Challenges for LNG Terminals in China

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Introduction

In recent decades, the role of gas in the global energy sector has grown significantly. As the cleanest fossil fuel, Liquefied Natural Gas (LNG) is recognised as the key fuel that could relieve pressure on the global energy demands. In response to environmental concerns, the Chinese government has set a target within its 12th Five Year Plan maps for the use of cleaner energy resources. To reach this target, approximately 50-60 billion cubic metres (bcm) of natural gas must be imported by 2015. Today there are more than 10 onshore LNG terminals operating in China including one floating terminal (in Tianjin) with a receiving capacity of 3.0 bcm under construction.

In this article, the author will give a brief introduction about the development and future trends of LNG terminals in China, and will comment on the receiving capacity and geographical position of existing and planned LNG terminals. The technology and environmental challenges especially for LNG terminals in China will be identified and discussed as will the alternative designs and location of LNG terminals. As a conclusion, the development of technologies, standards, regulations and training will be stated separately.

China's gas consumption

Air pollution has become a prominent problem in the cities of China. Local governments are now faced with the dual challenge of maintaining economic growth whilst complying with environmental regulations. To achieve this, piped natural gas is seen as the best alternative to LPG, biomass and coal. The energy intensity target of the 12th Five Year Plan set by State Council in China mandated that non-fossil energy sources should be increased to 11.4 percent of the country's total energy use. According to the China Energy Statistical Yearbook 2013, the total natural gas consumption as a percentage of total energy production increased from 2.7 percent in the year 2000 to 4.3 percent in 2012, while the average daily energy consumption increased from 0.7 percent to 3.6 percent. China's gas consumption is expected to increase exponentially in the coming years in order to adopt these regulatory measures and meet demand.

Development of LNG in China

Since the late 1990s, investment in the LNG industry has heated up in China. LNG terminals owned by the three major state-owned oil companies have continued to be put into operation. Moreover, private capital injected into gas related projects has intensified competition between market players in China. As most of the LNG terminals in operation were built at a rapid pace, the related domestic regulations and standards are still in their infancy. Future challenges for port management and environmental protection shall be considered in order to secure a safer and more reliable development of LNG terminals in China.

In the last few years, the LNG receiving capacity of China has increased from 0.7 percent to 2.9 percent of the global LNG receiving capacity. By 2015, there will be 14 LNG receiving terminals (see Table 1) with a combined capacity of 120 bcm of natural gas per annum. Based on the statistics in table 1, three national oil companies (CNOOC, CNPC, Sinopec) are the lead LNG terminal builders in China. CNOOC is considered as the Chinese pioneer of LNG and built the first LNG terminal in Guangdong with a long-term sales and purchase agreement (SAP) with the Australian NWS project. This project was put into operation in 2006. The second terminal operated by CNOOC is located in Fujian with cargo from Indonesia, while the third one is located in Shanghai with a SAP with Indonesian and Malaysian investors. Following these projects, LNG terminals such as Dalian ad Rudong were put into operation separately. In 2013, the total capacity of existing LNG terminal in China was recorded at 21.9 million metric tonnes per annum (mtpa) and when terminals under construction are completed this will rise to this will rise to 43.1 mtpa.

According to the geographical distributions shown in Figure 1, all LNG terminals either in operation or under construction are scattered along the coastline from Liaoning Province in the north to Hainan Province in the south. This shows that there has been no regional monopoly so far and that the development of terminals is still very much balanced. However, most of the construction of these terminals is divided into two phases and projects to expand the capacity of terminals such as Guangdong, Shanghai and Fujian are still ongoing. After capacity expansion, more than half of total capacities will be located in southern China and approximately 35 percent of total

Status	Location	Capacity (MTPA)	Open	Leading company
Existing	Dapeng, Guangdong	6.7	2006	CNOOC, BP
	Fujian	2.6	2009	CNOOC, Fujian Investment & Development Co.
	Mengtougou, Shanghai	0.1	2008	Shanghai Gas Group
	Yangshan, Shanghai	3	2009	Shenergy Group, CNOOC
	Rudong, Jiangsu	3.5	2011	PetroChina, Pacific Oil
	Dalian, Liaoning	3	2011	PetroChina, Dalian Port
	Ningbo, Zhejiang	3	2013	CNOOC, Ningbo Power Development Co. Ltd
Under construction	Qingdao	3		Sinopec
	Zhuhai	3.5		CNOOC, Guangdong Gas
	Hainan	2		CNOOC, Hainan Development Holding Co.
	Caofeidian, Tangshan	3.5		PetroChina
	Diefu, Shenzhen	4		CNOOC, Shenzhen Energy Group
	Beihai, Guangxi	3		Sinopec
	Tianjin (FRSU)	2.2		CNOOC

Table 1: LNG terminals in China.

capacity will be in eastern China.

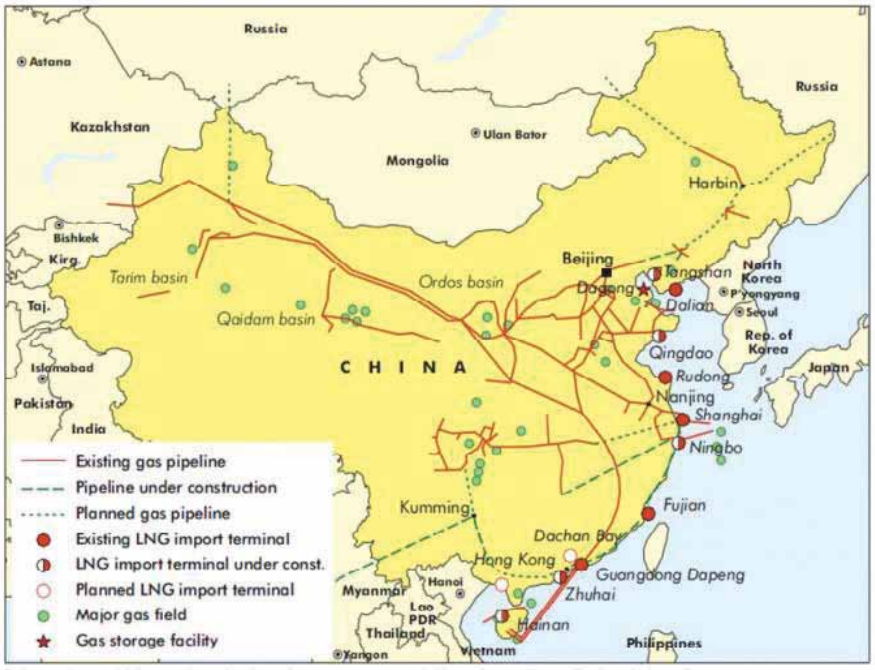
Because of the shorter construction period and less land acquisition, the first floating storage and regasification units (FSRU) are now under construction in Tianjin, on the Bohai Gulf of northern China. The first phase of the FSRU project is designed to have an annual receiving capacity of 3 bcm and the second phase will increase its capacity to 8 bcm. In November 2013, CNOOC, the major operator of the Tianjin terminal, announced the official start of trail operation under a sale contract with GDF Suez.

Obviously, China is building excess LNG capacity and the race in building LNG terminals between Chinese market players is getting more and more intense. However, the global LNG market is likely to remain tight this year as the demand side of LNG continued to grow, especially in Asia. Currently, the construction progress of those projects without long-term gas supply contract is quite slow. Chinese importers are still looking for bigger supply contracts and new supply regions because of increasing demands.

Future challenges

China was self-sufficient in natural gas until 2006 and only became a net gas importer when it started importing LNG from Australia in 2007. Currently, the infrastructure for natural gas is still under development in the country to meet increasing demand. Besides the construction of big LNG terminals along the coastline, LNG operators in China are also concentrating on the development of FSRU and small-scale terminals along Yangtze River to strengthen its LNG industrial chain. Therefore, the alternative design and location of future LNG terminals needs to be further investigated considering the techniques and experiences of countries like Japan and Northern European countries.

More comprehensive analysis for the whole LNG supply chain shall be carried out to find the most suitable sites for safe and sustainable development in the future. An assessment on the safety and security of the waterways associated with the project will be carried out by a competent organisation in conjunction with national and industrial standards. However, there is still no comprehensive safety assessment framework for LNG terminals in China. The only national



Picture courtesy of Petroleum Economist, CNPC, IEA

Figure 1: LNG terminal distribution in China.

standard for the design of LNG terminals in China was implemented in 2010 and still needs to be amended for the new developments in the LNG industry.

Moreover, both existing terminals and those under construction must consider the environmental challenges. All the construction and operation of LNG projects shall be conducted according to the relevant laws, regulations and rules so as to minimise and mitigate the environmental impacts to the sensitive onshore or nearshore resources. Those rules and regulations relating to LNG terminals including large coastal terminals, small-scale terminals and FSRU for environmental protection are still under development in China.

There has become an urgent need recently for technical expertise into the improved management of future LNG terminals. These experts will have vast knowledge of LNG terminals and be familiar with the international standards and regulations relating to safety, security and environmental protection. Suitable training courses for managerial personnel and workers are needed for the further expansion of LNG terminals in China.

Conclusion

Due to environmental concerns, the Chinese government has set a target within its 12th Five Year plan maps for the use of cleaner energy resources. To reach this target, approximately 50-60 bcm of natural gas needs to be imported come 2015. There are seven Chinese LNG terminals in operation with a receiving capacity of 21.9 mtpa and another seven under construction, including one FRSU, with capacity of 3 mtpa.

However, when compared with the rapid construction pace, the development of technologies, standards, regulations and training is relatively slow in China. There is still a lot of work to do to fill the gap between China and western countries by importing not only natural gas but also advanced technologies and experience. National standards shall be revised and updated according to the new technology adopted. A comprehensive risk management framework as well as navigation and environmental safety assessment for both big and small-scale terminals shall be carried out during preparatory phases. Better training programmes will also be provided for managers and their staff in order to encourage both technical innovation and the future expansion of LNG terminals in the country.

About the author

Miss Xie Jieying is a lecturer in the navigation department of the Shanghai Maritime University. Apart from being a teacher, she is also a certified officer. In 2013, she received a master's degree in Maritime Safety and Environmental Administration from the World Maritime University in Malmo, Sweden. She is now a doctorate candidate in vehicle operation engineering. In recent years, she has engaged in the education of maritime cargo operations including containerisation and modern cargo operations, whilst actively taken part in related studies and projects involving marine terminal operations and environmental protection.

About the organisation

Shanghai Maritime University (SMU) is a multi-disciplinary university with a special emphasis on shipping, logistics and ocean science. The history of SMU can be traced back to 1909 at the end of Qing Dynasty and the university has been honored as a "cradle of international shipping specialists". At present the university runs 19 doctoral programs, 59 master's degree programs, 45 bachelor's degree programs. SMU has over 20,000 full-time students, including 17,000 undergraduates and over 3,000 postgraduate students. In the MOE evaluation of undergraduate education in 2004, SMU was awarded an "A"(Excellent). SMU has always attached much importance to exchange and cooperation with overseas institutions, and has established close ties with over 70 overseas universities and academies.

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