THE MAKING OF YEMEN LNG

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Yemen
1. ABSTRACT

The Final Investment Decision (FID) for the Yemen LNG project was taken on 26 August 2005, almost ten years after The Republic of Yemen and the sponsors of Yemen LNG first entered into agreements relating to the project. Today, construction of the plant has started and the first cargo delivery is projected for the end of 2008. The fact that Yemen LNG was able to launch its project in 2005, is due to Yemen LNG’s ability to seize the market opportunities that presented themselves in mid 2004, allowing Yemen LNG to finalise sales and purchase agreements for the full guaranteed plant capacity of 6.7 million tonnes per annum.

How did Yemen LNG get where it is today?

At the start of the project in 1995, the LNG markets targeted by Yemen LNG were in Asia. However, the 1997 Asian economic crisis led LNG buyers in that region to review their demand requirements downward, putting a break on negotiations for long-term LNG sales and purchase contracts for several years. In 2002, Asian markets became active again. New markets such as China and India opened up, but harsh competition for access to these markets led to the acceptance of difficult commercial conditions from a Seller’s perspective. In mid-2004, Korea Gas Corporation launched its tender for long-term supply of LNG. Since, Korea is the second largest LNG market in the world and Yemen LNG included two Korean shareholders at the time, Yemen LNG was understandably highly motivated to participate in this tender.

The need for additional natural gas supplies for the United States market provided a further opportunity for Yemen LNG. A careful analysis of the LNG quality specifications allowed Yemen LNG to target both the Asian and United States markets at the same time. Yemen LNG decided to offer volumes through a competitive process to a US buyer who could adjust his first delivery date to the requirements of Yemen LNG. In this process Suez LNG Trading S.A. was selected as the winner and became Yemen LNG’s second customer. An additional LNG purchase commitment by its main foreign shareholder, Total S.A., at this critical time not only provided attractive terms to Yemen LNG, but strengthened the credibility and flexibility of the project to the other LNG buyers and equipment suppliers.

By spreading sales between three reputable buyers in two established markets with a mix of FOB and Ex-ship terms, Yemen LNG successfully managed to minimise project risks.

Careful plant design preparation, planning of the equipment tenders and short-listing of the most competitive equipment suppliers allowed a swift award of the construction contracts while the sales contracts were being finalised. In parallel, a tender process resulted in competitive charter party rates being obtained for the four vessels required for the ex-ships sales.

Yemen LNG is grateful for the continuous support of the Government of the Republic of Yemen.
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2. Introduction

The Final Investment Decision (FID) for the Yemen LNG project was taken on 26 August 2005, almost ten years after The Republic of Yemen and the sponsors of Yemen LNG first entered into agreements relating to the project. Yemen LNG will be the single largest construction project ever undertaken in the Republic of Yemen. It is a cornerstone in the government’s development policy and marks a new step in the development of the Republic of Yemen’s natural resources. Yemen LNG will be project financed and will become a reference for future industrial development projects in Yemen. Yemen LNG is committed to providing a significant contribution to Yemeni society through the creation of new jobs and the sponsorship of sustainable community projects. This paper gives a brief overview of the Yemen LNG project, the history and orientation for the next three decades of continued operations.

3. Project Description

3.1. Overview

The project involves the construction and operation of a two-train natural gas liquefaction plant with a guaranteed capacity of 6.7 million tonnes per annum (“MTPA”), plus associated pipelines, storage and port facilities. The plant and port facilities will be located at the deep water port of Balhaf, on the southern coast of Yemen, which provides the project with access to world markets. The project will use natural gas that is extracted from the developed fields in the Marib region of central Yemen. These fields have been producing reliably since 1986.

Graph 1: YLNG Liquefaction Plant and Gas Fields
3.2. Sponsors of Yemen LNG

The main sponsors of Yemen LNG are The Government of the Republic of Yemen through Yemen Gas Company (YGC) and the General Authority for Social Security and Pensions (GASSP) and its foreign shareholders, Total, Hunt, SK, Kogas and Hyundai. Yemen LNG is a limited liability company whose objects include all matters related to the development of the project. The shareholders in Yemen LNG and their respective percentage shareholdings are as follows:

<table>
<thead>
<tr>
<th>Company</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yemen Gas Company (YGC)</td>
<td>16.73%</td>
</tr>
<tr>
<td>General Authority for Social Security and Pensions</td>
<td>5.00%</td>
</tr>
<tr>
<td>TOTAL Yemen LNG Company Ltd.</td>
<td>39.62%</td>
</tr>
<tr>
<td>Yemen Hunt LNG Company, LLC</td>
<td>17.22%</td>
</tr>
<tr>
<td>SK</td>
<td>9.55%</td>
</tr>
<tr>
<td>Kogas</td>
<td>6.00%</td>
</tr>
<tr>
<td>Hyundai</td>
<td>5.88%</td>
</tr>
</tbody>
</table>

3.3. Plant and Port Facilities

The operation of the liquefaction unit for the plant will be based on the proven industry standard APC1 process. Front-End Engineering studies were carried out in 1997 and later updated in 1999 by Bechtel and Technip. The plant engineering, procurement and construction (“EPC”) contract was signed with YEMGAS FZCO, a joint venture among Technip, JGC and KBR on 6 September 2005.

The plant will include such ancillary facilities (power generation, desalination, waste water treatment and steam generation) as are necessary to enable the project to be operated on a self-supporting basis in a safe, efficient, reliable manner in accordance with applicable international standards respecting the environment. Two 140,000 m³ storage tanks will be constructed. Yemen LNG expects the plant to be operational for 335 days in each year, from December 2008 for half of the capacity, (Train 1), and from May 2009 for the full capacity, (Trains 1 & 2).
The location for the construction of the port facilities at Balhaf was selected because of the natural shelter it provides from winds, currents and marine conditions. Yemen LNG intends to use the port facilities to accommodate the loading of up to 150 vessels in each year, and will be able to carry out such loading operations for up to 24 hours a day throughout the year, weather and visibility permitting.

The port facilities have been designed to accommodate vessels with capacities ranging from 70,000 m$^3$ to 205,000 m$^3$.

### 3.4. Reserves

The Republic of Yemen has dedicated the natural gas reserves in Block 18 of the Marib fields for use in the project. Proven natural gas reserves in the dedicated fields have been certified at approximately 10 trillion cubic feet in 2005, of which 1 trillion cubic feet has been reserved for future domestic use. The existing natural gas production facilities in the dedicated fields have a capacity of 3.2 billion cubic feet ("bcf") per day and are currently producing in excess of 2 bcf per day of natural gas, which is extracted and re-injected for oil recovery purposes. The project will require approximately 1.2 bcf of natural gas per day when operating at its guaranteed capacity.

### 3.5. Pipelines

The project involves the construction of two main pipelines. The first pipeline is for the transportation and supply of natural gas from the dedicated fields to the liquefaction plant. It will run for approximately 320km from a natural gas processing unit located in the dedicated fields of the Marib region of central Yemen to the plant at Balhaf. The second pipeline is a spur line, which will run for approximately 200 km from a natural gas processing unit located in the dedicated fields to Ma’Bar, and will transport the natural gas from the dedicated fields that has been reserved for domestic use.
3.6. Shipping Arrangements

Under the ex-ship SPA with Total Gas & Power, Yemen LNG will need to procure four LNG ships to deliver about 2.00 MTPA of LNG to certain specified ports in the Gulf of Mexico, including Sabine Pass, Louisiana and Altamira Mexico.

Yemen LNG will not own the ships it requires to meet its shipping obligations. Therefore, Yemen LNG has selected two ship owners, AP Moller and MISC, through a competitive tender process and has entered into time charter parties with both ship owners for two vessels each. All four vessels are dual fuel diesel electric engine burning mainly gas and some diesel oil. The two AP Moller vessels will have capacity of 165,000 m$^3$ each and will be built at the Samsung shipyards in Korea. The two MISC vessels will have capacity of 157,000 m$^3$ each and will be built by the Mitsubishi Heavy Industries shipyards in Japan. All four vessels will use the membrane technology and all four ships will be delivered during 2008 from the shipyards to the ship-owners.

4. Marketing of Yemen LNG

4.1. Early Efforts

Initially, Yemen LNG was planned with a capacity of 5.3 MTPA. Yemen LNG was mainly targeting markets in Asia (Korea, Japan, Taiwan, China and India), but also looked for opportunities in Europe. European LNG markets, however, seemed relatively less attractive than Asian markets in the mid-90s, because of pipe gas competition in Europe. In the US, the LNG market was little more than a tiny niche market as LNG could not compete with natural gas produced domestically or imported from Canada.

The first efforts to bring gas from Yemen to the Asian markets came to a halt when the Asian economic crisis in 1997 forced all major LNG buyers to review their purchase requirements downwards. The sale of LNG into any of the Asian markets on a long-term basis became virtually impossible. This, however, did not stop Yemen LNG from continuing working with its potential future customers. In particular, Yemen LNG continued entertaining a close contact with Kogas in spite of the difficult market situation.

4.2. Revised Marketing Strategy and Technical Challenges

In this context, Yemen LNG reviewed its marketing strategy and reassessed possibilities to sell not only to Asia, but also to markets in the Atlantic Basin. Yemen’s geographical location gives it the option to target markets either East or West of Suez. To do so, Yemen LNG had to address both commercial and technical challenges. One of the key technical challenges Yemen LNG had to overcome related to the different gas specifications in the respective target markets:

While continental European gas markets operate with wide spec ranges which can accommodate most types of LNG produced, the US market and the Asian markets are at opposite ends of the spectrum of quality specs. The main discrepancies relate to the parameters affecting the inter-changeability of gases distributed and in particular the established standards for the Gross Calorific Value (GCV) or the
Wobbe Index. The US requires a lean gas, while Asian markets are looking for LNG with high GCVs. For Yemen LNG to operate as a producer offering its LNG at the same time to high GCV markets in Asia and low GCV specs in the US, it was necessary to design upstream facilities and the LNG plant in a way that allows the production of a quality specification which is acceptable in either market.

Graph 3: Spread of LNG Qualities in Different LNG Plants Worldwide

The above Graph 3 shows the various LNG qualities currently produced or planned in the near future, in a Gross Calorific Value / Wobbe Index plot.

- Far East (Japan, Korea), where gas distributed has a GCV around 44 to 45 MJ/m$^3$ (n), i.e. 1,115 to 1,140 Btu/scf, may need to inject in LNG a certain amount of propane or butane, thus leading the LNG buyers to favour relatively rich qualities in order to minimise the cost of LPG injection.

- The UK and the US, where gas currently distributed is lean, with a GCV usually lower than 41 MJ/m$^3$ (n), i.e. 1,050 Btu/scf, may require nitrogen injection at the receiving terminal in order to cope with the local specifications. Due to the limitation in acceptable nitrogen content, especially in the US, LNG buyers can only accept a relatively lean LNG quality.

In view of the above constraints, Yemen LNG opted to design the upstream facilities and the plant such as to produce a quality of LNG in a range around 1,080 Btu/scf, which is acceptable for both Korean and US buyers. Currently, the two main gas processing centres in the Marib production area operate three cryogenic units to extract LPGs. A fourth unit is under study which will allow the processing of the feed gas in line with the LNG plant requirements.
4.3. Commercial Break-Through

By defining the marketing strategy in this way, allowed Yemen LNG to actively promote its project in both the Asian and the Atlantic Basin markets. Yemen LNG sponsors further decided to increase plant size from 5.3 to 6.7 MTPA to reduce unit production costs. The economic competitiveness of Yemen LNG also benefited from the progress made in shipping technology and the resulting lowering of shipping costs.

All these elements taken together contributed to Yemen LNG being ready to submit a competitive bid for the tender launched by Korea Gas Corporation in August 2004. It further allowed Yemen LNG to offer volumes through a competitive process to the US market. The sales and purchase agreement with Suez LNG Trading S.A. created the outlet in the US market which Yemen LNG had been looking for. An additional LNG purchase commitment by its main foreign shareholder, Total S.A., at this critical time not only provided attractive terms, but strengthened the credibility and flexibility of the project to the other LNG buyers and equipment suppliers.

By spreading sales between three reputable buyers in two established markets with a mix of FOB and Ex-ship terms, Yemen LNG successfully managed to minimise project risks. Careful plant design preparation, planning of the equipment tenders and pre-selection of equipment suppliers allowed a swift award of the construction contracts while the sales contracts were being finalised.

Yemen LNG has signed three long-term LNG sales and purchase agreements (“SPAs”) for a total contracted volume of 6.7 MTPA on a FOB basis (see table below).

<table>
<thead>
<tr>
<th>Buyer</th>
<th>Volume (MTPA)</th>
<th>Basis</th>
<th>First delivery</th>
<th>Duration (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kogas</td>
<td>2.00</td>
<td>FOB</td>
<td>Dec 08</td>
<td>20 + 5</td>
</tr>
<tr>
<td>Suez</td>
<td>2.55</td>
<td>FOB</td>
<td>May-July 09</td>
<td>20</td>
</tr>
<tr>
<td>Total Gas &amp; Power</td>
<td>2.00 *</td>
<td>DES</td>
<td>Jan-July 09</td>
<td>20</td>
</tr>
<tr>
<td>Sum</td>
<td>6.55</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Equivalent to 2.15 MTPA on a FOB basis

LNG purchased by Kogas and Suez LNG will be delivered free on board at Yemen LNG’s port facilities in Balhaf for transportation to designated ports in Korea and the United States, respectively. LNG purchased by Total Gas & Power will be delivered ex-ship at certain specified ports in the United States, including Sabine Pass, Louisiana.

Once the sale and purchase agreements were signed, the EPC contract was awarded in September 2005. Construction is now on-going and on track for a start-up of commercial operations in December 2008.
5. YLNG’s Sustainable Development and Environment strategy

As the single largest business venture in Yemen’s history, YLNG is committed to leaving an important positive legacy in Yemen, during and following this project. Yemen LNG will create several thousand jobs during the construction of the plant and close to 500 during operations. Yemen LNG places special importance on the training of Yemeni nationals to ensure transfer of knowledge and to guarantee operations at the highest quality standards. In anticipation of the operations phase, Yemen LNG is actively recruiting Yemeni nationals for long-term employment and anticipates recruiting and training more than 200 local operations and technical staff by 2008. Yemen LNG is further contributing to the development of local industry by providing local contractors with opportunities to participate in the project through technical and other support services to the plant.

Through its Sustainable Development and Environmental (SDE) strategy Yemen LNG is focusing on areas as diverse as promoting local communities, contributions to environmental protection programmes and sponsorship of historical and cultural sites.

The Company has recruited local community liaison officers who are actively consulting with local communities in order to better identify the areas where community investment is most needed. It has also commissioned several external consultants and has engaged dialogue with local non-governmental organisations to collaborate in development programmes.

As such, Yemen LNG is working closely together with local authorities and non-governmental organisations to protect the environment along the coastline and in particular the coral reefs and marine populations. Yemen LNG will be making a contribution to the Coastal Zone Management Plan, which is the outcome of a number of studies that were funded by the Global Environment Facility of the World Bank. To be in a position to better understand and monitor the biodiversity in and around Balhaf, where the plant will be located, Yemen LNG has commissioned two extensive studies on the environmental baseline which provide valuable insights into the quality and range of the corals and marine life in that area.

To contribute in preserving Yemen’s rich cultural heritage, Yemen LNG has recently commissioned an archaeological survey carried out by a joint venture between the Deutsches Archäologisches Institut (DAI) and the Centre Français d’Archéologie et de Sciences Sociales de Sana’a (CEFAS). Thanks to this survey a number of sites of archaeological interest were discovered, most particularly the Darbas Bronze age settlement with irrigation channels near the northern entrance to Wadi Jirdan. Several other projects related to the preservation of historical sites are currently being evaluated with the sponsorship of Yemen LNG who will continue to play an active role in the preservation of Yemen’s culture heritage.

6. Conclusion

Yemen LNG had re-defined its strategy in a way that has allowed it to adapt quickly to a changing market environment. At a time when competition amongst new LNG projects world-wide was particularly severe, Yemen LNG was in a position to grasp the market opportunities when they
presented themselves. This success would not have been possible without the continuous support from the Government of the Republic of Yemen and without the determination and perseverance of Yemen LNG’s shareholders.

For the years ahead, Yemen LNG is determined to establish itself as a first-class LNG producer. It is committed to become a model for an industrial development in Yemen and to make a significant contribution to Yemeni society throughout its project lifetime.
REFERENCES