With respect to the Request for Information received from the EPA on the 13 May 2022, Esso provides the following response, taking into consideration:

a) Risks of harm to human health and the environment have been eliminated so far as reasonably practicable.
b) Where it is not reasonably practicable to eliminate risks of harm to human health and the environment, how those risks have been reduced so far as reasonably practicable.
c) The likelihood of risks eventuating.
d) The degree of harm that would result if those risks eventuated.
e) What the person concerned knows, or ought reasonably to know, about the harm or risks of harm and any ways of eliminating or reducing those risks (your state of knowledge in managing the risk).
f) The availability and suitability of ways to eliminate or reduce those risks.
g) The cost of eliminating or reducing those risks.

Noise

Question
a) The noise modelling undertaken as part of this application has not considered the cumulative noise from other contributing industries as per Environment Protection Regulation 2021 (regulation 119). Please provide updated information (including modelling if applicable) addressing the cumulative noise, including any existing industry emitting noise and future proposed industries.
b) EPA notes that noise attenuation measures have been proposed. However, there is not sufficient information describing other noise attenuation measures and not sufficient information assessing if the risk of harm has been minimised so far as reasonably practicable. Please provide supporting information addressing those issues
c) Esso Australia Pty Ltd provided responses to community questions on 5 May 2022. Question 1 related to infra sound and the response included an assessment of the low frequency noise for the proposal. In reviewing that information and the application, EPA request that the following is provided: i. An assessment of alternative equipment that could be used to minimise the low frequency noise emissions; ii. An assessment of any proposed mitigation measures to reduce the risk of low frequency noise; and iii. Measurements or other information supporting how the modelled impacts of low frequency noise was undertaken.

Response

1. EVALUATION OF RISK

Esso has an established risk management framework that provides an overarching and consistent approach to the identification, assessment and management of risks.

A risk assessment was completed for each environmental aspect and source of risk for the Hastings Generation Project, and is summarized in the Development Licence Application - APP009563 (DLA), Section 9; and detailed in the DLA Attachment 11 (*Human Health and Environmental Risk Assessment*).

When a risk has been evaluated as a lower risk, based on the process detailed in the *Human Health and Environmental Risk Assessment* (DLA Attachment 11), and the identified regulatory, corporate and/or industry good practice controls are implemented, Esso considers the risk to be managed to so far as reasonably practicable (SFARP) and no further detailed engineering evaluation of controls is required. The application of feasible and readily implementable alternatives, additional or improved controls may be adopted opportunistically when demonstrated to further reduce potential environmental impacts or risks.

When a risk is has been evaluated to be moderate or high, in addition to relevant regulatory, corporate and/or industry good practice controls being implemented; alternate, additional or improved controls should be proposed and evaluated according to their feasibility, reasonableness and practicability to implement to further reduce the potential for impacts from the Project.

When evaluating additional controls a hierarchy of controls can be applied:

- eliminate – remove the source preventing the impact, i.e. eliminate the hazard
- substitution – replace the source preventing the impact
- engineering – introduce engineering controls to prevent or control the source having an impact
- separate – separate the source from the receptor preventing impact
- administrative – procedures, competency and training implemented to minimise the source causing the impact
- pollution control – implement a pollution control system to reduce the impact
- contingency planning – mitigate control reducing impact; and
- monitoring – program or system used to monitor the impact over time.

2. SUMMARY OF RISK ASSESSMENT

This assessment looks at the noise impacts associated with operating the power generation facility.

The Project evaluated noise emissions from its operations, with noise controls adopted as detailed in the DLA Section 9, to have a lower residual risk. A SFARP evaluation was undertaken as part of this assessment, and is summarized in Section 6 of this document.

The risk assessment finding is summarized below and the risk assessment process is detailed further in the DLA Section 9 and DLA Attachment 11 (*Human Health and Environment Risk Assessment*).

Table 1: Environmental Noise Risk Assessment

Aspect	Source of Risk	Potential Impact	Severity	Likelihood	Residual Risk
Noise emissions	Generation of noise from • Solar Titan 130 power generation package • Lube oil cooler • Fuel gas skid • Instrument air compressor • Water purification pumps • transformers	Could result in unacceptable noise levels at sensitive receptors	Low	Very unlikely	Lower
Cumulative noise emissions	Noise from Hastings Generation Project combined with high background noise	Could result in unacceptable noise levels at sensitive receptors	Low	Very unlikely	Lower

3. SOURCE OF RISK

During operations, noise is expected to be generated from the following equipment:

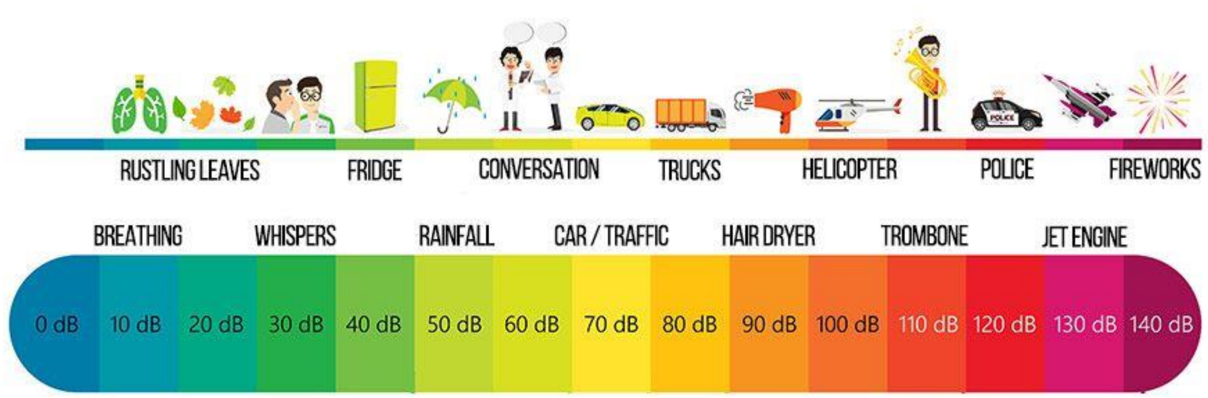
- Solar Titan 130 power generation package, including enclosure; enclosure ventilation; turbine air system; and combustion outlet system
- Lube oil cooler
- Fuel gas skid
- Instrument air compressor
- Water purification pumps
- Transformers

Noise modelling predicts that the dominant low frequency noise (inclusive of infrasound) from the project results from the Titan 130 package, in particular the exhaust stack outlet, and to a lesser extent the enclosure and associated ducting and inlets / outlets.

4. ENVIRONMENTAL IMPACT

Noise modelling was undertaken to determine the expected noise levels, under worst case scenario, at the closest noise sensitive receptors. This investigation is presented in DLA Attachment 7 (*Environmental Noise Impact Assessment*). It was found that the Project's predicted noise emissions were below the most stringent (night-time) noise limits, as shown in Table 2. When comparing the Project's predicted noise emissions to decibel hear range, shown in Figure 1, the sound received at NSR1 would be similar to that of a fridge.

Figure 1: Decibel Hearing Range



4.1. Cumulative Noise

Background noise assessments undertaken as part of the *Environmental Noise Impact Assessment* (DLA Attachment 7), measured the existing noise at sensitive receptor locations. This included both natural and man-made noise sources, including the neighbouring Long Island Point (LIP) facility.

To further evaluate the Project's noise emissions, a study was commissioned to examine the cumulative impacts on noise sensitive receivers (NSRs). This is documented in *Hastings Generation Project*

Environmental Noise Impact Assessment Rev 2 (Attachment A). This document is an update to DLA Attachment 7.

This study examined the influence of existing industrial noise from neighbouring LIP. Noise level predictions assumed adverse weather conditions for sound propagation towards the noise sensitive receivers and that all items of plant are operated continuously. Cumulative effective noise was assessed considering current ambient noise, including LIP, and the addition of noise generated from the Project. The modelled sound power levels at the nearest sensitive receivers were below the most stringent (night-time) noise limits, as shown below.

Table 2: Predicted Noise Levels at Noise Sensitive Receivers

Receiver	Noise Limit dB(A)	Effective Noise Level (HGP) dB(A)	Cumulative Effective Noise Level (HGP + LIP) dB(A)
NSR1	49	46	47
NSR2	41	34	38
NSR3	42	34	39
NSR4	43	31	38

An examination of potential future noise emissions that could contribute to cumulative noise levels was undertaken. This examination included a review of proposed development in the area through the EPA's approved projects and Engage Victoria's Development Licence websites. No new developments were identified that could contribute to existing noise levels in the immediate area.

4.2. Low Frequency Noise

The range of human hearing stretches from 20 Hz through to 20,000 Hz (20 kHz). Low frequency noise is classified as sound emitted below 160 Hz, while infrasound is sound 20 Hz and below. The true low end of hearing is in the 20 Hz to 80 Hz frequencies. Between 20 Hz to 40 Hz sound is often felt rather than heard. In musical terms, sound at 40 Hz to 80 Hz is the lowest note of the four-bass. It is what gives music the feeling of rumbling in the chest. Sound emitted in the 80 Hz to 160 Hz frequencies is more in the audible range, but still associated with the bass notes. Common examples of low frequency sounds include: barking dogs, sounds from a lawnmower and thunder.

To better understand the Project's noise emissions in the low frequency range, modelling was undertaken and detailed in the *Low Frequency Noise and Infrasound Analysis Addendum* (Attachment C).

Noise modelling of low frequency noise or infrasound was undertaken using the existing noise model and methodology used to determine compliance with the regulations in the report *Environmental Noise Impact Assessment, Rev 2* (ENIA) (Attachment A). The details of the project and its operations as affecting noise emissions, as well as assessment methodology to determine compliance with the regulations is provided in the ENIA, Section 2 – Description of Site & Operations; and Section 5 – Noise Modelling Methodology.

In addition to the methodology outlined in the ENIA, low frequency sound power levels for the exhaust stack of the three packages has been modelled in SoundPlan.

4.2.1. Modelling Uncertainty

Noise modelling was undertaken using the CONCAWE[12] algorithm. Uncertainty of the CONCAWE algorithm has been determined in a CONCAWE report[2]. The 95% confidence limits for Octave Band frequencies ranging from 63 Hz to 4 kHz with various meteorological categories within the algorithm. The project selected the worst case weather conditions for noise propagation to use in the model, and this corresponds to meteorological category 6, shown below and in Table 2-1 of the *Low Frequency* Noise *and Infrasound Analysis Addendum* (Attachment C).

95% Confidence Limits for CONCAWE Model								
Meteorological Category	dB(A)	Octave Band Centre Frequency						
		63	125	250	500	1k	2k	4k
6	4.6	5.2	6.1	6.7	9.3	4.9	5.5	8.2

A further statistical assessment of the CONCAWE algorithm was determined in the CONCAWE report. The mean differences between the predicted and observed noise levels in each meteorological category were calculated, providing a quantitative measure of model algorithm performance over a longer-term timeframe. The mean difference for overall level and individual octave bands are listed in Table 3.

Table 3: Mean difference for the CONCAWE model

Mean Difference (Observed minus predicted) for CONCAWE Model								
Meteorological Category	dB(A)	Octave Band Centre Frequency, Hz						
		63	125	250	500	1k	2k	4k
6	0.5	-0.8	-0.3	-1.7	1.2	-0.2	0.1	-0.9

The mean difference for the algorithm does not include infrasound frequencies, however, from the table above we can see that, generally across all meteorological conditions the confidence limits decrease with low frequency noise. Therefore, a conservative assessment of mean difference for infrasound is 0.5 to -0.8 dB.

4.2.2. Noise Measurement Uncertainty

Background noise measurements were undertaken using a Brüel & Kjaer Sound Level Meter. The meter is designed to meet the requirements for Type 1 instruments as specified in AS IEC 61672.1-2004 and for 1/3 octave band filters as specified in AS/NZS 4476:1997 *Acoustics – Octave band and factional octave band filters.*

The standard does not provide an acceptable level of linear deviation for 1/3 octave band data measured at 12.5 Hz. However, a review of the sound level meter's User Manual states that the meter has a +/- 1 dB response for frequencies ranging from 6.8 Hz to 22.4 Hz.

[1] CONCAWE (Conservation of Clean Air and Water in Europe) was established in 1963 by a group of oil companies to carry out research on environmental issues relevant to the oil industry.
[2] The propagation of noise from petroleum and petrochemical complexes to neighbouring communities, CONCAWE Report 4/81, 1981

4.2.3. Low Frequency Sound

Low frequency noise is known to produce a number of negative physiological reactions (i.e. changes to blood pressure and heart rate, headaches, vertigo, sleep disturbance, difficulty breathing and anxiety); subjective complaints (i.e. feelings of vibrations, pressure and annoyance) and mental and physical performance impairment (i.e. fatigue, irritability and lack of concentration) [1] [2] [3].

Low frequency noise is present from natural sources, such as wind and wave action; and also from man-made sources, such as: passing aircraft, industrial machines, road and traffic noise, compressors, wind turbines and air conditioners [4] [5].

It is approximated that 2.5% of the population may have a low frequency threshold which is at least 12 dB below the average threshold [6]. The UK Department of Environment, Food and Rural Affairs (Defra), together with the University of Salford developed a procedure [7] and assessment criteria [8] for low frequency noise disturbance. This extensive 5 year study formed the basis the EPA's low frequency noise guideline [4].

The project compared its predicted Z-weighted (linear) noise levels against the outdoor low frequency threshold levels, listed in the EPA's *Noise Guideline: Assessing low frequency noise. Publication 1996, June 2021* [4]. These are presented in Table 4 and shown in Figure 2. The advice provided in EPA Publication 1996 is that the threshold values are to be considered a guideline rather than compliance limits, providing a threshold in which a disturbance might occur. Low frequency noise is to consider:

- Noise level
- Character of the noise – such as tonality, frequency modulation or whether the noise is fluctuating or continuous
- Baseline noise levels

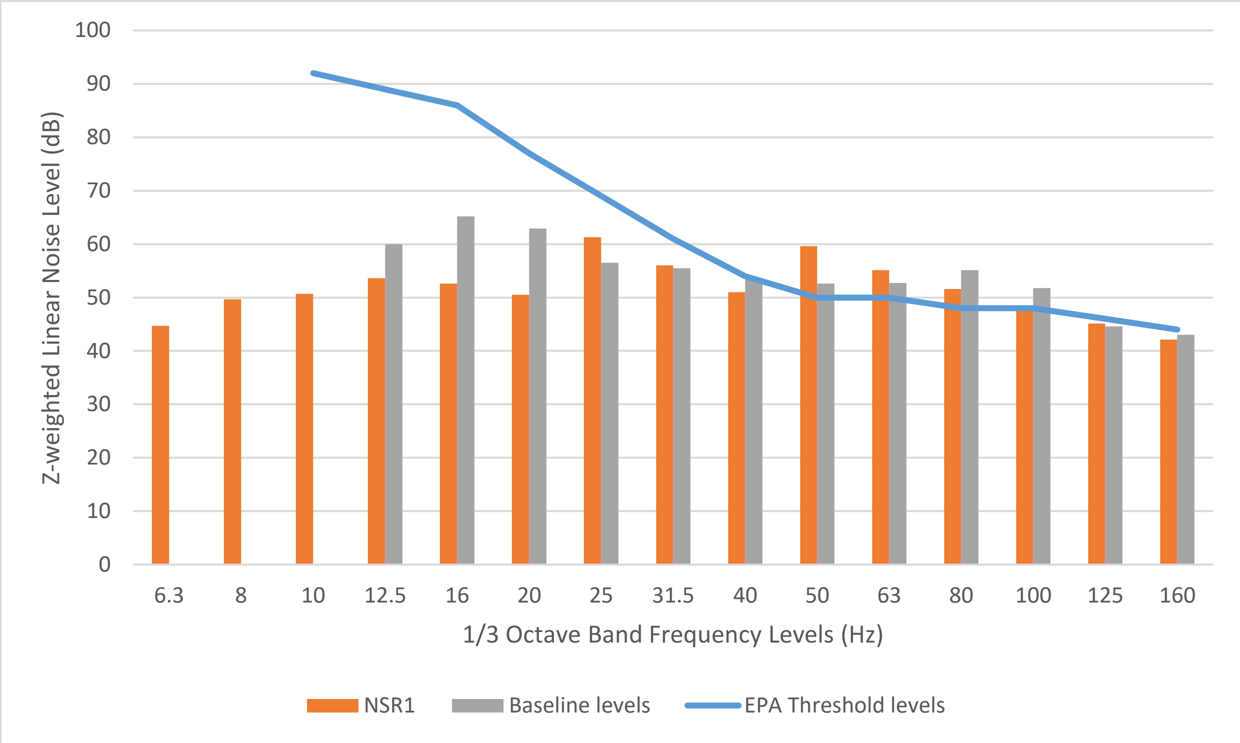
For this assessment, no tonality or frequency modulation characteristics were detected.

Baseline levels were measured during the field monitoring undertaken as part of the *Environmental Noise Impact Assessment* (Attachment A). These baseline levels are exclusive of any sound predicted from the Hastings Generation facility.

Table 4: Assessment Predicted Low Frequency Levels at NSR1

One-third Octave Frequency Levels (Hz) (Lzeq dB)															
	6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
Threshold levels	-	-	92	89	86	77	69	61	54	50	50	48	48	46	44
NSR1	44.7	49.7	50.7	53.6	52.6	50.5	61.3	56	51	59.6	55.1	51.6	48.3	45.1	42.1
Baseline levels	-	-	-	60	65.2	62.9	56.5	55.5	53.4	52.6	52.7	55.1	51.8	44.6	43

Figure 2: Predicted Low Frequency Levels at NSR1



Exceedances in the 50 Hz, 63 Hz, 80 Hz and 100 Hz bands are predicted. However, the exceedances in the 80 and 100 Hz bands are below the baseline levels measured and are therefore unlikely to be audible. The predicted noise levels from the project at NSR1 in the 50 Hz and 63 Hz bands are approximately 30 dB(A) in each band (refer to *Low Frequency Noise and Infrasound Analysis (*Attachment C*)).* Predicted noise in the 63 Hz band is within 3 dB of current baseline levels and it is therefore unlikely that the increase in noise in this band will be audible. Received noise levels in the 50 Hz band are likely to be only faintly audible.

Baseline levels exceed the guideline thresholds for the 50 Hz, 63 Hz, 80 Hz, 100 Hz and 125 Hz bands.

Fluctuating sounds are known to be a more disturbing than steady sounds [6], and therefore it was suggested by Defra that the threshold for continuous sounds, likely to be emitted from the HGP, should be relaxed by 5 dB.

There are no exceedances below 50 Hz, especially in the infrasound range (< 20 Hz). It is not anticipated that there will be any significant infrasound from the project.

The overall effective noise level of 46 dB(A) at NSR1 is unaffected and the Project falls under the noise limit of 49 dB(A), and as such is compliant with the relevant regulations.

5. CONTROL MEASURES

The Titan 130 gas turbine package has a number of standard noise controls, being:

- Turbine air inlet silencer
- Turbine exhaust silencer

- Ventilation exhaust silencer
- Low noise enclosure

To minimize the Project's noise impacts on the surrounding environment and community, the Project has proposed to adopt the following additional noise mitigation measures, as highlighted in the DLA, Section 10.2, to include:

- Design specifications for the gas turbine generators and associated equipment is to meet a noise level of 85 dB(A) at 1m for rotary equipment.
- Turbine generators to be fully enclosed, with enclosures being fitted with noise attenuation materials.
- The enclosure ventilation openings are to be equipped with silencers
- Noise mitigation design including: acoustic blankets; cladding on web of skid beam; and additional enclosure door seals.

Table 5 demonstrates that with the addition of extra noise controls, the project is able to further reduce the noise levels, measured at the source, from individual components within the power plant.

Table 5: Comparison of Noise Levels at Source, of Standard Noise Attenuation Measures vs Additional Noise Controls

Description	Standard Noise Attenuation, dB(A)	With Additional Noise Control, dB(A)
Exhaust stack outlet	104	103
Gas turbine generator package	111	107
Lube oil cooler	100	98
Turbine air inlet	97	
Fuel gas skid	96	
Instrument air package	95	
Water purification pump	92	
Transformer	90	

A full examination of all noise controls considered by the project can be found in the *Noise Control Assessment Addendum* (Attachment B).

6. DEMONSTRATION OF SFARP

Whilst noise emissions are evaluated as a lower residual risk based upon the risk assessment undertaken for the project, a more detailed demonstration of acceptability has been provided.

<table>
<tr><th>Hierarchy of Controls</th><th>Control Measure</th><th>Accept/ Reject</th><th>Noise Reduction, dB(A), if known</th><th>Reason</th></tr>
<tr><td>Eliminate</td><td>Do not undertake night-time operations</td><td>Reject</td><td></td><td>Limiting activity to day-time hours would potentially reduce overall noise from HGP and subsequently reduce the potential for adverse impact to fauna, including seabirds and shorebirds, and the community.

However, by limiting night-time operations, gas production for South-East Australia would be severely limited at night, or could lead to flaring of ethane at LIP at night, creating additional lighting and air emissions impacts upon the regional fauna and community.

This option is not accepted.</td></tr>
<tr><td>Substitute</td><td>Alternative gas turbine packages</td><td>Reject</td><td>Addition of 5 dB(A)</td><td>Esso considered seven different gas turbine packages from three different vendors during the tendering process.

A comparison of tender packages for noise levels, showed the preferred option, the Solar Titan 130 being able to meet a noise level of 85 dB(A) at 1 metre; as opposed to the alternative vendor’s systems examined meeting 90 dB(A) at 1 meter.

<table>
<tr><th>Manufacturer</th><th>Cost</th><th>Able to meet 85 dB(A) at 1m</th></tr>
<tr><td>GE – option 1</td><td>$$</td><td>No</td></tr>
<tr><td>GE – option 2</td><td>$</td><td>No</td></tr>
<tr><td>GE – option 3</td><td>$$$</td><td>No</td></tr>
<tr><td>Siemens – option 1</td><td>$$</td><td>No</td></tr>
<tr><td>Siemens – option 2</td><td>$$</td><td>No</td></tr>
<tr><td>Solar – option 1</td><td>$$$</td><td>Yes</td></tr>
<tr><td>Solar – option 2 (Titan 130)</td><td>$$$</td><td>Yes</td></tr>
</table></td></tr>
<tr><td>Engineer</td><td>Acoustic blanket on engine exhaust expansion joint</td><td>Accept</td><td>1 dB(A)</td><td>Expansion joints are typically an acoustic weak point. Installation of an acoustic blanket over the expansion joints will reduce noise emissions.</td></tr>
<tr><td></td><td>Acoustic blanket on turbine air inlet silencer and flex duct</td><td>Accept</td><td>4 dB(A)</td><td>The flange ducting connection to the enclosure and the ducting from the enclosure upstream to the silencer are typically higher noise components of the package. This is due to noise breaking out from within the ducts.</td></tr>
</table>

Hierarchy of Controls	Control Measure	Accept/ Reject	Noise Reduction, dB(A), if known	Reason
				The acoustic blanket provides noise attenuation on the flanging.
	Cladding on web of skid beam	Accept		Noise from the turbine base plate can radiate from under the skid beam and can be a significant noise source. The installation of a skid skirt can reduce noise radiating from under the skid.
	Enclosure door seals	Accept		Enclosure doors are typically an acoustic weak point for the enclosure where noise leakage is likely to occur. The installation of additional door seals will reduce the noise break-out from the enclosure.
	Acoustic blanket on ventilation inlet elbow and fans	Accept		This blanket provides noise attenuation for the ventilation air inlet including breakout noise from the ventilation fan casing. These can be high noise equipment items, particularly for the fan casing and connections to the ducting.
	Low noise lube oil coolers	Accept	2 dB	The standard lube oil cooler supplied by Solar has a lower than industry standard noise level. Additional noise control can be achieved by inclusion of a low noise fan that could lead to a reduced sound power level.
	Installation of low noise trim valves on fuel gas skids	Reject	Negligible	Noise emanating from the fuel gas skid is the result of flow noise generated from within the valves. Potential noise control treatments include the insulation of low noise trim valves or acoustic insulation over piping downstream of the valve.
	Acoustic installation over piping downstream of the fuel gas skid valve	Reject	Negligible	
	Low noise cooling fans on the transformer	Reject	Negligible	Noise from the transformer usually results from the cooling fans. Low noise fans can reduce emissions. However, an installed noise controls will likely have an insignificant effect of noise levels at NSRs due to the package having a low sound power level.
	Low noise cowling on the water purification pump	Reject	Negligible	Noise from water purification pumps usually results from the electric motor driving the pump. Installation of low noise cowling could reduce noise levels. However, given the package having a low sound power, the negligible improvement will have insignificant impact upon NSRs.

Hierarchy of Controls	Control Measure	Accept/ Reject	Noise Reduction, dB(A), if known	Reason
	Instrument air package enclosure	Accept		The instrument air package is an enclosed package, with high performance noise attenuation.
	Additional Exhaust stack silencer	Reject	Negligible	Solar installs a silencer in the combustion exhaust stack as standard noise control. Any further high performance exhaust silencer would likely only provide marginal improvement with regards to low frequency / infrasound. In addition the cost associated with installing additional stack silencers in each stack would run into the millions and delay project start-up. Resulting in either natural gas supply uncertainty for South East Australia or increased flaring of ethane at LIP. This option has not been considered further.
	Exhaust stack cladding	Reject	Unknown	Exhaust stack vibration could lead to increased low frequency vibrations. This can be overcome through the use of increased casing thickness or additional cladding on each exhaust stack. The cost for this is in the order of millions of dollars per stack, and would delay the project for a minimum of 12 months. Resulting in either natural gas supply uncertainty for South East Australia or increased flaring of ethane at LIP. This option has not been considered further.
Separate	Install a sound wall between HGP and sensitive receivers	Reject	Negligible	A noise wall would need to block line of sight between the packages and the nearest NSRs. To achieve this the wall would need to be approximately 70m long and 10m high. A wall of this height would require complex structural engineering to ensure its integrity. Additionally the dominant noise source from the project would be the combustion exhaust outlet, which is approximately 15m above ground. Higher than the considered noise wall. This noise control would incur an excess cost for little to no improvement in noise levels at NSRs.
Administrative	Incident management system implemented	Accept		All incidents, non-conformances and complaints received shall be recorded, investigated and corrective measures implemented to mitigate further occurrences.
	Risk Management & Monitoring Program	Accept		A Risk Management and Monitoring Program will be developed as outlined in the Standard Conditions for an Operating Licence [9].

Hierarchy of Controls	Control Measure	Accept/ Reject	Noise Reduction, dB(A), if known	Reason
	Changing operational conditions	Reject		Any changes in operational conditions that may influence low frequency sound, would result in negligible improvement in noise reduction and may lead to stability and reliability issues with the package. Therefore this option has not been considered further.
	Preventative maintenance program	Accept		Restriction on fuel flow or irregular fuel pumps can lead to frequency fluctuations and increased low frequency noise. The project will adopt a preventative maintenance program, to mitigate poor performing equipment.
	Remote online monitoring system	Accept		Solar offer an online monitoring system (Insight), that can be remotely monitored by Solar or a nominated third party to identify irregularities in the turbine and generator system. Control parameters monitored include vibration, a source of low frequency noise. Monitoring of the power plant is also conducted by operations personnel onsite. By monitoring the system in real time can lead to the prevention of increased noise emissions, including low frequency noise.
Monitoring	Noise monitoring at site boundary	Accept		Monitoring will be undertaken in line with the Risk Management & Monitoring Program developed for HGP. In addition, monitoring will be undertaken at the site boundary should a noise complaint be received as part of the incident investigation. Corrective actions will be implemented in accordance with the Incident Management System.

Noise emission meets the EPA's *Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues. Publication 1826.4* [10] when assessed as an individual noise source and a cumulative source.

Noise emissions, in the low frequency range of 50, 63, 80 and 100 Hz are predicted to exceed the guideline thresholds detailed in the EPA's *Noise Guideline: Low frequency noise assessment*. But are lower than the background levels in the 80 Hz and 100 Hz bands, and are therefore unlikely to be audible. Current baseline levels exceed in the 50 Hz and 63 Hz, and predicted impacts from the project are well below the effective overall limit for these bands. Predicted noise in the 63 Hz band is within 3 dB of current baseline levels and it is therefore unlikely that the increase in noise in this band will be audible. Received noise levels in the 50 Hz band are likely to be only faintly audible.

There are no exceedances below 50 Hz, especially in the infrasound range (< 20 Hz). It is not anticipated that there will be any significant infrasound from the project.

The project will still fall below the most stringent noise (night-time) limit of 49 dB(A) at NSR1.

Low frequency noise was also modelled for NSR 2 – 4 (refer to Appendix A, of the *Low Frequency Noise and Infrasound Analysis (Attachment C)*). These result showed no predicted exceedances in either the infrasound or low frequency noise ranges emanating from the HGP facility.

Uncertainty arising for noise modelling or sound measurement is in the order of +/- 1 dB. Uncertainty has been considered when assessing the risk of non-compliance.

The SFARP evaluation has identified no reasonable or practicable alternative, additional or improved controls.

There has been a single submission raised by stakeholders in relation to the potential risk from low frequency noise emissions, in particular infrasound (<20 Hz). Adverse impacts from low frequency noise, while possible are not normally associated with gas-fired power stations. The neighbouring industrial facility, LIP, has been operating gas-fired turbines for a number of years without identifying a cause for concern from low frequency noise. This supports the premise that the gas-fired turbines at HGP present an acceptable low frequency noise risk.

Esso is satisfied that routine noise emissions from HGP represent a low residual risk that is broadly acceptable. The HGP *Environmental Management Plan* (DLA Attachment 5) has identified an Environmental Operational Objective (EOO) for noise management as:

> *Prevent undue disturbance to neighbouring community and wildlife.*

Esso is satisfied that this EOO will be met with the mitigation measure proposed, and therefore, considers the impact to be managed to an acceptable level.

Air

EPA understands that under OL000002613, two high pressure flares and one low pressure flare is operated. EPA understands the purpose of the two high pressure flares are to destroy flammable gas released by pressure control valves across the facility. EPA understands that the low-pressure flare is operated to protect the refrigerated storage tanks.

EPA has reviewed the memorandum that was submitted to EPA on 22nd June 2017. The information in that memorandum outlined the methods used to minimise flaring and black smoke from flaring. With the changes proposed in the development licence application, EPA request that the following information is provided.

Item	Question
1)	An assessment for the need for flaring following the construction of the new ethane power generators

Response

There will continue to be a need to operate both the high-pressure and low-pressure flares at the Long Island Point Fractionation Plant following the construction of the new ethane power generators. The use of flares to maintain the fractionation and LPG storage facilities in a safe state is accepted industry design.

The flares are used for safety and environmental control at the fractionation plant for situations which include emergencies, unplanned events, process upsets and equipment failures. Furthermore, the use of flares as a control device for destroying hydrocarbons in a safe and efficient manner is documented in the Long Island Point Major Hazard Facility Safety Case as one of the controls critical to the safe operation of the facility.

The Long Island Point flares are used during operational upsets to manage the disposal of excess ethane, propane and butane. The fractionation plant vessels and process direct all three gases through to the high pressure flare system, while propane and butane are both directed to the low pressure flare system. The construction of the new ethane power generators is not anticipated to impact the likelihood of propane or butane being flared at the Long Island Point facility in the future. There is however a reduction in potential future flaring of ethane from the Long Island Point facility.

Currently ethane is flared at the Long Island Point Fractionation Plant due to a variety of causes including the following.

Cause of Ethane Flaring	Impact of Project on Flaring
Ethane customer ability to accept ethane	This project will reduce flaring of ethane associated with future shutdowns of our ethane customer. Currently, when the ethane customer is unable to accept ethane, there are two practical options available. The first is to flare ethane via the HP flares at Long Island Point. The second is a significant curtailment or complete shutdown of natural gas supply to Victoria from the Longford gas plants. Given that the second option ceases supply of an essential service to Victoria, flaring of ethane at Long Island Point is the likely outcome. The design of the Hastings Generator plant includes three separate Gas Turbine Generator trains, along with their own individual fuel conditioning skids. This design is anticipated to minimise the likelihood of a full facility shutdown.
Operational issues associated with the ethane pipeline between Hastings and Altona	The Hastings Generator Project will no longer require the use of the ~80km ethane pipeline from Hastings to Altona. Therefore flaring as a result of operational issues with the pipeline will be eliminated. In December 2008 a rupture of the ethane pipeline caused by a third party marine incident resulted in a shutdown of the pipeline for approx. 4 months with associated ongoing flaring of ethane at the LIP Fractionation Plant. Similar incidents will be eliminated by the implementation of the Hastings Generator Project as the availability of the pipeline does not impact the operation of the Hastings Generator Project.
Operational upsets and emergencies at LIP	The Hastings Generation Project installs new equipment at a site adjacent to the Long Island Point Fractionation Plant, but does not fundamentally change the existing LPG processing plant. As such, it is anticipated that flaring of ethane, propane and butane from significant operational upsets or emergency situations will be largely unchanged.
Product specification restrictions	There are a combination of specific quality restrictions the ethane customer has and restrictions associated with the safe operation of the ethane pipeline from Hastings to Altona. After construction of the Hastings Generator facility, there will be scope to accept ethane which is outside of the specification that the current customer requires and hence reduce flaring.
Maintenance activities at the Long Island Point Fractionation Plant	Shutdown of the MDEA plant at the Long Island Point Fractionation Plant has previously resulted in flaring events at the site. It is anticipated that once the project has been constructed, flaring will be reduced through the ability to limit ethane throughput by coordination of plant shutdowns with periods of limited natural gas demand, and use of an MDEA bypass facility to enable continued potential utilisation of the Hastings Generator Plant for these short periods. The AQIA conducted as part of the Development Licence Application included an assessment of operations during an MDEA shutdown and found it is within acceptable limits.

Item	Question
2)	Information justifying how flaring will be minimised so far as reasonably practicable and describing any outstanding risk of flaring.

Response

Flaring of ethane at LIP has both environmental and financial impacts and so efforts are made to eliminate and reduce flaring so far as reasonably practicable according to the principles outlined below. Ultimately the Hastings Generator Project is designed to lower the risk of flaring ethane by providing an outlet for ethane processed at the Long Island Point Fractionation Plant should the downstream ethane customer be unable to accept ethane.

1. CONSIDERATION OF ELIMINATION OF FLARING

It is not possible to eliminate the flaring of ethane as the use of the high pressure flare system is integral to the design of the operating plant. Industry standards require the use of a pressure relief system that includes a device designed to destroy the excess hydrocarbons (flare) in order to reduce safety and environmental risk associated with the uncontrolled release of hydrocarbons. The use of a flare is included as appropriate design in the EU BAT 55 - *Best Available Techniques (BAT) Reference Document for the Refining of Mineral Oil and Gas*.

2. MINIMISATION OF FLARING

Flaring of ethane is minimized through a combination of plant and process design. Over the last five years the Long Island Point plant has been successful in reducing the ethane flaring by an order of magnitude through focus on controls as outlined below. Improvement in plant reliability and performance are seen as the most important mechanism to reduce flaring with improvements conducted on an ongoing basis as opportunities are identified and justified.

Activity	Impact on Flaring
General plant design standards	The plant has been designed to limit locations and situations where flaring could occur. This is achieved through implementation of design standards which include industry American Petroleum Institute standards, Australian Standards and ExxonMobil company standards to select appropriate process equipment, design the equipment to operate within a safe operating envelope and provide connections to a flare system only at locations where required.
Use of ethane as fuel	The Long Island Point plant has the ability to utilize an amount of ethane gas as fuel for processes at the site. The use of ethane in these situations replaces natural gas and has the ability to reduce the amount of gas required to be flared by a limited quantity during upsets downstream of the Long Island Point Plant. The plant is currently progressing a number of projects which aim to increase the ability of the plant to use ethane further in the future, but the quantity of ethane that can be disposed of this way is still anticipated to be limited to 10-20% of the total volume the proposed Hastings Generator Project is designed to consume.
Facility integrity and reliability management	ExxonMobil has implemented a Facility Integrity Management System which sets up a series of integrity management programs for each of the equipment types at site. Each program incorporates best practices in

Activity	Impact on Flaring
	integrity and reliability processes for equipment management and is based on both ExxonMobil's global experience, OEM recommendations and external standards. The implementation of this management system allows ExxonMobil to maintain equipment integrity and reliability in order to reduce flaring of ethane.
Advanced process control	Advanced process control is used at the Long Island Point Fractionation Plant to assist in reducing the risk of operating envelope excursions. The site operates using a Distributed Control System which is designed to maintain safe operation of the plant. A Dynamic Matrix Control system is also used to continually read and control key process variables in order to reduce human error and improve reliability of the operating process, thus leading to reduced ethane flaring.
Equipment redundancy	The Long Island Point Fractionation Plant was designed so that many items of process equipment have redundancy which enables ongoing operation to be maintained in the event of equipment failure or maintenance. This includes redundancy in equipment such as pumps, compressors and hot oil system capacity.
Ongoing technical monitoring	Technical monitoring of operating parameters and equipment improves reliability and reduces potential for equipment failure and associated ethane flaring.
MDEA flash tank vapour to fuel	The MDEA flash tank vapour has been directed to fuel. This is an example of a gas recovery system that reduces ethane flaring.
Daily coordination of processing rates across gas supply chain facilities	Oversupply of ethane as part of the LPG stream from the Longford Gas Plants, beyond the capacity of either the Long Island Point Fractionation Plant or the ethane customer would potentially result in flaring.
Ongoing improvements	Various projects have been identified and completed over the life of the Long Island Point facility which have reduced the potential for ethane flaring. Recent initiatives identified include control enhancements for the plant compressors to improve reliability and the Hastings Generator Project itself which provides a business continuity contingency for any future scenarios where the downstream ethane customer is unable to accept ethane.

3. LIKELIHOOD OF RISK AND DEGREE OF HARM

The likelihood of risk is associated with the frequency of flaring. Since 2017, there has been an order of magnitude reduction in ethane flaring. Flaring of ethane typically results in a moderately larger, brighter flare without any significant smoke. The exception to this are events requiring flare relief greater than 7% of maximum relief case relate to a plant upset (such as a Long Island Point plant/train shutdown or shutdown of the downstream ethane customer plant or plant sections). Review of recent operating history suggests that extended flaring events occur on a frequency of once every 1 – 2 years.

Future ethane processing at the Long Island Point Fractionation Plant will average less than 189 tonnes of ethane per day in line with reducing gas production rates in the Bass Strait and commensurate capacity of the gas turbine generators planned as part of the Hastings Generator Project. This is significantly lower than the ethane processing rates during previous extended flaring events and further reduces the likelihood of harm.

The degree of harm to human health and the environment is minimized for ethane by use of an elevated flare that efficiently incinerates the ethane gas. The safety and environmental impacts of venting ethane rather than the use of a flare actually increase the level of risk by increasing greenhouse gas impacts and potentially leading to a flammable gas cloud with potential for a fire or explosion. Emissions from the flare are recognized in the Long Island Point Operating Licence issued under the Victorian Environment Protection Act through the provision of a bubble limit for carbon monoxide, oxides of nitrogen, oxides of sulfur and total volatile organic compounds. A screening ambient air study was conducted in 2019 to evaluate the risk to public health associated with particulates from the Long Island Point Fractionation Plant. The outcome of the assessment was that the air quality was impacted by external factors including bushfires and transportation with no clear correlation to flaring at the Long Island Point plant noted.

Item	Question
3)	An assessment of any additional controls that can be installed, either as part of the proposed power generation plants or current operation, relating to the outstanding risk of flaring.

Response

Improvement in plant reliability and performance are seen as the most important mechanism to reduce the risk associated with flaring, with improvements conducted on an ongoing basis as opportunities are identified and justified. There are a number of controls currently under investigation for potential to reduce the risk associated with flaring at the Long Island Point Fractionation Plant. These include enhancements for the plant compressors to improve reliability (the impact of this initiative, would be to reduce the likelihood of propane and butane flaring) and the Hastings Generator Project itself which provides a business continuity contingency for any future scenarios where the downstream ethane customer is unable to accept ethane. The Hastings Generator Project is the most significant ethane flare reduction opportunity currently being pursued and without it being progressed the risk of flaring is higher.

Additional controls associated with the Long Island Point Fractionation Plant that may potentially reduce the risk associated with flaring are outlined in the response to question 4 below, and include consideration of alternate technologies for use for the high pressure flares at the Long Island Point plant. None of the alternate technologies eliminate the risk of flaring, but primarily reduce the potential impact of propane and butane flaring. An outlet for ethane is still required to prevent prolonged flaring of ethane from the Long Island Point Fractionation Plant.

In the design of the Hastings Generator Plant, any impacts on flaring at the Long Island Point Fractionation Plant are related to the reliability of the new facility. Shutdown of the gas turbine generators will result in an inability to process ethane and flaring at Long Island Point. To this end numerous decisions have and are continuing to be made during the design of the new facility to enhance its reliability. Key aspects that will reduce the risk of flaring include:

- Three independent gas turbine generators are proposed to be installed to limit single point failure causing shutdown of the entire Hastings Generator site and impact of failure on gas consumption capacity
- The selected Solar Titan gas turbine generator units are highly reliable units and remote monitoring technology is being installed which can allow early detection of potential reliability issues

- Consideration of one / more additional gas turbine units. Three gas turbine generators are proposed to be installed. The addition of further units is not considered reasonably practicable as it would require facility redesign, impacting the project schedule and increase risk of flaring through delayed facility availability. The operation of four units concurrently would potentially lead to flame out and an increase in flaring. Having a 4th unit on standby only would be a disproportionate additional cost with limited effectiveness as it would only be expected to be used a backup measure during rare extended outages

Item	Question
4)	An assessment addressing what constitutes industry Best Available Techniques or Technologies for flaring. In answering 4, you must review opportunities for improving the system in line with the European Commission's document Best Available Techniques (BAT) Reference Document for the Refining of Mineral Oil and Gas, specifically BAT 55. Flaring and maintaining smokeless operation of the flare during flaring is a particular concern raised by the community submitters. Please provide information answering the following questions: • To what extent will the proposal eliminate or minimise the frequency and duration of smoky flare events? • What is the expected frequency and duration of smoky flare events post the installation of the proposed modifications? • Under what circumstances will smokeless flaring not be maintained post the installation of the proposed modification? • Provide justification as to why it is not practicable to eliminate this proposed smoky flare operation.

Response

A review of industry best available techniques or technologies for flaring was conducted at Long Island Point in 2017 entitled "LIP Flare Study Report". Following this report, an independent review of the report and its findings was conducted by Advisian in 2018 entitled "LIP Flare Study Report Review". These reports identified and considered the alternate flaring technologies included in the BAT 55 Reference Document for the Refining of Mineral Oil and Gas. These included consideration of the relevant smokeless flare technologies available through implementation of:

- Steam assisted flares
- Air assisted flares
- Gas assisted flares

The reports both reached the conclusion that the water assisted flares currently installed at the Long Island Point Fractionation Plant reduced flaring as low as reasonably practicable and that the performance of the flare system was acceptable. This is consistent with the EU *Best Available Techniques (BAT) Reference Document for Common Waste Water and Waste Gas Treatment / Management Systems in the Chemical Sector* document which is referenced in BAT 55 and notes that correct design of flaring devices which is aimed to enable smokeless operation is applicable to new flares. In existing plants, applicability may be restricted due to e.g. maintenance time availability during the turnaround of the plant.

Technology	Pros	Cons	Feasibility
Steam Assist	Steam injection at the flare tip is a common technology used for reducing smoke production. Technically, it is likely to be feasible at the higher rates of flaring than water sprays.	The LIP Fractionation Plant does not have a steam system. Significant energy would be wasted in keeping a steam system online continuously for the very rare occasions that the steam would be required. High cost impact.	To install a steam assist system on the flare tips would require a significant infrastructure investment as the facility would have to add steam as a utility, which is not considered feasible. It would also consume additional methane as fuel gas and produce additional atmospheric emissions.
Air Assist	Air is a utility available at the LIP Fractionation Plant for field operation of the control and shutdown systems	The volumes of air required to reduce smoking at the high flare rates are significant and could not be catered for within the current Air System at the LIP Fractionation Plant. High cost impact.	A separate and dedicated Air System at the LIP Fractionation Plant would be required for this technology. This would include additional air compressors/blowers, pipework and control system updates, which are not considered feasible.
Fuel Assist	Fuel gas (methane) injection at the flare tip can also assist with reducing smoke. A natural gas line is already piped to the flares as a fuel for the pilot flame. However, the size of the existing piping would be undersized for fuel gas injection technology.	Methane is not produced at the LIP Fractionation Plant so would have to be consumed from the local natural gas network. Additional fuel gas infrastructure would need to be built to allow for the required higher volumes of methane. In addition, the use of methane would increase the CO_2 emissions. High cost impact.	The cost of the additional infrastructure and the additional methane usage would be high, which is not considered feasible. The environmental impact of increased flare emissions exceeds the impact of visible emissions from a smoky flare.

Please note that this analysis is consistent with that performed by Advisian in their 2018 review of flaring options at the Long Island Point Fractionation Plant.

The techniques for flaring operations noted in BAT 55 include the following:

BAT 55 Technique	Applicability
Use of pilot burners	The Long Island Point Fractionation Plant flares include pilot burners.
Steam injection	The flares in use at the Long island Point Fractionation Plant utilise two water suppression rings for smoke suppression consistent with the previous submissions to the EPA in 2017. There is currently no steam generation at the Long Island Point Plant and analysis has shown that a more energy intensive process would result from the installation of steam generation along with inferior performance as steam is not used elsewhere on site. The high pressure flares at the Long Island Point plant are located over one kilometre away from the proposed Hastings Generator site so it is not considered feasible that steam be created at the proposed Hastings Generator site with sufficient superheat capacity to be credibly used at the high pressure flares. Further issues that impact this option include high complexity, cost, and extended time to install & commission.
Use of flares rather than vents	Flares are used at the Long Island Point plant.
Knockout pots used to remove liquids	The high pressure flares are both provided with knockout vessels to remove liquids prior to disposal of the remaining gas in the flare.
Flare gas recovery	This technology is not suitable for the Long Island Point plant where process upsets or shutdowns are the predominant cause of flare events, and so there is no viable process location to return any recovered gas to without causing further flaring.
Automatic control	An automated control system is installed on the high pressure flares. This system is designed to control the quantity of water used for flare smoke suppression.
Flare monitoring	Ongoing monitoring of flaring occurs at site through video surveillance of the flare system. Flare gas flows are reviewed on a monthly basis to ensure continued focus on reduction and elimination of flaring where possible.

Esso has re-engaged with an external consultant to confirm whether any additional technologies are available or alternate flare reduction strategies could be implemented.

The Hastings Generator project however is anticipated to have little impact on smoky flare events in terms of frequency or duration at the Long Island Point fractionation plant. Ethane, when flared from the Long Island Point fractionation plant is directed to the high pressure elevated flares which are the flares associated with visible smoking events, however the events where smoky flares are present are typically caused by propane or butane related process conditions. The exception to this are events requiring flare relief greater than 7% of maximum relief case relate to a plant upset (such as a Long Island Point plant/train shutdown or shutdown of the downstream ethane customer plant or plant sections). Review of recent operating history suggests that extended flaring events occur on a frequency of once every 1 – 2 years.

As previously stated, future ethane processing at the Long Island Point Fractionation Plant will average less than 189 tonnes of ethane per day in line with reducing gas production rates in the Bass Strait and commensurate capacity of the gas turbine generators planned as part of the Hastings Generator Project. This will reduce the intensity of any future ethane flaring events. The frequency of prolonged flaring events is anticipated to drop as downstream customer shutdowns would be reduced as the new Hastings Generator Plant would be able to schedule maintenance to be specific to a gas turbine generator train rather than the whole facility.

Ultimately Esso believes that any decision on whether the flaring technology used at the Long Island Point Fractionation Plant reduces risk so far as reasonably practicable is not directly related to a decision as to whether to approve a project designed to reduce the risk associated with future flaring from customer shutdown. We request that should the EPA have interest in pursuing further discussion around flare technology at the Long Island Point Fractionation Plant that that discussion be separated from the separate Hastings Generator Plant application.

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[9] EPA, "Guidance for Operating Licences," EPA Publication 1850, Melbourne, 2021.

[10] EPA, "Noise limit and assessment protocol for the control of noise from commercial, industrial and trade premises and entertainment venues," EPA Publication 1826.4, Melbourne, 2021.

Attachments

A. *Hastings Generation Project Environmental Noise Impact Assessment, Rev 2* (2022)
B. *Noise Control Assessment Addendum*
C. *Low Frequency Noise and Infrasound Analysis Addendum*