Government of **Western Australia**
Department of **State Development**

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Mr Ian Blayney MLA
Chairman
Economics and Industry Standing Committee
Parliament House
PERTH WA 6000

Dear Mr Blayney

COMMITTEE INQUIRY INTO THE ECONOMIC IMPLICATIONS OF FLOATING LIQUEFIED NATURAL GAS OPERATIONS

Thank you for your letter of 17 September 2013, regarding the Economic and Industry Standing Committee inquiry into the economic impacts of Floating Liquefied Natural Gas (FLNG) operations.

Please find attached the submission of the Department of State Development to the inquiry.

In response to your request, please also be aware that the Department is unable to provide the Committee with forecast data regarding the possible economic implications of companies using FLNG operations as an alternative to onshore gas processing. Such forecasts require detailed information about specific FLNG developments, which is not available publically at this time. The information you have sought will have to be provided by the companies developing the projects.

If you have any question in relation to the Department's submission, please contact Nicky Cusworth, Deputy Director General, Strategic Policy, on 9222 0410.

Yours sincerely

Stephen Wood
DIRECTOR GENERAL

2 October 2013

Att

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Submission to the Inquiry into the Economic Implications of Floating Liquefied Natural Gas Operations

Executive Summary

Floating Liquefied Natural Gas (FLNG) is a new technology for processing gas into LNG offshore using floating vessels. It draws on some existing vessel-based technologies such as degasifying LNG and oil production.

There are a number of FLNG projects committed or under consideration across the world. Until recently, the technology was considered most appropriate for accessing remote or stranded gas that would otherwise be uneconomic to develop, or as a way of reducing up-front capital costs.

In Australia, Royal Dutch Shell's Prelude project is the only FLNG project under construction. Woodside is considering the use of three FLNG vessels to process gas from the Browse Basin.

There is limited and inconsistent information in the public domain on the capital and operating costs of FLNG, or how it compares to onshore LNG processing. The relative costs of onshore and FLNG processing will depend on the characteristics of each project such as the distance from land, vessel selection and the construction costs in the host country.

The key capital cost difference between an FLNG and onshore project is the cost of the FLNG vessels as compared to the onshore plant and associated pipelines. The difference between operating cost is harder to determine as those facilities have not been operated previously and will be dependent on the location of vessels.

Companies investing in FLNG claim they will be able to keep better control of capital costs through the use of shipyards to construct their vessels, the potential to re-use FLNG vessels and a reduction in construction costs over time as construction in the more controlled environment becomes increasingly standardised. Risks in the control of other offshore capital costs will remain the same.

In the absence of the requirement to access land for onshore gas processing, FLNG projects are unlikely to incur the costs typically associated with securing land such as native title, environmental and other approvals.

It is difficult to increase the capacity of FLNG vessels. To raise production from an FLNG project significantly, it is expected that the production infrastructure will need to be replicated, for example by adding a new fully contained vessel. By comparison, onshore LNG facilities can expand production without replicating the entire production process, though additional trains are needed for significant capacity expansion.

Clearly the environmental impact on land from FLNG projects is expected to be smaller than onshore LNG processing due to the absence of pipelines to shore, dredging and more limited need for supporting onshore activities and infrastructure. Social impacts are likely to be significant during the construction phase, with construction workers, fuel and materials having to transit through or near onshore communities on their way to and from offshore sites.

Where FLNG replaces what otherwise would have been onshore processing of gas, the State Government forgoes revenue from State payroll taxes and certain transaction duties and may receive a lesser flow of royalties for the gas in State waters due to the lower production capability of FLNG. Other significant losses to the State include the diminished construction; employment opportunities; investment in social and economic infrastructure, the development of regional communities, rates and Indigenous benefits.

The economic benefits of FLNG projects for Western Australia are likely to be substantially lower than for onshore LNG processing. On current indications, vessel construction will take place in foreign shipyards, and much of the onshore servicing for Prelude will be supplied from Darwin.

Introduction

A number of petroleum and oil companies are expressing interest in developing floating Liquefied Natural Gas (FLNG) facilities to exploit gas fields in Western Australia and the rest of the world. For State Government and communities, the use of FLNG instead of onshore processing means that Government and those communities will receive fewer benefits from the commercialisation of the gas reserves. The operability of FLNG is untested, with the world's first FLNG project, the Petronas FLNG facility in the Bintalu gas field in Malaysia, expected to commence production in 2015. Western Australia's first operating FLNG project will be Royal Dutch Shell's Prelude FLNG project in the Browse Basin. The growing commercial interest in FLNG reflects the industry's view that the technology has potential to unlock remote and stranded gas and the ability to control costs by constructing the FLNG vessels in a more cost-controlled and increasingly standardised environment such as shipyards.

FLNG Technology

FLNG is a new production process for LNG, which involves the extraction, liquefaction, storage and offloading of natural gas via a vessel. The entire FLNG operation is contained within one or several large, floating barge-like processing facilities.

While there are no FLNG projects in operation, FLNG facilities are being designed and built based on existing floating oil and gas technologies, combining components from:

- floating storage and regasification units, which are floating terminals where LNG is received via a vessel, processed back to ambient temperature and pressure (regasification),and piped to shore; and
- floating production, storage and offloading facilities, which are currently used in the oil industry to produce, store and offload oil via a vessel or pipeline. Some oil tankers can be converted into these facilities.

Although the FLNG facilities built currently around the world borrow in part directly from floating production, storage and offloading facilities, which have been used in the oil industry for more than 35 years, they are more technically complex. FLNG vessels require gas liquefaction plant, which means that the few FLNG facilities currently under construction are being purpose-built. The liquefaction process and technology used in FLNG is the same as that used in onshore LNG plants.

A key benefit of FLNG technology is the potential to develop remote and small gas fields where onshore processing is not economically viable, such as in the case of Shell's Prelude FLNG project. Increasingly, proponents' motivation also appears to be containing capital and scheduling costs by progressively constructing facilities in closed shipyards rather than in varying onshore locations and conditions. The main capital cost difference expected between an FLNG and onshore project is the cost of FLNG vessels compared to onshore plant and linked pipelines. Other differences include the absence of dredging and supporting onshore infrastructure. As there is not yet a complete and operational FLNG project, the actual costs of FLNG are not known with certainty.

Proposed FLNG Projects

The use of FLNG technology is being developed or investigated as an option by a number of companies in Australia (Inpex, Petronas, Shell, Eni and Osaka partnership, PTTEP, and the ConocoPhillips/SK Energy Joint Venture), in Timor (Shell, GDF Suez), in Malaysia (Petronas), in Brazil (Petrobras), in Mozambique (Petronas, Pangea LNG BV and Eni Spa), in Israel (Noble Energy Mediterranean), in Columbia (Exmar NV) and in South Texas (Pangea LNG BV).

There is only one FLNG project currently under construction in Western Australia. Royal Dutch Shell (Shell) is developing the Prelude FLNG project in the Browse Basin. Operations are planned to start in 2017. While Prelude was expected to be the first operating FLNG facility in the world, Petronas now plans to deploy an FLNG facility at the Bintulu gas field in Malaysia in 2015.

The final investment decision for the Prelude FLNG project occurred in May 2011, with an estimated total capital expenditure by the company of around $12 billion to produce around 3.6 million tonnes of LNG a year.

The use of three FLNG vessels is also being considered for the development of the Browse LNG Joint Venture project in Western Australia. Woodside Chief Executive, Mr Peter Coleman, announced on behalf of the Joint Venture that a final investment decision will be taken for the Browse project in 2015.

FLNG is likely to be used in other parts of the world, where geography, security and field size preclude onshore processing. Companies looking to develop FLNG operations worldwide include:

- Malaysia's national oil company Petronas, which reached a final investment decision on an FLNG project off Sarawak in June 2012 and is now considering a second FLNG train off Sabah.
- Petrobras for the development of the Brazilian Santos Basin.
- Noble Energy Mediterranean (and partners) for the development of fields in the Tamar Basin in Israel.
- GDF Suez for the development of the Petrel, Frigate and Tern fields, in the Timor Sea Bonaparte Basin.
- Shell with a second FLNG venture, expected to be a Sunrise Woodside-operated joint venture in the Timor Sea.

The FLNG projects in the Santos and Tamar Basins achieved front end engineering and design in 2011.

Construction Costs

Companies investing in FLNG developments in Western Australia expect to incur lower capital and construction costs than for similar onshore developments. As no FLNG facility is operating yet, construction and operation cost estimates for FLNG are based on projections and not actual data. It will be some time before the actual costs of FLNG are known.

The same equipment is needed for certain parts of both FLNG and onshore LNG processing. This includes expenditure incurred before final investment decision; eg. appraisal and production wells; production manifolds; subsea flow-lines; riser bases and flexible risers, and the liquefaction facilities themselves. The costs and risk of cost increases for these facilities are likely to be similar for both types of project.

The key difference expected between the capital cost of FLNG and onshore LNG processing is the cost of the FLNG vessels compared to onshore plant and pipelines.

FLNG does not need onshore facilities such as the port infrastructure and jetties necessary to ship LNG, or pipelines to transport the gas to shore. Onshore production requires a large, fixed, offshore rig to collect and transport and pump the gas, whereas it is expected that FLNG vessels could be reused once a field is depleted.

Companies investing in FLNG expect to be able to keep better control of cost increases through the use of production facilities such as the Samsung shipyards in South Korea.

The ability to stage projects and ramp-up production and capital expenditures can also make FLNG more financially attractive compared to onshore projects, where much capital expenditure is up front.

However, in some respects FLNG is less flexible and has higher costs than onshore processing. It has less scope for economies of scale, as growth in production requires equipment and infrastructure to be replicated. A single port facility could in principle service several LNG trains and even several proponents, reducing long-run average costs. Each FLNG vessel will require a separate slug catcher and possibly a mercury removal unit, where only one is necessary for a typical onshore LNG project.

In Western Australia, Shell estimates that its Prelude project will cost between US$3 billion and US$3.5 billion for every one million tonnes of production capacity, or between US$10.8 billion and US$12.6 billion in total. Most available information suggests that the vessel itself will cost around $5 billion, with the remaining US$7.6 billion being mostly subsea and exploration costs. These subsea and exploration costs would essentially cover the cost of offshore infrastructure, part of which is common to FLNG and onshore LNG projects.

Shell claims that FLNG is more cost effective than onshore processing. However, the Brazilian Company Petrobras did not proceed with its 3 million tonne a year FLNG project proposal in the Santos Basin Libra Field (off the coast of Rio De Janeiro), citing falling gas prices and project economics as the reason. Petrobras opted for a pipeline to shore and onshore processing for domestic and export use instead. This indicates that the relative costs of onshore and FLNG processing will depend on the characteristics of each project such as the distance from land, the composition of the resource, vessel selection and the construction costs in the particular country.

The Department has little independent information upon which it can assess the cost of an FLNG project or compare it to an onshore project. It has to rely on information made publically available by companies considering FLNG projects. Differences in gas fields and in assumptions used by companies to calculate costs make comparisons of production costs between FLNG and onshore projects difficult. Shell claims that an FLNG project for a dry gas field (excluding LPG and condensate) with a liquefaction capacity of 6 million tonnes a year would have a similar capital cost to its current Prelude project. If Shell still expects Prelude to cost around $12 billion, this suggests a cost of around $2,000 per tonne per year of liquefaction capacity. In comparison, after upward cost revisions, the Gorgon project is now expected to cost around $52 billion for 15.6 million tonnes a year of liquefaction capacity, or about $3,300 per tonne per year[1].

According to Woodside, the reference case for the development of the Browse LNG project is a phased development comprising three FLNG facilities[2]. The Australian Financial Review[3] is quoting unidentified sources that state that a two or three-vessel FLNG option for the Browse project could cost around $40 billion, for a production somewhat modestly lower than the 12 million tonnes initially planned for the onshore development.

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[1] GasTech News, 3 September 2013, http://www.gastechnews.com/lng/browse-decision-highlights-cost-benefits-of-flng/

[2] Australian Financial Review, 21 August 2013, Companies and Markets, page 13

[3] Australian Financial Review, 21 August 2013, Companies and Markets, page 13

The final expected cost will not be known until Woodside takes a final investment decision in 2015. An analyst from Macquarie Securities, Adrian Wood, has stated that the cost of an onshore Browse LNG project could have been around $60 billion and possibly significantly higher, with a Woodside executive recognising that this estimate was not far off the mark[4]. During Woodside's half-year results meeting, the FLNG offshore alternative was estimated to offer cost savings of 35 to 50 per cent. Wood Mackenzie reports that the internal rate of return for an onshore LNG facility at the Browse LNG Precinct could be less than 11 per cent compared with 13 per cent for FLNG, but that the balance in favour of FLNG could worsen if problems are encountered with the deployment of FLNG in Western Australia's challenging marine environment[5].

Shell expects that the unit cost of FLNG vessels will decrease significantly in future as the construction process is increasingly standardised and economies of scale are achieved. Adrian Wood, an analyst from Macquarie Securities, expects costs beyond the Prelude "prototype" to decrease by 10 to 15 per cent for each subsequent vessel[6].

Economic and Fiscal Effects

Overall, FLNG projects are likely to deliver less revenue to government than their onshore equivalents.

Most State government revenues derived from LNG development are gained from payroll tax and stamp duties paid during the construction phase of onshore LNG projects. Since very little construction work is done in Western Australia, most of that revenue will be lost.

Royalties for offshore gas fields are typically paid to the Commonwealth Government through the Petroleum Resource Rent Tax (PRRT), rather than to the State, though the State receives royalties (or a share of PRRT under unitisation agreements with the Commonwealth) for gas sourced from Western Australian waters.

For fields that are divided between Commonwealth and State waters, as in the case of the Browse gas field, an *ad hoc* scheme for the distribution of royalties revenues between the Commonwealth and State would apply. This would depend on a unitisation agreement based on how much gas is in State water and how much is in Commonwealth water. A revenue share agreement based on Commonwealth collection of the PRRT over all fields (in Commonwealth and State waters) would require the State to reach agreement over royalties with the Commonwealth.

At this time FLNG facilities are not expected to produce at the same rate or quantity as onshore LNG processing, so full exploitation of a given reserve is likely to take longer and yield a smaller royalty stream each year. However, if FLNG projects are quicker to bring gas to production, then there could be benefits through earlier realisation of royalty revenues.

According to the Department of Commerce Local Content Report of May 2013, local content levels for Western Australian onshore LNG projects under construction range from 66 per cent for Chevron's Gorgon project and 68 per cent for Wheatstone to 88 per cent for Woodside's North West Shelf North Rankin development. These estimates have increased significantly in the past year.

FLNG is expected to have lower local content levels during the construction phase than onshore LNG project. Most of the major equipment and construction contracts for Shell's Prelude FLNG project were awarded to overseas companies. Samsung Heavy Industries in South Korea began constructing Prelude's floating facility in October 2012. FMC Technologies (USA) is constructing the project's subsea equipment and Emerson (USA) is the main supplier for automation systems.

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[4] Sunday Times, 25 August 2013, Business News, Page 67

[5] West Australian, 30 January 2013, Statement by Wood McKenzie

[6] Sunday Times, 25 August 2013, Business News, Page 67

Overseas companies have also been contracted for the turret mooring system, wells and other key equipment. However, the construction of subsea infrastructure is expected to create job opportunities in the local economy. For example, the construction of Prelude's subsea infrastructure may require more than 1,200 workers at its peak[7]. In turn, construction activities generate demand for support services, with the corresponding demand for indirect workforce.

Shell claims that Prelude will create approximately 1,000 long term jobs[8] in Australia. It also claims that the Prelude Project would produce around $200 million of benefits to the Australian community if 70 per cent of the 200 contracts available by 2017 were given to Australian companies[9]. It is difficult to assess the accuracy of these estimates, as few local contracts have been awarded to date. Shell's Prelude newsletter refers to three Western Australian companies and two educational institutions that are currently benefitting from the FLNG project: Pressure Dynamics (high pressure units), FMC (storage of well heads), Decmil (production and design of onshore supply base); Challenger Institute/Curtin University (on training packages for technicians) and the University of Western Australia (offshore engineering capability, sediment structure, subsea infrastructure).

The economic benefits for Western Australia during the operation phase will also depend on the location of supporting onshore infrastructure and services such as a supply base and administration. Shell proposes that the supply base for Prelude will be in Darwin.

Indigenous benefits are expected to be significantly lower for FLNG projects than for onshore developments, in part because of the absence of native title negotiations and the nature of offshore operational work. Shell has developed an Indigenous Training and Employment Strategy. Indigenous-owned companies and companies that can demonstrate strong indigenous engagement are encouraged to register interest in the Prelude Project. These opportunities are, however, considerably less than the package that was negotiated for onshore processing at James Price Point.

Domestic gas

The State has limited opportunity to ensure its domestic gas policy on FLNG projects in Commonwealth waters is adhered to. For onshore projects, the policy is typically applied through land-based approvals and/or State Agreements.

The Government clarified its domestic gas policy with the release of the Strategic Energy Initiative in 2012. The policy requires LNG Producers to commit to make available for the domestic market gas equivalent to 15 per cent of their LNG export production by:

- reserving domestic gas equivalent to 15 per cent of LNG production from each LNG export project;
- developing, or obtaining access to, the necessary infrastructure (including a domestic gas plant, associated facilities and offshore pipelines) to meet their domestic gas commitments as part of the approvals process; and
- showing diligence and good faith in marketing gas into the domestic market.

The policy implies that for each 1 million tonne of annual LNG export, the LNG producer must make available 22 terajoules a day of gas to the domestic market. Along these lines, if Shell's Prelude FLNG project was an onshore project, it would supply 80 terajoules a day to the Western Australia's domestic market.

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[7] DSD estimates

[8] Shell Global website, http://www.shell.com/global/aboutshell/major-projects-2/prelude-flng/overview.html

[9] Transcript of Evidence provided by Shell Australia, Wednesday, 26 June 2013, Inquiry into the Economic Implications of Floating Liquefied Natural Gas Operations, http://www.parliament.wa.gov.au/parliament/commit.nsf/(WebInquiries)/12E97F0B529389C648257B7400157A93?opendocument

Historically two operators, Woodside Energy and Apache Energy, have supplied most of Western Australia's domestic gas, with approximately 98.3 per cent of domestic demand supplied by the North West Shelf Joint Venture project, Varanus Island and Devil Creek processing facilities. The North West Shelf Joint Venture project is the largest, supplying 55 per cent of the total market. The Macedon project has just commenced production and will have a production capacity of around 200 terajoules a day, or 10 to 15% of the domestic market but is dedicated to BHPB's operation. As at the date of this submission, Western Australia has eight domestic gas processing facilities, and a further two facilities, Gorgon and Wheatstone under construction. The gas market in the eastern states currently has more than 15 different producers.

This dependence on a few gas projects to supply the energy market is significant as natural gas represents 56 per cent of primary fuel source in Western Australia. In contrast, the east coast market has a greater diversity of energy sources, a network of interconnecting electricity and energy and a lower reliance on gas in overall energy use, with only 13.1 per cent of electricity generated from natural gas. In Victoria, gas fuels as little as 3 per cent of total electricity production. Coal is the main energy fuel in the eastern states.

Most domestic gas in Western Australia is delivered into pipelines and traded under bilateral contracts, which are typically for medium to long-term supply. It is difficult for FLNG projects to supply the domestic market, as no buyer has an LNG regasification facility able to feed into one of the eight transmission pipelines in Western Australia. Western Australian pipelines are not connected to any other jurisdiction, which prevents interstate gas transfer and isolates the Western Australian gas market.

Apart from gas pipelines and LNG, another option for the large-scale transportation of natural gas to the domestic market could be compressed natural gas (CNG). This requires less capital and energy to process than liquefaction, and does not need regasification. However, whether CNG is viable as a significant source of domestic supply has not been tested.

Environmental and Social Impact

FLNG projects would obviously have a less complex land environmental footprint than onshore facilities, making the environmental approval process more straightforward.

Social impacts, however, could be greater for FLNG than for carefully planned onshore developments, especially during the construction phase of FLNG projects. The impacts of FLNG are likely to be more diffused and less subject to government influence. In particular, the Department is concerned that the development of FLNG in the Browse Basin could cause more negative social impacts in Broome and the surrounding communities than the onshore LNG facility proposed at James Price Point. Agreements covering development of the onshore Browse LNG precinct included extensive provisions to enable community input and to minimise social impacts, for example by bussing the construction workforce to accommodation out of town. They also provided governance arrangements ensuring community input into management of the project, and an assessment of cumulative impacts.

The construction workforce for an FLNG project is likely to be smaller than for an onshore development. In the case of the Prelude FLNG project, the Department believes it will exceed 1,200 at its peak. Moving this number of construction workers from Broome by helicopter to offshore FLNG facilities could have a significant adverse effect on local infrastructure and amenity, especially if more than one FLNG project is under construction at the same time.

The Browse LNG precinct agreements also made provision for extensive social benefits, such as indigenous training and amenities that are unlikely to be realised under FLNG developments.

Conclusion

FLNG is an important innovation in the oil and gas industry, as it can unlock remote and stranded gas assets which would be unprofitable otherwise. Several key players in the industry are considering the use of the FLNG technology to develop gas fields around the world, including in Western Australia. As no FLNG project has yet operated the viability of the projects, or any operational risks or difficulties, are not fully known.

Following the announcement of the Prelude FLNG project in the Browse Basin, a number of new FLNG developments are being considered in the State. Prelude will enable the exploitation of an asset that would not have been developed without FLNG, but the use of FLNG for gas fields that could feasibly be developed through onshore processing means a significant loss of benefits for the economy and the community, through lower fiscal revenues, fewer local jobs and lower domestic gas supply.

At this stage, the extent of that loss is hard to assess as there is no operational FLNG project in the world. Better information on royalties and tax revenues, job opportunities and domestic gas supply will emerge as the projects' details are established. There is currently limited and inconsistent information in the public domain on the costs and profitability of FLNG, or on the environmental and social implications of such projects. Only the oil and gas companies can provide detailed information on FLNG development and its economic, social and environmental effects; and even these companies at this time know only projected data.