तेल एवं गैस उत्पादन प्रौद्योगिकी संस्थान
Institute of Oil and Gas Production Technology
पनवेल, नवी मुंबई
Panvel, Navi Mumbai

Project Report

on

झलोरा जीजीएस-1, अहमदाबाद एसेट की भूतल सुविधाओं की पर्याप्तता जांच

Adequacy Check of Surface Facilities at Jhalora GGS-1, Ahmedabad Asset

मार्च – 2023

तेल एवं गैस उत्पादन प्रौद्योगिकी संस्थान
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कं. सं.: IO.22I.PT_AM.118U *दिनांक: 10/04/2023*

विषय: झलोरा जीजीएस-1, अहमदाबाद एसेट की भूतल सुविधाओं की पर्याप्तता जांच
Subject: Adequacy Check of Surface Facilities at Jhalora GGS-1, Ahmedabad Asset

" **झलोरा जीजीएस-1, 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 Jhalora GGS-1, Ahmedabad Asset**" for your kind perusal.

नितिन. बी. जोशी
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Acc No: 3138

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Adequacy Check of Surface Facilities at Jhalora GGS-1, Ahmedabad Asset

कार्यकेंद्र: **अहमदाबाद परिसंपत्ति**
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Executive Summary

This pertains to the project titled "**Adequacy Check of Surface Facilities at Jhalora GGS-1, Ahmedabad Asset**" taken up by IOGPT as an unscheduled project under AWP 2022-23.

Presently, Jhalora GGS-1 is processing around 3,100 m^3/d liquid with 90-95% water cut and 60,000 SCMD gas received from 77 wells. There are four 2-phase emulsion separators, a gas KOD, eight heater treaters (HTs), crude storage tanks and pumping system, utilities such as flare system, fire water system etc. Further 1000 m^3/d emulsion from South Kadi GGS and Viraj GGS is also fed to HTs at GGS-1. After processing, crude oil received in storage tanks, is dispatched to Nawagam CTF trunk line. The separated gas from KOD is routed to Sanand GCP. The water separated from heater treaters is routed to the Jhalora ETP for further treatment and disposal.

Earlier, a study titled "Feasibility Study on Facility for Separation of Free Water at Jhalora GGS-1" was carried out by the IOGPT in July'22. In the said study, various scenarios have been worked out to establish number of heater treaters required considering with and without installing FWKOD. Asset further desired to extend the former study and carry out the adequacy study of the GGS.

As per the long term profile, the peak production is expected to be around 3617 m^3/d liquid and 64,717 SCMD gas including 55,000 SCMD lift gas. In addition 1,000 m^3/d emulsion from South Kadi GGS and Viraj GGS has also been considered for the study. 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 adequacy check of group separators & HTs are reworked out considering various scenarios in reference to the earlier study, based on which additional equipment required are as follows:

- Scenario-1 (existing system), without free water separation: An additional group separator and 8 HTs are required.
- Scenario-2, free water separation in FWKOD by installing upstream of HTs: an additional group separator, 3 FWKODs and 2 HTs are required.
- Scenario-3, free water separation by installing 3 phase separator/FWKOD in place of existing separators: 3 no. three phase separator / FWKODs and 2 HTs are required.

Considering less fuel gas consumption and less pressure drop, Scenario-3 is preferred.

Further, the study concludes that the existing manifold, gas KOD, crude oil storage and test facilities are adequate; while oil dispatch pumping system, utilities such as flare system, oil pit pump, closed drain system, instrument air system and fire water pumping system are inadequate. Accordingly, new facilities required to address the inadequacy are brought out in the report.

Rajiv Nischal

Rajiv Nischal
GGM-HOI IOGPT

Contents

1.0 Background

Jhalora Oil Field is located on the west of Ahmedabad city at a distance of around 40 km. There are two GGSs, viz. Jhalora GGS-1 and Jhalora GGS-2, where well-fluid produced from this field is received, processed and dispatched.

Presently, Jhalora GGS-1 is processing around 3,100 m^3/d liquid with 90-95% water cut and 60,000 SCMD gas received from 77 wells. There are four 2-phase emulsion separators, a gas KOD, eight heater treaters crude storage tanks and pumping system, utilities such as flare system, fire water system etc. at Jhalora GGS-I. Further 1000 m^3/d emulsion from South Kadi GGS and Viraj GGS is also fed to Heater Treaters (HTs) at GGS-1. After processing, crude oil received in storage tanks, is dispatched to Nawagam CTF trunk line. The separated gas from KOD is routed to Sanand GCP. The water separated from heater treaters is routed to the Jhalora ETP for further treatment and disposal.

Earlier, a study titled "Feasibility Study on Facility for Separation of Free Water at Jhalora GGS-1" was carried out by the IOGPT in July'22. In the said study, following three scenarios have been considered for adequacy of existing heater treaters (HT):

- Scenario-I (Existing scenario): Without free water separation before routing to heater treaters and considering present operating philosophy of heater treaters
- Scenario-II: Free water separation before routing the liquid to heater treaters and considering present operating philosophy of HTs
- Scenario-III: Free water separation before routing the liquid to heater treaters and considering all heater treaters in parallel

In the study, simulation has been carried out, which revealed that additional eight heater treaters will be needed in Scenario-I, additional two heater treaters in Scenario-II and additional five heater treaters in Scenario-III.

Further, for separation of free water, two options have been conceptualised:

- Option-I: Three-phase separators / three phase Free Water Knock-Out Drums (FWKOD) in place of the existing two phase-separators
- Option-II: Two-phase (oil and water) FWKODs at downstream of the existing two-phase separators

Both the options, viz., Option-I & Option-II are suitable.

Considering the two scenarios (Scenario-II & Scenario-III) of heat duty requirement and two options (Option-I & Option-II) for free water separation, four schemes have been conceptualised. The said study report suggested that Asset may select suitable scheme based on operational flexibility and field conditions.

Further to above, an upcoming ASP Jhalora EOR project is envisaged at GGS wherein oil gain is envisaged. As per the profile provided by the Asset, peak liquid is 3,617 m^3/day, peak oil is 266 m^3/day, peak water is 3,356 m^3/day and 64,717 SCMD gas including 55,000 SCMD lift gas.

Considering the peak quantities as per the profile, Asset desires adequacy check of surface facilities of Jahlora GGS-1. Accordingly, the study titled "Adequacy Check of Surface Facilities at Jhalora GGS-1, Ahmedabad Asset" has been taken up by IOGPT as an 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 is briefed below:

3.1 Long term production profile

LTOGP of Jhalora GGS-1 is provided by the Asset is given below in Table 3.1.

Table 3.1: Long term production profile of Jhalora GGS-I

Year	Liquid Production (m^3/d)	Oil Production (m^3/d)	Effluent generation (m^3/d)	Associated Gas (m^3/d)
2022-23	3053	218	2835	7954
2023-24	3334	235	3099	8580
2024-25	3310	243	3066	8886
2025-26	3274	250	3024	9113
2026-27	**3617**	261	**3356**	9542
2027-28	3605	**266**	3339	**9717**
2028-29	3591	265	3326	9671
2029-30	3586	265	3321	9677
2030-31	3582	265	3318	9665
2031-32	3576	261	3315	9534
2032-33	3577	263	3314	9591
Peak lift gas is 55,000 SCMD				

3.2 Gas composition is given in Table 3.2.

Table 3.2: Gas composition

Components (Mole %)	Jhalora GGS-1
Methane	90.70
Ethane	2.09
Propane	1.12
i-Butane	0.39
n-Butane	0.25
i-Pentane	0.13
n-Pentane	0.09
n-Hexane+	0.57
CO2	4.20
Nitrogen	0.46

3.3 Crude oil analysis:

i. Density (kg/m^3) : 912

ii. API Gravity : 23.57

iii. Distillation Profile: ASTM–D86 Data given in Table 3.3.

Table 3.3: Distillation Profile

Temperature, ^{0}C	% Volume
IBP=93^{0}C	
100	2.0
125	4.0
150	7.0
175	16.0
200	21.0
210	23.0
225	25.0
250	29.0
275	39.0
300	49.0

3.4 Other design parameters considered in the study

3.4.1 Inlet battery limit pressure & temperature at Jhalora GGS-I: 5.0 kg/cm^2g & 22-46^{0}C

3.4.2 Around 1,000 m^3/day emulsion from S. Kadi & Viraj GGS (Avg W/C 35%) is also to be treated in heater treaters at Jhalora GGS-I.

3.4.3 Required temperature in Heater Treaters: 78 ^{0}C

3.4.4 Duty of each Heater Treater: 1.42 MMBTU/hr

3.5 Process Description of Jhalora GGS-I

Jhalora GGS-I consists of emulsion header and test header. Well-fluid from the wells and field headers is received in emulsion header or test header. The well-fluid from the emulsion header is routed to four numbers of emulsion separators. The gas separated from the emulsion separators is sent to gas scrubber and further routed to GCP Sanand. The liquid seprated from the emulsion separator, along with the emulsion received from the South Kadi GGS and Viraj GGS, is routed to heater treaters. There are eight existing heater treaters. Four out of the eight heater treaters, operating in parallel to one another, act as primary heater treaters, that is, these are first stage of heater treaters. Another three heater treaters, operating in parallel to one another, are operating as a secondary heater treaters, that is, these are operating as second stage of heater treaters. One heater treater is kept as standby or under maintenance. The liquid separated from the emulsion separator, along with the emulsion from the South Kadi GGS and Viraj GGS, is routed to the primary heater treaters. After separation of free water, the emusion is further routed to the secondary heater treaters. The separated oil from the secondary heater treaters is routed to crude oil storage tanks, from where it is pumped to Sanand GGS-II. The water separated from primary as well as secondary heater treaters is routed to the Jhalora ETP for further treatment and disposal.

A test train consisting of test header and two number of test separators is also available for testing of the wells. Gas separated from the test seprators is metered and routed to the gas scrubber along with the gas from the emulsion separators. The liquid separated from the test seprators is stored in the four numbers of test tanks and after measurement, it is pumped to the heater treaters.

The schematic of the existing processing facility at Jhalora GGS-1 is shown in Figure 3.1 below.

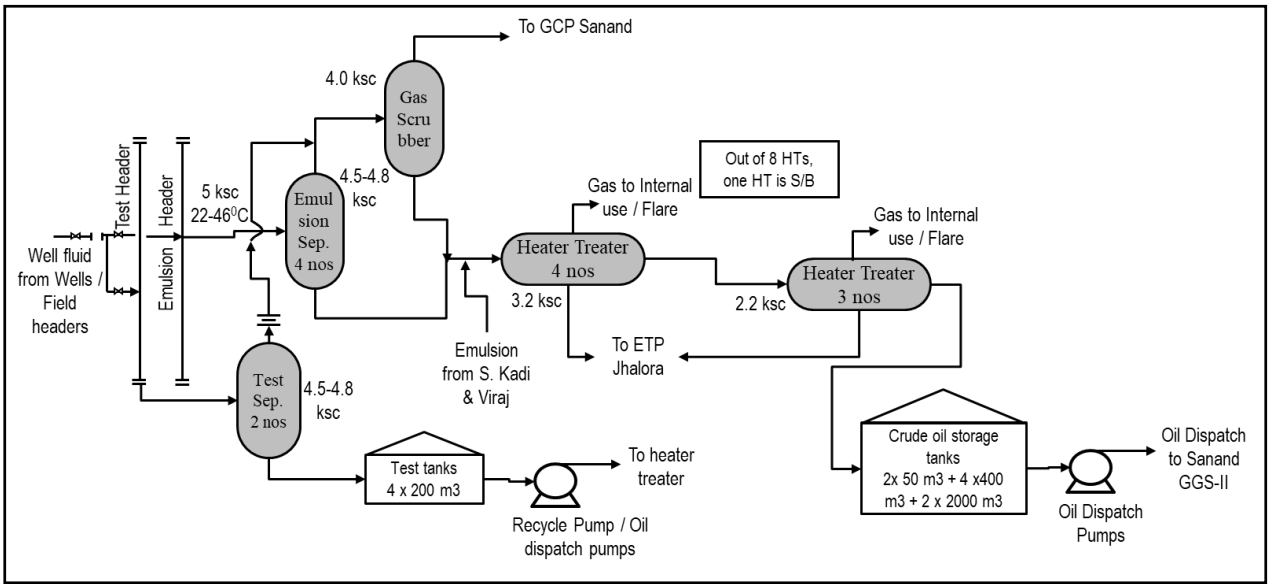

Figure 3.1: Schematic of existing process facilities at Jhalora GGS-1

4.0 Adequacy Check of Surface Facilities

4.1 Capacity of the installation

Peak well fluid considered for adequacy check of Jhalora GGS-1 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
Jhalora GGS-1	3617	266	3356	64,717 SCMD (9,717 SCMD Associated Gas+ 55,000 SCMD lift gas)

Also about 1,000 m^3/d emusion with 35% water cut (i.e., 650 m^3/day crude oil and 350 m^3/day water) from South Kadi GGS and Viraj GGS will be routed to heater treaters along with liquid emulsion coming from group separators of Jhalora GGS-1.

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	2 no. 8" manifolds	8"	Adequate

4.3 Group Separators & Heater Treaters

Table 4.3: Adequacy check of group separators

Sr. No.	Facilities	Existing Dimensions	Required Dimensions	Remarks
1	Group Separators (4 no. x 25 % each) Op. Pr: 4.5-5 kg/cm^2 Op. Temp: 22-46 ^{0}C	1.2 m (ID) x 4.5 m H Feed: 4" Gas O/L: 4" Liquid O/L: 4"	1.2 m (ID) x 4.8 m H Feed: 6" Gas: 4" Liquid: 4"	Inadequate. An additional separator in parallel to existing separators is required.*

In this regard, an earlier study titled "Feasibility Study on Facility for Separation of Free Water at Jhalora GGS-1" carried out in July'22 by IOGPT, as mentioned earlier in Section-1 may be referred to. In the said study, the required number of heater treaters are established considering with and without Free Water Knockout Drum (FWKOD). Futher the free water separation can be achieved by installing either 3-phase separator / 3-phase free water knock out drum (FWKOD) in place of the existing 2- phase separators or by installing FWKOD at the downstream of the existing 2-phase separator.

Based on above, adequacy check of group separators and heater treaters have been rechecked for the various scenarios considered in the earlier study as mentioned below:

- Scenario-1: Existing system (without free water separation)
- Scenario-2, Free water separation before routing the liquid to heater treaters - by installing FWKOD downstream of existing separators
- Scenario-3: Free water separation before routing the liquid to heater treaters - by installing FWKOD in place of existing separators

As intimated by Asset, the existing seven heater treaters will be available for heating the liquid, whereas one heater treater will be stand-by or under maintenance as is the present operating philosophy.

Scheme details of each scenario are briefly reproduced below:

4.3.1 Scenario-1 (Existing scenario): Without free water separation before routing to the heater treaters

As informed by the Asset, 80% free water separation in primary heater treaters has been considered for heat duty calculation in this scenario. The heat duty requirement along with analysis of temperature, which can be achieved with the existing heater treaters and requirement of additional heater treater for heating up to 78 ^{0}C has been determined.

The total heat duty requirement to heat the peak liquid of Jhalora GGS-I along with the emusion from South Kadi GGS and Viraj GGS will be around 21.4 MMBTU/hr. The existing heater treaters can raise the temperature of liquid up to 43 ^{0}C. However, to achieve temperature of 78 ^{0}C at the heater treater outlet, eight additional heater treaters will be required in the secondary stage.

Also one additional group separator is required.

4.3.2 Scenario-2: Free water separation before routing the liquid to heater treaters - by installing FWKOD downstream of existing separators

Asset intimated that after attaining 50-55 ^{0}C in primary heater treaters, total water content in emulsion oil will be around 50%. This has been considered for heat duty calculation in this scenario. The heat duty requirement along with the analysis of temperature which can be achieved with the existing heater treaters and requirement of additional heater treaters for heating upto 78 ^{0}C has been determined.

The total heat duty requirement to heat the peak liquid of Jhalora GGS-I after free water separation before routing to the heater treaters along with the emusion from South Kadi GGS and Viraj GGS will be around 12.5 MMBTU/hr. The existing heater treaters can raise the temperature of liquid up to 70 ^{0}C. However, in

order to achieve heater treater outlet temperature of 78 ^{0}C, two additional heater treaters are required in the primary heater treaters. Also one additional group separator is required.

The schematic for scenario-2, free water separation before routing the liquid to heater treaters - by installing FWKOD downstream of existing separators is as shown in Figure 4.1.

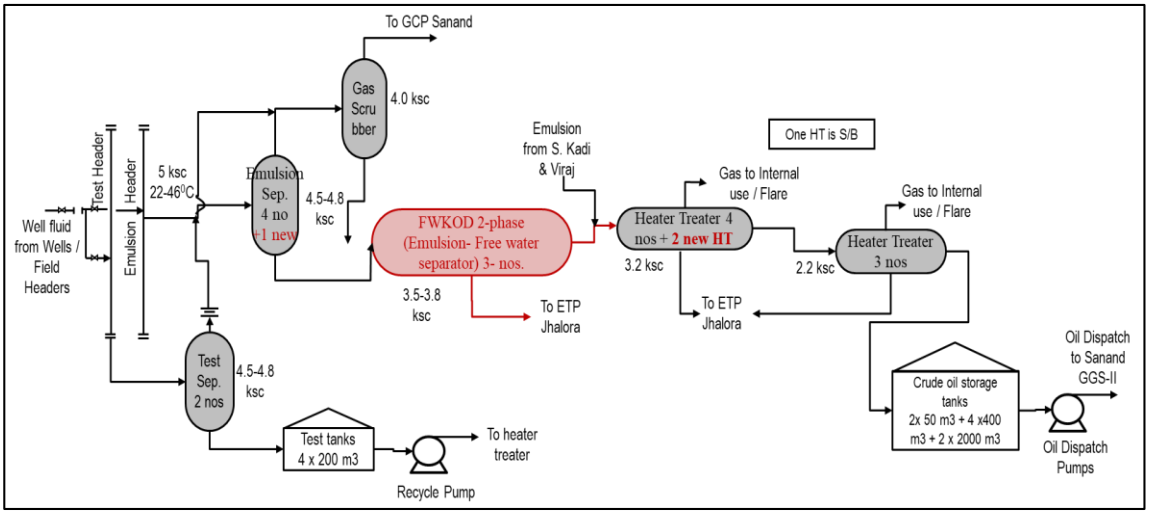

Figure 4.1: Free water separation before routing the liquid to heater treaters - by installing FWKOD downstream of existing separators

4.3.3 Scenario-3: Free water separation before routing the liquid to heater treaters - by installing FWKOD in place of existing separators

Asset intimated that after attaining 50-55 ^{0}C in primary heater treaters, total water content in emulsion oil will be around 50%. This has been considered for heat duty calculation in this scenario. The heat duty requirement along with the analysis of temperature which can be achieved with the existing heater treaters and requirement of additional heater treaters for heating upto 78 ^{0}C has been determined.

The total heat duty requirement to heat the peak liquid of Jhalora GGS-I after free water separation before routing to the heater treaters along with the emusion from South Kadi GGS and Viraj GGS will be around 12.5 MMBTU/hr. The existing heater treaters can raise the temperature of liquid up to 70 ^{0}C. However, in order to achieve heater treater outlet temperature of 78 ^{0}C, two additional heater treaters are required in the primary heater treaters.

The schematic for scenario-3, free water separation before routing the liquid to heater treaters - by installing FWKOD in place of existing separators is as shown in Figure 4.2.

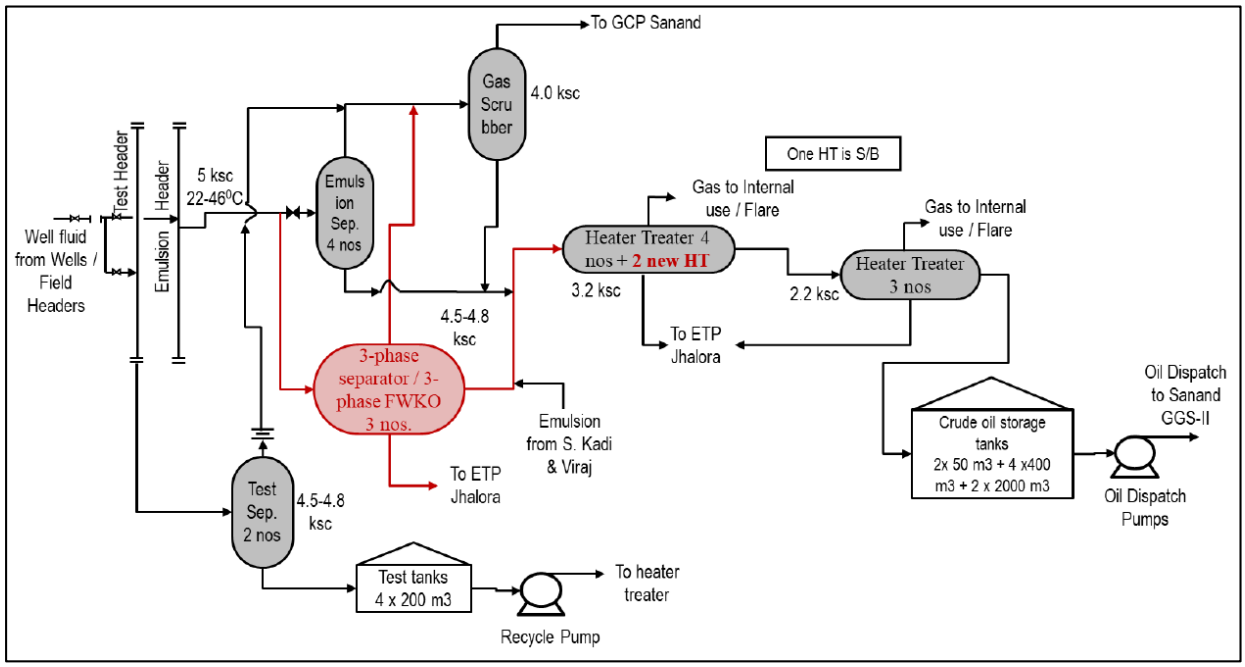

Figure 4.2: Free water separation before routing the liquid to heater treaters - by installing FWKOD in place of existing separators

4.3.4 Summary of simulation results of different scenarios

Table 4.4: Summary of Simulation Results of Different Scenarios

	Scenario	Additional Facilities required	Remarks
1	(Existing scenario) Without free water separation before routing to the heater treaters	• 1 additional group separator • 8 additional heater treaters	--
2	Free water separation before routing the liquid to heater treaters -by installing FWKOD downstream of existing separators	• 1 additional group separator • 3 additional FWKOD • 2 additional heater treaters	• Less fuel gas consumption • May arise additional pressure drop & increase of back pressure at wellhead
3	Free water separation before routing the liquid to heater treaters -by installing FWKOD in place of existing separators	• 3 additional 3-phase separator / FWKOD • 2 additional heater treaters • Existing separators to be dismantled	• Less fuel gas Consumption

Of the above-mentioned three scenarios, considering less fuel gas consumption and less pressure drop, Scenario-3 is preferred.

Further to above, 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.

4.4 Gas KOD

Table 4.5: Adequacy check of Gas KOD

Sr. No.	Facilities	Existing Dimensions	Required Dimensions	Remarks
1	Gas KOD (1 no.) Op. Pr: 4 kg/cm^2 Op. Temp: 22-46 ^{0}C	1.2 m (ID) x 4.5 m H Feed: 8” Gas: 8” Liquid: 4”	1.2 m (ID) x 2.6 m H Feed: 6” Gas: 4” Liquid: 4”	Adequate

4.5 Crude oil storage tanks

Table 4.6: Crude oil storage tanks

Sr. No.	Facilities	Existing Capacity	Required Capacity	Remarks
1	Crude oil storage tanks	5700 m^3 2 no. x 50 m^3 4 no. x 400 m^3 2 no. x 2000 m^3	3435 m^3 (266 m^3 of Jhalora+ 650 m^3 of South Kadi GGS & Viraj GGS	Adequate considering 3 days storage and 80 % filling.

4.6 Pumps

Table 4.7: Adequacy check of pumps

Sr. No.	Facilities	Existing Capacity	Required Capacity	Remarks
1	Crude oil dispatch pumps	ODP-1: 1 no. x 35 m^3/hr ODP-2: 1 no. x 45 m^3/hr ODP-4: 1 no. x 30 m^3/hr ODP-5: 1 no. x 25 m^3/hr	916 m^3/day ~39 m^3/hr (24 hr pumping)	Inadequate* considering operational issue in ODP-1 and ODP-2. Hence, considering only ODP-4,5 working, one additional 25 m^3/hr pump is required.

*Asset informed during winter season, trunk line pressure goes beyond 25 ksc at which ODP-1 and ODP-2 fail to work as pump belts start slipping.

4.7 Miscellaneous Utilities etc.

Table 4.8: 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 110 m^3/day, Oil: 15 m^3/day, Water: 95 m^3/day, Gas: 2,000 SCMD	Liquid 110 m^3/day, Oil: 15 m^3/day, Water: 95 m^3/day, Gas: 2,000 SCMD	Adequate
2	Lift gas manifold 4" header	Lift gas: 55,000 SCMD	Lift gas: 55,000 SCMD	Adequate
3	Fire water tanks Fire water pumps	1 no. x 600 m^3 (2 no. of compartment 300 m^3) 273 m^3/hr (engine driven) 295 m^3/hr (motor driven)	600 m^3 288 m^3/hr	Adequate Inadequate. Existing 273 m^3/hr engine driven pump to be replaced with 288 m^3/hr.
4	Flare system Flare stack Flare KOD Flare KOD pumps Water seal drum with Flare ignition system	64,717 SCMD (present flare stack in defunct state)	64,717 SCMD 4" x 30 m 5 m^3/hr (1+1) 1.2 m (ID) x 3.5 m (L) 0.5 m (ID)x 3.3 m (L)	Inadequate, new flare system is required.
5	Instrument air system	Presently servo system	250 m^3/hr	Required
6	Pit pump	1 no. x 10 m^3/hr (no stanby)	10 m^3/hr	One standby pump is required
7	Closed drain system	--	Closed drain system alongwith pumps	Required

4.8 Adequacy check results

Based on Table 4.2 thru Table 4.8, it is seen that the existing manifold, gas KOD, crude oil storage and test facilities are adequate; while group separators, heater treaters, oil dispatch pumping system, utilities such as flare system, oil pit pump, instrument air system and fire water pumping system are inadequate.

New facilities required to address the inadequacy as well as considering free water separation are as tabulated below in Table 4.9.

Table 4.9: Broad additional equipment list and facilities

S.N	Name	Type	Nos.	Design/Capacity	Operating Pr. (kg/cm^{2}g)	Op. Temp. (ºC)
Separators						
1	3-ph separator/FWKOD*	Horizontal 3-phase	3	3.1 m (ID) x 9.1 m (H)	5.0	25-45
2	Heater treaters	Gas fired	2	1.45 MMBTU/hr	3.2-2.2	25-80
*As per the LTOGP of the Jhalora GGS-I, peak liquid production will be around 3,617 m^3/d. Considering 10% design margin, the required liquid handling capacity of 3-phase separators will be around 4,000 m^3/d and hence, two separators of 2,000 m^3/d liquid handling capacity each will be adequate. However, Asset desires to have three separators / FWKOD of 1,500 m^3/d liquid handling capacity each, so that if one of the unit is under repair / maintenance, there will be minimum impact on production. *As API of the crude oil is 23 and inlet temperature 25-45 ^{0}C, the recommended liquid residence time is 20-30 minutes for three-phase separation. Hence, liquid residence time of 30 minutes has been considered for sizing of the vessel.						
Pumps					Suction/ Disch. Pr. (kg/cm^{2}g)	Op. Temp. (ºC)
1	Crude oil dispatch Pumps	----	1	25 m^3/hr	Atm / 25	22-80
Miscellaneous / Packaged items						
1	Instrumentation & Plant Air compressor system	Centrifugal	1+1	250 m^3/hr	----	----
2	Instrument air receiver	----	----	For a period of 45 minutes	----	----
3	Fire water pump	----	1	288 m^3/hr	----	----
4	Flare system Flare stack Flare KOD Water seal drum with Flare ignition system	----	----	4" x 30 m 1.2 m (ID) x 3.5 m (L) 0.5 m (ID)x 3.3 m (L)	----	----
5	Oil pit pump	----	1	10 m^3/hr	Atm / 5	Amb
6	Closed drain system alongwith pumps	----	1	----	----	----
Remarks: 1. Asset informed that back pressure is observed in liquid drain line of gas scrubber connected to overhead storage tanks particularly during winter season due to congealing effect and due to height of the liquid column in the tanks leading to less or no draining from the gas scrubber. Heat tracing of this line and also provision for routing to closed drain system are suggested.						

5.0 Summary

- Jhalora GGS-I of Ahmedabad Asset presently processes around 3,100 m^3/d liquid along with 90-95% water cut and 60,000 m^3/d total gas. Further 1000 m^3/d emulsion from South Kadi GGS and Viraj GGS is also fed to Heater Treaters (HTs) at GGS-1.
- Facilities comprise of group header, 4 no. of group separators, gas KOD, 8 no. of heater treaters, crude oil storage and pumping facilities, utilities such as test facilities, flare system and off-sites etc.
- Earlier, a study titled "Feasibility Study on Facility for Separation of Free Water at Jhalora GGS-1" was carried out by the IOGPT in July'22. In the said study, various scenarios have been worked out to establish number of heater treaters required considering with and without installing FWKOD.
- As per long term profile, the peak production is expected to be around 3617 m^3/day liquid, 266 m^3/d crude oil, 3356 m^3/d Water and 64,717 SCMD Gas including 55,000 SCMD lift gas. Considering the profile, Asset has requested to check the adequacy of the existing facilities at Jhalora GGS-1.
- 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 adequacy check of group separators & heater treaters are reworked out considering various scenarios in reference to the earlier study. Accordingly additional equipment required are as follows:
    - Scenario-1 (existing system), without free water separation: An additional group separator and 8 heater treaters are required.
    - Scenario-2, free water separation in FWKOD by installing upstream of HTs: an additional group separator, 3 no. of FWKODs and 2 heater treaters are required.
    - Scenario-3, free water separation by installing 3 phase separator/FWKOD in place of existing separators: 3 no. of three phase separator / FWKODs and 2 heater treaters are required.

  Considering less fuel gas consumption and less pressure drop, Scenario-3 is preferred.
- Further, the study concludes that the existing manifold, gas KOD, crude oil storage and test facilities are adequate; while oil dispatch pumping system, utilities such as flare system, oil pit pump, closed drain system, instrument air system and fire water pumping system are inadequate.
- Hence, new facilities are envisaged such as 3 no. FWKOD, 2 no. heater treaters, 1 no. oil dispatch pump, utilities such as flare system, instrument air system, 1 fire water pump and 1 oil pit pump etc.

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