Floating Liquefaction (FLNG): How far will it go?

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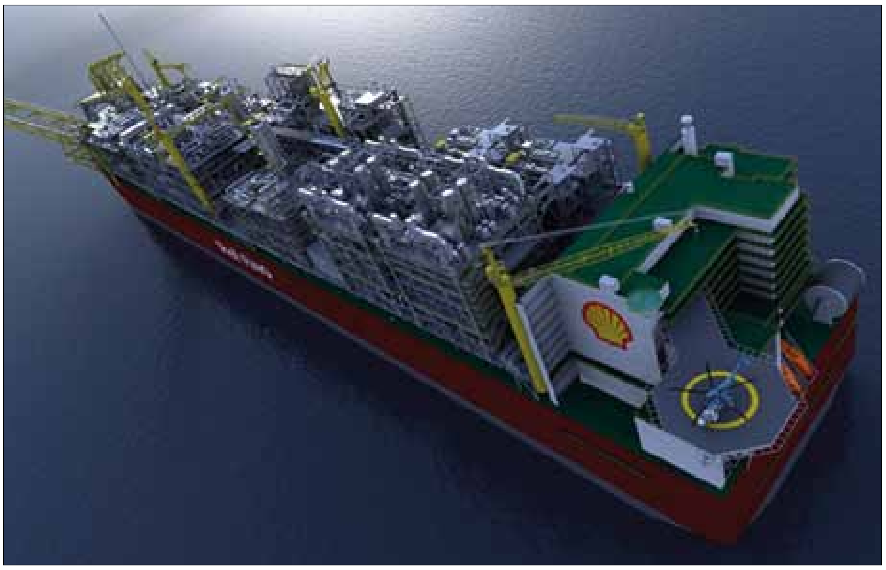
The liquefaction of gas offshore utilising floating LNG (FLNG) has been the nirvana of LNG developers since the basic concept was developed in the 1990s. Companies saw the potential of FLNG as a means to access stranded gas fields that could not otherwise be economically developed, either because they are too far from shore, or too small to support an economic land-based liquefaction project. In May 2011 'theory' took a huge step closer to 'fact' as Shell took the final investment decision on its 3.5 million tonne Prelude project in Australia with start-up in 2016/7, a strategic move as the company aims to replicate the concept for other projects in a "build one build many" strategy. Other companies have also announced that they are planning to move ahead with FLNG projects. Flex and Hoegh have each claimed that they will launch rival projects in Papua New Guinea by 2014, though neither company has taken Final Investment Decision (FID), and no sooner had Shell announced its decision to move ahead with the project than Malaysia's Petronas announced it was going ahead with Technip to develop a smaller 2 million tonne project to commercialise offshore Malaysian gas fields. FLNG projects are certainly gathering momentum, but which projects will go ahead and why?

Why FLNG?

Growing demand for clean energy, recent policy moves away from nuclear and a perception that gas pipelines may not necessarily give the assurance of security of supply that gas buyers seek, underpins a good growth story for LNG. Estimates are that LNG demand will double by 2025 and, in reality, if an economic project can be developed then buyers will be in place for the volume – but where are the projects that will supply this demand? Discovered offshore gas reserves, which have been defined by many developers as "stranded" due to their remoteness or location in deep water often cannot be developed commercially using onshore facilities. Where this is associated gas it is often re-injected or simply flared – thus foregoing the market value of the gas. Liquefying the gas offshore can access more reserves and stop flaring, thereby giving a low opportunity cost for the gas compared with liquefaction. Offshore LNG, therefore, saves building a sub-sea pipeline to move gas to shore, gives access to smaller reserves economically and theoretically the unit can be moved to a new location once the exploitation of the original field is completed.

Project promoters also argue that the costs of marine liquefaction and loading facilities are lower than those of onshore plants – some developers claim 20-30 per cent cheaper – and that construction time can be up to 25 per cent shorter than land based projects, as the facilities can be built in yards that have purpose built facilities, not in the remote greenfield locations that are typical of many onshore projects. Permitting and approval processes are seen as easier than similar onshore plants as offshore projects are subject to different regulation requirements. Floating Storage and Re-gasification Unit (FSRU) projects potentially open up the business to newer smaller companies to participate in the LNG sector. In a business that, to date, has used economies of scale as a means to reduce unit costs, (which has meant that the absolute cost of the projects has increased), size and, therefore, high costs have acted as a barrier to entry. The involvement of new players can only be good news to a contractor capacity constrained business. Project developers also argue that the lack of onshore sites

Artist's impression of the Shell Prelude FLNG Project



Source: Shell

for liquefaction plants means that they are being pushed offshore to develop new projects. FLNG thus removes a major obstacle to bringing these gas fields to market.

Options

There are two designs that are being considered by project developers:

Barge based facility that would carry the size of plant that could be built onshore

Under this design, the liquefaction facilities are mounted on a barge-like structure, with the LNG stored in the hull underneath. On 20th May 2011, Shell announced its intention to go ahead with this design concept in the world's first FLNG project at the Prelude field 200km offshore Western Australia in 200-250 metres of water. The project has been designed to produce 3.6 million tonnes of LNG, 1.3 million tonnes of condensate and 0.4 million tonnes per annum of liquid petroleum gas (these liquids providing an important revenue to support the project's economics). The vessel is being constructed in the Samsung yard in South Korea by a joint venture of Samsung Heavy Industries and Technip. The construction is scheduled to be completed in 2016 with start of production planned for late 2016 or early 2017. The liquefaction unit will be 488 metres long - the length of which is equivalent to four soccer pitches or the first hole at Augusta golf course, Georgia, USA (home of the annual US Masters golf) and weighs 600,000 tonnes. Shell is promoting a second FLNG vessel to be used for the development of the Sunrise field in the Timor Sea in the Joint Development Area between Australia and Timor Leste. This project is not currently proceeding, as the Timor Leste Government would prefer the project to be developed as an onshore plant. Until this is resolved, the project is unlikely to move forward.

Petrobras has also been considering floating LNG as a means to evacuate gas from the huge pre-salt associated gas reserves offshore Brazil. Japan's Inpex is planning an FLNG project to commercialise gas in the Masela block in Indonesia. In July 2011 it announced that Shell had taken a 30 per cent stake in the Masela block, and Inpex in its statement said that Shell's expertise in large-scale offshore gas development activities and its FLNG experience were factors in its decision to involve Shell as a partner. At the same time, Inpex announced that it intends to award front-end engineering and design in the first half of 2012, which would suggest a 2013 FID and start-up in 2018.

Ship based design, where the liquefaction plant is built on a purpose built vessel that is sized as a conventional LNG ship

This design is being pursued by several companies including; Flex LNG; SBM/Linde/IHI; Hoegh LNG/Lummus (CB&I)/Aker; Teekay; Excelerate Energy; Malaysian International Shipping Company and GDF Suez. All these companies are looking at developing FLNG projects in the 1.5-3.00 million tonnes per annum range. Flex ordered four FLNG vessels from the Samsung yard in South Korea in 2007, and at that time announced that they would be producing LNG by 2011 - to date none have been delivered as the liquefaction projects are yet to be firmed up. No other production units have been ordered.

Companies were initially looking at developing these FLNG units as offshore projects, but the focus of two companies, Flex and Hoegh, has moved to placing the FSRUs inside a harbour, therefore reducing some of the technical risks of operating in open water. Both companies have plans to use in-harbour FSRUs for the commercialisation of gas in →

Artist's impression of Flex LNG Papua New Guinea proposed FLNG project

Source: Flex LNG presentation to the FLNG Conference, London, 2011

→ Papua New Guinea. In April 2011, Flex LNG announced the signing of firm agreements with InterOil Corp, Pacific LNG, LNGL and SHI to develop an inland FLNG jetty location for a 2.0 million tonnes FLNG facility with a condensate stripping plant to use gas from the Elk and Antelope Gas fields. In May 2011 Hoegh LNG announced that it had established a holding company "PNG Floating FPSO Ltd" with Petromin PNG Holdings Limited and DSME E&R Limited to develop a LNG FPSO project in Papua New Guinea and to develop a FLNG project, to be constructed at the DSME ship yard in South Korea, capable of producing up to 3 million tons of LNG annually, with a storage capacity of 220,000 cubic metres.

Other companies are developing FLNG projects; for example in February 2011 Malaysian state-run Petronas and Malaysian International Shipping Corporation awarded a front end engineering and design contract for an FLNG project to Technip and Daewoo for a project in Malaysia. GDF Suez is developing the Bonaparte FLNG project in North-Western Australia, targeting first LNG in 2018, and Excelerate is looking to develop a 3 million tonne facility, using three one million tonne LNG trains, and having completed front-end engineering and design (FEED), they are currently evaluating which project to proceed on.

Challenges to development

The list of challenges to the development of FLNG has been long discussed at LNG conferences and used by traditional LNG project developers to gain advantage over offshore projects. Yes, the challenges are many, but the industry needs change and access to new liquefaction capacity and certainly FLNG projects will be developed – the key question is when and how many?

All LNG projects, floating or land based, are capital intensive and structured around long-term, offtake agreements to provide the necessary revenue flow to support the project economics and, in many cases, the financing of the project. FLNG is a new technology and this means that lenders, who are often conservative in their approach, will seek support guarantees from project sponsors. Finance will, therefore, be difficult to obtain unless the shareholders are large creditworthy companies; indeed in such cases the companies will probably prefer to finance off their own balance sheets. This will mean that smaller companies without deep balance sheets will not be able to develop such projects or will have to bring larger companies or governments in as shareholders to give the necessary credit support.

FLNG also faces local in-country challenges – often governments see LNG projects as a means to develop their infrastructure and create jobs. Can FLNG projects achieve the local content requirements that governments seek, especially as a key advantage of FLNG is that the vessels can be constructed in specialised shipyards, thus avoiding local costs of development and potentially speeding up the project? Can the cost savings be achieved? Will there be cost overruns as developers start implementation?

Developers also face technological challenges. Can the facilities economically manage the treatment of liquids and impurities? Will the facilities have enough flexibility to manage changes in gas quality, in the feed gas either at the first location or, if moved to an alternative location, from new gas fields of a different quality? In such cases additional equipment may be required. But if so, will there

Artist's impression of Flex LNG Papua New Guinea proposed FLNG project Source: Hoegh LNG presentation to the FLNG Conference. London, 2011

be space on the FLNG for such changes? Will space on the vessel be a limiting factor? There has also been a lot of discussion by project developers about the operational challenges facing FLNG – will the workforce be safe? How to manage the transfer of LNG between two floating structures using flexible hoses? How will the liquefaction equipment perform when the vessels are in motion on the sea? All these challenges will have to be resolved and proven as manageable to the sponsors and financiers. And, finally a key point, how will they impact on the project economics. Developers are indicating unit costs in the range US$700m to US$1bn per million metric tonnes[1] (the Shell Prelude project is reported to potentially be above this range), and at these costs, is FLNG still attractive to project developers? If costs were to be substantially above this range, it may move developers towards favouring land- based liquefaction projects.

Commercial structures

FLNG projects are likely to include a range of different stakeholders including upstream participants, national oil companies (or equivalent), FLNG vessel owners and/or operators, buyers of LNG (and natural gas liquids), vessel suppliers to move the liquids and suppliers of services to the FLNG and Federal/State/Local government bodies. Some of these stakeholders are new to the LNG liquefaction business and this could give rise to structuring complexities. Economic viability and cost of procuring the vessel and the allocation of risk for failure to perform across the LNG chain, as a result of the FLNG not operating correctly, will mean that lenders will seek extensive completion guarantees which may not fall away until a long time after start-up. For example, if an FLNG has been designed to withstand a specific strength of storm, lenders may insist that shareholder guarantees do not fall away until such a storm has been experienced, and this may only happen every 5 or 10 years, then the guarantees would have to remain in place for that period of time.

This would encourage the development of these new technology projects by large credit-worthy companies who can finance from their own balance sheet, without recourse to third party debt. This is what Shell has done with the Prelude FLNG project, keeping 100 per cent of the equity and using corporate debt to finance its construction. Shell will also take all the output into its LNG portfolio and the reported LNG sales of 0.8 million tonnes to Osaka Gas and 2 million tonnes to CPC will be supplied from this portfolio without a link to the Prelude project as a single supply source. This will mean that Shell can develop the project without "partner drag" and so focus on the technical aspects of the project without the distractions of marketing of the LNG and project financing. The LNG buyers also have the comfort that if Prelude is late for any reason, then they still get their LNG from the Shell portfolio of aggregated volumes. It will be difficult for smaller companies to structure a similar deal: their commercial structure would have to be established such that the risks are allocated specifically to give the buyer the necessary supply assurances that the LNG will be produced from the FLNG facility, while giving the developer the contractual and technical freedom to develop the project. These joint challenges may explain the delays in many FLNG projects to date.

Conclusions

Companies have been looking at FLNG as a means to produce LNG since the 1990s, and maybe earlier, with 2011 seeing the first FID. There are several other projects being considered with many companies seeking to succeed in this next frontier for LNG.

The key challenges are technology and financing, and these are inextricably linked. Once the first project has been successful the technology risk will reduce and bankers will be more pre-disposed to lend money, thus opening up the sector to smaller companies who aspire to be project developers. Projects with large backers, or other economic drivers (such as the Brazil pre-salt where the gas has to be moved to enable vast oil reserves to be tapped) will proceed; others where technological risks can be reduced (such as locating the FLNG facility in a harbour) may also proceed. But the number of "true" offshore FLNG units will be limited until the industry has seen a track record of successful operation.

The industry needs new technology to access and move remote deep water gas to market. FLNG is such a technology and is here, hopefully, to stay. That said, its impact on overall LNG production will be limited and by 2025 could represent only 5-10 per cent total LNG production globally. ■

1. The industry compares liquefaction costs using an indices of $/metric tonne installed capacity (i.e. the capital cost of a project divided by its capacity). Whereas in the period up to 2005 liquefaction costs were $300-600/metric tonne installed capacity (MTIC), newer projects are proceeding at far higher costs. Over the period 2008-2011 projects have taken investment decisions on the basis of capacity costs in the region $1000-1800/MTIC or higher (with expansion projects $700-900/MTIC).