तेल एवं गैस उत्पादन प्रौद्योगिकी संस्थान

Institute of Oil and Gas Production Technology

पनवेल, नवी मुंबई

Panvel, Navi Mumbai

Project Report

on

एम.बी.ए. बेसिन के अशोकनगर#1 से गैस बिक्री के लिए व्यवहार्यता अध्ययन

Viability Study for Gas Sale from Asokenagar#1, MBA Basin

मार्च - 2023

ओएनजीसी
ONGC

तेल एवं गैस उत्पादन प्रौद्योगिकी संस्थान

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कं.सं.:IO.22I.PT_MB.036S   दिनांक: 03/04/2023

विषय: एम.बी.ए. बेसिन के अशोकनगर#1 से गैस बिक्री के लिए व्यवहार्यता अध्ययन

Subject: Viability Study for Gas Sale from Asokenagar#1, MBA Basin

" एम.बी.ए. बेसिन के अशोकनगर#1 से गैस बिक्री के लिए व्यवहार्यता अध्ययन " रिपोर्ट की प्रति आपके अवलोकनार्थ संलग्न है।

Please find enclosed a copy of the report on "Viability Study for Gas Sale from Asokenagar#1, MBA Basin" for your kind perusal.

एन.बी.जोशी
N. B. Joshi
Head of Department, SF & PE

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Project No: IO.22I.PT_MB.036S
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Viability Study for Gas Sale from Asokenagar#1, MBA Basin

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Executive Summary

This pertains to the project titled "**Viability Study for Gas Sale from Asokenagar#1, MBA Basin**" taken up by IOGPT as a scheduled project under AWP 2022-23.

Asokenagar-1 (AK-1) is located in the JV Block of MBA Basin, which was awarded to ONGC-OIL consortium in NELP-VII round (PI ONGC: 75%, OIL: 25%) on 23.12.2009. AK-1 is the first ever well drilled in this block and Basin wants to explore the options to monetize gas from AK-1 well.

In the present study, four options for monetizing the gas have been explored, viz., conversion of gas into diesel by GTL (Gas-to-Liquid), conversion of gas into CNG, supply to HPCL city gas grid and supply to GAIL pipeline. Technical analysis has been carried out for all the four options, which reveals that all the options are technically feasible to monetize AK-1 well.

Ballpark economic analysis has been done for gas production of 20,000 SCMD for all the options. The study shows that converting gas into diesel using GTL technology will yield IRR of 15%. Converting the gas into CNG is economically viable option (IRR of 12%) only if the CNG is sold at a minimum rate of 11$/MMBTU. Supply to HPCL city grid line and supply to GAIL pipeline have negative IRR for 20,000 SCMD gas production. Breakeven sales gas quantities for supply to HPCL city grid line and supply to GAIL pipeline are 33,000 SCMD and 37,500 SCMD respectively to make the options economically viable.

The option of converting gas into diesel using GTL technology is found to be the most viable amongst the options considered. Details of the study have been elaborated in the report.

Rajiv-Nischal

Rajiv Nischal
GGM-HOI IOGPT

Contents

1.0 Background

Asokenagar-1 (AK-1), the discovery well of the Bengal-Purnea Block of MBA Basin is located in the JV Block WB-ONN-2005/4 of West Bengal which was awarded to ONGC-OIL consortium in NELP-VII round (PI ONGC: 75%, OIL: 25%) on 23.12.2009. AK-1 is the first ever well drilled in this block which produced commercial gas and oil. Basin is interested in exploring the options to monetize gas from AK-1 well. Accordingly the project has been taken up by IOGPT to explore the various feasible options to monetize the AK-1 well.

2.0 Scope of work

The scope of work includes:

- Literature Survey
- Vendor Interaction

3.0 Input data & Basis of study

Following data have been received from MBA Basin for the present study.

1. The envisaged gas production profiles for AK-1 well:

Year	Avg Gas rate	Anual gas	Cum Gas	Avg Water Rate
	m3/d	MMm3	MMm3	m3/d
1	20000	7.3	7.3	0.0
2	20000	7.3	14.6	0.0
3	20000	7.3	21.9	0.0
4	20000	7.3	29.2	0.2
5	20000	7.3	36.5	0.5
6	20000	7.3	43.8	0.9
7	20000	7.3	51.1	1.5
8	14000	5.1	56.3	1.4
9	13000	4.7	61.0	1.7
10	12000	4.4	65.4	2.1
11	11000	4.0	69.4	2.8
12	10000	3.7	73.1	5.2

Figure 3.1: Envisaged gas production profile

2. Gas composition of AK1 well:

Component	Mole%
C_1	88.42
C_2	6.93
C_3	2.13
i-C_4	0.64
n-C_4	0.52
i-C_5	0.28
n-C_5	0.17
N_2	0.83
CO_2	0.1
Sp Gr.	0.63997
Density, gm/cc	0.7
NCV, kcal/m^3	9088
Mol Wt.	18.5

Figure 3.2: Gas composition of AK-1 well

3. Presently there is no processing facility available at well site of well AK-1.
4. A QPS (Quick Production Setup) was conceptualized by IOGPT in March, 2019. References has been taken in the present study from the same.
5. References have also been taken from the earlier study conducted by IOGPT, titled as, "Viability analysis of CNG & GTL Technologies for NELP Block VN-ONN-2009/3"
6. In the present study, 4 options have been explored to monetize the AK-1 well:
    - **Gas to liquid conversion**
    - **CNG based solution**
    - **Supply to HPCL city gas grid**
    - **Supply to GAIL pipeline**

4.0 Gas to Liquid Conversion (GTL):

Gas to liquids (GTL) is a chemical process to convert natural gas or other gaseous hydrocarbons into longer-chain hydrocarbons such as gasoline or diesel fuel. The future for the technology lies mainly with natural gas - in particular, low-cost remote natural gas or gas associated with oil production that is now flared.

4.1 GTL Process Overview:

GTL process occurs in two distinct stages; i.e., production of synthesis gas (Syngas) in the reformer followed by generation of liquid products in the reactor via Fischer-Tropsch (F-T) reaction. In the first stage, generation of Syngas such as hydrogen and carbon monoxide occurs, whereas in second stage, liquid product such as synthetic crude or diesel or wax etc. can be made from Syngas depending upon the type of catalyst used.

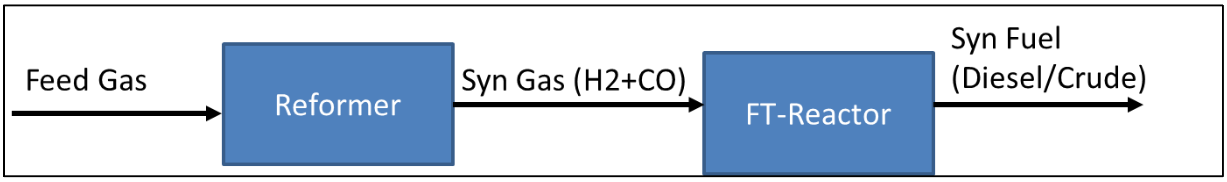

Figure 4.2: GTL Process Overview

The reformer is a fired reactor with a mechanical design intended to maximize heat recovery into the process gas, fuel and combustion air. The H_2:CO ratio of the Syngas produced by the reformer is generally lies between 1.8 and 2.1. A fraction of the hydrogen is used as fuel for reformer firing.

The main reaction involved in the reformer are:

Stage-I: Syngas Production Reaction

$$CH_4 + H_2O = CO + 3H_2$$

$$CH_4 + CO_2 = 2CO + 2H_2$$

$$CO + H_2O = CO_2 + H_2$$

In the Fischer-Tropsch reactors, hot Syngas is sent downward through tubes generally filled with cobalt-based catalyst. There is a single product stream leaving the bottom of the FT reactor containing three phases viz., Tail Gas (vapor), Fischer Tropsch Syncrude/diesel (liquid) and Fischer Tropsch Reaction Water (liquid). The product stream is sent into a KOD (internal part of the unit) for 3-phase separation. After separation, the Tail Gas is recycled and sent to the reformer unit. The end product which is Syncrude or diesel can be utilized for commercial or internal purpose, whereas the water produced is almost pure and can be used for gardening purpose.

Stage-II: Fischer Tropsch Reaction (F-T) reaction

$$(2n + 1)H_2 + nCO = CnH_{2n+2} + nH_2O \text{ ….. Paraffins}$$

$$(2n)H_2 + nCO = CnH_{2}n + nH_2O \text{ ..... Olefins}$$

$$CO + H_2O = CO2 + H_2 \text{ ..... Water gas shift reaction}$$

4.2 GTL Plant Worldwide

The gas to liquid (GTL) process was developed in the early 1900's and has met many global successes with facilities having been constructed in various countries such as Malaysia, South Africa, Qatar, USA, Israel, UK etc. A broad list of GTL plants world-wide along with installed capacity is shown in Table 4.1.

Table 4.1: GTL Plant location worldwide

Operator, Location	Capacity
PetroSA, Mosselbay, SA	Gas: 6.3 MMSCMD; 22,500 bpd
Shell, Bintulu, Malaysia	Gas: 3 MMSCMD; Prod: 12,000 bpd
Sasol's Oryx, Qatar	Gas: 7 MMSCMD; 34,000 bpd
Shell's Pearl GTL, Qatar	Gas: 28 MMSCMD; 140,000 bpd
Escravos GTL, Nigeria	Gas: 7 MMSCMD; 34,000 bpd
Diesel-GreyRock, USA	Gas: 0.6 MMSCMD; 2,000 bpd
Diesel-GreyRock,Toledo, Ohio	Gas: 8500 SCMD; 30 bpd
GTL-M/S VELOCYS, USA	Gas: 1700 SCMD; 6 bpd
GTL-CALVERT ENERGY, USA	Gas: 5700 SCMD; 25 bpd
GTL-CALVERT ENERGY, USA	Gas: 1,40,000SCMD; 500 BPD, CHEVRON, Israel & USA

Nearly 20 GTL technology suppliers including the above-mentioned vendors were contacted through mail & company websites with request to provide availability of technology suitable for gas quantity of 20,000 SCMD. However, only M/s Calvert Energy, USA responded and shared technical details and budgetary deatils. Study was carried out based on the inputs provided by M/s Calvert Energy.

4.3 New Development in Gas to Liquid (GTL) Technology.

The gas to liquid (GTL) process works based on Fischer-Tropsch (FT) reaction and is a century old process. The main issue of GTL plant for not being widely adopted in India is high capital expenditure and large foot print area. GTL processes mainly consists of Reformer and FT reactor. Recently, with research & development, GTL process CAPEX, OPEX & foot print area have come down significantly with Plasma Arc reformer instead of conventional Steam Reformer.

- **Conventional v/s Plasma reformer**

In **conventional reformer**, there is a steam methane reformer (SMR), wherein natural gas feedstock and steam at 20 atm and 500°C (with an exit temperature of approximately 800°C) pass over a nickel catalyst contained in tubes within a firebox. The heat of reaction is supplied by burning some of the feedstock. In the process, Syngas is generated using steam & catalyst. The reformer is operated at high temperature (~800 deg C) and high pressure (~20 barg). The generated Syngas is cooled and sent to FT reactor, wherein it is converted into liquid hydrocarbon. For steam generation in the process, external steam generation unit is required, which is quite bulky and cost intensive with respect to both CAPEX and OPEX.

A new low temperature **plasma reformer** has been developed for the production of Syngas from natural gas whereby electricity provides the reaction energy for the endothermic process. Low temperature plasma reforming, which is non-equilibrium thermodynamic, can produce low temperature plasma by dielectric barrier discharge (DBD), gliding arc discharge, microwave discharge, RF discharge, etc. It forms active free radicals, atoms and electrons with excited state rapidly through dissociation, electron collision, electron excitation and energy relaxation leading to the acceleration of chemical reaction. Taking DBD plasma reforming as an example, it changes low-temperature reforming reaction path and decreases reaction activation energy through applying voltage to both ends of CH_4 until current breakdown to induce electron avalanche. When cooperated with catalyst to accelerate and orient reaction, low temperature plasma reforming also has high conversion and recovery rate (ref: IPTC-21365-MS).

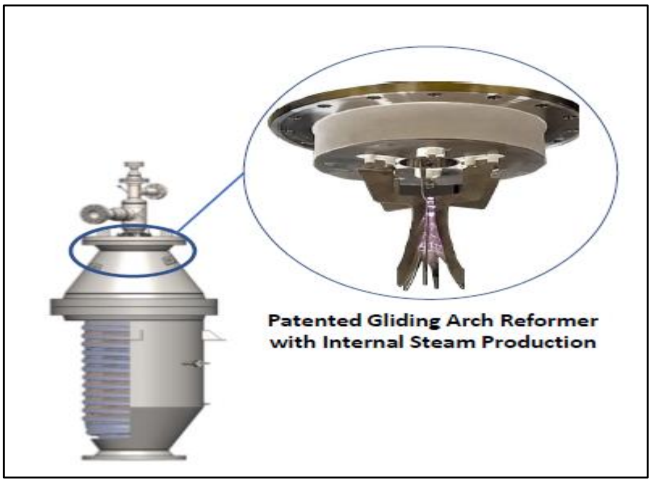

Figure 4.2: Plasma Reformer

Plasma Reformer (Figure 4.2) generates Syngas without use of any external steam. Water generated in downstream FT reactor is utilized for Syngas generation and hence no external steam generation unit is required.

Difference between conventional and plasma reformer is shown in Table 4.2 (prepared based on vendor inputs).

Table 4.2: Comparison between Conventional and Plasma Reformers	
Steam methane reformer (SMR)	**Plasma Reformer**
SMR requires 20 times more power than Plasma Reformer	1 MMSCFD reformer consumes less than 4 kW
Requires solid catalyst and many rotating equipment for its operation	Non-Catalytic Process - Gliding Plasma is the catalyst
8 times larger foot-print	Smaller foot print
Uses 15% to 18% of the feed gas to produce Syngas (means around 15-18% feed gas is burned in the reformer to raise the reformer to ~800 deg C)	Uses less than 8% of the feed to produce Syngas
Feed gas requires pre-treatment and separation	Requires no pre-treatment or separation
OPEX: High	OPEX is 60% lesser than other reformers.
CAPEX: High	CAPEX up to 50% less

- **Conventional reactor and Calvert FT reactor**

Interaction with the technology supplier M/s Calvert Energy revealed the following claims with respect to FT reactor as shown in Table 4.3.

Table 4.3: Comparison between Conventional reactor and Calvert FT reactor	
Traditional FT reactor	**Calvert FT reactor**
1” or 2” reactor tubes; Poor catalytic to liquids yield	4” reactor tube that translates in much higher quantity of Syngas to liquids yield (+15%)
Taller reactor, prone to weld fatigue	Aluminum reactor tub extrusion which helps to control the reactor temperature
Large footprint	Small footprint

4.4 Advantages of GTL:

- It can be used for stranded gas or in FGRU
- Direct conversion of syn-crude or syn-diesel can be achieved
- Syn-diesel has no sulphur and hence, market value is higher than regular diesel
- It can handle H_2S up to 100 ppm, CO_2 up to 30% without pretreatment
- Small foot print
- No waste generation; only byproduct is water which can be used for agricultural purpose
- Automated; only one operator is required
- Modular, scalable and mobile

4.5 Details of GTL plant

Based on the details received from the vendor M/s Calvert Energy, USA; a schematic of process applicable for the present case has been developed. Further, equipment list, ball-park economic analysis etc. have been carried out as described in the following sections.

4.5.1 Broad Process Flow Diagram and Stream Summary

Natural gas from the well shall be taken into an existing knockout drum (KOD) to drain out the liquid, if any. Gas coming out of KOD is routed to Modular GTL package, which generally consists of reformer and F-T reactor. Depending on type of the catalyst used, high-end product can be obtained, which could be Syncrude or diesel. Along with high-end product, water will also be produced, which can be utilized for gardening/agricultural purpose.

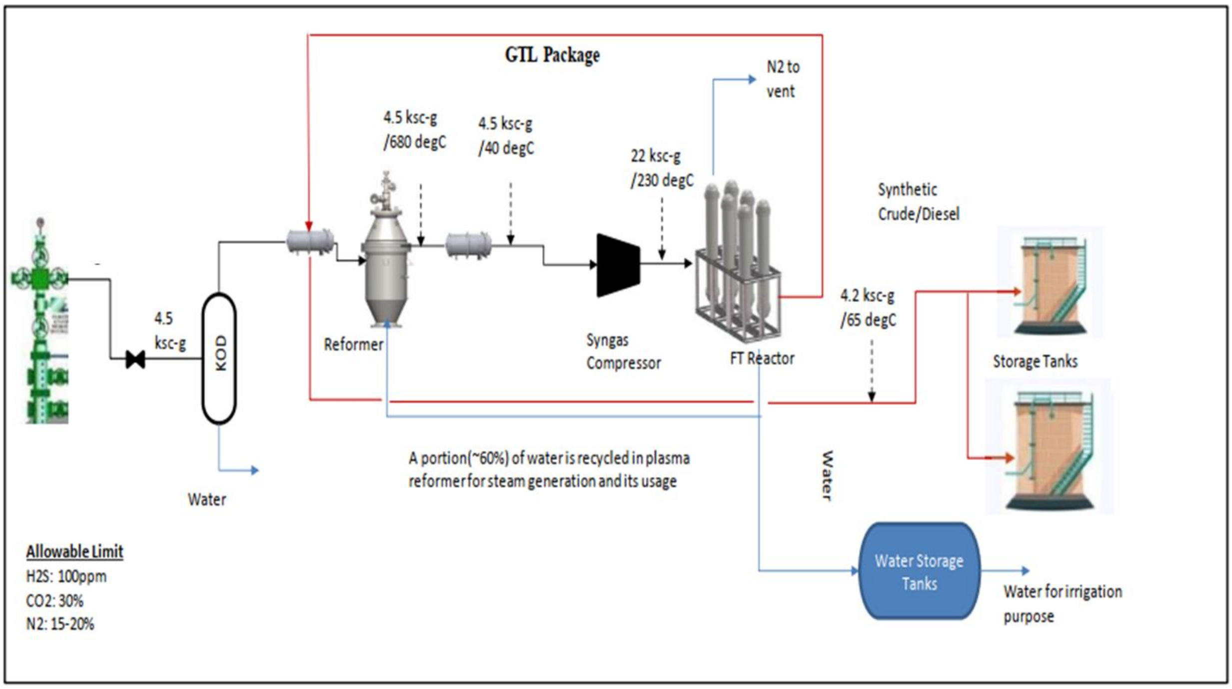

Figure 4.3: Broad schematic overview of GTL Process

For 60,000 SCMD natural gas, approximately 190 bbl/d diesel or around 214 bbl/d synthetic crude can be generated.

4.5.2 Major Equipment

List of major equipment and other details such as pressure, temperature and other parameters for the present case are shown in Table 4.4.

Table 4.4: Major Equipment required and other parameters		
Gas Quantity, SCMD		20,000
Final Product	Diesel Production, bbl/d	71.5
Water generation and storage, bbl/d		20
Minimum Inlet Pressure Requirement, barg		4.1
Product Temperature, deg C		60
Turndown, %		33
Power Requirement		0.5 MW
Diesel Storage Tanks		2 x 25 m^3
Water Storage Tanks		20 m^3

4.5.3 Foot Print Area-GTL

Considering GTL plant, storage tanks, tanker loading bay, pumps etc., foot-print area for 20,000 SCMD plant works out to be around ~8 Acre. As per discussion and email received from the vendor, flare system is not required. However, requirement of flare system should be reviewed during risk analysis.

4.6 Ball Park Economic Analysis:

For feasibility analysis, ball park economic analysis has been carried out. The details of the analysis are summarised below.

4.6.1 Basis of Economic Analysis-GTL

Basis of ball-park economic analysis:

- Gas quantity:
  As per long term production profile shown in Table 4.5.

Table 4.5: Envisaged gas production profiles for AK1 well

Year	Gas Rate	Annual Gas
	m3/d	MMm3
1	20000	7.3
2	20000	7.3
3	20000	7.3
4	20000	7.3
5	20000	7.3
6	20000	7.3
7	20000	7.3
8	14000	5.1
9	13000	4.7

10	12000	4.4
11	11000	4.0
12	10000	3.7

- Diesel Price
    - For Sales: Rs 62/litre (Ref: Hazira RTP)
    - For Internal Consumption: Rs 90/litre
- Crude Selling Price: 75 USD/bbl
- Conversion Rate: 1 USD=INR 80
- Costing includes cost of surface facilities such as GTL unit, storage tanks, DG set etc.
- OPEX includes catalyst cost, repair and maintenance cost, manpower cost etc.
- Corporate Tax: 25% (Ref: ONGC circular No. DLH/PAS/New-Tax-Rate/Nov-21, dated 18 Nov 2021).
- Royalty: 10% on total gas production
- Average calorific Value of Gas: 9000 kcal/m3
- GST: 18%
- Port Handling Charges: 1%, Ocean Freight:6%
- Insurance: 2%, Edu Cess:3%, Contingency: 10%
- GST on Hiring of GTL: 18%

Well drilling cost, pipeline cost, tanker transportation cost etc. are not considered in costing.

4.6.2 Ball Park Economic Analysis

Ball park economic analysis has been carried out for diesel and crude production for various cases for maximum revenue generation.

Based on long term production profile & onetime equipment purchase:

- Case-1: One time purchase of one GTL unit, based on given gas production profile and internal utilization of diesel generated

  This case is based on long term gas production profile and considering purchase of one GTL unit, having a capacity of 28,000 SCMD and generating around 100 bbl of diesel for 28,000 SCMD gas. The generated diesel will be utilized for internal purpose. The price of diesel in this case has been considered as 90 INR/litre.
- Case-2: One time purchase of one GTL unit, based on given gas production profile and sale of diesel generated to OMC

This case is based on long term gas production profile and considering purchase of one GTL unit, having a capacity of 28,000 SCMD and generating around 100 bbl of diesel for 28,000 SCMD gas. The generated diesel will be sold to oil marketing company. The price of diesel in this case has been taken as 62 INR/litre as Refinery Transfer Price (RTP) of Hazira plant of ONGC.

Ball park cost analysis summary of Case-1 & Case-2 is shown in Table 4.6.

Table 4.6: Ball Park Economic Analysis for Case-1 & Case-2				
Basis		1 unit of 28,000 SCMD capacity		
		Case-1	Case-2	Unit
Diesel Production per day		71.5	71.5	BBL/d
CAPEX (only GTL)	GTL	72	72	INR, crore
OPEX/annum		11.5	11.5	INR, crore
Sales Revenue, without taxes		389.1	266.9	INR, crore
Payback		4.2	-	years
IRR		15.5	3	%
*Considering 9₹/kwh electricity cost (Rate to be confirmed for WB electricity board)				

Based on given long term production and Hiring of GTL units:

As per communication, technology provider has also agreed for providing GTL units on hiring basis. Accordingly economic analysis has been worked out for the production profiles considered above and discussed in the following sections.

- Case-3: Hiring of one GTL unit, given gas production profile and internal utilization of diesel generated

  In this case the given long term gas production has been considered for hiring of GTL unit, having unit capacity of 28,000 SCMD generating around 100 bbl of diesel per unit for 28,000 SCMD gas. Hiring of cost of GTL is considered as OPEX. The generated diesel will be utilized for internal purpose. The price of diesel in this case has been considered as 90 INR/litre.
- Case-4: Hiring of GTL unit, given gas production profile and sale of diesel generated to OMC

  In this case the given long term gas production has been considered for hiring of GTL unit, having unit capacity of 28,000 SCMD generating around 100 bbl of diesel per unit for 28,000 SCMD gas. Hiring of cost of GTL is considered as OPEX. The generated diesel will be sold to oil marketing company (OMCs). The price of diesel has been taken as 62 INR/litre as Refinery Transfer Price (RTP) of Hazira plant of ONGC.

Ball park cost analysis summary of Case-3 & Case-4 is shown in Table 4.7.

Table 4.7: Ball Park Economic Analysis for Case-3 & Case-4				
Capacity of 1 unit	28,000 SMD			Unit
Basis	Case-3		Case-4	
Number of GTL units	1		1	
Diesel Production per day	71.5		71.5	BBL
OPEX per Annum	GTL-Hiring Cost	22.78	22.78	INR, crore
	Electricity (0.47 MW)	3.7	3.7	INR, crore
	Miscellaneous	1.5	1.5	INR, crore
Total OPEX/annum	28		28	INR, crore
NPV	0.42		-10	INR, crore
IRR	7.6		Negative	%
*Considering 9₹/kwh electricity cost (Rate to be confirmed for WB electricity board)				

From Table 4.6 and Table 4.7, it is evident that for the given profile, GTL is a viable option with one time purchase and generated diesel to be used for internal utilization, i.e., Case-1. Ballpark economic analysis suggests that other cases are unviable.

4.6.3 Quality of Diesel Produced: Quality of diesel produced is shown in Annexure-II. A comparative analysis between BS-VI standards and parameters of diesel produced from GTL is shown in Table 4.8.

Table 4.8: Comparison between parameters of BS-VI diesel and GTL diesel		
Parameters	BS-VI standard	Diesel from GTL
	IS 1460 : 2017(BS-VI)	EN 15940
Cetane Number	51 (min)	70 (min)
Density @15°C, kg/m3	810-845	765-800
Kinematic Viscosity, cst	2.0-4.5	2.0-4.5
Flash point, °C	35 (min-Abel method)	55 (min)
95% Vol recovered at Temp, °C	360	360
Lubricity @ 60°C,microns	460	460
Total Sulfur, mg/kg	10	5
Ash content % by mass	0.01	0.01
Water Content, mg/kg	200	200
Oxidation Stability, g/m^3	25 (max) 20 (min)	25 (max) 20 (min)
Fame Content, %v/v	7	7

Above table reveals that quality of diesel produced from GTL is almost comparable with BS-VI standards.

5.0 Exploring the Possibility of Compressed Natural Gas (CNG):

CNG is produced by compressing natural gas to less than 1% of its volume at standard atmospheric pressure. To provide adequate driving range, CNG is stored on-board a vehicle in a compressed gaseous state at a pressure of up to 250 barg. A schematic of CNG process is shown in Figure 5.1.

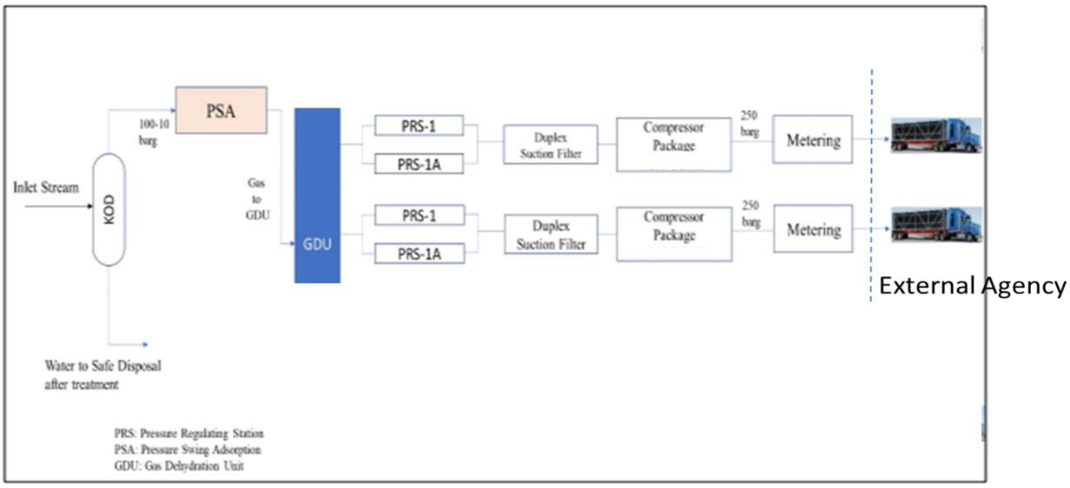

Figure 5.1: Schematic diagram of CNG Plant

5.1 Basis of study for CNG

- Gas Composition: Given in Figure 3.2
- Given Pressure: In absence of long term pressure profile, the study has been carried out assuming that pressure will deplete up to 10 Ksc-g in future.
- Automotive CNG delivery pressure: 250 barg, which is generally adhered to in the industry.
- Gas is to be delivered at battery limit of the CNG plant, transportation of gas from boundary of CNG plant to consumer is not included in the economic analysis.
- Required Specs for CNG: Automotive CNG specifications as per IS-15958 is shown in Table 5.1.

<table>
<tr><th colspan="3">Table 5.1: Automotive specification as per IS-15958</th></tr>
<tr><td>Component</td><td colspan="2">Mole fraction</td></tr>
<tr><td>C1</td><td>90</td><td>Min</td></tr>
<tr><td>C2</td><td>6</td><td>Max</td></tr>
<tr><td>C3</td><td rowspan="5">3</td><td rowspan="5">Max</td></tr>
<tr><td>iC4</td></tr>
<tr><td>nC4</td></tr>
<tr><td>iC5</td></tr>
<tr><td>nC5</td></tr>
<tr><td>C6+</td><td>0.5</td><td>Max</td></tr>
<tr><td>CO2</td><td>3.5</td><td>Max</td></tr>
</table>

N2		
Water	5	mg/litre
He		
H2	0.1	Max

5.2 Comparative study with required and given gas composition:

A comparative analysis between the specifications of the required and the available gas composition is shown in Table 5.2.

Table 5.2: Automotive Specification Vs Available Gas Composition

Automotive specification as per IS-15958			Available Gas Composition of #AK-1
Component	Mole %		Mole %
C1	90	Min	88.42
C2	6	Max	6.93
C3	3	Max	1.61
iC4			
nC4			
iC5			
nC5			
C6+	0.5	Max	0
CO2	3.5	Max	0.93
N2			
Water	5	mg/litre	-
He	-	-	-
H2	0.1	Max	-

From above table, it is evident that in order to meet automotive CNG IS-15958 specification, the C_1 concentration needs to be increased and C_2 component is to be reduced from the given feed gas. In view of these, pressure swing adsorption (PSA) system shall be required to meet the automotive specification as per IS-15958.

5.3 Comparative study with the required and the given gas composition

Inlet gas stream pressure is kept as 45 kg/cm^{2}g, however designing of the system is done in the range of 45-10 kg/cm^{2}g so that if the pressure falls in future, the system shall be able to work up to 10 kg/cm^{2}g. Enrichment of CH_4 can be done in PSA. The C_1 enriched gas received from the PSA process will be taken to a molecular sieve based GDU system to remove the moisture to around 5.0 ppm by volume to meet the automotive standard. After dehydration, gas will be routed to pressure regulating station and then to gas engine driven compressor. The gas will be compressed to around 250 kg/cm^{2}g. After compression, gas will be filled in a CNG Cascade truck.

- Mobilization of gas through cascade truck: Transportation of gas through containers is a general approach for transportation of gas and it is a very reliable mode of receiving gas, where gas connectivity thorough pipeline is not available. Generally two types of cascade containers are used, viz., normal cascade and jumbo cascade. In general, normal cascade has a capacity to store around 700 m3 gas and jumbo cascade has a capacity to store around 4000 m3 gas. Jumbo cascade is shown in Figure 5.2 and Figure 5.3 below.

Figure 5.2: Jumbo cascade

Figure 5.3: Jumbo cascade

5.4 Approximate Plot Area for CNG station

- Approximate plot area works out to be around 20 Acre.

5.5 Ball Park Economic Analysis-CNG

Ball-park economic analysis has been carried out for the given long term production profile. It is assumed that gas is to be delivered at battery limit of the CNG plant. The economic analysis does not include transportation of gas from boundary of CNG plant to consumer.

- Gas quantity: Refer figure 3.1
- Conversion Rate: 1 USD=INR 80
- Costing includes cost of surface facilities such as CNG unit, GDU, PSA, Flare System, Fire water system, KOD etc.
- OPEX includes manpower cost & gas consumption in compressor etc.
- Corporate Tax: 25% (Ref: ONGC circular No. DLH/PAS/New-Tax-Rate/Nov-21, dated 18 Nov 2021)

- Royalty: 10% on total gas production
- Calorific Value of Gas: 8300 kcal/m3
- GST: 18%
- VAT: 14%
- Land Cost: 1.0 Lakh Rs per acre per year
- Escalation of land cost: 20% after every 3 years
- Excise Duty: 14%
- Insurance: 2%, Edu. Cess: 3%, Contingency: 10%

Well drilling cost, pipeline cost etc. are not considered in costing.

Details of the ball park economic analysis study are given in Table-5.3.

Table-5.3: Ball Park Economic Analysis for CNG

CNG Production		As per production profile	SCMD
CAPEX	Project Cost	37.4	INR, crore
Total OPEX / Annum (including manpower cost)		3.8	INR, crore
Sales Price, $/MMBTU		11	$/MMBTU
Payback, Years		4.8	years
IRR, %		12	%

Ball park economic analysis indicates that, for the given production profile, the project will be viable, when CNG is sold at a minimum price of 11 $/MMBTU.

6.0 Supply to HPCL City Gas Grid

Basis:

- Distance of HPCL connection from proposed QPS (Quick Production Set-up) is 3 km
- Pressure required at HPCL end 30-35 ksc
- Quantity of sales gas considered in the study: 20,000 SCMD
- Sales gas specification required are as per PNGRB guidelines

For supplying the gas to HPCL city gas grid, a 4" pipeline of 3 km is required along with a QPS (Quick Production Set-up). For details of QPS, refer to the IOGPT report, titled as, "Scheme conceptualization of Quick Production Set-up (QPS) for early monetization of hydrocarbon at Ashoknagar, Kolkata". In the ball park economic analysis, a GDU cost is also considered in the QPS costing. Table 6.1 shows the ball park economic analysis for HPCL city gas grid option.

Table 6.1: Ball Park Economic Analysis for HPCL City Gas Grid Option

CNG Production		As per production profile	SCMD
CAPEX	Project Cost	46.85	INR, crore
Total OPEX/annum including Manpower cost		7.19	INR, crore
Sales Price, $/MMBTU		8.5	$/MMBTU
Payback, Years		-	years
IRR, %		Negative	%

The preliminary economic analysis indicates that supplying 20,000 SCMD gas is not a viable option. However, if the supplied gas is more than 33,000 SCMD then this option become viable (IRR>12%) considering the gas sales price as 8.5 $/MMBTU.

7.0 Supply to GAIL Pipeline

Basis:

- Distance of GAIL connection from proposed QPS (Quick Production Set-up) is 33 km
- Pressure required at GAIL end 49 ksc
- Quantity of sales gas considered in the study: 20,000 SCMD
- Sales gas specification required are as per PNGRB guideline.

For supplying the gas to GAIL pipeline, a 4" pipeline of 33 km is required along with a QPS (Quick Production Set-up). For details of QPS, refer to the IOGPT report, titled as, "Scheme conceptualization of Quick Production Set-up (QPS) for early monetization of hydrocarbon at Ashoknagar, Kolkata". In the ball park economic analysis, a GDU cost is also considered along in the QPS costing. Table 7.1 shows the ball park economic analysis for GAIL pipeline option.

Table-7.1: Ball Park Economic Analysis for GAIL Pipeline Option

CNG Production		As per production profile	SCMD
CAPEX	Project Cost	61.1	INR, crore
Total OPEX/annum including Manpower cost		7.19	INR, crore
Sales Price, $/MMBTU		8.5	$/MMBTU
Payback, Years		-	years
IRR, %		Negative	%

The preliminary economic analysis indicates that supplying 20,000 SCMD gas is not a viable option. However, if the supplied gas is more than 37,500 SCMD then this option become viable (IRR>12%) considering the gas sales price as 8.5 $/MMBTU.

8.0 Economical comparison amongst all options

Based on the techno-economics, a comparative study has been done between all 4 options, which is shown in Table 8.1.

Table 8.1 Ballpark Economic Comparison

Options	CAPEX (cr.)	OPEX (cr. / year)	IRR (%)	Remark
GTL	72	11.5	15.5	Unit purchase + Diesel used for internal use
CNG	37.4	3.8	12	CNG rate: 11 $/ MMBTU
HPCL City Gas Grid	46.8	7.2	Negative	Gas price: 8.5 $/MMBTU
GAIL Pipeline	61.1	7.2	Negative	Gas price: 8.5 $/MMBTU

From the above table, it is indicative that for the given production profile, GTL is the most suitable option with one time unit purchase and use of produced diesel for internal consumption.

NOTE: Costing done in the study are just ballpark estimates. These cost need to be updated by Basin based on the real time cost data base of Engineering Services before taking approval for field implementation.

9.0 Summary and Conclusion

- Four options for monetizing the gas have been explored, viz., conversion of gas into diesel by GTL, gas into CNG, supply of gas to HPCL city gas grid and supply of gas to GAIL pipeline.
- Technical and economic analysis have been carried out considering one time purchase of GTL modules as well as in hiring.
- Comparison of the four options indicates that for the given production profile of #AK-1 well, GTL is the most suitable option with one time unit purchase and use of produced diesel for internal consumption.
- Breakeven quantities for gas sales to HPCL city gas grid and GAIL pipeline have also been calculated to make the project viable (IRR>12%).
- This report has been made with inputs from vendors & guidelines for taxation / prices from ONGC internal sources for arriving at ballpark financial analysis. Basin may peruse report at their end.

Annexures

Annexure-I: Costing of GTL for another gas profile

Input data & Basis of study

Following data have been received from MBA Basin for the costing calculations for another gas profile.

1. The envisaged gas production profile for AK-1 well:

Year	Avg Gas rate m3/d	Gas rate, MMm3 Per Annum	Cum Gas MMm3	Avg Water Rate m3/d
1	60000	21.9	21.9	0.1
2	52000	19.0	40.9	2.1
3	42000	15.3	56.2	6.2
4	29655	10.9	67.1	20.5
5	16534	6.0	73.1	30.0

Figure A.3: Envisaged gas production profile#2

For profile no. 2, a constant profile of 28,000 SCMD for 5 years has been considered in consultation with Basin.

2. For profile no. 2, a constant profile of 28,000 SCMD for 5 years has been considered in consultation with Basin.
3. Gas composition of AK1 well: Refer figure 3.2

Ballpark economic analysis

Similar to Profile-1 (figure 3.1), 4 cases have been considered while doing the economic analysis of GTL option for the given profile (Figure A.1).

Table A.1 Ballpark economic analysis for GTL option for profile#2

Case No.	Description	Payback Period (Yr.)	IRR (%)	NPV (Cr. INR)
1	One time purchase + internal utilization of diesel	3.6	17.3	16.7
2	One time purchase + sale of diesel	4.9	0.4	-30
3	Hiring + internal utilization of diesel	NA	NA	40.7
4	Hiring + sale of diesel	NA	NA	6.8

From the above table it is evident that Case-3, i.e., hiring of GTL unit and using the produced diesel for internal consumption is the most viable option for this profile.

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