ARUN LNG PLANT – FIRST TIME IN LNG HISTORY, EXPORT CONVERTED INTO IMPORT TERMINAL

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ABSTRACT

The Arun LNG plant, located in Lhokseumawe area in the central east of Aceh province northern part of Sumatera Island of Indonesia, had become one of the largest LNG liquefaction plant in the world. It has been operating for almost 34 years and had successfully achieved its most production of 76,000 m3/day, equal to 224 cargoes in 1994.

Arun LNG production has been in declining since early 1995 as the feed gas producing from Block B and NSO facilities (upstream gas field, operating by ExxonMobil) starting its natural decline phase. Such gas supply situation also impacted on the closing down some industries mainly 2 (two) fertilizer plants, and 1 (one) pulp and paper plant becomes a crucial issue locally and even nationally.

This paper elaborate the Arun LNG plant to be converted to become an LNG receiving, regasification, and trading hub facilities. The project is designed primarily to utilize the existing LNG storage and loading facilities as receiving and hub terminals by adding new facilities to vaporize LNG send gas to customer. It will be the first LNG export terminal converted into import terminal and expected not only to maintain the sustainability of industrial activities in Aceh province but also positioning itself become the gas hub for domestic as well as LNG & LPG trading hub internationally.

INTRODUCTION

Arun Liquified Natural Gas (LNG) plant located at Lhokseumawe a sizeble town in Aceh area, the northern part of Sumatera is one of the pioneers of LNG liquefaction industry in the world. It has been in operation since 1978, processing the feed gas from Arun gas field located at around 30 – 60 kilometers distance from the LNG plant. The Arun LNG plant, owned by the Government of Indonesia, has been operating by PT Arun NGL, a joint venture non-profit operating company, where PT Pertamina (Persero), Mobil LNG Indonesia and JILCO shares 55%, 30%, 15% respectively. In its peak, the LNG yearly production yielded reaching approximately of 12.5 million tons. Arun LNG production has been in decline since early 1995 along with the decline of gas deliverability of the upstream gas field. As there is no new prospected gas reserve, Arun LNG operation will be ceased in 2014 as the existing LNG Sales Contract is terminated. The unavailability of gas supply will also close down the others industries in the area surrounding.

This situation, decommisioning of industries in Aceh area, becoming the concern of Indonesian government since it will directly impact to the economic activities in that area, and expose to the social issues in the near future.

Having such situation, the Government of Indonesia is considering options pertinent to the reutilization of Arun LNG facilities after the termination of LNG processing operation, one of which is to convert the plant into LNG receiving terminal and regasification facility.

The rationale behind the conversion:

- Existing gas demand from industries in Aceh and potential gas supply to Medan, about 375 kilometers distance south of Lhokseumawe.
- The LNG plant facilities are in good condition (as it has been well maintaining) to be converted into LNG receiving terminal and regasification facilities. The regasification and the additional infrastructures can be installed as additional facilities to the plant.

- Ample LNG supply is available from domestic as well as from international market.
- The availability of gas from the regasification facility will maintain the continues operation of the exisitng industries and could stimulate the development of relevant industries in the area around Lhokseumawe and also Medan, including: industries that could use the latent heat of LNG vaporization (food processing, cold storage, air separation, etc.) and methane-based petrochemical industries which using methane as feedstock.

This project is targeted to complete by end of 2014, in which PT Pertamina (Persero) has been prepared the feasibility study and Front End Engineering Design (FEED) since 2009 to execute the project.

OBJECTIVES

The main objective for the project is to provide gas for industries and electricity, not only for Aceh province but also for North Sumatera province (mainly its capital city of Medan) by revitalizing the Arun LNG Plant facilities and building the gas transmission pipeline from Arun to Medan.

The other benefit from the project is expected to the following issues:

1. National Interest
    a. To enhance National Energy Security and Sustainability;
    b. Having the LNG storage, receiving and regasification in northern part of Sumatera island, will strengthening the energy supply on the western part of Indonesia to support Government policy on energy diversification by replacing petroleum fuel with gas;
    c. To create national gas infrastructure to support the gas network long term program along the Indonesia continental
2. Commercial Interest
    a. To revitalize the industry such as fertilizer, pulp paper and power plant.
    b. To be used to take the opportunity for LNG or Liquified Petroleum Gas (LPG) trading.
    c. Create multiplier effects on the economy.

DEVELOPMENT

Gas Supply & Demand

The gas demand comes from the existing fertilizer plants (3 x 60 MMSCFD), pulp and paper (10 MMSCFD), power plant in Lhokseumawe which is currently being constructed (40 MMSCFD), power plant in Medan (60 MMSCFD), industries in Medan 20 MMSCFD. As the typical demand of gas is supply-driven, new demand from new industries and power is expected when the regas faciities is already in operation.

Having LNG production will be stop in 2014, there will be still some tail gas (and condensate) will be produced from existing ExxonMobil gas field until 2018. On top of it, it is expected that there will be 2 (two) new short term upstream gas supply on stream in 2015/2016. How ever, all of the local gas supply still un able to fulfill the gas demand for Aceh province and North Sumatera province.

The gas supply and demand is shown in the following Table.

Table 1: Gas Supply and Demand

YEAR	TOTAL GAS DEMAND	TOTAL GAS SUPPLY FROM OTHER SOURCES	TO BE SUPPLIED BY THE CONVERSION PROJECT
2014 - 2020	398 MMscfd – 432 MMscfd	177 MMscfd	221 MMscfd – 255 MMscfd

Based on the above supply-demand balance, the initial of 200 MMSCFD re-gasification facilities will be constructed on the first phase and will be doubled to 400 MMSCFD in 2025.

LNG Source

Unlike gas supply chain where the gas is supplied directly from well-head using pipeline, which generally has a fixed supply source, the inherent benefit of gas supply business through LNG regasification is its flexibility to receive LNG from different sources. Nevertheless, for a reliable gas business, long term sustainable LNG supply contract need to be secured. As required for Final Investment Decision (FID) to be taken, the Project has secured the re-gasification user by signing the Head of Agreement Arun Regas between PT Pertamina (Persero) and PT Perusahaan Listrik Negara (PT PLN, a State Electricity Enterprise) in January 21, 2013. By this Head of Agreement (HoA), PT PLN will re-gasify its allocated LNG Tangguh to be supplied to its existing power plant in Medan and to its new power plant in Lhokseumawe. It is expected that in the future LNG from other sources, either domestic LNG or LNG from international market will enter into this project.

Technology

The conversion plant is designed to receive LNG with a certain specification from Tangguh plant in Papua, Eastern Indonesia - as lean LNG and from Badak plant in Borneo - as rich LNG (the composition of both LNG is shown in the following table). The send out gas quality is still within the range of the LNG specification.

Table 2: LNG Composition from Tangguh & Badak LNG Plant

No.	Composition	LNG Tangguh	LNG Badak
1	CH_4	0.9685	0.9065
2	C_2H_4	0.0215	0.0504
3	C_3H_4	0.0050	0.0310
4	i-C_4H_{10}	0.0009	0.0060
5	n-C_4H_{10}	0.0011	0.0058
6	i-C_5H_{12}	0.0001	0.0001
7	n-C_6H_{14}	0.0000	0.0000
8	N_2	0.0029	0.0002
9	O_2	0.0000	0.0000
10	CO_2	0.0000	0.0000
11	**Total**	1.0000	1.0000

There are 2 (two) main process in this conversion project, they are regasification process and excess Boil Off Gas (BOG) handling especially during unloading mode.

Regasification process type

Two regasification process were reviewed, the Open Rack Vaporizer (ORV) type – sea water spray, which requires higher capital expenditure and Submerged Combustion Vaporizers (SCV) type – fuel burned, which requires higher operationg expenditure.

The ORV type which is considered more efficient is then selected due to the following reason :

1. The existing sea water system facility can be reused for regasification unit. It will reduced the investment cost
2. Operating cost for ORV lower than SCV and others vaporizer.
3. Easier to operate and maintenance.

The cold energy resulted from the LNG vaporization is not utilized yet at this point of time. It is expected that by energizing the economy in Arun area, some investment will be coming to take advantage of the cold energy availability.

Excess BOG handling method

As the LNG is stored at cryogenic temperatures, no matter how well the tank is insulated there will be some degree of heat leak from the surroundings, which will result in generation of BOG. BOG generation increase significantly during unloading due to heat in leak a long the pipe, heat loss in motor cargo pump, pressure drop of control valve and from the LNG tank. This excessive BOG shall be properly handled to apply zero flaring concepts to meet the project's fit for purpose.

Two methods of handling excess BOG were considered, recondensing the BOG and compression by BOG booster compressor.

For this conversion project, compression method is selected due to following reasons:

1. Simplicity to control the BOG flow.
2. The reuse of the existing Feed Booster Compressor will reduce the capital expenditure of this project.

Based on aforesaid explanation, the process description of the project can be seen in Figure 1.

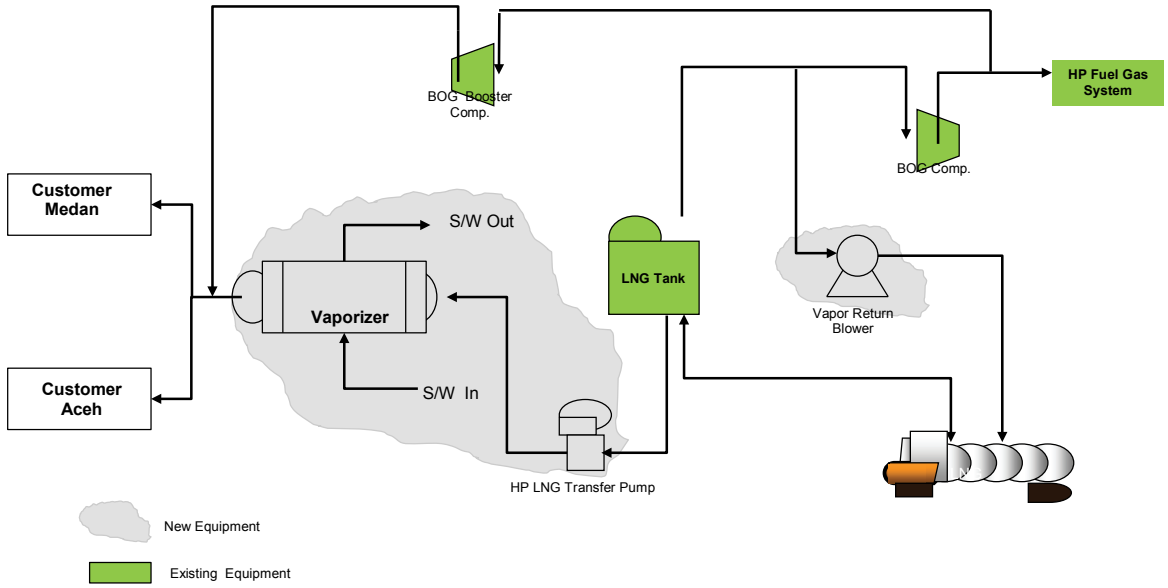

Figure 1: Simplified Diagram for LNG Receiving & Regasification Facility

LNG from LNG ship is transferred to LNG Storage Tank by Cargo Pump. LNG from storage tank is pumped by LNG Transfer Pump to re-gasification unit (ORV). This vaporizer uses seawater as heating media to vaporize the LNG.

During unloading LNG from ship to LNG storage tank, an exessive BOG is generated. This BOG will be sent and split into two stream, one stream as BOG return to ship and another stream sent to BOG compressor to be used as High Pressure (HP) Fuel Gas for Power Generator. In case there is an excess of HP Fuel Gas, it will be recompressed in the BOG Booster Compressor. The compressed gas then sent to the customers combining with the regasified LNG from the Vaporizer.

As previously stated, this conversion project will reutilize the existing well-maintained LNG Facilities:

- 1 ea LNG Loading Berth
- 1 set LNG Loading & Circulation Lines
- 6 ea LNG Loading Pumps
- 5 ea LNG Circulation Pumps
- 5 ea LNG Storage Tanks
- 2 ea LNG Boil-off Gas Compressor
- 2 set Power Generators Gas turbine drivers
- 1 ea Emergency Power Generator Diesel Engine driver
- 1 ea Laboratory Facilities
- 1 ea Power Generator Room
- 1 ea Power Generator Control Room
- 9 ea Electrical Substation
- 1 unit Storage & Loading Control Room
- Residue gas pipe line
- Utilities Unit such as Nitrogen plant, Air Plant, Seawater facilities, Water Treatment Plant, Fire Water Station and other related Supporting Units.

On top of those available facilities, some new facilities need to be installed which include:

- LNG and Seawater Lines for LNG Re-gasification or Vaporizers
- LNG Re-gasification or Vaporizers
- Excess BOG Handling System (Booster Compressors Motor Drivers – Existing Equipment which is relocated from its original location))
- High Pressure LNG Transfer Pumps which directly use to sent out the gas.
- LNG Vapor Return Blower
- Pipeline manifold for send-out the gas to the costumers
- Control system
- Bulk Material of related discipline.

Project Economic

The input variables of the economic model for the market in Aceh province are capital expenditure, operational expenditure, gas sales price and the expected return. The economic model calculates the minimum margin needed to achieve the desired return. The margin is then used to determine maximum LNG prices that would satisfy the desired return. Gas sales price is set in accordance to the willingness of the target market to pay.

The economic model for the market in Sumatera Utara province includes the capital expenditure of regasification and pipeline from Arun to Medan, operational expenditure, the expected return, and gas/LNG purchase prices. The economic model of this project calculates the minimum margin needed to achieve the desired return and the margin is in turn used to determine the minimum gas sales price in North Sumatera. The gas sales price in North Sumatera should be comparable with diesel price used by power plant industries in North Sumatera.

As the project stages, the re-gassification facilities will be built on the first phase and followed by the pipeline construction from Arun to Medan.

CONCLUSION

1. With the declining of gas resource from the existing field in Aceh province, some local gas customers have stopped their operation. PT Pertamina (Persero) explores the opportunities to revive the local industries by conducting some modification to existing well-maintained LNG plant facilities and converting into import terminal.

2. Through the conversion project Indonesia is developing an integrated gas infrastructure in the western part of the country and positioned the facilities to become a national gas supply infrastructure and an international trading hub for LPG and LNG.