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EVALUATION OF PERFORMANCE OPTIMIZATION OF MODULAR GAS TECHNOLOGY (MGT) SYSTEM FOR MONETISATION OF ASSOCIATED STRANDED GAS IN THE NIGER DELTA

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ABSTRACT

Nigeria with its vast natural gas reserve has only reached a peak power generation of 5074MW for over 190Million heads of population, making it 26.7MW only per million heads of population. A key way to solve this problem is efficient utilization of her associated gas. Much of this resource is flared either because it is not in volumes suitable to justify pipeline construction or its location makes it far from market and very costly to get to use destinations. Electricity is mostly generated through turbine systems being supplied gas by large pipeline networks. The new technology called Gas-to-Wire is the onsite generation of power using mini plants that are modular and scalable. This technology holds great potential for the vast stranded gases in the Niger Delta, and with it, such gases are harnessed onsite for power generation. It obviates the capital intensive project of constructing pipelines for gas transportation to central location. This paper describes the use of associated stranded gas processed using MGT for power generation and optimization of methane recovery in the MGT unit for more power production. The results show that methane optimization yields higher units of electricity for the investor at the expense of the NGL.

KEYWORDS: Stranded, Optimization, Power, Modular, Technology.

1. INTRODUCTION

In the recent transition in energy usage to a cleaner energy mix and low carbon future, natural gas is seen as the energy source with the potentials to play the role of a ‘bridge’ fuel from the fossil fuels towards an alternative energy source. This potential is due to its better environmental credentials (lower emissions of CO_2, sulphur and other pollutants) when burnt and its higher efficiency in power generation when compared with oil or coal.

Nigeria has abundant natural gas reserves. The proven gas reserves is more than 190tcf of gas. A good proportion of this gas comes as associated gas during oil production. Unfortunately, due to a lot of factors, this gas cannot find its way to the market, hence they are considered stranded. The chief reason why Nigeria gas is not utilised or harness is because they are considered as stranded. The principal reasons why gases are considered stranded are;

1. The field is remote
2. The field is located in deepwater
3. The field is marginal that is to say the field is too small to justify a gas pipeline for long term production (Onwukwe and Duru, 2015)

Other reasons may include

i. Inadequate pressure to transmit associated gas at surface facility thereby requiring booster stations
ii. Lack of application of adequate technology
iii. Weak legislation by the government to stop gas flaring.

Owing to the above reasons, much of the associated gas was flared. The country loses an estimated annual revenue of $2.5billion to gas flaring with an estimate of about 850bcf of natural gas being flared annually (Lean, 2008). The recognition of this economic loss has instigated the government into setting strategies of exploiting the abundant natural gas resources to enhance economic development. First the government promulgated the associated gas re-injection act and the associated gas re-injection (amendment) in 2004. This mandated the oil producing companies to produce detail account of the use of their associated gas utilization strategy. This was with the vision of eradicating gas flaring and encouraging gas re-injection in the fields. Unfortunately the target

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was never achieved as the operating companies preferred to pay the penalty and continue in flaring gas than developing gas utilization projects for the associated gas. Thus the vision of eradication of gas flaring was not achieve by 2008.

Several means to convert the stranded gas to useful means exist. Aside the transportation of the gas to the market via pipelines other mans to harness the associated gases are, the liquefaction of the gas to liquefied natural gas (LNG), the chemical conversion of the gas to liquid fuels by gas to liquid technology (GTL), the conversion of the gas to petrochemicals, the conversion of the gas to hydrate to enable easy transportation via gas to hydrates technologies (GTH), and the production of compressed natural gas by compressing the gas at high pressures and putting them in pressure tight container as CNG. Another form is to convert the gas to electrical power by use of gas turbines. This means holds great potentials for a country like Nigeria that is grappling with power supply. The electricity can be generated at the field, close to the field or the gas can be channeled to huge turbine plants for mega electricity generation. The generation of power from electricity at or near the field is termed gas to wire. It is a special case of gas to power that encourages stranded gas utilization and flare gas reduction. The power can be used in power onsite equipment, some of it sent to nearby host communities and depending on the quantity of production others sent to the national grid system.

2. LITERATURE REVIEW

(i) Gas-to-Wire

Presently, much of natural gas transported is used for electricity generation at the final destination. Through gas-to-wire, GtW, generation of electricity can be done anywhere, particularly at or near the reservoir source and transported by cable to the required destination(s). For instance, offshore or isolated gas could be used to fuel and offshore power plant which would generate electricity for sale onshore or to other offshore customers. The challenges of GtW includes the high cost of installing power lines, significant energy losses from cables along the distance transmission lines and large volume of gas needed for power generation (Kanshio and Agogo, 2017).

This means holds great potentials for a country like Nigeria that is grappling with power supply. The electricity can be generated at the field, close to the field or the gas can be channeled to huge turbine plants for mega electricity generation. The generation of power form electricity at or near the field is termed gas to wire. It is a special case of gas to power that encourages stranded gas utilization and flare gas reduction. The power can be used in power onsite equipment, some of it sent to nearby host communities and depending on the quantity of production others sent to the national grid system.

The hitherto flared gas is being channeled into gas powered projects for rapid utilization and monetization with a view to maximizing value addition to the nation's natural gas resource. The gas to power project has been promoted by many private and government support ventures and initiatives in the country. One of such example is the Sustainable Utilization of Nigeria’s Gas and Renewable Energy Resources (SUNGAS) project which aims to encourage the sustainable use of Nigeria’s energy resources (LFF, 2011). This is achieved through harnessing gas from flares to meet local energy needs in the Niger Delta which is critical to local development in the region. The gas to power demonstration project was a product of partnership between the private sector and the federal government. The projects utilizes associated natural gas from either a flow station or oil well which is fed into a micro turbine which generates electricity for domestic and small business consumption within the local region.

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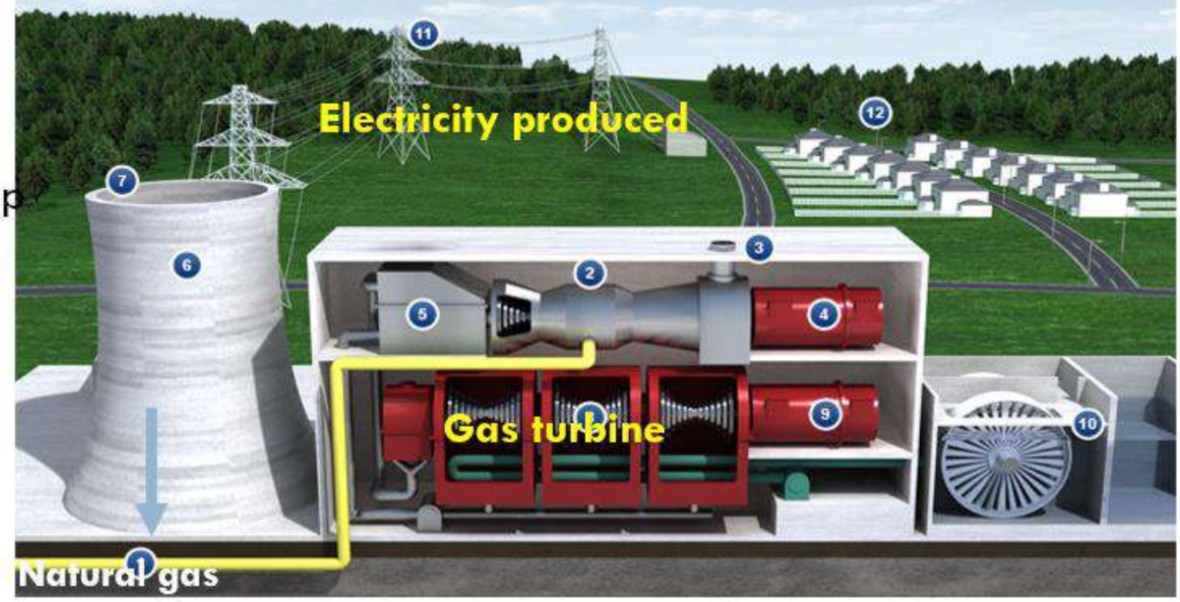

Figure 1: Natural gas to power pictorial view (Kanshio and Agogo, 2017).

The project deploys a 0.5 MW gas turbine to produce and distribute electricity to around 3,000 households, 500 small businesses, 5 health centers and 6 schools in the Niger delta region of Nigeria. A strong community ownership element is built into the project design. The entire assets and operations is managed and maintained by a community-based utility company owned by the community to make the gas to power project sustainably managed. This instance represents the first time in Nigeria that a community will generate its own power from a hi-tech micro turbine rather than through unsustainable diesel and gasoline generators that create high levels of pollution and impacts human health negatively. The project has been replicated in other parts of the Niger Delta as a sustainable local solution to domestic and industrial electricity needs

(ii) The Modular Technology

Modular design is a design approach that subdivides a system into smaller parts called modules or skids that can be independently created and then used in different systems. A modular system can be characterized by functional partitioning into discrete scalable, reusable modules; rigorous use of well-defined modular interfaces; and making use of industry standards for interfaces.

Besides reduction in cost (due to less customization, and shorter learning time), and flexibility in design, modularity offers other benefits such as augmentation (adding new solution by merely plugging in a new module), and exclusion (Malumfashi, 2008)

This level of integration may cost a bit more in up-front design and construction; however, money is saved in the later phases. Smaller crews are required for construction and testing. Connections are more centralized and easier to make. Also, fabrication of modules can be done indoors unlike traditional construction, further speeding up the overall process. This culminates into more rapid installations with fewer termination errors and a shorter pre-commissioning phase.

A modular process skid is a process system contained within a frame that allows the process system to be easily transported. Individual skids can contain complete process systems and multiple process skids can be combined to create larger process systems or entire portable plants. They are sometimes called “a system in a box.” An example of a multi-skid process system might include a raw materials skid, a utilities skid and a processing unit which work in tandem.

Process skids are considered an alternative to traditional stick-built construction where process system parts are shipped individually and installed incrementally at the manufacturing site. They provide the advantage of parallel construction, where process systems are built off-site in a fabrication facility while civil site upgrades are completed at the plant site simultaneously. Skids are not always appropriate. If individual process parts are large and cannot reasonably be contained within the frame of a modular process skid, traditional construction methods are preferred.

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All skids have the following characteristics in common:

- **Portable design**– because they are self-contained units, built within frames, skid systems are easier to transport than traditional process systems.
- **Small footprint** – process skid frames allow equipment layering. Piping, tanks, and necessary process equipment can be fit into a smaller footprint with a skid design
- **Gathered process connections** – process connections are gathered into one spot on the skid, making plant connections easier. In traditional process systems, connections are spread throughout the plant.
- **Controlled assembly** – skids are typically built in controlled conditions offsite. Existing operations are not affected by skid fabrication.
- **FAT** before installation – Factory acceptance testing (FAT) can be completed before modular process skids are shipped to site. This reduces the amount of on-site startup time.
- **Accessible layout** – skids are designed for accessibility, usually including a center hallway, and major pieces of equipment placed around the edge of the frame.

(a) Benefits of a Modular Skid Design

Below are the additional benefits of a process plant modularization

- Fastest Time to Market
- Cost Savings
- High Quality Assembly & Fabrication
- Superior Safety
- Reduced Resource Requirements
- Modules provide for easy relocation as your business needs change
- Secrecy of process technology is protected as fabrication occurs behind closed doors in EPIC's state-of-the-art plant.
- Higher quality is achieved through controlled, production style skid construction of the system in the skid manufacturer plant

3. MATERIALS AND METHODS

To discuss the methods involved in the utilization of associated gas for onsite power generation using mini modular gas turbine system, the following stages in the operation is identified.

1) The pre-treatment of the inlet feed associated gas from wellhead or flare points
2) The removal of natural gas liquids from the feedstream
3) The turbine power generation to electricity
4) The optimization of the turbine plant in design for enhancement of performance and productivity.

Pretreatment of the Feed Gas

The associated gas coming from oil wells after separation contains impurities and liquid condensable liquids that must be removed before the resulting gas is ready for use in the turbine plant. Usually the kind of processing and degree of purity depends on the nature of the flare gas and the degree of primary oil field separation and field processing of the gas if there was any. Sometimes the gas coming from the flare may not require much treatment and processing before they can be used in the turbine plant. The reason for treatment is to remove contaminants in the gas that would pose problems for the turbines, while the reason for processing is to extract the valuable liquid end of the gas as NGLs which are sold either as purity products or mix. The resulting NGLs provide additional revenue to the operators aside the sales that would result from the sales of electrical power after the conversion of the gas to electricity using the gas turbines.

The gaseous contaminant in flare gas are (Freireich and Tennyson, 1972)

- Sulphur compounds like H_2S and mercaptans
- CO_2
- Nitrogen

The presence of H_2S in the gas makes the gas sour. Both CO_2 and H_2S are called acid gases and are the major constituent of gaseous impurities in the gas. The pretreatment of the flare gas involves removal of the acid gases. This is called sweetening of the gas.

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The process selected for sweetening a sour gas depends on the general conditions:

- H_2S and mercaptan concentration in the sour gas, and sales gas H_2S and total sulfur limits
- maximum design flow rate
- raw gas inlet pressure
- requirement for sulfur recovery
- acceptable method of waste products disposal

Processing of the Gas or NGL Recovery

After the pretreatment of the flared gas, the next is to recover the liquid portion of the gas. Natural Gas Liquids Recovery is a process for separating ethane and heavier hydrocarbons (C_2+) from natural gas.

Many process configurations are used to recover hydrocarbons in the field and in gas plants. The best configuration depends upon many variables, including (Campbell, 1981; Maddox, and Erbar, 1982):

• Product slate
• Gas volumes
• Gas composition
• Pressures, both inlet and outlet

There are two principle methods for removing NGLs from the natural gas stream namely; the absorption method and the cryogenic expander process. Among others are gas refrigeration using chillers, J-T valve systems

Modular Gas Processing Technology (MGT)

The modular technology is applied in natural gas processing by taking a traditional system design and fitting it into a self-contained unit on a frame that can be lifted and moved as a single piece of equipment.

For the modular technology, there are two main technologies;

- The modular gas capture technology
- The modular gas processing technology.

The modular gas capture technology is fitted with movable skids. Its main work is to capture natural gas from various locations such as

1. From the flare delivery pipe
2. From wellhead in stranded wells
3. From wellheads in offshore locations.

The modular gas capture technology captures the gas and brings it to the processing site. The reason is that the volume of gas from one location may not be adequate to install an independent processing facility there. Another reason is that the location may be far from areas of need and usage of the processed products such as the dry gas and the NGLs. Many factors and conditions govern the location of the modular gas processing facility. Such factors include

- The volume of the gas
- The proximity to end user
- The proximity to several well locations
- The mole composition of the gas etc.

Depending on the volume of the gas, the choice of desired products and end user location, the modular processing technology can be either stationary or scalable. The stationary technology handle greater volume and are located strategically. The scalable technologies may be needed at locations where there is on the site processing needs for the natural gas, otherwise the gas can be capture and brought to a central modular gas processing facility.

The design of the modular gas processing plant is governed by the following factors

- The volume of gas
- The mole ration of the feed gas
- The level of contaminant and impurities
- The choice of desired output product
- The choice of usage and specification of the outlet gas etc.

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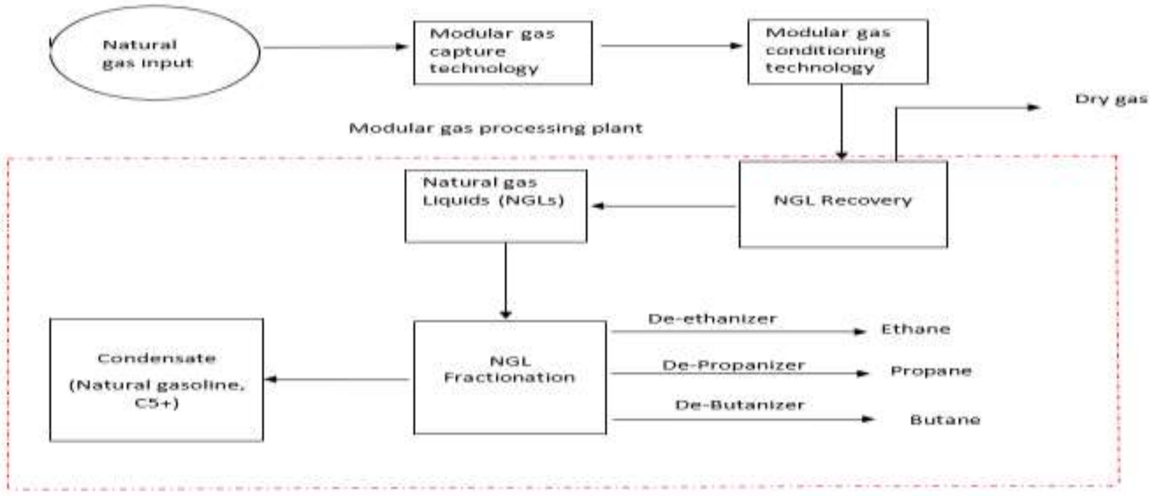

Figure 2: Natural gas Process layout

Performance of the Modular Gas Plant (Base Case)

The performance here has been considered in terms of the yield of the several products
The products recovered from the modular gas plant are

- Dry gas (methane) for power generation
- Ethane
- Propane
- Butane
- LPG
- Natural gasoline or plant condensates (pentane plus)

The inlet gas compostion matters so much in the design of the modular gas unit.
For a base case, the inlet case composition of the gas stream is given below

Table 1: Inlet gas composition

Component	Mole Percent (%)
Methane	79.59
Ethane	8.76
Propane	6.63
Iso-butane	1.16
N-butane	1.3
Iso-pentane	0.54
N-pentane	0.63
Hexane plus	0.27
Carbondioxide	0.75
Nitrogen	0.37
Total	100
Inlet Gas	**20MMScfd**

The cryogenic turbo-expander technology used for the modular gas processing plant has the capacity to recover

- 97% of the methane
- 90% of the ethane
- 99% of the propane

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- 100% of the C4+

The GPA gives the following physical quantities for gas

Table 2 : GPA Standard Factors (GPA, 2009)							
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Cu. Ft/lb mole (379.482)	**BTU/ Gal**	**gal/ lb-mol**	**Ft3 Gas/ Gal Liq.**	**Gallons per MCF (GPM)**	**Gross Btu/ Ft3**	**Ft3 Gas/ Ft3 Liquid**	**Ft3 Gas/ Bbls Liquid**
Methane	6.417	6.4170	59.14	16.91	1,010	442.3979	2483.896
Ethane	65,897	10.1230	37.49	26.68	1,758	280.4446	1574.59
Propane	90,875	10.4280	36.39	27.48	2,497	272.2161	1528.39
Norma Butane	102,950	11.9330	31.80	31.45	3,237	237.8805	1335.609
Isobutane	98,924	12.3860	30.64	32.64	3,229	229.2031	1286.889
Pentanes+	110,020	13.7210	27.66	36.16	3,978	206.9111	1161.728

Note that 1 bbl = 42gal
Also 1 bbl = 5.615 cuft

Table 3: Liquid yields of gas stream

Cu. Ft/lb mole	**Gallons per MCF (GPM)**	**Barrels per MCF**	**Barrels per MMCF**
Methane	16.91	0.402616	402.6164
Ethane	26.68	0.635234	635.2339
Propane	27.48	0.654281	654.2814
Normal Butane	31.45	0.748805	748.8046
Isobutane	32.64	0.777138	777.1377
Pentanes+	36.16	0.860947	860.9467

Following the preparation of the raw feedstream to recover turbine plant quality gas, the feedstream gas was pretreated to remove unacceptable level of impurities such as CO_2 and nitrogen. The next was the recovery of the Natural gas liquids (NGLs) such that the resultant methane flue gas would be channeled to the turbine plant for electricity generation using the combined cycle gas turbine.

The NGL recovery matrix is summarized below.

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Table 4: Summary of results of NGL extraction

COMPONENT	MOLE PERCENT	GAL/MOL	GPM	AVALAIBLE GAL/DAY	ESTIMATED RECOVERY	NET RECOVERED LIQUIDS GAL/D	NET RECOVERED LIQUIDS BBLS/D	RESIDUE GAS VOL MMSCFD	RESIDUE GAS MOLE %
Nitrogen	0.37				0			0.074	0.452406251
Carbondioxid	0.75				0			0.15	0.917039698
Methane	79.59	6.417			0			15.918	97.31625276
Ethane	8.76	10.123	2.336803	46736.07	90	42062.45988	1001.48714	0.1752	1.071102367
Propane	6.63	10.428	1.821895	36437.9	97	35344.76513	841.5420268	0.03978	0.243198928
Iso-butane	1.16	12.386	0.378615	7572.301	100	7572.30119	180.2928855	0	0
N-butane	1.3	11.933	0.408791	8175.829	100	8175.829157	194.662599	0	0
Iso-pentane	0.54	13.855	0.197156	3943.112	100	3943.111926	93.88361729	0	0
N-pentane	0.63	13.712	0.227641	4552.817	100	4552.816734	108.4003984	0	0
Hexane plus	0.27	15.566	0.110751	2215.03	100	2215.029962	52.73880862	0	0
TOTAL	100					**103866.314**	**2473.007476**	**16.35698**	**100**
INLET GAS	20MMSCFD								

From the 20mmscfd of raw inlet gas, 2473bbls/d of NGL was recovered leaving behind 16.36MMscfd of turbine quality gas to be used for power generation. Thus the recovered NGL is sold and revenue is generated for the investor. It is very difficult to achieve 100% ethane recovery in the plant.

Optimizing methane Recovery in MGT Plant

Since the work centres on power generation, we shall re-design the modular gas process plant to recover more of the methane. This is because methane gas is the principal constituent of the residue gas utilized in power generation. For the base case, only 97% of the total methane volume present in the feed gas was recovered. The lost 3% is not accounted for. For optimsation, the plant would be design to recover more of the methane by improving on methane recovery efficiency and by utilizing a new approach and addition to the existing modular unit. This addition is the introduction of modular cracking units that will perform catalytic or thermal cracking to the heavier NGLs such as the butane and the natural gasoline to yield more volumes of methane. The flow diagram for the proposed enhanced modular process plant is given below.

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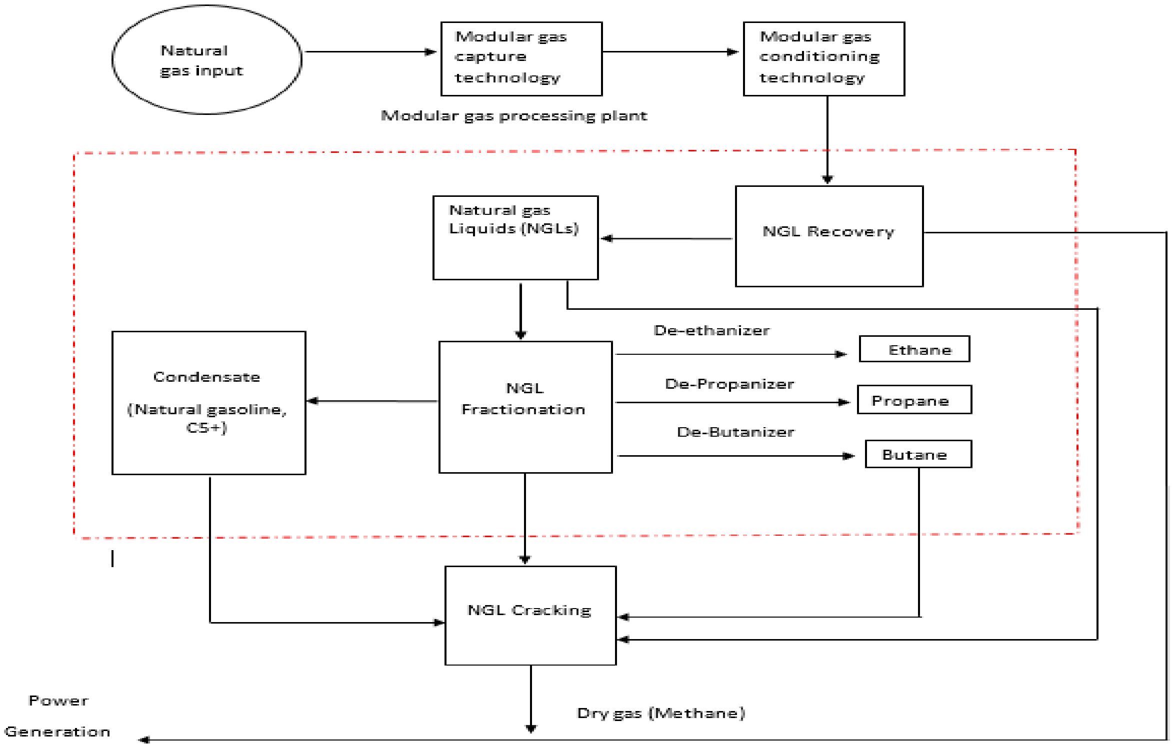

Figure 3: the Enhanced modular process plant for higher methane recovery.

Cracking of Liquid ends

cracking is the process whereby complex organic molecules or long-chain hydrocarbons are broken down into simpler molecules such as light hydrocarbons, by the breaking of carbon-carbon bonds in the precursors. The rate of cracking and the end products are strongly dependent on the temperature and presence of catalysts. Cracking is also the process of breaking a long-chain hydrocarbons into short ones. This process might require high temperatures and high pressure.

In this work the heavier hydrocarbon molecules such as the NGLs can be cracked to yield more volumes of methane since the project objective is power generation. The enhanced modular process plant is incorporated with a cracking unit. The cracking may take several route until adequate methane production is reached.

The products to be cracked are the NGLs. Sometimes because of the usefulness of ethane, it can be sold as petrochemical feedstock or can be put to methane production alongside the rest of the NGLs. In most cases, the intermediate product in cracking NGLs result in first stage production of ethylene gas and other products according to the carbon number of the precursor gas. The plant must be staged to achieve the cracking of the resulting intermediates to methane. In this case where some of the intermediates are useful, they are recovered and sold. The cracking economics must be such that the cost of modular enhancement and operation cost of cracking of the NGLs must be paid off by the resulting revenue accruing from the sales of the methane gas to power generation companies.

Naphtha Cracking (Pentane plus fraction)

Straight run or hydrocracked naphtha is used as feedstock in commercially established ethylene production industries. To simplify the process, an attempt on naphtha cracking which is steam pyrolysis technology is discussed aiming to produce concentrated ethylene with fewer by-products like acetylene, BTX etc. A cracking furnace having a separate convection section for preheating and a radiant section is used. Its interior contains burners placed along the sidewalls or at the bottom of the furnace. The temperature in the furnace continuously maintained between 950 to 1000^{o}C by the series of burners controlling. 5 bar pressure is maintained in the tubes by the naphtha feed pumps.

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By a heat exchanger, fresh feedstock (Naphtha) is preheated with cracked products stream that comes out from the furnace. The preheat naphtha is mixed with steam and passes to the convective section. Its temperature is raised to 300°C temperature and pass to the radiation section of the furnace for further increasing to 800°C. This is the condition where naphtha is cracked into simple compounds.

Steam is added to dilute the feedstock at a ratio of 0.6 kg/kg HC to prevent the coke formation at the cracking zone. High temperature product gas is cooled by removing the latent heat of water in steam generators that produce HP steam with 10 to 14Mpa. Transfer line heat exchangers operate with high thermal efficiency during cooling of the product gas. Products from C_2 to C_4 group are formed during cracking along with some quantity of BTX and ethylbenzene, Hydrogen and fuel oil. Optimum values of residence time, the steam ratio as well as temperature and pressure affect the by-products formation.

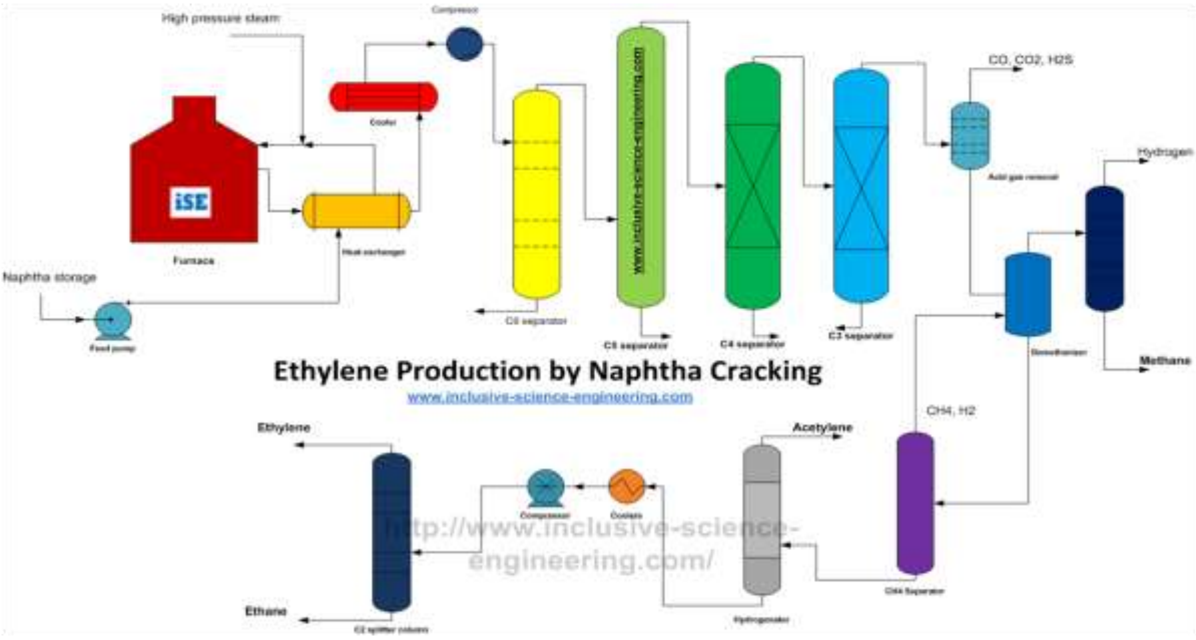

Figure 4: Simplified flow diagram for naphtha cracking (Science engineering .com)

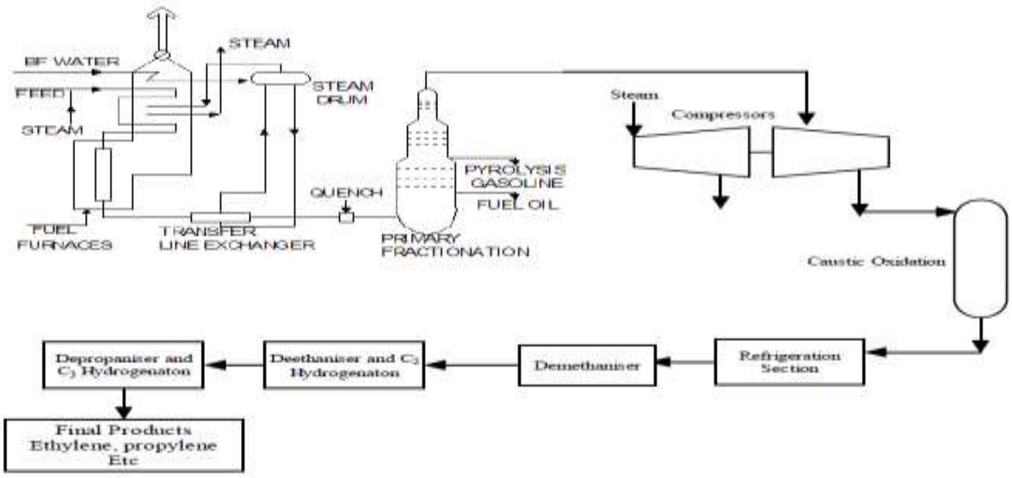

Figure 5: Process schematics for production of ethylene through cracking of naphtha (Butwell et al, 1982)

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When the naptha and heavier hydrocarbon have been reduced through cracking to ethane and ethylene. The next step in the cracking process is the conversion of these products to methane. The reulting methane gas undergoes processing to get rid of some entrained liquids and off gases. Then the methane gas is channeled to the route for power generation.
This process increases the methane yield for our base case from 97% to 99.5% composition of the residue gas.

Technical Performance of Modular Gas Turbine
Parameters given
Heat content of natural gas = 1029Btu/Cft (from literatures)
Heat rate of natural gas = 10408 Btu/Kwh
1 kWh = 3412 Btu
Efficiency for conventional turbine (CT) = 1Kwh/heat rate
Efficiency for conventional turbine (CT) = 3412/10408 = 0.32782475 ≈ 32.78%
Efficiency for combined cycle Gas turbine (CCGT) = 55% (from literatures)
Table 5 was developed from these parametres given above.

Table 5: Performance parametres turbine plants

Natural Gas Feed Rate(MMscfd)	Heat Content(Btu/Cft)	Heat Rate(Btu/Kwh)	CT Efficiency	CCGT Efficiency
20	1029	10,408	32.78%	55%
40	1029	10,408	32.78%	55%
60	1029	10,408	32.78%	55%
80	1029	10,408	32.78%	55%
100	1029	10,408	32.78%	55%

From the parametres given above,

- Kilowatt-hour generated per unit of fuel used = Fuel heat content (in Btu per physical unit) / Heat rate (in Btu per kWh)
- Kilowatt-hour generated per unit of fuel used = 1029/10408 = 0.098866257Kwh/scf Or 98.87Kwh/Mcf
- $Daily\ allowable\ energy\ generated(Kwh) =\ Feedrate(\text{MMscfd})x\ 0.098866257Kwh/Scf$

For 20MMscfd,
Daily allowable energy generated (Kwh) = 20000000 x x 0.09887Kwh/Scf = 1977325.2Kwh
Note that

$$Power = \frac{energy}{time}$$

$$Optimum\ power\ generated = \frac{daily\ available\ energy\ generated}{time}$$

For 20MMscfd
Optimum power generated = 1977325.2/ 24 = 82388.55KW
Power generated for both CT and CCGT in MW = optimum power generated x efficiency of plant/1000
For 20mmscf/d using CT plant, power generated = 82388.55x 0.32782475/1000 = 27.00900582MW
For 20mmscf/d using CCGT plant, power generated = 82388.55x 0.55/1000 = 45.3137025MW

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4. RESULTS AND DISCUSSION

Table 6 gives the power equivalent of the natural gas if all the stream were used in the turbine system for electicity generation. Several capacities of the turbine has also been considered.

Table 6: Results for calculations on performance parametres for turbine plants

Natural Gas Feed Rate(MMscfd))	Available Gas Volume(SCF)	Daily Available Energy Generated(Kwh/Scf)	Optimum Power Generated (KW)	CT Power Generated (MW)	CCGT Power Generated (MW)
20	20000000	1977325.2	82388.55	27.00900582	45.3137025
40	40000000	3954650.4	164777.1	54.01801164	90.627405
60	60000000	5931975.6	247165.65	81.02701747	135.9411075
80	80000000	7909300.8	329554.2	108.0360233	181.25481
100	100000000	9886626	411942.75	135.0450291	226.5685125

The above table gives the power equivalent of the natural gas if all the stream were used in the turbine system. Several capacities of the turbine has also been considered.

5. CONCLUSION

The conversion of associated flare gas to power has been considered. The work stems from the optimization approach. Investor may want to extract the liquid ends of the natural gas raw stream and sale them as NGL or the modular gas plant so used for the processing of the gas can be optimized with additional cracking units to convert the NGL to methane that would be utilized for power generation. This happens when the emphasis is on electricity generation rather than liquid fuels or in situation where the natural gas stream does not contain much of the liquid ends to justify the recovery of liquids. Thus for this, the liquids may just be cracked to lighter fractions of methane and used for power generation in the gas turbine plant.

Having presented the process results from both cases, the choice depends on the investor and the market conditions. If the recovery and sale of NGL would yield more revenue, then the investor can decide to follow that route, otherwise the whole stream might be used for the gas turbine to produce electricity with the much heavier ends that cannot be handled by the gas turbine cracked to lighter fractions.

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