Chapter 5

Air quality

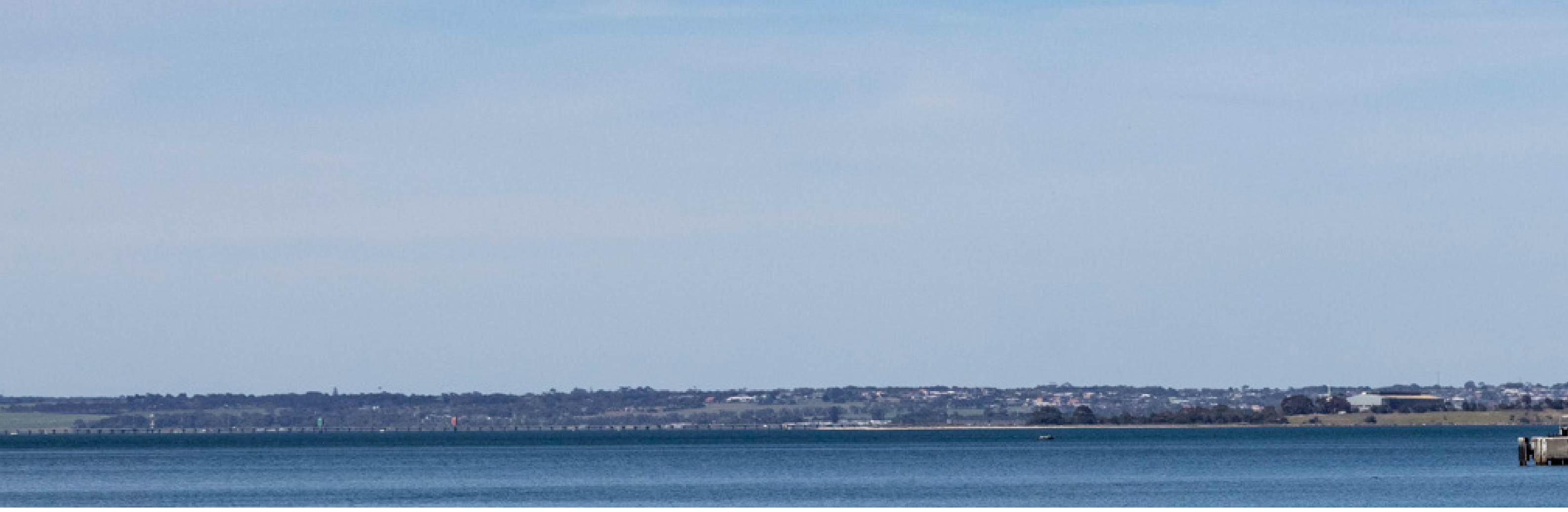
A full assessment was completed of the potential impacts on air quality from the project as part of the Environment Effects Statement (EES) (Technical Report H: Air quality impact assessment, hereafter referred to as AQ EES study).

The modelling undertaken in the AQ EES study showed no exceedances of adopted air quality criteria at any of the sensitive receptors in the study area. The AQ EES study concluded that air quality impacts from the Floating Storage Regasification Unit (FSRU) operations would be low, would not exceed adopted regulatory air quality criteria and would be localised in the vicinity of Refinery Pier and the refinery.

The Inquiry and Advisory Committee (IAC) considered the air quality criteria adopted in the EES to be appropriate and noted that the EPA supported that adopted criteria. The IAC also agreed that if the project is implemented in accordance with the assumptions in the modelled scenarios, the potential impacts on air quality would be acceptable (IAC Report No. 1, section 13.3 (iii)).

In addition, the IAC accepted the use of the Esperanza FSRU air emissions data which represents current best available technology, and for this reason further sensitivity testing would not be required (IAC Report No. 1, section 13.3 (iii)).

The IAC recommended that Viva Energy continue to work with the Victorian Environment Protection Authority (EPA Victoria) to compare the effects of bubble limits and stack specific limits in relation to air quality impacts on sensitive receptors.



This chapter provides a summary of the supplementary Air Quality study that has been undertaken in response to Recommendation 11 in **Table 5-1** of the Minister for Planning's Directions (Minister's Directions) for the Viva Energy Gas Terminal Project (the project) Supplementary Statement.

This chapter summarises the outcomes of Technical Report C: Supplementary air quality impact assessment.

The objectives of this chapter are to:

- Provide a summary of the technical response to Recommendation 11 of the Minister's Directions.
- Integrate the outcomes of the supplementary Air Quality study with key outcomes of the AQ EES study.
- Provide an update to the EES air quality mitigation measures where necessary.

Overview

The Minister's Direction relevant to the supplementary Air Quality study is Recommendation 11, which has asked Viva Energy to undertake sensitivity testing on the air quality model adopted for the project to confirm that operational impacts on air quality would be acceptable, considering:

a. The significance of the wake effects of the FSRU.
b. A 'worst-case' scenario for air emissions (but based on the use of best available technology [BAT]).
c. The implication of bubble limits and stack specific limits for sensitive receptors.

To understand how the configurations and orientations of the FSRU may influence the significance of wake effects and associated predicted pollutant ground level concentrations at sensitive receptors, sensitivity testing for a number of different FSRU configurations and two different FSRU orientations with and without a Liquefied Natural Gas (LNG) carrier berthed alongside the FSRU was conducted as part of the supplementary study.

The Esperanza FSRU, considered to be representative of current BAT, with its bow facing southeast alongside an LNG carrier (modelled in the AQ EES study), was determined to be the worst-case operating scenario among all configurations and orientations assessed. As demonstrated in the AQ EES study, all modelled pollutants were predicted to comply with relevant criteria at all modelled locations for this scenario.

It was determined that time-series pollutant concentrations resulting from the worst-case operating scenario for the Esperanza FSRU would not be discernible from background concentrations most of the time. Potential air quality impacts associated with the project would be minor. Emissions from a worst-case operating scenario would be compliant with all relevant regulatory criteria and would not cause significant adverse impacts on the surrounding environment.

It was determined that a combination of stack specific limits and annual bubble limits would be most suitable for the project, and this has been proposed for the EPA Victoria licence conditions. This combined approach would result in lower annual emissions and lower ground level annual average concentrations at sensitive receptors compared to stack specific limits only, noting that the emissions would be compliant with regulatory requirements under either licencing approach. The approach takes into consideration a gas production profile which fluctuates throughout the year in response to gas demand and minimises air emissions while providing flexibility to operate the FSRU at 100 percent gas production load when required. The bubble limits were calculated based on the preferred, open loop operating mode, with closed loop operating mode for peak load to cover any potential need to use the boilers, noting that the peak load scenario would be infrequent, approximately two days per winter month on average.

The open loop operating mode uses a continuous supply of seawater as a heat source to heat the LNG and the closed loop operating mode uses gas-fired boilers and recirculating seawater to generate steam to heat the LNG. Closed loop mode would only be used in the unlikely event that the refinery is unable to accept discharge water from the FSRU (e.g. during maintenance of the seawater transfer pipe).

5.1 Methodology

5.1.1 Minister's Directions

Table 5-1 of the Minister's Directions consolidates the recommendations for further work to inform the Supplementary Statement. The Minister's Direction relevant to the supplementary Air Quality study are set out below.

Table 5-1 Minister's Direction relevant to the supplementary Air Quality study

Recommendation	Description	Section addressed
Recommendation 11	Undertake sensitivity testing on the air quality modelling to confirm that operational impacts on air quality would be acceptable. Consider:	
	a. The significance of the wake effects of the floating storage and regasification unit (FSRU).	**Section 5.3.1**
	b. A 'worst-case' scenario for air emissions (but based on the use of best available technology [BAT]).	**Section 5.3.2**
	c. The implication of bubble limits and stack specific limits for sensitive receptors.	**Section 5.3.3**

A summary of the tasks that were undertaken to address the three items of further work is provided below:

- Methodology for Recommendation 11a: Analyse the difference between a number of general arrangements of FSRUs and model emissions using AERMOD for a number of different configurations and orientations.
- Methodology for Recommendation 11b: Compare the sensitivity testing results for different configurations and orientations of the FSRU and provide further discussion and analysis for the 'worst-case' scenario air quality impacts (noting that the IAC accepted the use of the Esperanza FSRU data which represents current BAT and did not consider that further sensitivity testing is required in this regard).
- Methodology for Recommendation 11c: Provide proposed project gas production profiles to demonstrate the gas demand trend over a year and establish the basis for calculating bubble limits, present the proposed stack specific limits and bubble limits and compare long-term (annual) air emissions and air quality impacts on sensitive receptors for stack specific limits only and a combination of stack and bubble limits.
- Identify any additional mitigation measures, if necessary.
- Confirm whether operational impacts on air quality are acceptable.

5.1.2 Study Area

The study area for the supplementary Air Quality study included the area within a 10km by 10km grid surrounding the FSRU to calculate pollutant concentrations at nearby populated regions with sensitive receptors and to ensure that the potential for wider regional impacts from the project were assessed.

5.2 Summary of the AQ EES study operation impact assessment

In accordance with Recommendation 11 in **Table 5-1** of the Minister's Directions, the focus of the supplementary air quality study was to conduct a sensitivity analysis of the air quality modelling and confirm the acceptability of the air quality impact associated with the operation of the FSRU.

During operation of the FSRU, fuel combustion in the engines and boilers would emit air pollutants. The primary pollutants from the FSRU gas-fuelled engines are expected to be nitrogen oxides (NOx), carbon monoxide (CO), and to a lesser extent, volatile organic compounds (VOC) (USEPA, 2000). The primary pollutants for the FSRU liquid-fuelled engines are expected to be particulate matter (PM10 and PM2.5) and sulfur dioxide (SO_2). CO, VOC, hazardous air pollutants (HAP) and particulate matter are primarily the result of incomplete combustion noting that the liquid-fuelled scenario is not expected to occur during normal operations, and would only occur during maintenance, start-up, and emergency situations. For natural gas-fired engines, formaldehyde accounts for approximately two-thirds of the total HAP emissions (USEPA 2000). Polycyclic aromatic hydrocarbons (PAH), benzene, toluene, xylenes, and others account for the remaining one-third of HAP emissions.

In the AQ EES study, modelling was undertaken to predict FSRU emissions across a range of operational scenarios, with and without a LNG carrier being berthed alongside the FSRU. LNG carriers would be berthed alongside the FSRU for up to 20 percent of the year while unloading LNG and would use boil-off gas at a rate of 0.9 tonnes per hour. The presence of an LNG carrier, in addition to its air emissions, may also influence the modelling results by creating a barrier effect next to the FSRU (i.e., a 'wake effect'). The modelling scenarios included the FSRU operating on boil-off gas as the primary fuel (gas-fuelled) or back-up fuel being marine diesel oil (liquid-fuelled). Additionally, scenarios considered whether the FSRU was operating in open loop regasification mode or closed loop regasification mode over summer or winter. In summer, there is less demand for gas and the FSRU would typically run at lower gas production rates than winter, meaning less fuel would be required. A peak load gas-fuelled scenario was also modelled as a worst-case scenario. The modelling outputs were compared to the Environment Reference Standard (ERS) objectives and air quality assessment criteria (AQAC) to understand potential air quality impacts on sensitive receptors and the environment. For the model, 26 sensitive receptor locations (residences and at Geelong Grammar School) and five industrial receptors were allocated to predict concentrations at specific locations. A 10km by 10km area was used to calculate pollutant concentrations at nearby populated regions with sensitive receptors.

All modelled air emission scenarios demonstrated that there are no exceedances of the adopted criteria for NO_2, CO, SO_2, PM10, PM2.5, benzene, formaldehyde, or PAH at any of the sensitive receptors modelled within the study area during operation of the FSRU. The AQ EES study air modelling assessment demonstrated that air quality impacts from the FSRU operation would be minor and localised in the vicinity of Refinery Pier and the Geelong Refinery, meet regulatory requirements and emissions are unlikely to have regional or state significant effects on the air environment.

5.3 Outcomes of supplementary tasks

The following sections present the outcomes of the tasks undertaken in the supplementary Air Quality impact assessment in response to Recommendation 11 of the Minister's Directions.

5.3.1 The significance of the wake effects of the FSRU

Undertake sensitivity testing on the air quality modelling to confirm that operational impacts on air quality would be acceptable. Consider:

a. The significance of the wake effects of the FSRU.

Building wake effect is the effect on plume dispersion caused by the presence of buildings near a stack, usually resulting in increased ground-level concentrations of pollutant. When the orientation of the FSRU changes, the distance and relative location between the stack, the land and sensitive receptors change. Wake effects influence how the plume would travel from stacks to sensitive receptors and, as a result, the ground level concentrations at sensitive receptors are influenced by distance and relative location.

Sensitivity testing in the AQ EES study showed that the model predicts ground level concentrations with no wake effects to be much lower compared to ground level concentrations with wake effects. To understand how the configurations and orientations of the FSRU may influence the significance of wake effects and associated predicted pollutant ground level concentrations at sensitive receptors, sensitivity analysis for a number of different configurations and two different FSRU orientations with and without an LNG carrier berthed alongside the FSRU was conducted. Consistent with the AQ EES study, sensitivity testing was conducted for the peak load scenario as a worst case. The peak load scenario would involve the operation of four natural gas-fuelled engines and two natural gas-fuelled boilers operating at 100 percent load, producing 620 terajoules per day (TJ/d) and operating in closed loop mode. Peak load represents the highest air quality impact during normal operations and is only expected to be used an average of two days per winter month, per year.

As described in the AQ EES study, closed loop is not preferred as the usual operating mode as it uses up to 2.5 percent of the LNG cargo to heat the LNG and has higher greenhouse gas emissions than open loop operation. Closed loop operating mode would only be utilised in the unlikely event that the FSRU was unable to discharge water through the seawater transfer pipe to the refinery, for example during FSRU maintenance or due to a pump or pipe failure.

The sensitivity results for peak load, with and without the LNG carrier berthed alongside the FSRU, indicate that:

- The one-hour 99.9th percentile NO_2 and maximum 24-hour PM_{10} are predicted to comply with the ERS criteria at all modelled receptors for all configurations and orientations of the FSRU.
- For both Esperanza and Golar FSRUs, higher maximum cumulative concentrations at discrete receptors (both sensitive and industrial) are predicted when the bow is facing southeast as compared to when it is facing northwest. It is also noted that some receptors are predicted to experience higher concentrations when the bow is facing northwest due to their relative locations to the FSRU.
- For both Esperanza and Golar FSRUs, the maximum cumulative one-hour 99.9th percentile NO_2 at all modelled locations (both discrete and gridded receptors) are predicted to be higher when the bows are facing northwest. However, these worst-affected areas are located southeast of the FSRU, further away from the coast, resulting in lower concentrations at sensitive receptors onshore.
- When the bows face southeast or northwest, Esperanza FSRU is predicted to have slightly higher maximum cumulative concentrations at sensitive receptors compared to Golar FSRU. It is also noted that some receptors are predicted to experience slightly higher concentrations for Golar FSRU due to their relative locations to the FSRU.
- The FSRU plus LNG carrier scenario is predicted to have higher concentrations at modelled receptors compared to the scenario without LNG.

In summary, predicted air quality impacts for the Esperanza and Golar FSRUs vary only slightly. However, lower ground level concentrations at onshore sensitive receptors are predicted when the bow is facing northwest compared to facing southeast.

The Esperanza FSRU with its bow facing southeast alongside an LNG carrier is predicted to be the worst-case scenario among all configurations and orientations assessed. Nonetheless, all modelled pollutants are predicted to comply with the relevant criteria at all sensitive receptor locations for this worst-case operating scenario. It is noted that the southeast orientation is the preferred orientation for the FSRU due to maritime and port operations safety reasons.

The finding of this supplementary study is consistent with the scenario modelled in the AQ EES study and has confirmed that operational impacts on air quality would be compliant with regulatory criteria and acceptable considering the significance of wake effects of the FSRU.

5.3.2 A 'worst-case' scenario for air emissions (but based on the use of BAT)

Undertake sensitivity testing on the air quality modelling to confirm that operational impacts on air quality would be acceptable. Consider:

b. A 'worst-case' scenario for air emissions (but based on the use of best available technology)

Air emissions from the FSRU are directly proportional to the number of engines and boilers required to meet market demand for gas at any point in time (i.e., air emissions increase as the number of engines and boilers that are being used increases). A higher gas production rate requires the use of more engines and therefore will result in higher air emissions.

The results of the sensitivity analysis outlined in **Section 5.3.1** demonstrated that the worst-case scenario for air emissions during normal operation would be the Esperanza FSRU, operating at peak load, with its bow facing southeast. This scenario is predicted to have the highest impacts on receptors for both NO2 and PM10. The Esperanza FSRU is considered to represent the current best available technology as accepted by the IAC.

To address concerns regarding the potential increase in pollutants against background concentrations, further analysis of the worst-case operating scenario has been undertaken. For the Esperanza FSRU operating at peak load with its bow facing southeast and with an LNG carrier berthed alongside it, it was found that:

- For more than 96 percent of the time, increases in one-hour average NO2 concentration as a result of the FSRU are less than five micrograms per cubic metre ($\mu g/m^3$) at any receptor and will not be discernible from background concentrations and are compliant with regulatory criteria of 150 $\mu g/m^3$.
- Only 0.08 percent of the hours (i.e., 34 out of 43848 hours modelled) at the most affected receptor are predicted to experience one-hour average NO2 concentrations greater than 55 $\mu g/m^3$. This means the highest range of predicted concentrations is expected to occur at non-sensitive and non-vulnerable locations at a very rare frequency and are compliant with the regulatory criteria of 150 µg/m3. Thus, the potential impacts are anticipated to be not significant.
- For over 98 percent of the time, predicted increases in the daily average PM10 concentration as a result of the FSRU are less than 1 µg/m3 at any receptor and will not be discernible from background concentrations and are compliant with regulatory criteria of 50 µg/m3.
- Only 0.1 percent of days (i.e., 2 out of 1827 days modelled) at the most affected receptor are predicted to experience a daily increase in PM10 concentration greater than 5 µg/m3 with a maximum of 5.2 µg/m3. This means that the highest range of predicted daily PM10 concentrations, accounting for approximately 10 percent of the regulatory criterion of 50 µg/m3 is expected to occur at non-sensitive and non-vulnerable locations at a very rare frequency. Thus, the potential impacts are anticipated to be negligible.

Time-varying background data for one-hour NO2 and 24-hour PM10 were also reviewed to calculate time-varying cumulative concentrations for the worst-case scenario. This was done to illustrate the overall air quality the local area can expect with the project and to demonstrate the project contribution in the context of background and cumulative concentrations.

- Cumulative one-hour NO2 concentrations are predicted to be below the regulatory criteria of 150 µg/m3 for all the hours modelled, project contributions would not be discernible from the background pollutant levels for most of the time and cumulative one-hour NO2 concentration are compliant with regulatory criteria.
- Incremental increases in daily average PM10 from the FSRU plus LNG carrier at peak load scenario are negligible, would not result in additional exceedances of the regulatory criteria of 50$\mu g/m^3$ (beyond those attributable to background concentrations) and are compliant with regulatory criteria.

In summary, assessment of the worst-case scenario has demonstrated that pollutant concentrations resulting from operation of the FSRU would not be discernible from background concentrations, most of time, and would be compliant with regulatory criteria. It is important to note that the worst-case peak load scenario would be infrequent (i.e., two days per winter month) according to market demand for gas. Standard winter and summer operating scenarios would result in lesser emissions (discussed further in **Section 5.3.3**). Potential air quality impacts associated with the project would be minor and emissions from a worst-case operating scenario would be compliant with regulatory criteria and would not cause significant adverse impacts on the surrounding environment.

The findings of this supplementary assessment are consistent with the findings of the AQ EES study and have confirmed that operational impacts on air quality would be acceptable considering a worst-case scenario for air emissions.

5.3.3 The implication of bubble limits and stack specific limits for sensitive receptors

Undertake sensitivity testing on the air quality modelling to confirm that operational impacts on air quality would be acceptable. Consider:

c. The implication of bubble limits and stack specific limits for sensitive receptors.

If approved, the project will require an EPA Victoria Development Licence and Operating Licence which will specify air emission limits which could be stack specific limits or bubble limits. Both approaches were calculated as part of the supplementary Air Quality study. Stack limits refer to the maximum amount of pollutant allowed to be discharged to air from an individual stack, while bubble limits refer to the maximum amount of pollutant that is allowed to be discharged to air from a whole site.

It is proposed that a combination of stack limits and bubble limits are adopted by the project to minimise air emissions, while providing flexibility to operate the FSRU at 100 percent gas production load when required. The implication of stack specific limits and a combination of stack specific limits and bubble limits for sensitive receptors is shown in **Table 5-4**.

The Esperanza FSRU, considered to represent BAT, was used as the reference design for the project to determine stack limits. Emission rates calculated based on 100 percent load of each engine and boiler are proposed to be the emission limits for each stack. The estimated pollutant emissions (grams per second (g/s)) for each stack were determined based on the manufacturer's emissions specifications. Internal combustion engines are often designed to operate most efficiently at or near their maximum load. Running an engine at higher loads is more fuel-efficient and results in lower air emissions per unit of power generated (g/kWh), compared to running the same engine at lower loads. For example, delivering the same amount of gas, on one engine running at 100 percent load would generate less air emissions than two engines running at 50 percent load.

The original AQ EES study demonstrated that during a peak load scenario, air quality impacts are negligible and would not result in additional exceedances of the criteria (beyond those attributable to background concentrations) and, in most cases, would not be discernible from the background pollutant levels. This has also been confirmed following sensitivity analysis of the worst-case scenario (refer to **Section 5.3.2**).

Table 5-2 below presents the specific emission rates and calculated emission limits per stack for NO2, CO and VOC. As gas demand increases, more engines will be turned on, but air emissions from the corresponding stacks will need to meet the proposed emission limits. Gas-fuelled particulate matter (PM10 and PM2.5) and SO2 emissions are expected to be negligible and are not considered to require a licence limit.

Table 5-2 Proposed stack specific limit

Stacks	Engine/boiler power rating	Emission rates (g/s)			Proposed stack specific emission limits (g/min)		
		NO_x (as NO_2)	CO	VOC	NO_x (as NO_2)	CO	VOC
Exhaust 1	5850 kW	1.95	1.46	0.796	117	88	48
Exhaust 2	7800 kW	2.6	1.95	1.06	156	117	64
Exhaust 3	7800 kW	2.6	1.95	1.06	156	117	64
Exhaust 4	7800 kW	2.6	1.95	1.06	156	117	64
Boiler 1	60 MW steam heating capacity	2.86	2.41	0.157	172	145	9
Boiler 2	60 MW steam heating capacity	2.86	2.41	0.157	172	145	9
Total		15.5	12.1	4.3	928	728	257

Table 5-3 presents the proposed annual bubble limits for the project. Summer, autumn and spring, winter and peak load operating scenarios were used to calculate the bubble limits. Autumn and spring (350TJ/d) emission rates were calculated using the average of summer (250TJ/d) and winter (500TJ/d) scenarios. The open loop operating scenario, which does not need boilers, is the preferred mode of FSRU operation for several reasons, as outlined in the original EES, and would also result in lower emissions when compared with the alternative closed loop operation. The bubble limits were calculated based on open loop operations for the four seasons, and closed loop for peak load to cover any potential need for the boilers. It is noted that the peak load production rate (620TJ/d) would be infrequent, approximately two days per winter months on average.

For the stack specific emission limits only scenario (**Table 5-2**), it would be possible to run all the engines and boilers on peak, 100 percent load all year long (although this is extremely unlikely to occur based on gas demand), as long as the stack specific emission limits are met.

If a combination of stack specific and bubble limits is adopted as a condition of operation, Viva Energy would not only need to meet the stack specific limits during normal operations, but also the annual bubble limits, which were calculated based on the predicted gas demand/production profile over a year. This allows for the implementation of more stringent annual emission pollutant load, while meeting operational requirements specifically to account for peak gas demand.

Table 5-3 Proposed bubble limits

Substance	Operating Scenario for bubble licence	Annual emissions (t/yr)
NO_x (as NO_2)	Proposed annual bubble limit (365 days): • 90 days summer open loop (~3 months) • 179 days spring/autumn open loop (~6 months) • 90 days winter open loop (~3 months) • 6 days peak load (2 days per winter month)	145
CO		130
VOC		57

Regarding implications for sensitive receptors, the maximum short-term impact to sensitive receptors (less than or equal to 24 hours average) would be the same regardless of whether stack limits are adopted, or whether a combination of stack and bubble limits are adopted. Both scenarios allow the FSRU to run on peak load for a whole day. However, the long-term annual average impact to sensitive receptors is expected to be lower however, if a combination of stack specific and bubble limits is selected.

The annual emission limits (in tonnes/year [t/yr]) for stack limits only, and for a combination of stack specific and bubble limits is presented in **Table 5-4**.

Maximum annual average pollutant concentrations were modelled for the stack specific limit only scenario and the combination limits scenario. The results of the modelling show that the combination limits scenario would result in lower annual emissions and lower ground level annual average concentrations at sensitive receptors. Therefore, a combination of stack specific limits and annual bubble limits is considered most appropriate for this project.

A combination of stack specific limits and bubble limits has been proposed which provides an emissions limit based on the use of best available technology.

The applicability of bubble limits is subject to the development licence statutory approval process. EPA Victoria will ultimately determine the stack specific limits and/or annual bubble limits which would form part of the operating licence conditions for the FSRU following approval.

Table 5-4 Annual emission limits

Substance	Stack specific limits only (t/yr)	Combination - Stack plus bubble limits (t/yr)
NO_x (as NO_2)	488	145
CO	382	130
VOC	135	57

5.4 Integrated assessment

The purpose of this section is to integrate the outcomes of the supplementary Air Quality study with the AQ EES study.

The AQ EES study concluded that:

- All modelled operating scenarios demonstrated that there are no exceedances of criteria at any of the modelled locations. All modelled air emission scenarios demonstrate that there are no exceedances of the adopted criteria for NO2, CO, SO2, PM10, PM2.5, benzene, formaldehyde or PAH at any of the sensitive receptors modelled within the study area during operation of the FSRU.
- The air modelling assessment demonstrates that air quality impacts from the FSRU operation would be minor and localised in the vicinity of Refinery Pier and the Geelong Refinery, meet regulatory requirements and emissions are unlikely to have regional or state significant effects on the air environment.

The findings of the supplementary Air Quality study and the findings of the EES air quality impact assessment are consistent with respect to project related air emissions and impacts. In addition, the supplementary study concluded that:

- Predicted air quality impacts for the Esperanza and Golar FSRUs vary only slightly. However, lower ground level concentrations at onshore sensitive receptors are predicted when the bow is facing northwest, compared to facing southeast but all scenarios are still compliant with regulatory criteria.
- Esperanza FSRU with its bow facing southeast alongside an LNG carrier is predicted to be the worst-case scenario among all configurations and orientations assessed, however all modelled pollutants were predicted to comply with relevant criteria at all sensitive receptor locations.
- Time-series concentration analysis for the worst-case scenario demonstrates that pollutant concentrations resulting from the operation of the FSRU would not be discernible from background concentrations most of time. Potential air quality impacts associated with the project would be minor, compliant with regulatory criteria and emissions would not cause significant adverse impacts on the surrounding environment.
- A combination of stack specific limits and bubble limits has been proposed which provides an emissions limit based on the use of best available technology. The applicability of bubble limits is subject to the development licence statutory approval process. EPA Victoria will ultimately determine the stack specific limits and/or annual bubble limits which would form part of the operating licence conditions for the FSRU following approval.

5.5 Mitigation measures

There are no changes to the overall conclusion of the original EES Air Quality impact assessment.

Therefore, no additional mitigation measures have been proposed as the original mitigation measures are considered both appropriate and adequate. Refer to Chapter 9: *Environmental Management Framework* for a list of the mitigation measures relevant to the further work undertaken for the Supplementary Statement.

5.6 Conclusion

To address Recommendation 11a of the Minister's Directions, the supplementary Air Quality study conducted sensitivity testing for the significance of wake effects of the FSRU. The modelling results demonstrated that predicted air quality impacts for the Esperanza and Golar FSRUs only vary slightly, and it was concluded that the worst-case scenario for all FSRU configurations and orientations assessed was the Esperanza FSRU with its bow facing southeast alongside an LNG carrier.

To address Recommendation 11b of the Minister's Directions, time-series project contribution and background concentrations were analysed for the worst-case scenario, which included operating the FSRU during peak load. The analysis demonstrated that NO2 and particulate matter (as PM10) emissions were predicted to comply with the relevant criteria at all sensitive, industrial, and gridded receptor locations.

It was also determined that pollutant concentrations resulting from the worst-case operation of the FSRU would not be discernible from background concentrations most of time. Potential air quality impacts associated with the project would be minor, comply with regulatory criteria and emissions from a worst-case operating scenario would not cause significant adverse impacts on the surrounding environment.

To address Recommendation 11c of the Minister's Directions, an impact analysis for stack specific limits only and a combination of stack specific and bubble limits scenarios was conducted. The analysis showed that implementing a combination of stack specific and annual bubble limits would result in lower annual project emissions, and lower ground level annual average concentrations of NO2, CO and VOC at sensitive receptors when compared with stack specific limits only, although both approaches would enable compliance with regulatory criteria. Therefore, during operation of the FSRU, a combination of stack specific limits and annual bubble limits is considered most appropriate.

In conclusion, the findings of the supplementary assessment were found to be consistent with the findings of the Air Quality impact assessment completed as part of the original AQ EES study and confirmed that operational impacts on air quality would be acceptable considering the significance of the wake effects of the FSRU and a worst-case scenario for air emissions. In addition, a combination of stack specific limits and bubble limits has been proposed which provides an emissions limit based on the use of BAT. The applicability of bubble limits is subject to the development licence statutory approval process. EPA Victoria will ultimately determine the stack specific limits and/or annual bubble limits which would form part of the operating licence conditions for the FSRU following approval.