FLOATING LNG: A REVIEW OF THE FORCES DRIVING THE DEVELOPMENT OF FLNG, CHALLENGES TO BE OVERCOME, PROJECT STRUCTURES AND RISK ALLOCATION IN A VIABLE FLNG PROJECT

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1. Introduction

FLNG has the potential to unlock significant reserves of stranded natural gas - provided challenges to its development, implementation and operation are successfully cleared.

Without FLNG, stranded gas would not otherwise be economical to monetise due to its geographic location, whether in terms of remoteness or deepwater, or relatively small size. In each case, physical impossibility and/or high capital costs mitigate against monetisation. By eliminating the need to build a costly fixed pipeline or other infrastructure, FLNG removes a major obstacle in bringing “stranded” gas to market.

2. What is FLNG?

Generically, there are three types of “floating LNG” currently implemented or being planned.

Floating Regasification: As used on floating storage and regas units (FSRUs) and shuttle regas vessels (SRVs). FSRUs are designed to receive LNG from a shuttle conventional LNG vessel, store and then regasify the LNG as and when required. The FSRUs may or may not also be designed to operate as a conventional LNG vessel, and may sail to pick up and deliver LNG cargoes anywhere in the world, within operating and insurance limits. FSRUs that are barge-like are unlikely to perform (or be able to perform) such ocean voyages. SRVs are designed to perform differently - they act more like a conventional LNG vessel, picking up and delivering cargoes, except that the regas delivery function is typically performed at a buoy located some distance from the shore. The intention being that the SRV will regasify and unload its cargo as soon as possible upon arrival at the remote buoy. The gas is then transported (via undersea pipeline) to gas storage facilities on-shore. Accordingly, SRVs are not intended to provide the LNG storage function of an FSRU. In both FSRUs and SRVs there is no (to date) gas liquefaction process.

On-board Reliquefaction: As a means of cargo preservation, on-board reliquefaction equipment has been installed on conventional LNG vessels. The reliquefaction equipment reliquefies LNG boil-off gas, with the resultant LNG being pumped back into the vessel’s containment system. While this system requires additional power input, it can be a useful means of preserving the value of the vessel’s LNG cargo.

Floating Liquefaction: Involves the production of LNG directly at offshore oil and gas fields by floating production storage and offloading (FPSO) type vessels. Of the three types of “floating LNG”, it is fair to say that floating liquefaction presents the most difficult technical, commercial, legal and operating issues.

This article focuses on floating liquefaction projects (for purposes of this article, “FLNG”).

3. LNG vs. FLNG Value Chain

LNG Value Chain: In a conventional LNG project, the “value chain” typically consists of the following:

- gas sale and purchase agreements (GSAs) between the gas suppliers and LNG Project Company (Project Co), whereby gas is delivered to the land-based liquefaction plant;
• engineering procurement and construction (EPC) or similar contract between the contractor and upstream participants or Project Co (as applicable) for construction of the LNG liquefaction plant and related infrastructure (gas receiving and processing, storage and marine infrastructure);

• where LNG is sold on a DES/CIF basis, time charter party (TCP) between the vessel owner and Project Co (or an affiliate) - and in respect of new-build vessels, the vessel shipbuilding or EPC contract (between the owner and shipyard/contractors, although many of the provisions of this contract will need to be aligned or back-to-back with the provisions of the TCP); and

• LNG sale and purchase agreements (LNG SPAs) between Project Co and third party buyers.

**FLNG Value Chain**: In addition to the above, the FLNG value chain may include the upstream legal and contractual regime governing the development and production of the gas field and the determination of the gas suppliers’ production share (including applicable laws, granting instruments such as licences and production sharing contracts (PSCs), and the inter-party equity allocation agreements such as joint operating agreements (JOAs)). Indeed, it is likely that such upstream arrangements will be considered integral to the FLNG value chain because, except for LNG and NGLs, there is no other means by which the gas suppliers can market their gas.

Further, downstream activities such as LNG regasification, gas storage, transportation (pipeline) and marketing arrangements may also form part of the FLNG value chain, and, in any case, will be important to consider, including in relation to the creditworthiness of the LNG buyers (some of whom may be direct investors in Project Co).

**Figure 1: Potential FLNG value chain.**

4. **Primary Challenges in Developing a Successful FLNG Project**

The list of challenges relevant to the development of an FLNG project is long. It potentially includes:

• reservoir risk at one end of the spectrum;

• operating and performance risk of each counterparty to each contract at each point along the value chain;

• LNG market risk and other downstream risks relating to regasification, storage, transportation and marketing of natural gas, at the other end of the spectrum.

In the context of the deployment and operation of an FLNG vessel, there are four primary challenges: technical, operational, commercial and legal. Each cover a multitude of sub-issues and challenges.

Before reviewing each of these issues, it is relevant to note the oil industry’s experience in the context of FPSOs - and the continuing technological and operational successes achieved over the past thirty (30) years or so. While FLNG vessels and projects present new and additional technical issues, there is substantial commonality of issues between oil FPSOs and FLNG vessels. The parallels include hull design, mooring systems, tank sloshing, marinisation of equipment, ship-to-ship transfers of liquids and maintenance in harsh, off-shore conditions. Further, by virtue of similar operating environments between FPSOs and FLNG vessels, there may also be operational parallels to be drawn. And finally, to the extent legal structures have been developed to address the peculiar issues relevant to FPSOs, then similar legal structures may be relevant to FLNG vessels. Accordingly, in developing FLNG projects, the LNG industry could usefully draw from the oil industry’s experience in relation to FPSOs.
a. **Technical Issues**

While the development and implementation of FLNG technology seems within grasp, the technology has not yet been successfully implemented on a commercial scale. Challenges include: the integration of the topside processing equipment with the hull (with a deck layout that meets all operational and safety requirements), selection of a containment system (with the difficulty of constantly changing volumes within the tanks and related sloshing issues), “marinisation” of equipment, vessel mooring systems, up-scaling of plant capacity and ship-to-ship offloading of LNG, particularly in dynamic metocean conditions.

b. **Operating Issues**

Consider the logistical issues relevant to operating a “floating port,” potentially located far from land-based services, without drydocking, for a period of 20 years or more. Relevant issues may include: the provision of tug services (if required), the scheduling of FLNG vessel and equipment maintenance (planned and unplanned), the delivery and storage of spare parts, fuels and catalysts, the scheduling of gas receipt, processing and liquefaction to meet LNG and NGL delivery obligations and the scheduling of liquid cargo transfers (both LNG and NGLs), in each case, in potentially dynamic metocean conditions. Recognising that failure at any stage of the process could cause contracted cargo delivery obligations to be breached, a shut-down of the FLNG vessel and, potentially, a “shut-in” of the field.

c. **Commercial Issues**

A key commercial issue will include the economic viability of the FLNG project, given such factors as:

- the availability and price of more accessible gas (land-based or not) and other fuels (such as oil);
- alternative pipeline and processing infrastructure;
- the cost of developing and operating the upstream assets for an integrated project;
- the cost of procuring and operating an FLNG vessel;
- the demand and market price for LNG and NGLs; and
- the allocation of risk for failure to perform any obligation at any point across the LNG value chain.

Other commercial issues may include: project cost comparisons with land-based unit liquefaction costs (including construction costs - which had, until recently, been increasing steeply), the condition of the ship building industry and steel prices - each trending in favour of FLNG vessel construction. Countered by the technical, operating, legal and other commercial challenges in developing an FLNG project and the willingness of the various counterparties to any project company to accept risk in relation thereto.

d. **Legal Issues**

Many legal issues are closely linked with the technical, operating and commercial issues described above. In that context, the legal responsibilities, obligations and legal risk for each operation in the FLNG process must be properly allocated. The potential counterparties includes:

- the upstream participants (including potential national oil companies (NOCs) or equivalent);
- FLNG vessel owner/operator or tolling operator (if applicable);
- buyers of LNG and NGLs;
- owners/operators of conventional LNG and NGLs vessels (responsible for transporting the cargoes to market);
• suppliers of fuels, catalysts and services (including tug services, if applicable); and
• relevant local government authorities.

Paragraphs 5 and 6 below consider “legal issues” in the broader context of an FLNG project (including project structures and risk allocation). In addition, however, there are important upstream and technology legal issues that may be relevant to an FLNG project.

**Upstream Issues:** The physical and legal proximity of the FLNG vessel to the upstream legal arrangements/regime will almost certainly impact the FLNG project. For example, will the cost (Capex and Opex) of acquisition, chartering and operating the FLNG vessel be recoverable under the scope of the granting instrument? If so, will title to the FLNG vessel be required to pass to the government upon termination of the granting instrument? Will the gas destined for the FLNG vessel be processed by the upstream participants separately, jointly, by a special purpose project company or by a third party under tolling arrangements - and do local laws require or prohibit any or all of he above options? How will the production “split” and the relative allocation over time influence the participants in deciding whether to market their own LNG or to form a marketing company to aggregate and sell the LNG? Where does title to the gas pass to participants, and does any transfer of title occur as LNG? Will the upstream participants be obliged to supply LNG to the relevant local market - and if so, on what terms, including pricing and liability for failure to take such supply? What is the basis of valuation of production entitlement (LNG or natural gas, and local or international market price)? The answers to these questions will be determined by applicable law and the upstream legal regime.

The gas supply agreement (GSA) should be aligned as closely as possible with the liability regime in the other material project contracts - including, in particular, in relation to delivery short-falls, non-delivery scenarios and termination events (see below). Other important legal issues will include whether or not the field reserves are dedicated to the project, and obligations relating to gas quality specification. The gas purchaser would also prefer the upstream sellers to be jointly and severally liable (and not just severally liable), with a single point of responsibility coordinated by a seller representative, including in relation to nominations, delivery and gas quality issues. Finally, what pricing methodology is used - “net-back” price, market price or “cost plus” basis?

**Figure 2: Selected Upstream Questions and Issues**

<table>
<thead>
<tr>
<th>Questions</th>
<th>Issues for Project Investment and Structuring</th>
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<tbody>
<tr>
<td><strong>Rights of upstream participants</strong>&lt;br&gt;Are rights to hydrocarbons exclusive or retained by the State?</td>
<td>• Where does title to gas pass?&lt;br&gt;• What level of State involvement in project structuring, and hydrocarbon marketing decisions?</td>
</tr>
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<td><strong>Recovery of costs and ownership and retention of infrastructure</strong>&lt;br&gt;Is there a cost recovery regime?&lt;br&gt;Are there rights of State or third parties to the project infrastructure?</td>
<td>• FLNG vessel ownership and legal structures relating to the vessel are impacted by cost recovery&lt;br&gt;• Protecting FLNG vessel from claim of State ownership&lt;br&gt;• Simpler decommissioning with FLNG technology</td>
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<td><strong>Sharing of production entitlement</strong>&lt;br&gt;Does the State have rights to production?&lt;br&gt;How will the participants’ production entitlement be impacted by the State’s involvement in lifting gas, LNG production capacity requirements and LNG sales?</td>
<td>• Actual cost recovery will impact allocation of hydrocarbon share to participants&lt;br&gt;• LNG marketing and project structuring are impacted by changing levels of production entitlement over the project life&lt;br&gt;• How will the State manage its entitlement to gas and the LNG produced?</td>
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Domestic vs. International market
Are there minimum requirements for domestic services and labour?
Must hydrocarbons be sold in the domestic market?
Must hydrocarbons to be “valued” on a domestic market basis?

- Sourcing and employment obligations - compounded by offshore environment and sophistication of technology
- Is there a local market for LNG?
- What is being valued - natural gas (from the reservoir) or LNG?
- How is the international market defined - when LNG sales are not on the basis of long term contracts or are separate and not aggregated sales?

Technology Issues: Two primary questions for consideration in relation to an FLNG project: (i) will the project utilise existing third-party technology (under licence or similar arrangement) or (ii) develop new/proprietary technology?

Under a licence, issues for consideration may include:

- the terms of the licence (geographic scope, purpose and limitations of use);
- rights of use for other projects - even in competition with the project in question;
- whether the licence is tied to a specific production level (with additional licence fees payable for higher production levels);
- ownership of any improvements made to the technology in implementing the project;
- ownership of jointly developed technology;
- will the licence be exclusive, irrevocable (if not, in what circumstances is it revocable?), fully paid, perpetual and royalty free.

In addition, the licensee would typically expect to be indemnified for any patent infringement by the licensor, together with general indemnity protection in relation to death, injury, damage or pollution arising from the technology. Finally, confidentiality, disclosure and dispute resolution issues will need careful consideration.

On the other hand, where new technology is to be developed, what legal arrangements will apply to the respective parties’ rights and obligations? In this case, the party wishing to develop the new or proprietary technology may enter into a front-end engineering and design (FEED) contract with a third party(ies) tasked with developing such technology (being the FEED contractor). Under a FEED arrangement, relevant issues may include:

- ownership of the “work product” and “excluded ” work product, i.e., work product to which the FEED contractor or other party retains ownership;
- whether or not the FEED contract is on a lump-sum milestone, fixed price basis;
- whether the primary FEED contractor provides a performance “wrap” in relation to the activities of each subcontractor;
- the requirement for on-going and frequent reporting, meetings and inspection rights during the development phase;
- the requirement to meet specified milestones in accordance with a detailed work schedule;
- incorporation of a detailed review and evaluation process of the technology (prior to “acceptance”);
- rights to accept or reject the technology (based on verifiable performance criteria);
- post-acceptance defect rectification obligations;
• whether liquidated damages are payable in respect of any delay in the work schedule (and how change orders and related costs are taken into account);

• force majeure provisions;

• approval or veto rights in relation to subcontractors; and

• HSSE provisions.

These are in addition to the indemnity, confidentiality, disclosure and dispute resolution issues noted above in relation to licensing.

5. FLNG Project Structures

There are three basic project structures for an FLNG project:

**Integrated Model:** Under the integrated model, the upstream participants’ share of production is set out in the respective granting instrument, i.e., the PSC or licence and, between the parties, the JOA or similar agreement. The upstream participants build all necessary infrastructure to produce, liquefy and market the natural gas - with the liquefaction plant, i.e., the FLNG vessel, being potentially treated as part of the overall “upstream” investment and infrastructure. Each upstream participant would typically retain title to their respective molecules of gas from the time they receive title under the granting instrument, until sold as LNG to a third party - but may agree to act collectively in selling their LNG. As with conventional LNG projects, the SPAs could either be on FOB (delivery at the FLNG vessel) or DES/CIF or similar terms (delivery at the buyer’s regasification facility or other agreed location). Under DES/CIF contracts, the upstream participants would also be responsible for arranging the shipping/transportation of the LNG to the buyers. Under the PSC and JOA, the operator of the field is typically responsible for procuring all necessary assets and services to develop the field and extract the reserves. To the extent that the FLNG vessel is considered part of such assets or services, the upstream participants (or a special purpose company (SPC) established by them or the operator as agent for or on behalf of the other participants) may enter into a TCP or tolling agreement or similar contract with the FLNG vessel owner/operator for provision of the vessel and related services. Such services would include receiving and processing natural gas, liquefying and storing the LNG and NGLs and offloading the same - in addition to the typical maritime functions of a vessel.

However, the choice and/or ability to integrate the FLNG vessel into the upstream arrangements will depend on applicable law and the terms of the granting instruments themselves - see below. Relevant issues may include: (i) the extent to which capital and/or operating costs of the FLNG vessel and related assets are recoverable under the PSC, (ii) whether the non-government participants’ allocation of production is sufficiently stable and/or known to permit entry into long-term LNG sale contracts (marketable volumes may vary depending on field cost recovery under the PSC) and (iii) the means by which the extracted reserves gas are valued under the PSC - see below. The point at which title to the gas or LNG passes from the government to each participant under applicable law and/or the PSC will also be relevant to structuring decisions.

The integrated model may grant each participant additional flexibility in dealing with its allocation of production (assuming each marketed its share separately), but this also raises operational issues relating to the use of the “scarce” resources of the FLNG vessel, including processing, offloading and berthing “bottlenecks.” As noted above, failure to timely offload LNG may result in a shut-down of the FLNG vessel’s gas processing or liquefaction activities and, potentially, a shut-in of another participant’s production (as the FLNG vessel would be unable to receive, process or liquefy natural gas with full LNG tanks). Each of these issues would need to be addressed in operational agreements between the upstream participants.

If the upstream participants agree to sell cargoes on a joint/collective basis, the use of an LNG marketing company (LNG Marketing Co) may also be considered which is a move toward the project company model, discussed below. If adopted, each participant would pass title (immediately upon receiving title from the government) to its gas or LNG to the LNG Marketing Co. The shareholders of LNG Marketing Co would be the upstream participants, possibly pro-rata their respective interest in the reserves. Use of an LNG marketing company may provide better leverage to the group of
upstream participants in negotiating the SPAs and TCPs (if applicable), and may also result in greater certainty of aggregate marketable volumes - which will be important in any long-term SPA. However, it would also involve relinquishing control over the marketing and sale of LNG by individual participants.

**Figure 3: Integrated FLNG Model**

**Project Company Model:** The most common model in conventional land-based liquefaction projects is the project company model - in which the Project Co that owns the LNG facility, i.e., the FLNG vessel, purchases natural gas feedstock from the upstream participants, processes and liquefies the gas into LNG (and NGLs) and sells the LNG (and NGLs) to buyers for its own account. Typically, but not necessarily, the upstream participants are some or all of the shareholders in Project Co, pro-rata their upstream participation interests - with the result that the project company model may reflect an integrated, partially integrated or non-integrated project structure.

Under this model, Project Co assumes the benefit and risk associated with marketing and selling LNG (including contractual risk and price fluctuations). Commercial considerations may also dictate the use of the project company model - for example, where the upstream participants are unwilling or unable to invest in the FLNG vessel. The model also provides greater flexibility to introduce new equity participants to this part of the value chain, for example, by permitting the owner or licensor of the FLNG technology or downstream LNG purchasers to take an equity interest in Project Co. The structure may also support and be more favourable to project financing by Project Co.

There are also many variations on the project company model, for example Project Co may source gas from its shareholders only, and sell the LNG to the same parties. Alternatively, it may source gas
and sell LNG from/to third parties, i.e., non-shareholders. In some land-based liquefaction projects, there are different ownership interests and different buy/sell obligations between the different LNG liquefaction trains. Additionally, Project Co may be owned directly or indirectly by the NOC, and operated by a operating company owned by the PSC contractors pro-rata their participation interest in the reserves.

**Figure 4: Project Company Model.**

**Tolling Model:** Under a tolling model, the owner/operator of the liquefaction facility, i.e., FLNG vessel (Tolling Co), does not take title to the gas and/or LNG as it is processed, liquefied and stored. Instead, Tolling Co receives a fee for providing the above services. Tolling Co would typically own or bare-boat charter the FLNG vessel, and enter into a tolling agreement with the upstream participants or a related SPC for provision of the tolling services - for a fee. The tolling fee is typically structured with two components - fixed fee for minimum volume or throughput obligations, and a variable fee for additional volumes. The fixed fee typically covers debt service or chartering costs (in relation to the FLNG vessel), fixed operating costs and an equity return for Tolling Co. The variable fee typically covers variable operating costs and an additional equity return for Tolling Co. As noted above, arrangements will likely be required between the tolling customers (known as inter-customer agreements) to deal with supply issues (volume and quality), offtake and FLNG capacity issues between the tolling customers and Tolling Co.

Tolling arrangements may be beneficial where the upstream participants prefer not to take FLNG vessel procurement and operating risk. With FLNG vessel capital costs potentially exceeding US$2 Billion per vessel, and with Tolling Co being responsible for procuring the FLNG vessel, this is a considerable saving on project development costs for the upstream participants - for which they may otherwise be responsible under an integrated model. In this case, FLNG vessel procurement and operating costs become a project expense rather than an upfront capital commitment for the upstream participants or Project Co. However, such arrangements require detailed analysis and modelling, and
would only be viable where LNG market prices support the additional margins payable to another participant, i.e., Tolling Co, in the overall FLNG value chain.

As an alternative structure, the LNG buyers could be the tolling customers instead of the upstream participants. In this case, the upstream participants would sell natural gas directly to the buyers (title to the gas being transferred to the buyers prior to it being processed, liquefied and stored as LNG), and the buyers would then contract with Tolling Co to process the gas.

**Figure 5: Tolling Model**

Finally, without elaborating on all the permutations, there are a number of potential hybrid FLNG project models that could be implemented - and which are created as a result of the differing obligations the applicable parties may elect to impose on themselves or others. Such hybrid models are likely to derive from one, two or all three of the above project models.

6. **Risk Allocation and Alignment of Interests**

The FLNG value chain is complex and inter-related and, depending on the structure adopted, may include a wide range of contracts. Critically, a failure to perform under any one of these “links” in the chain may trigger significant obligations under other contracts up or down the chain and, therefore, impact overall project viability and economics. For this reason, while participants at different points of the value chain may have separate commercial and legal objectives, careful coordination of legal terms and alignment of interests between all such contracts is ultimately desirable for all participants.

a. **GSAs**

Under GSAs, the gas seller(s) typically take “reservoir risk” (risks relating to the availability/quality of gas at source), gas infrastructure risk (issues relating to gas extraction and transportation
infrastructure), “start-up” risk, change in law risk (in respect of which “stabilisation” provisions should be contemplated) and political risk (such as expropriation). In conventional land-based liquefaction projects, responsibility for processing the gas (including stripping off the NGLs) may reside with either the gas sellers, buyers or in some cases a third party. However, in the context of an FLNG vessel, the operator of the FLNG vessel will be responsible for LNG vessel “performance” risk, including risks associated with gas processing, liquefaction and the storage and offloading of liquids (both LNG and NGLs) - as well as other maritime risks.

The liability regime under a GSA would reflect this risk allocation, and would typically provide some form of deliver-or-pay obligation on the gas seller(s) for their under-delivery of buyer nominated quantities (and specifications). There may also be buyer termination rights for seller’s prolonged failure to meet such obligations. Similarly, the gas buyers would typically be expected to have take-or-pay obligations for a specified and negotiated quantity which underpins seller’s economics. In this context, i.e., a gas seller default resulting in gas buyer default under (if applicable) any LNG SPA, an important issue for consideration is whether the gas buyer has recourse against the gas sellers in respect of any liquidated or other damages payable by the gas buyer under such LNG SPA - and, if so, whether such liability should be carved out from any general limitation on liability under the GSA.

The above circumstances illustrate again the importance of alignment between each of the major project contracts - and particularly between the GSAs and LNG SPAs. Other important provisions requiring a high degree of coordination (between the above contracts and other material project contracts) include: quantities and availability/delivery profiles, quality specifications, damages for delivery and/or acceptance shortfalls, conditions precedent and start-up timing, commissioning and build-up periods, term, termination provisions, nomination procedures and timing, force majeure and scheduled maintenance provisions. This is not to understate the importance of having alignment on other commercial and legal including boilerplate provisions in such contracts.

b. FLNG Vessel Construction

The risks in relation to FLNG vessel construction (as with conventional LNG vessels) is that the vessel will not be completed according to design, be delivered on time and on budget, be compliant with class or perform in accordance with expected design, capabilities and economics. These risks are potentially exacerbated in the context of FLNG vessels, given the issues involved with integrating the topside processing equipment with the hull and containment systems.

These types of risks are typically mitigated by design selection, FEED and engineering studies, the use of proven technology where possible, by using experienced and creditworthy contractors and industry accepted contracts where possible. In the ship building industry for conventional LNG vessels a lump-sum, turn-key construction or EPC contract is typically used. Whereas, on the operational side, a TCP is typically used. In each case, these contracts when properly drafted allocate risks to those most capable of managing them (itself a mitigation device) and serve to align the interests of the relevant counterparties. The EPC and TCP contracts are each briefly considered below.

c. Vessel Construction

Conventional LNG Vessel - Construction Contracts: Under a conventional LNG vessel construction or EPC contract, the shipyard typically takes primary responsibility (as between purchaser, shipyard and any other shipyard contractors) for design, construction, completion and delivery of the vessel within specifications, class and applicable law. Leaving aside HSSE and boilerplate provisions, other general protective provisions for the vessel purchaser typically include:

- a lump-sum contract with milestone payment (with each milestone verified by class representative);
- a shipyard obligation to provide detailed progress reports and drawings, etc,
- restrictions on the shipyard from making any material changes to the vessel without prior purchaser approval;
- wide ranging inspection rights of the hull/vessel at the shipyard;
• sub-contactor approval rights;
• appropriate force majeure events; and
• specific pre-delivery trials and tests of the vessel.

Other specific remedies in favour of the vessel purchaser (requiring alignment with the other project contracts, particularly the TCP) may include: liquidated damages for delay in delivery past the “scheduled delivery date” (with the right to terminate for material delay), shipyard warranties in relation to the vessel’s key performance parameters (with a specified percentage decrease in the contract price for specified deficiencies, and a right to terminate the contract for material failure) and shipyard responsibility to repair vessel defects that become apparent within a certain period of time.

The scope of such obligations will also need careful consideration, i.e., does it include the cost of making the vessel available for repair, the cost of dry-docking, the cost of gas freeing, warming up and inerting (as well as LNG used or wasted for re-cooling) and miscellaneous port related charges? In addition, what shipyard credit support will be provided in respect of its obligations under the contract - a refund guarantee from a creditworthy financial institution in respect of its pre-delivery obligations and, in some cases, a performance bond in respect of post delivery obligations.

**FLNG Vessel Construction - EPCIC Contracts:** Each of the provisions mentioned above with respect to EPC contracts for conventional LNG vessels will also be relevant to the construction of FLNG vessels and should be considered carefully in that context. However, FLNG vessel construction involves additional issues - relating particularly to integration of the specialist (processing and liquefaction related) top-side equipment with the hull, and vessel acceptance without in-situ performance testing and commissioning.

The potential “integration” risk for the vessel purchaser is that it may be factually difficult to prove that a fault or failure in the vessel’s performance was caused by one-part or another of the vessel. In order to avoid any legal “finger-pointing” over potential liability for such fault or failure, the FLNG vessel purchaser will ideally seek single-point responsibility for the vessel’s performance - a liability “wrap” by the primary contractor (most likely, but not necessarily, the shipyard).

Structurally, this may be achieved in numerous ways, for example, by having a single engineering procurement construction and integration (EPCI) contract between the shipyard and vessel purchaser. Under this arrangement, the shipyard could subcontract construction of the topside, while retaining responsibility for integrating the topside and hull and overall responsibility for the FLNG vessel’s performance. Presumably the shipyard would have separate contractual recourse against the topside contractors in relation to topside performance issues and, perhaps, topside/hull integration issues in respect of which the shipyard is liable to the vessel purchaser.

Alternatively, a similar result could be achieved where separate contracts exist between the vessel purchaser and shipyard for the hull construction, on the one hand, and topside contractor(s) for topside construction, on the other. Liability for overall vessel performance could then be achieved by overlaying these contractual arrangements with an additional umbrella contract between all three contracting parties allocating primary (single-point) responsibility for overall FLNG vessel performance issues to the relevant party.

In situ performance testing of the FLNG vessel may be addressed by including “commissioning” obligations into the EPCI contract, thereby becoming an engineering procurement construction integration and commissioning (EPCIC) contract. Such arrangements would include start-up and commissioning obligations, performance warranty and defect rectification provisions (as noted above), with the relevant performance levels and/or defects being determined after the FLNG vessel has been “hooked-up” to the gas field.

d. **Vessel Operation**

**Tolling Agreement:** Under tolling arrangements, Tolling Co typically only takes (in this context) FLNG vessel procurement and performance risk (including the risk that the FLNG vessel will be available for
use as and when required, and perform as required). In this context, FLNG vessel “performance” risk will include risks associated with gas processing (including stripping the NGLs), liquefaction and the storage and offloading of liquids (both LNG and NGLs) - as well as other standard maritime risks. Whereas, the tolling customers would typically take reservoir risk, gas infrastructure risk, start-up risk, upstream change in law and political risk (each as noted above). As a result, the tolling structure lends itself to project or similar financing at the Tolling Co level (in respect of the FLNG vessel). Other risks, such as LNG market and transportation risk and other downstream risks (as noted above) will be allocated in accordance with the applicable project contracts.

It will also be important to address issues relating to potential Tolling Co default under the tolling arrangements - ensuring that the tolling customers could take operational control of the FLNG vessel in circumstances where Tolling Co’s default prevents or delays critical FLNG vessel operations. This would typically be achieved by vessel bareboat and purchase options. Special consideration will also be required in relation to “quiet enjoyment” rights (potentially including step-in rights under a direct agreement) in relation to any default by FLNG vessel owner under its vessel financing. Similar issues are also raised in relation to any project financing of the FLNG project. Such agreement(s) should be structured to ensure that the FLNG vessel remains available to the tolling customers as intended, notwithstanding a financing default.

**Time Charter Party:** If the FLNG vessel is time chartered as opposed to owned, the TCP will typically allocate operational and performance risk of the vessel to the owner. As noted above, in relation to new-build vessels, these obligations will need to be coordinated and aligned with the obligations of the contractor(s) under the vessel EPC or similar contract, and with the other major project contracts.

In particular, under a TCP, the vessel owner (which, for the purposes of this article will include a “disponent owner” - where the vessel is operated under a bareboat charter or similar arrangement) agrees to dedicate the vessel to the charterer for the duration of the TCP. During this period, the owner is required to follow the lawful and reasonable instructions of the charterer subject to certain navigational and safety issues or where the vessel would be uninsured. The vessel owner is also responsible for providing the crew and all provisions, insurance, maintenance including drydocking and repairs and all certificates, etc., required to operate the vessel. In return, the charterer is typically required to procure and pay for all fuels, miscellaneous port charges, agency and similar fees. The charterer also pays a daily hire to the owner for use of the vessel, typically divided into two or three elements: a capital element (including an amount to cover the owner’s amortised capital costs and equity return), an additional cost element (covering any amortised modification or similar costs to the vessel) and an operating element (covering all the vessel’s operating costs for which the charterer is responsible).

Similar to the EPC contract, the vessel owner will typically be required to pay liquidated damages to the charterer for any delay in delivering the vessel past the “scheduled delivery date” (with the right to terminate for material delay). In addition, and in the context of a conventional LNG vessel, the owner will also typically be required to guarantee the performance parameters of the vessel such as: draft, speed, fuel consumption, LNG tank size, LNG loading and off-loading rate and boil-off rate. Failure to achieve the warranted performance levels may result in reduction of hire or termination (for material breach).

Whereas, in relation to FLNG vessels, certain additional performance parameters should be contemplated, including in relation to the FLNG vessel’s gas receiving capability, LNG and NGL production rate, LNG and NGL ship-to-ship off-loading rate, and fuel/catalyst consumption during FLNG operations and otherwise. Further, the FLNG vessel’s ability to remain in service at its station without drydocking for the entire duration of a long term TCP, i.e., 20 years, will be material, and protections other than the vessel being placed off-hire for the duration of such works should be considered.

Following the conventional LNG TCP model, any failure to achieve the warranted performance levels would result in a reduction in the daily rate of hire. If the vessel ceased to be available, it could be placed “off-hire,” in which case, no hire would be payable during the off-hire period. The TCP may also provide a termination right where the vessel is off-hire in excess of a specified period of time.
In addition (as with tolling arrangements, noted above), it will be important to address issues relating to FLNG vessel owner default under the charter arrangements - with vessel bareboat and/or purchase option rights. "Quiet enjoyment" rights and step-in rights will also need to be considered in relation to FLNG vessel financing default (by the vessel owner) and project financing default (by the relevant Project Co) in relation to any project financing.

e. LNG Sale and Purchase Agreements

LNG Marketing Co’s primary risk in relation to marketing and selling LNG is market risk - that is, the availability of LNG buyers and LNG pricing. Accordingly, the GSA and LNG SPA in combination should isolate LNG Marketing Co to the fullest extent possible from upstream risks (as noted above) and other downstream risks - such as: risks relating to availability and operation of the regasification and gas storage facilities (including construction, start-up, and commissioning risk), downstream gas market risk, downstream gas transportation risk, downstream change in law and political risk. The above risk allocation is primarily achieved by the liability regime and related provisions in the GSA (in relation to upstream risks) and the LNG SPA (in relation to upstream and downstream risks) - and the alignment between the GSA and LNG SPA.

The LNG SPA liability regime should include take-or-pay obligations on the LNG buyer for failure to take LNG deliveries as and when required and in the volumes required. These provisions can be complex, and may provide for certain flexibility between the parties - including, for example, buyer “make-up” rights or other mitigating provisions negotiated between seller and buyer. The LNG SPA may also provide termination rights for prolonged buyer default, with other provisions to protect LNG Marketing Co from the economic consequences of such termination being effected.

However, without careful alignment between the relevant contracts and provisions, the above structuring and other legal devices will not, by themselves, isolate LNG Marketing Co from all risks not directly allocated to it. For example, to the extent that any gas seller deliver-or-pay obligation under the GSA (in respect of gas seller default) does not cover any deliver-or-pay obligation imposed on LNG Marketing Co under the LNG SPA - then LNG Marketing Co has potential exposure to an upstream risk. And the same analysis applies in reverse, in relation to LNG Marketing Co’s inability to accept gas under the GSA due to any failure by an LNG buyer to take delivery of contracted quantities, although this should be ameliorated by flexibility in the sale arrangements, whereby LNG Marketing Co has the right to sell “spot” cargoes.

In the context of FLNG projects, particularly those in dynamic metocean conditions, there is a relatively high likelihood that LNG delivery from the FLNG vessel to a conventional LNG vessel will suffer delays and interruptions arising from the multitude of technical and operational issues (as noted above, including bad weather). Further, even in more benign metocean conditions, it is likely that any FLNG vessel’s predictability of supply in the context of long term LNG SPA supply contracts will be less certain than land-based LNG projects. The question then being: how is this risk to be mitigated, if at all?

While it is beyond the scope of this article to address these LNG SPA issues in detail, it is likely that diversification of LNG supply from other LNG projects or from “spot” LNG purchases, coupled with LNG SPA diversion rights under applicable LNG SPAs, may provide a hedge against delivery and scheduling issues relevant to an FLNG project. However, this “hedging” will not, by itself, address all relevant LNG SPA issues - and considerable attention will be required to LNG SPAs to make them viable in commercial and legal terms in the context of FLNG projects - including cargo scheduling, relevant liability regime, maintenance outages (perhaps on a “seasonal” basis), force majeure and diversion flexibility, to name a few.

7. Conclusion

Provided the above technical, operating, commercial and legal challenges to the development of FLNG can be overcome, FLNG has the potential to unlock significant volumes of stranded natural gas.