paliyad GGS was commissioned in 1991. Paliyad GGS has been designed for handling and processing of crude oil and gas produced from the wells located in the area. After the separation of liquid and gas, the crude oil is sent to CTF (K) and associated gas to GCP and nearby consumer.

Presently, Paliyad GGS processes around 380 m³/day liquid emulsion; 1.75 LSCMD gas including lift gas from 26 no. of flowing wells. Also GGS handles injection of water to 16 water injection wells.

In the present set up, the well fluid from group header is routed to three no. of bath heaters where the temperature of incoming well fluid is raised to about 60-80 °C and then routed to three no. of vertical group separators for separation of liquid and gas. After separation of gas, the liquid emulsion is routed to storage tanks. The liquid from the storage tanks is dispatched to CTF (K) for further processing. The gas received from the separators is passed through a gas KOD to recover any entrained liquid. Afterwards the processed gas is supplied to local consumers, fuel gas purpose for internal consumption and as lift gas. There is a provision to route excess gas to Limbodra GGS-1. Two (1 operating + 1 standby) hired gas compressors of capacity 1.0 LSCMD each are in operation for compressing the gas for gas injection into gas lift wells. Also there is a water injection header for distribution of water to water injection wells. The schematic of the existing surface facilities at Paliyad GGS is shown in Figure 1.1.

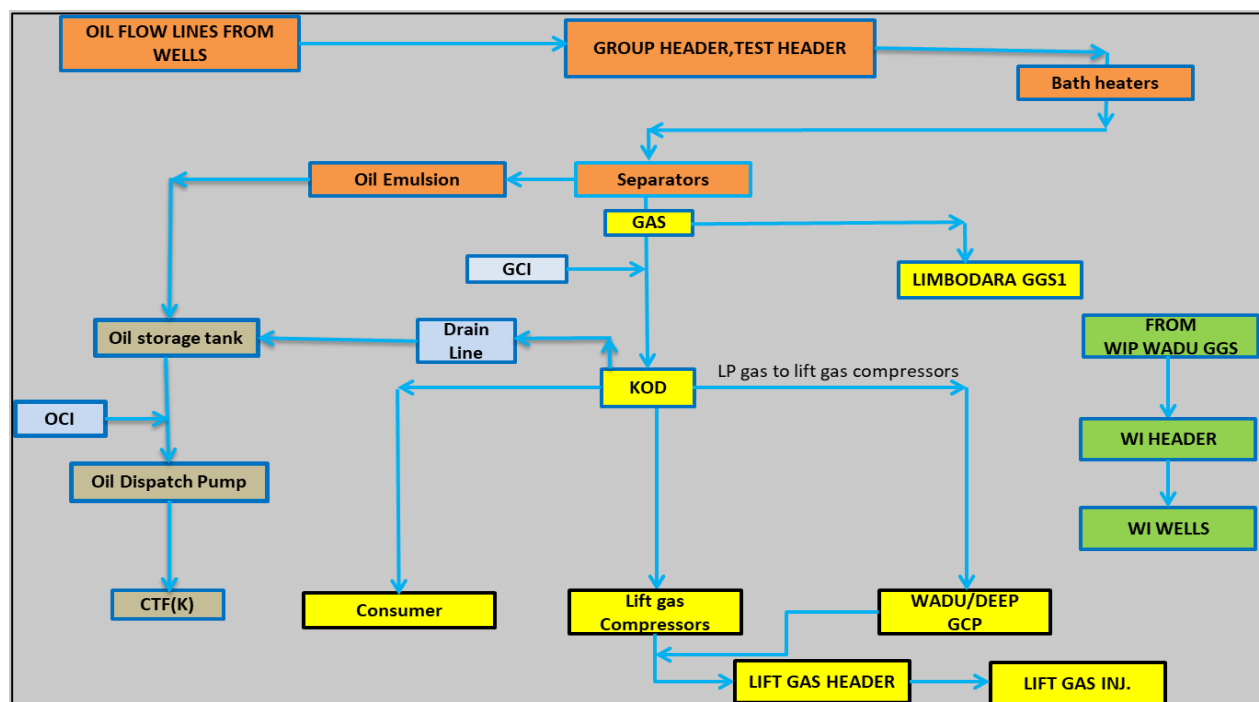


Figure 1.1: Existing Process flow diagram of Paliyad GGS

Asset informed that 14 new wells are planned to be drilled in Wadu-Paliyad field, which will be connected to Paliyad GGS. As per the profile, the peak liquid rate is 475 m³/day liquid emulsion and 2.06 LSCMD total gas (1.5 LSCMD lift gas and 55,500 SCMD associated gas). Peak water injection as per profile is 580 m³/day. Further Asset informed that presently there is no crude oil-water separation at Paliyad GGS and emulsion with ~50% is sent to CTF (Kalol) through trunk line and now intends for crude oil-water separation at Paliyad GGS.

Considering the increased number of wells, peak quantities as per the profile, requirement of heater treater and effluent handling facilities, Asset desires adequacy check of surface facilities of Paliyad GGS. Accordingly, the study titled “Adequacy Check of Surface Facilities at Paliyad GGS, Ahmedabad Asset” has been taken up by IOGPT as unscheduled project in AWP 2022-23.

2.0 Scope of work

- Review of existing system
- Simulation study, adequacy check and augmentation of facilities wherever required

3.0 Basis of study

The input data for this study such as long-term production profile, gas composition, crude oil analysis etc. are provided by the Asset. The input data considered for the adequacy check of surface facilities is briefed below:

3.1 Long term production profile

LTOGP of Paliyad field including lift gas is provided by the Asset is given below in Table 3.1.

Table 3.1: Production profile of Paliyad field								
Year	Liquid Rate	Oil Rate	Water cut	Q water	GOR	Gas	WI Rate	Total Gas being handled by separator
	m3/d	m3/d	%	m3/d		m3/d	m3/d	SCMD
2022-23	444	219	51	225.0	286	62720	574	192720
2023-24	467	215	54	252.1	301	64610	563	194610
2024-25	475	205	57	270.3	271	55422	552	185422
2025-26	460	180	61	279.9	249	44686	566	174686
2026-27	444	156	65	288.0	231	36026	570	166026
2027-28	437	133	70	304.3	225	29881	580	159881
2028-29	430	116	73	313.7	224	26076	580	156076
2029-30	424	102	76	322.2	226	22924	576	152924
2030-31	418	90	79	327.8	226	20260	566	150260

2031-32	412	81	80	331.0	223	17969	557	147969
2032-33	414	73	82	340.4	218	15964	547	145964
2033-34	410	66	84	343.2	214	14185	538	144185
2034-35	404	60	85	343.7	210	12605	529	142605
2035-36	393	54	86	339.6	208	11197	521	141197
2036-37	385	48	87	337.0	207	9951	512	139951
2037-38	384	44	89	339.6	202	8876	504	138876
2038-39	373	40	89	333.0	198	7922	496	137922
2039-40	368	37	90	330.9	193	7093	488	137093
Peak Values	475	205	90	344	271	55422	580	
Total Gas=Return Lift Gas + Associated Gas from formation Current HP Lift Gas Requirement= 1,30,000 SCMD Note: HP Lift Gas taken as constant 1,30,000 SCMD								

3.2 Lift gas requirement:

As suggested by the Asset, total gas (lift gas+associated gas) liquid ratio (GLR) from the above Table 3.1 is 434 (192720 SCMD gas / 444 m³/day liquid). Based on the GLR of 434 and peak liquid of 475 m³/day, the peak gas is 2.06 LSCMD (lift gas + associated gas).

- Peak lift gas is 1.5 LSCMD
- Associated gas is 55,500 SCMD

3.3 Gas composition is given in Table 3.2.

Table 3.2: Gas composition	
Components (Mole %)	Paliyad GGS
Methane	82.472
Ethane	6.029
Propane	4.682
i-Butane	1.182
n-Butane	1.575
i-Pentane	0.508
n-Pentane	0.502
n-Hexane+	1.048
CO ₂	1.805
Nitrogen	0.198
Molecular Weight	21.19
Net Calorific Value	10043.99 (kcal/m ³)
Gross Calorific Value	11075.27 (kcal/m ³)

3.4 Crude oil analysis:

- i. Water Cut (%v/v) : 50-65
- ii. Density at 15 deg C (gm/cc) : 0.8668
- iii. API Gravity : 32
- iv. Pour Point (°C) : 36
- v. Distillation Profile: ASTM–D86 Data given in Table 3.3.

Table 3.3: Crude Oil Distillation Data		
Weight of 100 ml crude oil (g)	80.92	
IBP	80.09°C	
Temperature Range, from IBP to	Recovery % volume (Cumulative) ml	
75°C	-	
100°C	0.1	
125°C	1.6	
150°C	6.7	
175°C	11.8	
200°C	15.8	
210°C	21	
225°C	22.7	
250°C	27.4	
275°C	33	
300°C	42.5	
	up to 210°C	up to 300°C
Residue (%w/w)	81.07	61
Distillate Recovery(%w/w)	18.93	39

3.5 Gas compressors for gas lift purpose:

- Present lift gas requirement: 1.30 LSCMD
- Existing installed capacity: 1.0 LSCMD (1 op+1 s/b) gas lift compressors (hired)
- Suction pr./temperature: 4.0-6.0 kg/cm²g / 25-60 °C
- Discharge pressure / temperature: 50-60 kg/cm²g / 50 °C
- Remaining lift gas requirement is met from the nearby lift gas pipeline of Wadu GGS

3.6 Liquid emulsion storage tanks and pumping facilities:

3.6.1 Storage tanks: 5 no. of 45 m³ capacity each & 1 no. of 200 m³

3.6.2 Three no. of emulsion transfer pumps of capacity 12.5 m³/hr each

3.7 Other design parameters considered in the study

- 3.7.1 Inlet battery limit pressure & temperature at header: 5.0 kg/cm²g & 25-40 °C
- 3.7.2 Operating pressure & temperature at group separator: 4.0 kg/cm²g & 60 °C
- 3.7.3 Operating pressure & temperature at bath heater: 4.5 kg/cm²g & 60 °C
- 3.7.4 Required operating pressure & temperature for new heater treater: 2.5-2.8 kg/cm²g & 80 °C
- 3.7.5 Required water cut specification in treated crude oil (heater treater outlet): less than 2%
- 3.7.6 Required dispatch pressure of the crude oil dispatch pumps: currently 5-15 kg/cm²
- 3.7.7 Required dispatch pressure of the effluent water dispatch pumps: 5-20 kg/cm²

3.8 Evacuation philosophy

- 3.8.1 Future evacuation philosophy of separated effluent water: Generated effluent water will be sent to GGS Wadu and then further it will sent to WIP-III. Asset informed pipeline requirement for routing effluent water will be decided at later stage.
- 3.8.2 Treated oil will be sent to CTF (Kalol) through the existing pipeline
- 3.8.3 Part associated gas from the separators is sent to the nearby Industries. (1) M/s Grow-more ceramics
(2) M/s Grow-more ceramics & Glass Ltd. (3) GAIL(India)

4.0 Adequacy Check of Surface Facilities

4.1 Capacity of the installation

Peak well fluid considered for adequacy check of Paliyad GGS is shown in Table 4.1.

Table 4.1: Peak quantity of liquid, oil, gas & produced water envisaged				
	Liquid, m ³ /day	Oil, m ³ /d	Water, m ³ /d	Gas, (Asso. + lift) SCMD
Paliyad GGS	475	205	344	2.06 LSCMD (55,500 Asso. Gas+ 1.5 LSCMD lift gas)

Adequacy Check

A simulation model for surface facilities was developed in Aspen HYSYS process simulator. Adequacy check has been carried out for handling peak loads. The results are shown below:

4.2 Manifold

Table 4.2: Adequacy check of Manifold				
Sl. No.	Manifold	Existing size	Required size	Remarks
1	Group header	8" x 26 no. of 4" fingers	8"	Header size is adequate. However, extension of header is required to handle 14 new wells

6" / 4" headers also existing

4.3 Bath heaters

Table 4.3: Adequacy check of bath heaters				
Sr. No.	Facilities	Existing heat duty	Required heat duty	Remarks
1	Bath Heaters (3 no. x 33 % each)	3 x 0.3 MMkcal/hr	3 x 0.3 MMkcal/hr (25 °C to 60 °C)	Adequate

4.4 Separators

Table 4.4: Adequacy check of group separators and KOD				
Sr. No.	Facilities	Existing Dimensions	Required Dimensions	Remarks
1	Group Separators (3 no. x 33 % each) Op. Pr: 4-4.5 kg/cm ² Op. Temp: 60 °C	1.2 m (ID) x 4.5 m H Feed: 6" Gas: 4" Liquid: 6"	1.2 m (ID) x 4.5 m H Feed: 6" Gas: 4" Liquid: 6"	Adequate
2	Gas KOD (1 no.) Op. Pr: 3.5-4 kg/cm ²	0.47 m (ID) x 2.1 m H Feed: 4" Gas: 4"	1 m (ID) x 2.7 m H Feed: 8" Gas: 6"	Inadequate. New Gas KOD of same size is envisaged in parallel to existing KOD

	Op. Temp: 60 °C	Liquid: 2"	Liquid: 2"	
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4.5 Heater Treater

Presently there is no heater treater at GGS and Asset desires crude oil-water separation at the installation itself, hence new heater treater is envisaged. The details of required heat duty are shown below in Table 4.5.

Table 4.5: New Heater Treater				
Sr. No.	Facilities	Existing heat duty	Required heat duty	Remarks
1	Heater treater	----	0.40 MMkcal/hr (60 °C to 80 °C)	Required heat duty for heater treater when all bath heaters are in operation.
			0.66 MMkcal/hr (45 °C to 80 °C)	Required heat duty for heater treater when one bath heater is under shut down and other bath heaters are in operation. *Hence, 2 no. of new heater treaters of CWS Baroda make are envisaged.

1) *Asset informed CWS Baroda make heater treaters having heat duty of 1.42 MMBTU/hr (0.35 MMkcal/hr) will be procured. Accordingly required number of heater treaters are envisaged.

2) A provision shall also be made to tap gas from outlet of heater treater so that the hydrocarbon gas released from the Heater Treater be reused as fuel gas in the heater treater by mixing it with the fuel gas being supplied to the Heater Treater instead of flaring it. This will result in saving of fuel gas.

4.6 Crude oil and effluent storage tanks

New effluent storage tanks are envisaged to receive the separated effluent from the heater treater.

Table 4.6: Adequacy check of crude and effluent storage tanks				
Sr. No.	Facilities	Existing Capacity	Required Capacity	Remarks
1	Crude oil storage tanks	425 m ³ 5 no. x 45 m ³ 1 no. x 200 m ³ (existing)	770 m ³	Inadequate considering 3 days storage and 80 % filling. Additional 1 no. x 350 m ³ oil storage tank required.
2	Effluent water storage tanks	----	430 m ³	Inadequate considering 1 day storage and 80 % filling. Additional 2 no. x 220 m ³ effluent water storage tanks required.

4.7 Pumps

Table 4.7: Adequacy check of pumps				
Sr. No.	Facilities	Existing Capacity	Required Capacity	Remarks
1	Crude oil dispatch pumps	3 no. x 12.5 m ³ /hr	10.3 m ³ /hr (24 hr pumping) (20 % margin)	Adequate
2	Effluent water dispatch pumps	----	17.2 m ³ /hr (24 hr pumping) (20 % margin)	Presently there are no effluent water pumps. New 2 no. x 17.2 m ³ /hr required (1 op. + 1 s/b)

4.8 Lift gas compressors

Table 4.8: Adequacy check of lift gas compressors				
Sr. No.	Facilities	Existing Capacity	Required Capacity	Remarks
1	Lift Gas Compressors	1.0 LSCMD (1+1) (hired)	1.5 LSCMD	Inadequate. However, Asset informed remaining lift gas is met through lift gas pipeline from Wadu GGS

4.9 Miscellaneous Utilities etc.

Table 4.9: Adequacy check of Miscellaneous Utilities etc.				
Sr. No.	Facilities	Existing capacity	Required capacity	Remarks
1	Test train: test header, test separator and test tanks	Liquid 85 m ³ /day, Oil: 22 m ³ /day, Water: 63 m ³ /day, Gas: 8,000 SCMD	Liquid 85 m ³ /day, Oil: 22 m ³ /day, Water: 63 m ³ /day, Gas: 8,000 SCMD	Adequate. However, extension of test header is required to handle well fluid of 14 new wells.
2	Lift gas manifold 4" header with 20 no. 2" fingers	Lift gas: 1.30 LSCMD	Lift gas: 1.5 LSCMD	Adequate. Already header extension is planned by the Asset
3	Water injection manifold 4" header with 17 no. 2" fingers	580 m ³ /day	580 m ³ /day	Adequate.
4	Fire water tanks Fire water pumps	1 no. x 350 m ³ & 1 no. x 300 m ³ 171 m ³ /hr (1 electrical + 1 diesel)	600 m ³ 288 m ³ /hr	Adequate Inadequate

5	Enclosed Ground Flare system Flare header Flare KOD Enclosed Ground Flare with Flare ignition system	1.2 LSCMD 8" pipeline 1.3 m (D) x 3 m (L) 1.2 LSCMD	2.06 LSCMD	Flare header, Flare KOD are adequate. However, Asset may contact vendor for scale up of existing enclosed ground flare system
6	Instrument air system	Presently servo system	100 m ³ /hr	Required

4.10 Adequacy check results

Based on the above tables, Table 4.2 thru Table 4.9, it is seen that existing bath heaters, group separators, lift gas compression system, crude oil pumping facilities, test facilities are adequate; while group and test manifold, gas KOD, crude oil storage, instrument air system, enclosed ground flare system and fire water pumping system are inadequate. Further for crude oil – water separation, new heater treaters, effluent storage and pumping facilities are envisaged.

New facilities required to address the inadequacy and additional facilities needed due to crude oil – water separation as per Asset requirement are as tabulated below in Table 4.10:

Table 4.10: Broad equipment list and facilities Paliyad GGS: Liquid 475 m³/day, Oil 205m³/d, Water 344m³/d, 2.06 LSCMD Gas, (55,500 SCMD Asso. + 1.55 LSCMD lift gas)						
S.N	Name	Type	Nos.	Design/Capacity	Operating Pr. (kg/cm ² g)	Op. Temp. (°C)
Vessels						
1	Gas KOD	Vertical 2-phase	1	0.47 m x 2.1 m (H) Same as existing gas KOD	3.0 - 4.0	25-60
Heat exchangers						
1	Heater treater	Fired heater	2	0.35 MMKcal/hr	2.0 - 3.0	45-80
Pumps					Suction/ Disch. Pr. (kg/cm ² g)	Op. Temp. (°C)
1	Effluent water dispatch Pumps	Centrifugal	1+1	17.2 m ³ /hr	Atm / 5-20	25-80
Storage tanks						
1	Crude Storage tanks	----	1	350 m ³	atm	----
2	Effluent water storage tanks	----	2	220 m ³	atm	----
Miscellaneous / Packaged items						
1	Instrumentation & Plant Air compressor system	Centrifugal	1+1	100 m ³ /hr	----	----

2	Instrument air receiver	----	----	For a period of 45 minutes	----	----
3	Fire water pump	----	1	288 m ³ /hr each	----	----
Remarks (1) Extension of 8" group header and 4" test header is envisaged to handle 14 new wells (2) Asset may contact vendor for scale up of enclosed ground flare system						

A schematic of process flow diagram showing new facilities at Paliyad GGS is provided in Figure 4.1.

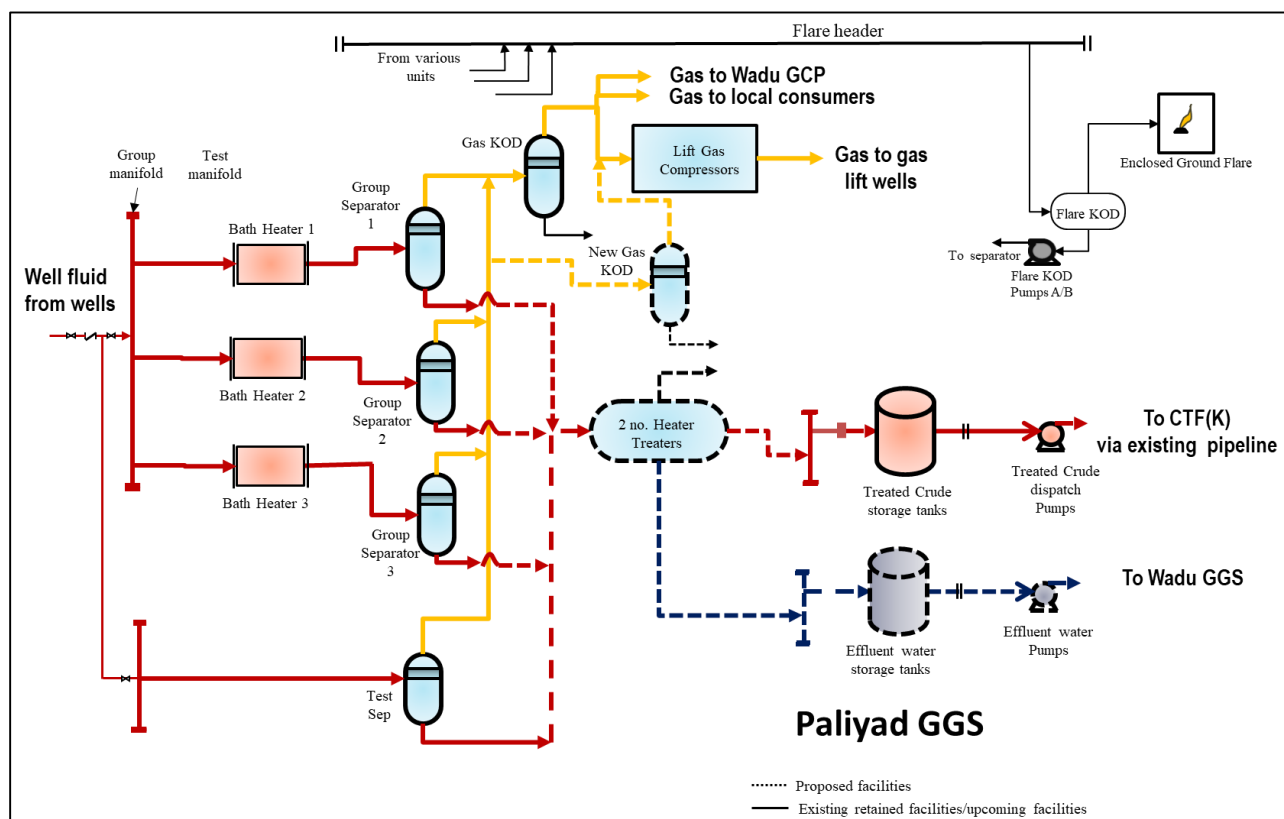


Figure 4.1: Schematic of process flow diagram showing required new facilities at Paliyad GGS

4.11 Plot area requirement:

The plot area required for new facilities comprising process area (heater treater, gas KOD & effluent pumps), crude storage tank and effluent storage tanks area is 140 m x 95 m: 13300 m² (3.3 acres); This excludes flare. The area required is estimated considering 60 m distance from the new process facilities and the existing installation/ from the boundary wall, the another side will be flare.

Asset is planning to install Enclosed Ground flare (EGF) at GGS and the flare project is under progress. As per OISD-118, For ground flare, the distances shall be of 150 m. However, in the instant case, as EGF is being adopted, Asset need to get distance exemption from the competent authority based on dispersion study (i.e., height of the EGF is such that the maximum GLC of pollutants including NO_x never exceeds the

prescribed ambient air quality limit as per latest national environmental act/CPCB/GPCB), radiation study (maximum allowable radiation level as per the latest available edition of API 521 i.e., shall not exceed 500 BTU/hr/ft² including solar radiation of 330 BTU/hr/ft²) and by taking up risk analysis if adequate land is not available and thereafter additional plot area requirement for flare system may be calculated.

The indicative plot plan (excluding flare area) is shown in Figure 4.2

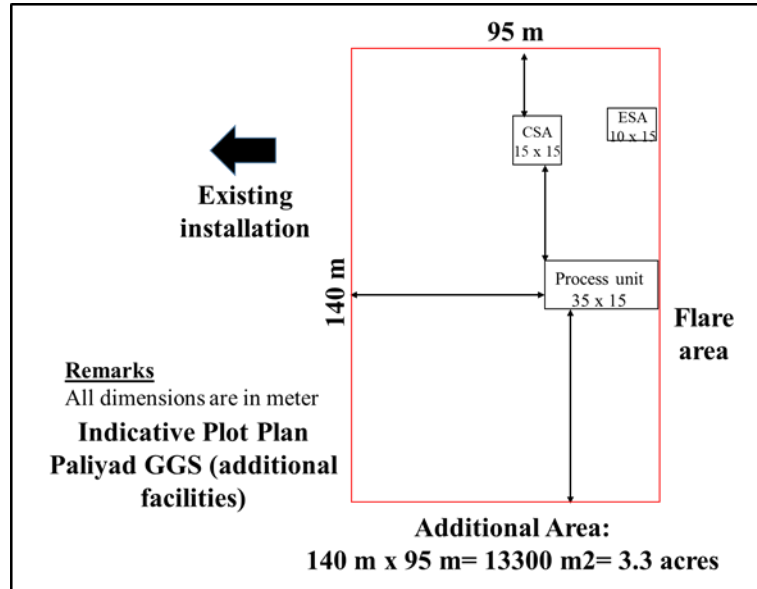


Figure 4.2: Indicative plot for additional facilities (excluding flare area) at Paliyad GGS

5.0 Summary

- Paliyad GGS is presently processing ~ 380 m³/day liquid emulsion; 1.75 LSCMD including lift gas from 26 no. of flowing wells. Also GGS handles injection of water to 16 water injection wells.
- The GGS is a non-processing installation, i.e., only gas-liquid separation takes place and the facilities comprise of group header, 3 no. bath heaters, 3 no. group separators, gas KOD, lift gas compressors, liquid storage and pumping facilities, utilities such as test facilities, fuel gas system, flare system and off-sites etc. The separated gas is dispatched to local consumers and also utilized for gas lift purpose. The liquid emulsion is dispatched to CTF (K).
- Asset informed that 14 new wells are planned to be drilled in Wadu-Paliyad field and will be connected to Paliyad GGS. As per long term profile, the peak production is expected to be around 475 m³/day liquid, 205 m³/d crude oil, 344 m³/d Water and 2.06 LSCMD Gas, (55,500 SCMD Associated gas & 1.55 LSCMD lift gas). Further, Asset desires crude oil-water separation and effluent handling facilities at GGS. Accordingly, Asset has requested to check the adequacy of the existing facilities at Paliyad GGS.
- Based on the input data such as long term production profile, gas composition, crude oil analysis etc., a simulation model was developed in Aspen HYSYS for reviewing adequacy of various equipment.
- The study concludes that the existing bath heaters, group separators, lift gas compression system, crude oil pumping facilities, test facilities are adequate; while group and test manifold, gas KOD, crude oil storage, instrument air system, enclosed ground flare system and fire water pumping system are inadequate. Further for crude oil – water separation, new heater treater, effluent storage and pumping facilities are envisaged.



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