**GAS IMPORT JETTY AND PIPELINE PROJECT**
**ENVIRONMENT EFFECTS STATEMENT**
**INQUIRY AND ADVISORY COMMITTEE**

**TECHNICAL NOTE**

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| **TECHNICAL NOTE NUMBER:** | TN 033 |
| **DATE:** | 19 October 2020 |
| **LOCATION:** | Crib Point Jetty Works |
| **EES/MAP BOOK REFERENCE:** | Chapter 4: Project Description |
| **SUBJECT:** | Response to request for information made by the IAC on 15 October 2020 (Document 234) in relation to the operation of the FSRU |
| **SUMMARY** | This technical note contains information regarding potential operating scenarios for the FSRU. |
| **REQUEST:** | By written direction issued on 15 October 2020 (Document 234), the IAC has requested advice concerning:<br>1. The expected or planned operation of the FSRU, including the periods and frequency of its operation, the number of trains that might typically be in operation in response to these demand factors and the number and frequency of LNG tankers.<br>2. Any FSRU operational limitations or requirements that might impact on that information.<br>3. The extent to which this material has been used to inform relevant evidence, such as Mr Kelp's modelling. |

**NOTE:**

**Question 1: Potential FSRU Operating Scenarios**

1. A variety of operating scenarios have been adopted within the EES for the purposes of modelling the potential environmental effects of the Floating Storage and Regasification Unit (**FSRU**). These scenarios are often (but not exclusively) worst-case scenarios based on the FSRU operating at maximum regasification capacity throughout the period of the relevant assessment (that is, utilising the three proposed regasification trains, such that the applicable gas flow rate is 750 mmscf/d).

2. In practice, the FSRU will operate at different levels of intensity throughout the course of any given year. In all years, higher rates of production are anticipated during the winter months, when demand for natural gas is at its highest. It is also expected that the volume of LNG importation will increase over time, as Victoria's existing sources of natural gas continue to decline.

3. The EES states in section 4.3 that it is anticipated that:

> *The FSRU would initially receive approximately 45 petajoules (PJ) of LNG per annum (approximately 12 LNG carriers). The amount of LNG could increase to*

*160 PJ per annum (approximately 40 LNG carriers) depending on demand. The number of LNG carriers would also depend on their storage capacity, which could vary from 140,000 to 170,000 m3.*

4. The initial estimate of 45 PJ remains consistent with AGL's expectations. The incorporated document has been updated to provide that the facility will not import more than 160 PJ of LNG (or 40 cargoes) during any given year.

5. The ultimate amount of LNG imported to the facility over time will depend on the complex interaction of a range of factors, which relevantly include (but are not limited to) market demand and supply conditions, prevailing import prices, and applicable regulatory requirements. The annual importation estimates contained within Mr Kelp's report are reasonable, although actual levels of importation may be higher or lower depending on market conditions. It is also the case that the precise rates of regasification will vary at any given point in time over the life of the facility and are likely to differ from year to year.

6. Demand in Victoria, especially during temperature extremes, can fluctuate significantly. Electricity supply from intermittent renewables also drives gas demand for gas powered generation. When the volume of gas injected into a pipeline system is greater than volume withdrawn the pipeline system is effectively storing gas; this is known as line pack. As the Victorian gas market is already characterised by relatively little line pack capacity, unexpected supply or demand changes can necessitate rapid response to ensure the system can operate. The flexible nature of the FSRU's operational capability would allow it to ramp up and down to meet these urgent requirement for system security, unless it is otherwise constrained.

7. For the purposes of assisting the Inquiry and Advisory Committee in its assessment of the environmental effects of the proposal, a number of profiles have been prepared (and included as Attachment 1 to this technical note) to illustrate an indicative range and distribution of rates at which the FSRU might operate over the course of any given year. The profiles are intended to be illustrative of potential operating scenarios and are not intended to be prescriptive in application.

8. The four profiles are described below:

   (a) the first profile has been prepared on the basis that the FSRU will process LNG with an energy equivalence of approximately 45 PJ per year. This is the amount of LNG that could be delivered by 12 cargoes of approximately 160,000m3 each;

   (b) the second profile has been prepared on the basis that the FSRU will process LNG with an energy equivalence of 80 PJ per year. This is the amount of LNG that could be delivered by approximately 21 cargoes;

   (c) the third profile has been prepared on the basis that the FSRU will process LNG with an energy equivalence of 120 PJ per year. This is the amount of LNG that could be delivered by approximately 31 cargoes; and

   (d) the fourth profile has been prepared on the basis that the FSRU will process LNG with an energy equivalence of 160 PJ per year. This is the amount of LNG that could be delivered by approximately 40 cargoes.

9. The operating parameters of the FSRU specified in section 4.3 of the EES have been adopted for the purposes of this exercise.

10. In each case, indicative average daily regasification rates have been specified to provide information concerning the rates at which the facility might operate during different times of the year. Corresponding information concerning the number of regasification trains in operation, the volume of seawater discharged from the FSRU, and the number of cargoes delivered during each month has been specified.

**Question 2: Operational Requirements**

11. The operating parameters of the FSRU are described in section 4.3 of the EES and are further described in the Works Approval Application.

12. The maximum operating regasification capacity of the FSRU, utilising the three proposed regasification trains, would be 750 mmscf/d. As stated in the EES, and as shown in the scenarios described in Attachment 1 to this technical note, it is anticipated that this would only occur for the equivalent of approximately 30 days in any given year.

13. The minimum operating regasification rate would be 50 mmscf/day. The FSRU can cease regasification for short periods of time. When regasification is not being carried out, small amounts of the LNG cargo continue to naturally 'boil-off' and tank pressure will increase over time. To manage this boil-off gas, the preferred option is the use a minimum send-out compressor that is capable of delivering approximately 5mmscf/d.

**Question 3: Mr Kelp's Modelling**

14. Mr Kelp's modelling was undertaken independently of the Proponents and as a means of informing Dr Fahrer's independent assessment of the Project's stated rationale and economic effects. The assumptions that Mr Kelp made in preparing the modelling are set out in section 2.1 of Mr Kelp's modelling report. These assumptions are consistent with the operating parameters specified in the EES.

15. Mr Kelp's independent modelling aligns closely with the description of the operation of the FSRU contained within the EES. Mr Kelp's modelled base case scenario shows initial annual import volumes of around 40 PJ per annum increasing over time to approximately 100 PJ per annum in 2040. Mr Kelp's modelling also shows that, depending on import prices and the composition of other suppliers to the market, the amount of LNG imported in 2040 may be as high as 160 PJ or as low as 65 PJ.[1]

16. Mr Kelp's analysis is also consistent with the EES and with the Proponents' expectations in that it shows the facility operating most intensively during the winter months when levels of demand are highest. Whereas Mr Kelp's modelling predicts operation during the initial phases of the Project to occur only within the winter months, the Proponents anticipate at least some (lower) level of production during the summer months. As shown in the indicative scenarios set out below, this would not result in higher levels of production than those modelled by Mr Kelp. Furthermore, as Mr Kelp noted in his modelling report, if additional production was to occur during the summer months (that is, in addition to the production modelled in his report during the winter months), this would be expected to have further dampening effect on Victorian wholesale gas outcomes.[2]

**CORRESPONDENCE:** N/A

**ATTACHMENTS:** 1 attachment:

1. Potential Operating Scenarios

**Attachment 1**

**Potential Operating Scenarios**

**Potential (Averaged) Operating Scenario at 45 PJ per annum**

| Month | Daily average regasification rate (mmscf/d) | Indicative Number of Regasification Trains in Operation | Daily average seawater intake and discharge volume | Quantity of LNG Processed | Number of Cargoes |
|---|---|---|---|---|---|
| January | 55 mmscf/d | 1 – 2 | 156,000 – 312,000 $m^3$/day | 1.9 | 0 |
| February | 55 mmscf/d | 1 – 2 | 156,000 – 312,000 $m^3$/day | 1.8 | 1 |
| March | 55 mmscf/d | 1 – 2 | 156,000 – 312,000 $m^3$/day | 1.9 | 0 |
| April | 108 mmscf/d | 1 – 2 | 156,000 - 312,000 $m^3$/day | 3.7 | 1 |
| May | 108 mmscf/d | 1 – 2 | 156,000 – 312,000 $m^3$/day | 3.8 | 1 |
| June | 215 mmscf/d | 1 – 3 | 156,000 – 468,000 $m^3$/day | 7.3 | 2 |
| July | 215 mmscf/d | 1 – 3 | 156,000 – 468,000 $m^3$/day | 7.6 | 2 |
| August | 215 mmscf/d | 1 – 3 | 156,000 – 468,000 $m^3$/day | 7.6 | 2 |
| September | 111 mmscf/d | 1 – 2 | 156,000 – 312,000 $m^3$/day | 3.8 | 1 |
| October | 54 mmscf/d | 1 – 2 | 156,000 – 312,000 $m^3$/day | 1.8 | 1 |
| November | 54 mmscf/d | 1 – 2 | 156,000 – 312,000 $m^3$/day | 1.8 | 0 |
| December | 54 mmscf/d | 1 – 2 | 156,000 – 312,000 $m^3$/day | 1.9 | 1 |

**Notes:**

- Daily average regasification rates measured as million standard cubic feet per day. Rates are expected to fluctuate inter-day and intra-day.
- Daily average seawater intake and discharge volumes inclusive of cooling water for engines and auxiliary machinery and excluding cooling of freshwater generator and intermittent flows relating to ballast water, water curtain and fire water testing.
- The operation of 3 trains (ie between 500mmscf/d – 750mmscf/d) would only occur for 30 equivalent days per annum.

**Potential (Averaged) Operating Scenario at 80 PJ per annum**

| Month | Daily average regasification rate (mmscf/d) | Indicative Number of Regasification Trains in Operation | Daily average seawater intake and discharge volume | Quantity of LNG Processed | Number of Cargoes |
|---|---|---|---|---|---|
| January | 165 mmscf/d | 1 - 3 | 312,000 $m^3$/day | 5.9 | 2 |
| February | 165 mmscf/d | 1 - 3 | 312,000 $m^3$/day | 5.3 | 1 |
| March | 165 mmscf/d | 1 - 3 | 156,000 – 468,000 $m^3$/day | 5.9 | 2 |
| April | 165 mmscf/d | 1 - 3 | 156,000 – 468,000 $m^3$/day | 5.7 | 1 |
| May | 215 mmscf/d | 1 - 3 | 156,000 – 468,000 $m^3$/day | 7.6 | 2 |
| June | 270 mmscf/d | 1 - 3 | 156,000 – 468,000 $m^3$/day | 9.3 | 3 |
| July | 270 mmscf/d | 1 - 3 | 156,000 – 468,000 $m^3$/day | 9.6 | 2 |
| August | 215 mmscf/d | 1 - 3 | 156,000 – 468,000 $m^3$/day | 7.6 | 2 |
| September | 165 mmscf/d | 1 - 3 | 312,000 $m^3$/day | 5.7 | 2 |
| October | 165 mmscf/d | 1 - 3 | 312,000 $m^3$/day | 5.9 | 1 |
| November | 165 mmscf/d | 1 - 3 | 312,000 $m^3$/day | 5.7 | 2 |
| December | 165 mmscf/d | 1 - 3 | 312,000 $m^3$/day | 5.9 | 1 |

**Notes:**

- Daily average regasification rates measured as million standard cubic feet per day. Rates are expected to fluctuate inter-day and intra-day.
- Daily average seawater intake and discharge volumes inclusive of cooling water for engines and auxiliary machinery and excluding cooling of freshwater generator and intermittent flows relating to ballast water, water curtain and fire water testing.
- The operation of 3 trains (ie between 500mmscf – 750mmscf) would only occur for 30 equivalent days per annum.
- Operations from September to February inclusive, may operate between 1-3 regasification trains, but the average seawater discharge will be no greater than 312,000m3/day based upon a 14 day average, as outlined in the EES.

**Potential (Averaged) Operating Scenario at 120 PJ per annum**

| Month | Daily average regasification rate (mmscf/d) | Indicative Number of Regasification Trains in Operation | Daily average seawater intake and discharge volume | Quantity of LNG Processed | Number of Cargoes |
|---|---|---|---|---|---|
| January | 220 mmscf/d | 1 - 3 | 312,000 $m^3$/day | 7.9 | 2 |
| February | 220 mmscf/d | 1 - 3 | 312,000 $m^3$/day | 7.2 | 2 |
| March | 220 mmscf/d | 1 - 3 | 156,000 – 468,000 $m^3$/day | 7.9 | 2 |
| April | 220 mmscf/d | 1 - 3 | 156,000 – 468,000 $m^3$/day | 7.7 | 2 |
| May | 325 mmscf/d | 1 - 3 | 312,000 – 468,000 $m^3$/day | 11.7 | 3 |
| June | 435 mmscf/d | 1 - 3 | 312,000 – 468,000 $m^3$/day | 15.2 | 4 |
| July | 435 mmscf/d | 1 - 3 | 312,000 – 468,000 $m^3$/day | 15.7 | 4 |
| August | 325 mmscf/d | 1 - 3 | 312,000 – 468,000 $m^3$/day | 11.7 | 3 |
| September | 325 mmscf/d | 1 - 3 | 312,000 $m^3$/day | 11.4 | 3 |
| October | 220 mmscf/d | 1 - 3 | 312,000 $m^3$/day | 7.9 | 2 |
| November | 220 mmscf/d | 1 - 3 | 312,000 $m^3$/day | 7.7 | 2 |
| December | 220 mmscf/d | 1 - 3 | 312,000 $m^3$/day | 7.9 | 2 |

**Notes:**

- Daily average regasification rates measured as million standard cubic feet per day. Rates are expected to fluctuate inter-day and intra-day.
- Daily average seawater intake and discharge volumes inclusive of cooling water for engines and auxiliary machinery and excluding cooling of freshwater generator and intermittent flows relating to ballast water, water curtain and fire water testing.
- The operation of 3 trains (ie between 500mmscf – 750mmscf) would only occur for 30 equivalent days per annum.
- Operations from September to February inclusive, may operate between 1-3 regasification trains, but the average seawater discharge will be no greater than 312,000m3/day based upon a 14 day average, as outlined in the EES.

**Potential (Averaged) Operating Scenario at 160 PJ per annum**

| Month | Daily average regasification rate (mmscf/d) | Indicative Number of Regasification Trains in Operation | Daily average seawater intake and discharge volume | Quantity of LNG Processed | Number of Cargoes |
|---|---|---|---|---|---|
| January | 220 mmscf/d | 1 - 3 | 312,000 $m^3$/day | 8.0 | 2 |
| February | 340 mmscf/d | 1 - 3 | 312,000 $m^3$/day | 12.0 | 3 |
| March | 374 mmscf/d | 1 - 3 | 156,000 – 468,000 $m^3$/day | 14.0 | 3 |
| April | 374 mmscf/d | 1 - 3 | 156,000 – 468,000 $m^3$/day | 14.0 | 3 |
| May | 374 mmscf/d | 1 - 3 | 156,000 – 468,000 $m^3$/day | 14.0 | 4 |
| June | 435 mmscf/d | 1 - 3 | 156,000 – 468,000 $m^3$/day | 16.0 | 4 |
| July | 435 mmscf/d | 1 - 3 | 156,000 – 468,000 $m^3$/day | 16.0 | 4 |
| August | 435 mmscf/d | 1 - 3 | 156,000 – 468,000 $m^3$/day | 16.0 | 4 |
| September | 374 mmscf/d | 1 - 3 | 312,000 $m^3$/day | 14.0 | 4 |
| October | 374 mmscf/d | 1 - 3 | 312,000 $m^3$/day | 14.0 | 3 |
| November | 374 mmscf/d | 1 - 3 | 312,000 $m^3$/day | 14.0 | 3 |
| December | 220 mmscf/d | 1 - 3 | 312,000 $m^3$/day | 8.0 | 3 |

**Notes:**

- Daily average regasification rates measured as million standard cubic feet per day. Rates are expected to fluctuate inter-day and intra-day.
- Daily average seawater intake and discharge volumes inclusive of cooling water for engines and auxiliary machinery and excluding cooling of freshwater generator and intermittent flows relating to ballast water, water curtain and fire water testing.
- The operation of 3 trains (ie between 500mmscf – 750mmscf) would only occur for 30 equivalent days per annum.
- Operations from September to February inclusive, may operate between 1-3 regasification trains, but the average seawater discharge will be no greater than 312,000m3/day based upon a 14 day average, as outlined in the EES.

**Potential Daily Operating Scenario at 160 PJ per annum**

The tables above reflect daily averaged regasification profiles. In reality, as the facility will participate in a market that includes other suppliers of gas with fluctuating daily and intra-day demand profiles, the level of regasification may vary throughout any given day. During winter cold-snaps, increased demand for heating and GPG (or GPG in summer heat waves), may require the facility to respond to short term demand requirements or for more extended periods if other suppliers suffer from scheduled or unscheduled outages. The gas network to date has relied on pipeline line-pack and gas storage facilities.

The following shows the 435 mmscf/d scenario as both an average daily figure (even and rateable supply) and as production rates may fluctuate in response to market requirements.