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AGL WHOLESALE GAS LIMITED

WORKS APPROVAL APPLICATION 1003907

RESPONSE TO SECTION 22(1) NOTICE TO SUPPLY FURTHER INFORMATION – QUESTIONS 5, 6, 9 AND 11

OPTIMISING FSRU OPERATIONS – CLOSED LOOP

Question 5 - Clause 20 of SEPP (Waters) gives priority to avoidance. Please explain why your proposal has not made all reasonable efforts to avoid wastewater generation, for example by only operating in closed loop mode?

1. INTRODUCTION

Clause 20 of SEPP (Waters) provides that, "[t]o protect beneficial uses, the discharge of wastewater to surface waters must be managed in accordance with the wastes hierarchy, with priority given to avoiding the generation of wastewater." Clause 21 requires an application for works approval to demonstrate that "all reasonable efforts" have been made to avoid, reuse and recycle wastewater.

For the reasons addressed below, AGL contends that:

(a) the proposal complies with the directives of these clauses, in that wastewater generated by the FSRU will be managed so as to protect beneficial uses, and in accordance with the wastes hierarchy;

(b) in particular, the proposal has incorporated "all reasonable efforts to avoid wastewater generation"; and

(c) closed loop mode operations should not be considered superior or exclusively to open loop mode, but instead a risk based approach that enables ongoing monitoring and operations to be performance based using actual measured outcomes should be considered, rather than restricting the particular operating mode of the FSRU

Further, consideration of the full range of matters that the EPA must consider - particularly greenhouse gas emissions in accordance with the SEPP (Air Quality Management) and the *Climate Change Act 2017* (Vic) and the principles of environmental protection - demonstrates that proposed operations strike an optimal balance.

The analysis that follows begins by briefly examining the key principles relevant to the question – the wastes hierarchy and "reasonable efforts" before considering how the proposed operations were developed and have been refined over time, and the impacts on beneficial uses of wastewater discharges from those proposed operations.

With this context, it becomes possible to assess whether reasonable efforts to avoid wastewater generation and discharge have been made. This assessment can be undertaken on two levels: within the narrow context of clauses 20 and 21 of SEPP (Waters), or in a broader context of relevant considerations for the EPA in assessing the Works Approval Application (WAA). At both levels, the proper conclusion is that reasonable efforts have been made to avoid the discharge of wastewater. Further, additional efforts to reduce the discharge of wastewater would come at an unacceptable environmental cost and be inefficient.

2. KEY PRINCIPLES

The central principles or concepts raised by this question are the wastes hierarchy and "reasonable efforts".

Clause 20 of SEPP (Waters) relates specifically to the wastes hierarchy and provides that, "[t]o protect beneficial uses, the discharge of wastewater to surface waters must be managed in accordance with the wastes hierarchy, with priority given to avoiding the generation of wastewater."

Clause 21 requires an application for works approval to demonstrate that "all reasonable efforts" have been made to avoid, reuse and recycle wastewater and to include all reasonably practicable measures to minimise risks to beneficial uses of receiving waters. Risk to the beneficial uses of Western Port have been addressed in AGL's response to Q3 of the EPA's s 22 notice (**Notice**).

The principle of the wastes hierarchy is contained within s 1I of the EP Act. It relevantly provides that wastes should be managed in accordance with the following order of preference:

(a) avoidance;

(b) re-use;

(c) re-cycling;

(d) recovery of energy;

(e) treatment;

(f) containment; and

(g) disposal.

It is notable that the principle is a principle and not a rule, and that it only establishes a *preference*. Similarly, clause 20 refers to priority being given to avoidance, not an absolute requirement. These are acknowledgments of a role for other considerations. This role is reinforced by the inclusion of the language of "reasonable efforts".

The SEPP provides no direct guidance about what is required to satisfy "all reasonable efforts". The phrase is however sensibly a synonym for "reasonably practicable", which is defined in clause 12 of the SEPP (Waters) (and a foundation of the *Environment Protection Act 2017* as it will be amended from commencement of the *Environment Protection Amendment Act 2018* on 1 July 2021):

> *Where this Policy requires actions or management practices to minimise risks to beneficial uses, so far as reasonably practicable, this means actions or management practices must have regard to –*
>
> *(a) the likelihood of those risks eventuating; and*
>
> *(b) the degree of harm that would results if those risks eventuated; and*
>
> *(c) what a person concerned knows, or ought to reasonably know, about the harm or risks of harm and any ways of eliminating or reducing those risks; and*
>
> *(d) the availability and suitability of ways to eliminate or reduce those risks; and*
>
> *(e) the costs of eliminating or reducing those risks.*

"Reasonably practicable" recognises the need for a risk-based and proportionate response to environmental risks, rather than an approach of environmental protection at any cost. This definition

provides useful guidance in considering AGL's efforts to minimise wastewater generation and disposal in the context of the wastes hierarchy.

It is evident from SEPP (Waters) that the purpose of seeking to avoid generation and discharges of wastewater is to protect beneficial uses of receiving waters. In the context of an obligation to reasonably avoid wastewater generation and discharge, impacts on beneficial uses of discharge are central.

It is therefore important, in answering this question, to consider how the proposed operations were developed and have been refined over time, and the impacts on beneficial uses of wastewater discharges from those proposed operations. It is then possible to assess whether reasonable efforts to avoid wastewater generation and discharge have been made.

3. PROPOSED OPERATIONS OF THE FSRU - EES AND WAA

3.1 Assessed operating modes

The FSRU operating modes and parameters that were assessed in the EES are described in section 7.2.2 of the WAA. These included open loop regasification (which was, and remains, the preferred and predominant operational mode for the FSRU), as well as combined loop regasification and closed loop regasification.

A variety of operating scenarios were adopted within the EES for the purposes of modelling the potential environmental effects of the FSRU. These scenarios were generally worst-case in the sense that they were premised on the FSRU operating at maximum regasification capacity throughout the entirety of the relevant assessment period (that is, utilising the three proposed regasification trains, such that the applicable gas flow rate would be 750 mmscf/d). When operating at this level of intensity, the FSRU would result in a daily seawater discharge volumes of 470,835 m3/day in open loop mode, and 186,912 m3/day in closed loop mode (see table 4.3 and 4.5 in Chapter 4 of the EES).

It is important to recognise, however, that the FSRU will generally operate at lower rates of regasification. Indeed, as demonstrated by the indicative operating scenarios specified in Technical Note 30, it is anticipated that the FSRU will generally operate at regasification rates that are substantially below the maximum rates utilised in much of the impact assessment, such that discharges of wastewater from the FSRU will generally be substantially below the levels modelled for the purposes of the EES and WAA.

It is also important to appreciate that the seawater discharged is available for re-use or re-cycling within Western Port, as set out in AGL's response to question 2 of the Notice.

On review of the initial marine impact assessments, and to minimise potential entrainment impacts during periods of the year when fish eggs and larvae are most prevalent in the North Arm of Western Port, a reduced mean daily seawater regasification flow was proposed during Spring and Summer (for the months of September to February) (see Table 9 in the WAA).

3.2 Environmental performance requirements

EPRs have been designed to minimise the environmental impacts of the operation of the FSRU as envisaged by the EES and the WAA. They are consistent with best practice for discharge design and management of residual chlorine and temperature in the site-specific environmental context of Crib Point. In particular:

(a) EPR ME02 – regulating chlorine discharges through two options:

(i) Option 1 – Varying chlorination rate at point of discharge – eliminates chlorine discharge at and around slack tide (at which time there is greatest scope for the pancake from the wastewater discharge to form at the seabed), and where

varying rates (not exceeding 0.1mg/L) could be implemented at other points in the tide cycle

(ii) Option 2 - Constant chlorination rate at point of discharge applies the chlorine discharge rate of 0.02mg/L consistent with the approved Port Kembla facility, but is not the preferred option given the consequences for maintenance and operation including inadequate control of biofouling prevention, requiring an increased maintenance and cleaning regime and inefficiency including cost, shut down and onshore waste disposal

This is discussed below in section 5 in the context of refinements,

(b) EPR ME03 – operates to limit rates of seawater intake (and consequently wastewater discharge) between August and February when the prevalence of icthyoplankton and other bioata is greatest;

(c) EPR ME04 – requires a six discharge port design to optimise dilution and mixing and minimise thermal differences. This optimised port design was determined as a result of the initial near field modelling; and

(d) EPRME05 – requires a high velocity discharge to increase dilution.

The EPRs will assist in ensuring that impacts are no greater than those predicted in the EES and WAA.

3.3 **Selection of operating mode**

As identified in Section 3.2.7 of EES Chapter 3: Project development[1], the EES assessed the significance of potential adverse impacts and environmental risks of operating in open, combined, and closed loop modes for a range of operating scenarios. Open loop mode was selected as the preferred operating mode given:

- its enhanced efficiency relative to closed loop or combined loop modes due to the use of seawater as an efficient heating source for the LNG in the regasification process;
- its superior environmental performance, including in terms of the emission of greenhouse gases, air pollutants, and noise; and
- the capacity to manage wastewater discharge (in the form of seawater that has been entrained within and discharged from the FSRU during operation) so as to protect beneficial uses and have minimal impact on the environment.

The generally inferior environmental performance of closed loop operation is a result of the need for gas-fired boilers in addition to the gas-fired engines. Although the boilers will operate on boil-off gas and will be fitted with economisers to enable the use of waste heat from the flue gases, operating in the closed loop mode would result in higher fuel consumption and higher greenhouse gas emissions. Closed loop operation would use around 3.3 per cent of the LNG stored on the FSRU to power the gas fired boilers for the regasification process. Predicted direct scope 1 greenhouse gas emissions would be approximately 4 times higher (difference of approximately 180,570 tCO2-e/year) under closed loop compared to open loop. The use of the gas-fired boilers also leads to higher predicted air emissions and noise levels.

The selection of open loop mode with combined loop mode during colder months is consistent with international best practice.[2] To AGL's knowledge, all operating FSRUs utilise open loop or combined

[1] See also WAA, Section 7.

[2] SEPP (Waters): "the best combination of techniques, methods, processes or technology used in an industry sector or activity that demonstrably minimises the environmental impact of that industry sector or activity."

loop operation except in some locations where there are freezing temperatures, and then closed loop is utilised as the seawater cannot be heated enough through combined loop to be efficiently used for regasification.[3] For example, closed loop is used in China and Lithuania in winter where there are freezing temperatures. The temperature in Western Port is never low enough to require closed loop to be used.

The comparative environmental performance of open loop and closed loop modes are summarised in Table 10 of the WAA, reproduced below. It is also possible to operate the FSRU in combined loop mode, being an open loop process with the use of boilers to heat the sea water where necessary, and hybrid mode, being a combination over time of open and closed loop mode. The environmental performance of hybrid would be the same as the environmental performance of open or closed loop mode set out in the table below, depending on the operating mode at any given time. The environmental performance of combined loop mode would largely reflect open loop mode with slightly higher greenhouse gas emissions.

Table 10 Integrated Environmental Assessment of Key Environmental Aspects for the Project

Environmental Aspect	Feature	Open loop	Closed loop	Comparison of regasification modes
Air	Source of fuel for engine and boilers (boilers required for closed loop only)	Boil-off gas (natural gas) used in engines	Boil-off gas (natural gas) used in engines and boilers	The use of natural gas rather than other fuel sources such as diesel, reduce particulate matter, SOx and NOx emissions. Due to the use of fewer pieces of equipment, the anticipated air emissions are lower during operation in open loop mode.
Greenhouse Gas	Source of heat for regasification process	Seawater is used as the heating medium for regasification. As the seawater is continuously consumed and discharged there is no requirement to reheat the seawater resulting in less energy consumption and therefore less Greenhouse Gas (GHG) emissions. Total operational GHG emissions of 57,454 tCO_2-e/year.	A once-off intake of 500 kL of seawater that is recirculated in a closed loop. Boilers are required to generate steam to reheat seawater for the regasification process that requires additional energy (compared to open loop), resulting in increased GHG emissions. Boil-off gas is used as the fuel for the boilers. Total operational GHG emissions of 238,027 tCO_2-e/year.	Less GHG emissions (approximately 180,573 tCO_2-e/year) anticipated during operation in open loop mode compared to closed loop mode.
Noise	Noise emission sources	Fewer pieces of noise generating equipment used during operation in open loop mode e.g. no boilers required.	Use of boilers (additional noise generating equipment) to generate steam for the regasification process.	Less noise emissions sources due to fewer pieces of equipment during operation in open loop mode (i.e. no boilers required).
Water	Discharge of regasification process water (seawater) to the marine environment	Continuous seawater intake and discharge of a large volume of cooler chlorinated seawater during regasification. Maximum continuous discharge of approximately 468,000 m^3/day at -7°C for the regasification process, plus ballast water and other minor discharges, compared to ambient seawater temperature.	A once-off intake of 500 kL of seawater and a once-off discharge of 500 kL of sea water when closed loop mode is turned off. There is also a continuous intake and discharge of seawater during closed loop mode related to cooling water requirements of the engines, atmospheric dump condenser, auxiliary machines and freshwater generator. Maximum continuous discharge of approximately 187,000 m^3/day (including the volume of seawater (cooling water) from the engine room, auxiliary machine, the atmospheric dump condenser and the freshwater generator) at approximately +4 °C when mixed compared to ambient seawater temperature.	A larger volume of continuous discharge of seawater (284,000 m^3/day) to the marine environment is anticipated during operation in open loop mode compared to closed loop mode. Impacts on the marine environment assessed as acceptable and low risk in both cases.

4. IMPACTS ON MARINE ENVIRONMENT – EES AND WAA PROPOSED OPERATIONS

The potential impacts to the marine environment of both open and closed loop modes were assessed as part of the EES and found to be acceptable.

In particular, the entrainment modelling demonstrated that entrainment rates for phytoplankton, zooplankton and icthyoplankton can be considered insignificant, particularly given the rates of daily

[3] AGL is aware of one FSRU approved in the USA for closed loop only operation, but it did not go into commercial operation.

predation and the extent to which the various planktonic communities will be replenished over these 7 and 21 day periods[4], and the conservatism inherent in the modelling.

Detailed hydrodynamic modelling[5] has also shown that, when operating in open loop mode without an adjacent LNG carrier, tidally averaged chlorine concentrations at the seabed would be below the default guideline value of 2.2 µg/L (0.0022 mg/L) at all locations.[6] The impact assessment demonstrated that the operation of the FSRU (even when operating in peak capacity and with chlorinated discharge at a constant 100 µg/L (0.1mg/L)) would have no material impact on benthic biota in the immediate vicinity of the FSRU, and minimal risk to marine organisms encountering the plume of seawater.

The modelling also demonstrated that discharge from the FSRU would be well-removed from more sensitive and ecologically significant features (such as areas of seagrass or intertidal zones).

Importantly, while the level of entrainment and the impact envelope for closed loop mode are smaller than for open loop mode, the impacts of open loop are not significant and are within acceptable limits. The modelling, which was accepted by all experts involved in the IAC hearing, shows that neither envelope reaches a sensitive receptor. Similarly, if entrainment is not causing significant impacts under either mode, entrainment is not a determining factor between the operating modes.

Therefore operation in either mode as proposed in the WAA and EES would be consistent with protection of beneficial uses of the receiving marine environment. However, open loop is the preferred operating mode for the reasons set out in this response.

5. PROPOSED REFINEMENTS TO THE OPERATION AND DESIGN OF THE FSRU

Whilst operation as proposed in the EES was assessed to be acceptable, refinements were proposed in respect of aspects of the design and operation of the FSRU in open loop mode during the IAC hearing process.

First, as set out in Technical Note 15, operational measures were specified as a means of mitigating the increased impacts that would be associated with the discharge of wastewater whilst an LNG carrier is moored adjacent to the FSRU. Pursuant to those measures, AGL is committed to operating the FSRU in a manner that is consistent with a minimised area of impact, being the modelled extent of the discharge as if the FSRU was operating without an adjacent LNG carrier. In this way, if the FSRU is to operate while an LNG carrier is moored alongside, it will be necessary to innovate the operations or design of the FSRU to achieve the same minimised impact area.

As addressed in the witness statement of Dr Ian Wallis, this may be achieved by the reconfiguration of the discharge ports (so that the discharge from one regasification train may be directed to the west), so as to allow the FSRU to continue to operate at a low rate of regasification while an adjacent LNG carrier is present. Further analysis in this respect will be provided as part of the updated marine modelling and assessment being undertaken in accordance with questions 14 and 15 of the Notice.

Second, options were identified to modify the internal biofouling processes so as to lower the concentration of residual chlorine produced oxidants (CPO) in wastewater discharged from the FSRU (which, for the purposes of the EES, was modelled at 1 mg/L at the point of discharge). These matters were addressed in Technical Notes 35 and 53, and informed the formulation of the alternate design specifications contained in EPR ME02. In short, it is AGL's position that:

- Whilst it may be theoretically possible to operate the FSRU to achieve a chlorine discharge of zero by avoiding electrolysis altogether, this approach is not proven and is not practicable at all times when the FSRU is operating;

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[4] See IAC Document 540 at p 5-6 and the Proponents Closing Submissions on the Intake of Seawater at p39-45.

[5] See Technical Report A and the Hydrodynamic Modelling Report in Annexure H to Technical Report A.

[6] See IAC Document 395 at p9 and the Proponents Closing Submissions on the Discharge of Seawater at p 45- 53.

- A reduction in chlorine discharge to 0.02mg/L is technically feasible, but has consequences for maintenance and operation including:
    - inadequate control of biofouling prevention, requiring an increased maintenance and cleaning regime;
    - inefficiency including cost, shut down and onshore waste disposal; and
    - potential for one train to be shut down at periods of high gas demand; and
- An alternative regime could be implemented whereby chlorine discharge would be eliminated at and around slack tide (at which time there is greatest scope for the pancake of cool water to form at the seabed), and where varying rates (not exceeding 0.1 mg/L) could be implemented at other points in the tidal cycle.

AGL's inquiries in relation to chlorine discharge levels of LNG facilities and power station facilities across Australia and the around the world, and applicable guidance and standards, indicate that these options in EPR ME02 are consistent with international best practice.

AGL contends that, given the particular tidal characteristics of the North Arm of Western Port and the extent to which tidal currents influence dispersion, the option whereby variable rates of CPO are permitted throughout the tidal cycle is superior to the constant chlorination option. This notwithstanding, the implementation of either of the two options, would result in considerably lesser concentrations of CPO at all locations (and under all scenarios) than were modelled in the EES.

The implementation of the refinements developed during the course of the IAC hearing, and other potential modifications to further reduce impacts, will result in reductions in impacts while the FSRU is operating in open loop mode. Additional modelling being undertaken in accordance with questions 14 and 15 of the Notice will quantify the extent of reduction.

AGL concludes, on the basis of the acceptability of impacts modelled as part of the EES/WAA, that the impacts of open loop operation on the marine environment will, with the implementation of proposed refinements, be consistent with best practice and the protection of beneficial uses in Western Port.

6. ASSESSMENT OF REASONABLE EFFORTS TO AVOID WASTEWATER GENERATION AND DISPOSAL

It is apparent from the wastes hierarchy and the concept of reasonable efforts (or reasonably practicable) that the application of the hierarchy does not require the avoidance of wastewater generation under any circumstance. Instead, in the context of clauses 20 and 21 of SEPP (Waters), the hierarchy must be applied having regard to the particular characteristics of the proposal in question, and the capacity for wastewater discharge to be managed so as to protect beneficial uses, and the requirements of the EP Act more broadly, including principle of integrated environmental management.

The starting point in assessing the FSRU in relation to the obligation to take all reasonable efforts to avoid wastewater disposal is to recognise that no method of regasification can occur without the utilisation of seawater and the associated discharge of wastewater. In this sense, the Project cannot avoid wastewater generation, regardless of whether it operates in closed loop, combined loop, or open loop modes.

The second point is that, for the reasons addressed in AGL's response to question 2 of the Notice, under any of the proposed modes of operation, the wastewater in question will relevantly be "re-used" or "re-cycled" in the sense that it would be returned to its source (the surface waters of Western Port) where it can be utilised for any one or more of the protected beneficial uses.

The third point is that options for avoiding wastewater generation have been comprehensively considered, with closed loop mode fully assessed in the EES and WAA.

At this point, AGL contends that the conclusion should be reached that AGL has made all reasonable efforts to avoid the generation and discharge of wastewater, as required by clause 21.

To the extent that this conclusion is disputed, and it is said that more should be done to avoid wastewater, AGL contends that further avoidance is not required by "reasonable efforts" and is not supported by other considerations that must be central to EPA's decision making.

While lower volumes of wastewater would be generated in closed loop mode, it does not follow that this mode of operation should be considered superior to open loop mode. In particular, because wastewater discharge from both modes of operation can be managed so as to protect beneficial uses, the environmental and economic costs of the lower wastewater discharges associated with closed loop mode require careful consideration.

In fact, a balancing exercise is prescribed by "all reasonable efforts" or "reasonably practicable" and by the EP Act principles of environmental protection of integrated decision making and integrated environmental management, which must inform EPA's decision making in relation to the works approval application.[7]

6.1 The principle of integrated environmental management

The principle of integrated environmental management (s 1J) provides:

> *If approaches to managing environmental impacts on one segment of the environment have potential impacts on another segment, the best practicable environmental outcome should be sought.*

This is an explicit recognition that there will sometimes be a conflict between minimising impacts on different segments of the environment, and a requirement, where this occurs, to undertake a balancing or trade-off to achieve the best practicable outcome.

The principle of integrated environmental management is of particular relevance in assessing a project like the FSRU in which different operating scenarios create different impacts to different segments of the environment.

Closed loop regasification and open loop regasification each have a range of impacts, which upon an integrated assessment have led AGL to prefer open loop regasification, as set out in section 3.3 above. It is clear that, although there are less wastewater discharges associated with closed loop mode, discharges to air, including greenhouse gases, and noise discharges will be higher than in open loop mode.

In this context, it is important to consider the broader decision-making context – beyond SEPP (Waters). SEPP (Waters) and its requirements regarding wastewater discharges, are not the only consideration in the assessment of the WAA.

In particular, policy including *all* SEPPs is the primary consideration for EPA in deciding a works approval application (EP Act, s 20C). SEPP (Air Quality Management) requires that generators of greenhouse gas emissions:

- avoid and minimise emissions in accordance with the principles of the waste hierarchy;
- pursue continuous improvement; and
- apply best practice to the management of their emissions.

[7] In the context of SEPP (Waters), the principles of environment protection provide guidance as to what those considerations are. EPA is required to have regard to the principles in administering the EP Act, including the assessment of the WAA (s 1A(3)), and the administration of SEPP (Waters) must be based on the principles (cl 11).

Similarly, the *Climate Change Act 2017* requires the EPA to have regard to the potential contribution to the State's greenhouse gas emissions of the decision or action (s 17(2)(b)). It is highlighted that this is not a generic obligation applicable to all decision makers in all contexts, but an obligation imposed on just 19 specified decisions, including EPA making a decision on a works approval application.

Like discharges to the marine environment, GHG emissions are inevitable with the FSRU project, but policy requires their minimisation in the same way as it requires the minimisation of wastewater generation. SEPP (Air Quality Management) confirms that the wastes hierarchy applies to GHG emissions, just as it applies to wastewater. The operation of the FSRU in open loop mode, with combined loop mode during colder months, represents best practice, and minimised GHG generation.

There is no basis to place greater weight on SEPP (Waters) above other policy considerations such as the SEPP (Air Quality Management) and the *Climate Change Act 2017* requirements in relation to the reduction of GHG emissions. In particular, the fact that acceptable levels of GHG emissions are not prescribed by SEPP does not mean that they should be given less weight than wastewater.

AGL contends that the use of open loop operations as regulated through the EPRs reflects an optimised balance between impacts on marine waters and other segments of the environment.

6.2 The principle of integration of economic, social and environmental considerations

The principle of integration of economic, social and environmental considerations (s 1B) provides that:

> *(1) Sound environmental practices and procedures should be adopted as a basis for ecologically sustainable development for the benefit of all human beings and the environment.*
>
> *(2) This requires the effective integration of economic, social and environmental considerations in decision making processes with the need to improve community wellbeing and the benefit of future generations.*
>
> *(3) The measures adopted should be cost-effective and in proportion to the significance of the environmental problems being addressed.*

AGL contends that sound environmental practices and procedures have been adopted consistent with ecologically sustainable development for all human beings and the environment. Chapter 24: Sustainability of the EES responds to the ecologically sustainable development component of the Scoping Requirements.

Of particular relevance to question 5, the integration principle contemplates consideration of cost-effectiveness and proportionality.

As set out in EPA Publication 1565:

> *The integration of economic, social and environmental concerns aims to optimise the outcome of available trade-offs or compromises between competing concerns and values, and assist in reaching a balanced decision, rather than provide the absolute maximum level of protection of the environment.*

This principle is closely aligned with the definition of "reasonably practicable", discussed earlier.

AGL contends that the use of open loop operations, as regulated through the EPRs, is consistent with the notion of management practices which integrate economic, social and environmental concerns, are cost effective and in proportion to relevant environmental risks, and minimise those risks so far as reasonably practicable.

As discussed in section 4 and 5 above, there is a low likelihood of harm to the marine environment being caused by the wastewater discharge. Any further reduction in wastewater discharge by

operating in closed loop mode would come at a disproportionate economic cost (the consumption of 3.3 per cent of the cargo) and environmental cost (greenhouse gas, other air and noise emissions), such that it is neither reasonably practicable nor consistent with the principle of integrated decision making to require closed loop mode. What is proposed for FSRU operations is environmentally balanced, efficient and in proportion to the environmental risks – an optimised balance.

6.3 The wastes hierarchy principle

Returning to the focus of question 5 – the wastes hierarchy – the principles discussed above and the concept of reasonably practicable are clearly incorporated in EPA guidance in relation to the wastes hierarchy. Guidance recognises that trade-offs will sometimes be appropriate, confirming that EPA will look for evidence that:

> • *the applicant has considered the possibility of adopting options at higher levels in the wastes hierarchy, and has not rejected them without adequate investigation and analysis*
>
> • *the applicant's proposal is at the highest level in the wastes hierarchy that allows an outcome consistent with statutory policy and best practice, involves acceptable risk, and is 'practicable', that is, relevant and reasonably available and affordable*
>
> • *the applicant is advancing a proposal at a lower level in the hierarchy that it believes is significantly superior in overall terms (based on environmental risk and practicability considerations), and has documented the investigations and analyses undertaken to reach this conclusion.* [8]

In relation to the Project, AGL has comprehensively considered the possibility of further avoidance of wastewater discharges. On the basis of that assessment, AGL has concluded that open loop mode, with higher wastewater discharge than that involved with closed loop operations:

- achieves best practice;
- avoids disposal to the extent necessary to achieve low and acceptable impacts to beneficial uses of the marine waters; and
- is superior based on overall environmental impacts and what is reasonably practicable to minimise risks to beneficial uses of the marine waters.

7. CONCLUSION

AGL contends that it has made all reasonable efforts to avoid waste discharges, including wastewater generation within the context of the proposal, given the necessity of the discharge, the provision of wastewater for re-use, the minimal and acceptable impacts of the wastewater on the marine environment, and the environmental disbenefits and inefficiency of additional mitigation.

AGL therefore contends that the requirements of clauses 20 and 21 of the SEPP for reasonable efforts to minimise wastewater generation and discharges are satisfied, and that the proposed mode of FSRU operation represents an optimised balance consistent with EPA's obligation to consider both wastewater impacts *as well as* impacts beyond wastewater discharges and the principles of environment protection.

In these circumstances, there is no proper basis upon which to restrict the particular operating mode of the FSRU, rather focus should be on risk based environmental performance conditions. Appropriate outcomes can be achieved in open, closed or combined loop mode. What is proposed, after refinement through the IAC hearing, represents an optimised balance between competing interests.

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[8] EPA Publication 1565: Application of the environment protection principles to EPA's approval process (June 2014), p 8.

If EPA remains unsure of the appropriate balance, AGL suggests that the appropriate response would be to allow AGL to proceed as proposed (open loop and combined loop) subject to monitoring and the potential for later adjustment. EPR-ME16 already requires monitoring, with details to be confirmed with EPA. If that monitoring demonstrates unacceptable marine impacts, the operating mode could be changed – the capacity for the FSRU to operate in different modes should be considered a positive attribute of the proposal.

This approach would avoid imposing conditions on operations that are likely to lead to unnecessary environmental and economic costs, while ensuring that any unanticipated impacts on the marine environment will be detected and can be promptly addressed.

While AGL is strongly of the view that this approach is appropriate, it also notes that, if EPA considers that the balance requires adjustment, then there is the option of a hybrid of different modes, with closed loop being used during more ecologically sensitive times of the year and open or combined loop at other times. We can provide further detail on this, if required, to inform the EPA's assessment of AGL's WAA.

Question 6 - Please compare the wastewater discharge associated with closed loop operations with the wastewater discharge associated with the LNG carriers and with other vessels using the Western Port.

1. WASTEWATER DISCHARGES FROM LNG CARRIERS VISITING THE FSRU.

AGL has undertaken a comparison of the wastewater discharges associated with closed loop operations against the discharges associated with the typical discharges associated with the two main types of LNG carriers.

The global fleet of LNG Carriers is over 500 vessels, all encompassing different build dates, technologies, propulsion systems and therefore different water usage requirements.

Through AGL's commercial arrangements with Hoegh LNG, AGL has been able to obtain typical water discharges for a dual fuel diesel electric LNG Carrier (LNGC DFDE) and a typical spherical (Moss) tank LNG carrier with steam turbines (LNGC ST) during LNG unloading operations, which are provided in the table below

TYPICAL CONTINUOUS DISCHARGES DURING LNG UNLOADING			
Description	**Sea water discharge m^3/day**		
	FSRU	**LNCG DFDE**	**LNCG ST**
Main generator FW cooler	29,280[9]	29,280	0
Fresh water generator	2,112	2,112	2,160
Aux machinery FW cooler	45,840	45,840	21,144
Steam condenser	80,400	0	204,000
Water curtain	5,760	5,760	5,760
Total discharge	163,392	82,992	233,064

Nearly half of the FSRU's water use in closed loop mode is associated with the dump condenser, which is a safety provision, provided to remove the energy from any excess steam generated by the FSRU boilers. In normal operation, when in closed loop mode, there is no excess steam and water runs through the dump condenser without any change in temperature. However, if there is an unforeseen operational upset that causes a regasification train to shutdown unexpectedly, the dump condenser is used to safely take away the energy of the excess steam until the system is fully shutdown or returned to normal operation.

The comparison in the table above shows that the discharges from the LNGC ST carriers are typically higher than those from the FSRU, and that the discharges from a LNGC DFDE will be very similar to those from the FSRU (given they both use DFDE technology).

[9]AGL notes that the amount of main generator FW cooler sea water discharge was incorrectly identified as 58,560 in the EES (for example see Chapter 6 Marine Biodiversity at p 90), and that the amounts in the table above are correct.

2. WASTEWATER DISCHARGES FROM OTHER VESSELS IN WESTERN PORT.

In order to make a comparison between wastewater discharges from other vessels in Western Port, and the projected discharges from the FSRU, AGL has made general inquiries about vessel data with the Port of Hastings Development Authority and the Victorian Regional Channels Authority (VRCA).

AGL was able to obtain some indicative vessel water discharge rates from the VRCA based on the Harbour Master's general knowledge, and set out in the table below. However, AGL has been unable to validate these discharges or confirm if it is inclusive of all water discharge from the vessels. AGL is also unaware of the water quality parameters of these discharges.

VESSEL TYPE	APPROX.VESSEL LENGTH	SEAWATER RATE FOR ENGINE COOLING OR CLOSED LOOP COOLING	
		Alongside m3/d	Underway m3/d
Large Gas Tankers	220 m	8400	19200
Small Gas Tankers	100 m	720	2400
Crude oil Tankers	270 m	7200	14400
MR Vessels	175 m	7200	14400
LR Vessels	250 m	7200	14400
Vessels at SW2	180 m	7200	14400
Passenger ships	300 m	38400	38400

AGL is not able to provide any analysis of the difference between the water discharges of the various types. Discharge of water from the vessels is highly dependent on the cooling water requirements and therefore correlates to power usage of the vessels and the use of steam condensers on the vessels. This information is not available for AGL to review and analyse.

AGL notes that the FSRU undertakes different processes and has a different function to other vessels utilising the Port of Hastings. In particular, AGL notes that the FSRU has significant power requirements due to the LNG pumping and process requirements as well as the requirement for a dump condenser, which would partly explain the differences in discharge rates.

OPTIMISING FSRU OPERATIONS - COMBINED LOOP

Question 9 - Clause 21(2)(b)(i) of SEPP (Waters) requires an application to include all reasonably practicable measures to ensure the wastewater discharge does not exceed the environmental quality objectives set out in Schedule 3 to SEPP (Waters). Explain:

(a) **what is the area of water that will exceed the proposed guideline values for temperature and chlorine-produced oxidants?**

(b) **how the FSRU design, operation and management will minimise the area exceeding the proposed guideline values for temperature and chlorine-produced oxidants.**

1. INTRODUCTION

Clause 21 of SEPP (Waters) provides that an application for approval to discharge wastewater must include all reasonably practicable measures to ensure that the wastewater discharge does not exceed the environmental quality objectives set out in Sch 3 of the SEPP and minimise risks to the beneficial uses of the receiving water.

Risk to the beneficial uses of Western Port have been addressed in AGL's response to Q3 of the EPA's Notice. AGL is of the view that wastewater discharge from the FSRU can be treated and managed to a level to protect beneficial uses.

This answer addresses clause 21(2)(b)(i), which relates to environmental quality objectives, that for Western Port are set out in Table 7 of Schedule 3 to the SEPP (Waters). However, AGL reserves the right to provide further information in support of this question in due course. In particular, and as articulated to the EPA previously, AGL is undertaking further marine modelling to demonstrate the area, or maybe more accurately the volume (m^3), within which there is an exceedance of an environmental quality objective. This modelling is important, as it adopts the refined operation, management and design of the FSRU that were developed and articulated throughout the IAC hearing. These refinements are explained in AGL's response to Question 5 of Notice.

2. KEY PRINCIPLES

SEPP (Waters) as a whole seeks to sustain the beneficial uses of Victoria's water environments.[10] The explanatory note for clause 21 explains that the clause "sets out the requirements for applicants of works approvals …to manage their discharges so as to minimise risks to beneficial uses".

Considering clause 21(2)(b)(i) as a standalone principle, therefore, is a somewhat artificial construction of the SEPP (Waters). The EPA's enquiry should consider the broader context of risks to beneficial uses, rather than focus solely on possible exceedance of an environmental quality objective at the exclusion of this broader context. This approach is supported by clause 17(2) of the SEPP (Waters) which states that non-attainment of an environmental quality objective does not indicate that one or more beneficial uses *is* at risk. Instead it indicates that there may be a risk, and then provides for an investigation to assess the risks and consideration of actions to address them.

Furthermore, clause 21 provides that a works approval applicant must demonstrate "reasonably practicable" measures to avoid exceedance to the environmental quality objectives. AGL has previously addressed the concept of "reasonably practicable" measures in its response to Question 5 of the Notice, however we emphasise that this term recognises the need for a risk-based and proportionate response to environmental risks, with a particular focus on impacts to beneficial uses.

[10] SEPP (Waters), preamble.

3. ENVIRONMENTAL QUALITY OBJECTIVES AND INDICATORS IN WESTERN PORT BAY

The environmental quality objectives and indicators for the North Arm of Western Port Bay are set out in Table 7 of Schedule 3 to the SEPP (Waters). Clause 3 of Schedule 3 also sets out additional environmental quality objectives for biological indicators that apply to marine waters. In particular, these seek to "support the maintenance…of the current cover, extent and condition of seagrasses, within the bounds of natural variation", and limit increases in the frequency, duration and spatial extent of harmful algal blooms.

The operation of the FSRU will not alter nutrient concentrations, dissolved oxygen, suspended solids, pH or light attenuation. The seawater discharged will be of a different temperature and will contain residual concentrations of chlorine-produced oxidants (**CPOs**). AGL notes that the temperature differential is not a specified environmental quality indicator for the purpose of the North Arm of Western Port. Despite that, the environmental quality objectives for temperature has been determined by reference to the 25th and 75th percentile temperature change at Crib Point, in accordance with the process established in SEPP (Waters). As explained in the Works Approval Application (**WAA**) exhibited with the EES, the guideline value for temperature corresponding to these percentiles is 0.5°C.[11] For CPOs, as a toxicant, the environmental quality objective is 99% protection. Although the subject of discussion in the IAC hearing, for the purpose of the modelling that is being undertaken, the default guideline value will be 2.2µg/L (0.0022 mg/L) – this will be explained further in the report being prepared in response to Q14 and 15 that will accompany the additional marine modelling as requested by the EPA.

As the extensive modelling undertaken for the EES showed, the seawater discharged from the FSRU will quickly mix with the surrounding waters and return to background conditions. The FSRU discharge ports have been designed to create optimal mixing conditions, discussed further below.

The exact area within which the CPO and temperature will exceed the guideline value of 0.5°C and 2.2µg/L will be determined by the marine modelling which is currenting being undertaken. AGL will provide this information to the EPA, and respond further to this questions, once the modelling has been completed. However, and as explained in Question 5, the marine modelling undertaken for the EES,[12] which does not account for all of the proposed refinements to the operation and design of the FSRU, demonstrates that:

(a) when operating in open loop mode without an adjacent LNG carrier, tidally averaged chlorine concentrations at the seabed would be below the default guideline value of 2.2 µg/L (0.0022 mg/L) at all locations;

(b) discharge from the FSRU would be well-removed from more sensitive and ecologically significant features (such as areas of seagrass or intertidal zones); and

(c) in respect of temperature differential, the physical extent of any difference would be limited to the close vicinity of the FSRU, and will remain within the natural temperature variation experienced in the North Arm.

It is anticipated that the modelling currently being undertaken will demonstrate a reduced area of impact, as a result of the operational and design refinements that AGL have made to the FSRU. These are detailed in other answers AGL have provided to the Notice, including Question 5, however the following design, operation and management aspects of the FSRU will minimise the area exceeding the environmental quality objective:

- Optimising the direction and orientation of the discharge ports to enhance dilution, as a result of the near-field modelling.

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[11] See Attachment VIII of the EES, Works Approval Application, in particular section 12.2.5.

[12] See Technical Report A and the Hydrodynamic Modelling Report in Annexure H to Technical Report A.

- Committing to operate the FSRU in a manner consistent with a minimised area of impact, being the modelled extent of the discharge as if the FSRU was operating without an adjacent LNG carrier. If the FSRU is to operate while an LNG carrier is moored alongside, it will be necessary to achieve the same minimised impact area.

- Modification of the electrolysis processes to reduce the level of residual CPO discharged, in accordance with proposed EPR-ME02.

Question 11 - Explain whether the proposal would be consistent with the environmental protection principles under the Environment Protection Act 1970, with reference to EPA's publication 1565. They must include, but not be limited to, the following:

(a) **integration of economic, social and environmental considerations (s.1B)**

(b) **waste hierarchy (s.1I).**

For the purpose of this question we have focused on those aspects of the principles considered most relevant to this Project.

SECTION IN THE ACT	PRINCIPLE	EXPLANATION WHETHER THE PROPOSAL IS CONSISTENT WITH THE PRINCIPLE
1B	**The principle of integration of economic, social and environmental considerations** (1) Sound environmental practices and procedures should be adopted as a basis for ecologically sustainable development for the benefit of all human beings and the environment. (2) This requires the effective integration of economic, social and environmental considerations in decision-making processes with the need to improve community wellbeing and the benefit of future generations. (3) The measures adopted should be cost-effective and in proportion to the significance of the environmental problems being addressed.	Below is a general summary of how the proposal is consistent with this principle. Please refer also to the response to Question 5. (1) Environmental performance requirements (EPRs) were developed as part of the 17 impact assessments carried out to avoid, minimise and manage impacts. These EPRs are based on compliance with legislation and standard requirements that are typically incorporated into the delivery of infrastructure projects of similar type, scale and complexity as well as best practice. The EPRs have been further refined through the IAC process. The EPRs determine the environmental outcomes that the design, construction and operation of the project must achieve such that ecologically sustainable development will be achieved. (2) Effective integration of economic, social and environmental considerations is facilitated through the EES process and other approvals processes required for the project. In particular, the EES Scoping Requirements required that the main EES report include the evaluation of the implications of the project and alternatives for the implementation of applicable legislation and policy, including the principles and objectives of ESD and environmental protection. The EES draft evaluation objectives were framed to include the objectives and principles of ESD and environmental protection. Chapter 24: *Sustainability* of the EES responds to the ecologically sustainable development (ESD) component of the Scoping Requirements. The chapter presents a desktop review of how the Project aligns with the principles and objectives of ESD. To conduct this desktop review, a sustainability framework was developed. This involved two components; ESD principles drawn from Commonwealth and State legislation; and ESD objectives drawn from the United Nations Sustainable Development Goals. A desktop review of the proponent's sustainability commitments, the EES risk registers, technical assessments and proposed mitigation measures was undertaken using this framework to review how the Project aligns with the principles and objectives of ESD. (3) The EPRs that have been proposed by the project are based on compliance with legislation and standard requirements that are typically incorporated into the delivery of infrastructure projects of similar type, scale

		and complexity. Further, they implement and are consistent with best practice. This means that the EPRs are cost-effective and in proportion to the significance of potential impacts being managed.
1C	**The precautionary principle** (1) If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. (2) Decision-making should be guided by: (a) a careful evaluation to avoid serious or irreversible damage to the environment wherever practicable; (b) an assessment of the risk-weighted consequences of various options.	The EES assessment used a systematic risk based approach to understand the existing environment, identify potential impacts of the project on the environment and evaluate the effectiveness of the outcomes of EPRs to avoid, minimise or manage potential impacts. The precautionary principle does not stand for the proposition that risk must be eliminated. It is engaged only when there is a threat of serious or irreversible environmental damage. No such threat has been identified in the assessment of this project. The precautionary principle should not be applied on the basis that every conceivable, hypothetical risk will eventuate, unless proven otherwise. This is not consistent with the evidence provided in the course of the IAC hearing and is not how the principle should be applied. The EES is informed by consideration of risks that may realistically occur, which is consistent with the Scoping Requirements. As a matter of good practice rather than as an application of the "precautionary principle", the EES has been precautionary, in the sense of being highly conservative, in various ways. It is important to recognize, for instance, that the majority of assessments have been undertaken on the basis of the FSRU operating at peak rates of regasification capacity. As the indicative operating scenarios documented in Technical Note 33 demonstrate, these should properly be considered worst-case assumptions. Actual operating levels will vary throughout the course of any given year and over the lifespan of the Project, but will generally be below peak rate.
1D	**The principle of intergenerational equity** The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	Compliance with the proposed EPRs would ensure that the health, diversity and productivity of the environment is maintained for the benefit of future generations. This is demonstrated by the various technical studies supporting the EES, and the evidence presented to the IAC.
1E	**The principle of conservation of biological diversity and ecological integrity** The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.	The Project and proposed mitigation measures have been developed with the specific purpose of avoiding and, where avoidance is not possible, minimising potential impacts on the marine environment and the terrestrial and freshwater environment, particularly in relation to flora, fauna and their habitats which are protected under State and Commonwealth legislation. The conservation of biological diversity and ecological integrity within the marine and terrestrial environment is being considered by various decision makers as part of the EES process and other key approvals required.

		The following draft evaluation objectives for the EES addressed marine biodiversity and terrestrial and freshwater ecology (see sections 4.2, 4.3 and 4.6). In particular, draft evaluation objective 4.2 provided that: Biodiversity – To avoid, minimise or offset potential adverse effects on native flora and fauna and their habitats, especially listed threatened or migratory species and listed threatened communities. The EES chapters 6 and 7, and the supporting technical reports A and B addressed this objective. Further evidence was provided from Dr Wallis and Mr Chidgey on marine ecology impacts and Mr Brett Lane on terrestrial and freshwater ecology during the IAC hearing. AGL refers the EPA to its closing submissions to the IAC on the topics of marine ecology and terrestrial and freshwater ecology. AGL is undertaking further modelling and revised impact assessment in relation to the proposal and the refined operating parameters including the options in EPR MEO2, and reserves its right to add to this response in light of the additional modelling and impact assessment to be undertaken.
1I	**The principle of the wastes hierarchy** Wastes should be managed in accordance with the following order of preference: (a) avoidance (b) re-use (c) recycling (d) recovery of energy (e) treatment (f) containment (g) disposal.	The wastes hierarchy has been applied for the minimisation and management of waste and wastewater generated as a result of the operation of the FSRU. This includes the following: • Segregation of solid and liquid waste streams to maximise reuse and recycling potential. • Treatment of certain types of waste onboard the FSRU prior to disposal. • Reuse of cooling water streams from the engines and auxiliary machinery systems within the regasification seawater loop. Please refer to the response to Question 5 regarding application of this principle to the wastewater discharge. The minimisation of emissions of waste to air, consistent with the wastes hierarchy, has also been a central consideration for the project. Emissions of waste greenhouse gas have been avoided through selection of open and combined loop operational modes, as discussed in relation to the principle of integrated environmental management (s 1J), below and see further the response to Question 5.
1J	**The principle of integrated environmental management** If approaches to managing environmental impacts on one segment of the environment have potential impacts on another segment, the best practicable environmental outcome should be sought.	This matter is dealt with in some detail in our answer to Question 5 of the Notice, set out above, however we offer the following additional comment. AGL's position continues to be that, particularly with the implementation of refined management and treatment measures, the relative implications of operations in closed loop for emissions and feasibility are such that open and combined loop operations represent the best practicable environmental outcome. The substantial greenhouse gas emissions of closed

		loop mode outweigh the impacts on the marine environment of open and combined loop modes, which are relatively higher than in closed loop mode but within acceptable limits.