



# Darwin Airshed LNG Licence Review

A review of current Environment Protection Licences under the *Waste Management and Pollution Control Act 1998 (NT)* for liquefied natural gas (LNG) facilities in the Darwin airshed  
July 2026

|                 |                                   |
|-----------------|-----------------------------------|
| Document title  | Darwin Airshed LNG Licence Review |
| Contact details | Environmental Regulation Division |
| Approved by     | NT EPA                            |
| Date approved   | 14 July 2026                      |
| Document review | None                              |
| TRM number      | 33-D26-11939                      |

| Version | Date         | Author                            | Detail                                   |
|---------|--------------|-----------------------------------|------------------------------------------|
| 0.1     | 22 May 2026  | Environmental Regulation Division | Draft for peer review and agency comment |
| 1.0     | 14 July 2026 | Environmental Regulation Division | Final report                             |

**Table of Abbreviations**

| Abbreviation     | Details                                                      |
|------------------|--------------------------------------------------------------|
| AAQ              | Ambient Air Quality                                          |
| AAQM             | Ambient Air Quality Monitoring                               |
| AEMP             | Annual Environmental Monitoring Program                      |
| AEMR             | Annual Environmental Monitoring Report                       |
| AGI              | Acid Gas Incinerator                                         |
| AGRU             | Acid Gas Removal Unit                                        |
| ALARP            | As Low As Reasonably Practicable                             |
| aMDEA            | Activated Methyldiethanolamine                               |
| APLNG            | Australia-Pacific LNG                                        |
| AQIA             | Air Quality Impact Assessment                                |
| BPT              | Best Practicable Technology                                  |
| BTEX             | Benzene, toluene, ethylbenzene and xylene                    |
| CCPP             | Combined Cycle Power Plant                                   |
| CER              | Clean Energy Regulator                                       |
| CH <sub>4</sub>  | Methane                                                      |
| CO               | Carbon monoxide                                              |
| CO <sub>2</sub>  | Carbon dioxide                                               |
| DLNG             | Darwin LNG                                                   |
| DLPE             | Department of Lands, Planning and Environment                |
| EPA              | Environment Protection Approval (under the WMPCA)            |
| EPL              | Environment Protection Licence (under the WMPCA)             |
| EPO              | Environment Protection Objective established under the WMPCA |
| FEMP             | Fugitive Emissions Management Plan                           |
| GHG              | Greenhouse Gas                                               |
| GLNG             | Gladstone LNG                                                |
| GTG              | Gas Turbine Generator                                        |
| H <sub>2</sub> S | Hydrogen sulfide                                             |
| LDAR             | Leak Detection and Repair                                    |
| LNG              | Liquefied natural gas                                        |

|                   |                                                        |
|-------------------|--------------------------------------------------------|
| MASDP             | Middle Arm Strategic Development Project               |
| N <sub>2</sub> O  | Nitrous oxide                                          |
| NEPC              | National Environment Protection Council                |
| NEPM              | National Environment Protection Measure                |
| NGER              | National Greenhouse and Energy Reporting               |
| NGSF              | Newcastle Gas Storage Facility                         |
| NMVOC             | Non-methane volatile organic compounds                 |
| NO <sub>x</sub>   | Oxides of nitrogen (NO, NO <sub>2</sub> )              |
| NPI               | National Pollutant Inventory                           |
| NSW EPA           | New South Wales Environment Protection Agency          |
| NT EPA            | Northern Territory Environment Protection Authority    |
| O <sub>3</sub>    | Ozone                                                  |
| OEMP              | Operations Environmental Management Plan               |
| PAHs              | Polycyclic aromatic hydrocarbons                       |
| PFAS              | Per-and polyfluorinated substances                     |
| PM <sub>10</sub>  | Particulate Matter <10 µm diameter                     |
| PM <sub>2.5</sub> | Particulate Matter <2.5 µm diameter                    |
| QA/QC             | Quality Assurance/Quality Control                      |
| REMP              | Receiving Environment Monitoring Program               |
| SFAIRP            | So far as is reasonably practicable                    |
| SO <sub>x</sub>   | Sulfur oxides                                          |
| ToR               | Terms of Reference                                     |
| TVOC              | Total Volatile Organic Compounds                       |
| US EPA            | United States Environment Protection Agency            |
| VOC               | Volatile Organic Compounds                             |
| WHRU              | Waste heat recovery unit                               |
| WMPCA             | <i>Waste Management and Pollution Control Act 1998</i> |

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## 1. Executive Summary

This report reviews the environment protection licences regulating air emissions from the two liquefied natural gas (LNG) processing facilities in the Darwin airshed — INPEX's Ichthys LNG (EPL228) and Santos' Darwin LNG (EPL217) — under the *Waste Management and Pollution Control Act 1998* (WMPCA). The review was initiated following a significant upward revision of INPEX's 2023/24 emissions estimates (including benzene) and related community concern about potential human health impacts. The review considers whether current licence settings remain fit-for-purpose, contemporary and enforceable.

Sections 2–5 establish the regulatory and operating context and summarise stakeholder engagement, peer review and benchmarking across Australian jurisdictions. Benchmarking confirms LNG licensing across Australia is risk-based and controls emissions through specified release points, monitoring and annual reporting. However, approaches vary widely for pollutant coverage, monitoring frequency, numeric limits, ambient monitoring, transparency and governance. The Northern Territory (NT) licences are comparatively comprehensive, reflecting the proximity of facilities to sensitive receptors and the pollutant profile of offshore feed gas, but the review identifies opportunities to strengthen clarity, consistency and contemporary alignment. The recommendations were also informed by stakeholder consultation, New South Wales Environment Protection Authority (NSW EPA) peer-review and consultation with NT Health.

Sections 5–7 assess whether current conditions adequately protect human health, support effective community engagement and reflect contemporary best practice and quality assurance. The review finds that clearer, more objective and consistently applied controls are required to improve confidence that emissions are being minimised as far as reasonably practicable and that monitoring and reporting are sufficiently robust. Key themes include the need to: strengthen outcomes-based and pollution control equipment obligations; address gaps in the regulation of acid gas incineration and hot venting, including cumulative impacts from concurrent hot venting; expand and modernise the use of numeric emission limits and monitoring, including consideration of aMDEA and other solvents; strengthen point-source monitoring and require continuous data to be used for emissions estimation where available; strengthen transparency and access to information; and lift the level of independent assurance and quality control supporting core management documents and reporting.

Sections 8–9 address consistency and enforceability. Section 8 finds that, while both licences contain a broadly consistent mix of standard and bespoke conditions, there is value in updating standard conditions and further aligning some bespoke requirements where comparable risks are being managed, particularly for fugitive emissions. Section 9 concludes that both licences are generally enforceable, especially for administrative, monitoring, reporting and numeric limit conditions, but that enforceability is stronger where obligations are clear, objective and supported by defined thresholds, timeframes and verification mechanisms. The report therefore recommends that any future amendments be drafted in clear, unambiguous language, include compliance thresholds where possible, clearly define requirements and exemptions, and ensure any differences between licences remain justified by facility-specific risk and context.

### Key findings

- **Benchmarking outcome:** NT licences are comprehensive when compared with other Australian licences, but improvement opportunities exist to better align with contemporary best practice, particularly around numeric limits, monitoring confidence and transparency.
- **Hot venting and pollution control equipment operability:** Priority gaps include clearer enforceable hot venting duration limits in EPL228, expectations for incinerator/thermal oxidiser availability, reporting on downtime, and provisions to avoid cumulative impacts from concurrent hot venting from both facilities.

- **Numeric emission limits beyond NO<sub>x</sub>:** The review recommends expanding the use of enforceable concentration and mass emission limits to additional pollutants of concern, including investigation of aMDEA and other solvents from gas processing, to improve clarity, evidentiary certainty and regulatory leverage.
- **Monitoring uplift and emissions estimation:** The review recommends strengthening point-source monitoring to improve confidence in estimates and enable timely detection of performance issues, including continuous monitoring capability for key pollutants of concern in the acid gas stream at Ichthys LNG and use of continuous data for emissions estimation where available.
- **Ambient air monitoring and cumulative impacts:** Improve public assurance through a government-operated ambient air monitoring framework supported by industry cost recovery, with timely public access to continuous data and clearer assessment of facility contributions against relevant national and NT EPA standards.
- **Consistency and enforceability:** Differences between EPL217 and EPL228 should be explicitly risk-justified; amendments should prioritise clear thresholds, defined timeframes and unambiguous drafting to support enforceable regulation.

## Recommendations

| #                       | Recommendation                                                                                                                                                                                                                                |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Recommendation 1</b> | Align and strengthen outcomes-based and pollution control conditions in both licences to require licensees to minimise pollution to air, and install, operate and maintain pollution control equipment.                                       |
| <b>Recommendation 2</b> | Include clearer hot venting duration limits in EPL228 and specify the expected availability of incineration equipment in both licences with a view to reach 99% availability.                                                                 |
| <b>Recommendation 3</b> | Include provisions in both licences to avoid cumulative impacts from concurrent hot venting from both facilities.                                                                                                                             |
| <b>Recommendation 4</b> | Require reporting of AGI/thermal oxidiser downtime in the Annual Environmental Monitoring Report (AEMR).                                                                                                                                      |
| <b>Recommendation 5</b> | Apply numerical emission concentration limits and maximum mass emissions rates to pollutants of concern in both licences.                                                                                                                     |
| <b>Recommendation 6</b> | Investigate loss of aMDEA and other solvents from gas processing and consider inclusion of this pollutant in emission concentration limits and maximum emissions rates.                                                                       |
| <b>Recommendation 7</b> | Require the installation of continuous monitoring equipment for the acid gas stream at Ichthys LNG, capable of measuring benzene and other pollutants of concern in real time.                                                                |
| <b>Recommendation 8</b> | Update monitoring requirements to reflect current operations and ensure that required monitoring frequencies and parameters are consistent between facilities and sufficient to provide a comprehensive understanding of pollutant emissions. |

|                          |                                                                                                                                                                                                                                  |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Recommendation 9</b>  | Require the use of continuous data for emissions estimation where available.                                                                                                                                                     |
| <b>Recommendation 10</b> | Require all licensees to implement ambient air quality monitoring in the receiving airshed, unless required through other legislative mechanisms.                                                                                |
| <b>Recommendation 11</b> | Require licensees to provide continuous ambient air quality monitoring data required under the licence to the public in real time, unless provided through other legislative mechanisms.                                         |
| <b>Recommendation 12</b> | Require an update of the Receiving Environment Monitoring Program Plan (REMP) for EPL228 which incorporates modelling based on revised emissions estimates and considers any additional requirements resulting from this review. |
| <b>Recommendation 13</b> | Require licensees to estimate their annual average contribution to the total airshed capacity for recognised pollutants under national and NT EPA defined standards.                                                             |
| <b>Recommendation 14</b> | Align licence conditions to require both licensees to convene community consultative committees and review community consultative committee performance and efficacy every two years.                                            |
| <b>Recommendation 15</b> | Amend licence conditions to ensure that information of interest to the public, including flaring activities, is made available by licensees and can be shared by the regulator (see also Recommendation 11).                     |
| <b>Recommendation 16</b> | Require an audit every 5 years to verify that facilities are implementing best practice for pollution control.                                                                                                                   |
| <b>Recommendation 17</b> | Require regular review of the Operations Environment Management Plan (OEMP) to ensure best practice is incorporated.                                                                                                             |
| <b>Recommendation 18</b> | Strengthen requirements for independent (third party) reviews of OEMPs.                                                                                                                                                          |
| <b>Recommendation 19</b> | Align requirements for review and certification of REMP, AEMR to ensure plans and reports submitted are quality controlled.                                                                                                      |
| <b>Recommendation 20</b> | Align audit requirements across licences and strengthen the ability of the NT EPA to define scope items.                                                                                                                         |
| <b>Recommendation 21</b> | Update standard licence conditions in both licences to current wording.                                                                                                                                                          |
| <b>Recommendation 22</b> | Update EPL228 fugitive emissions conditions to align with EPL217.                                                                                                                                                                |
| <b>Recommendation 23</b> | Ensure any amendments use unambiguous language, provide compliance thresholds where possible and clearly define requirements and exemptions.                                                                                     |

## 2. Introduction

### 2.1. Reasons for conducting this review

In October 2025, INPEX, the operator of the Ichthys Liquefied Natural Gas (LNG) facility in Darwin, revised its emissions estimates for 2023/24 upwards by a significant amount after conducting a review of estimation methods. The revised estimates included a revision of estimated benzene emissions from ~5 tonnes to ~500 tonnes, leading to community concerns about human health risks from pollutant emissions.

These revelations followed a review by the Department of Lands, Planning and Environment (DLPE) in early 2025 that had identified discrepancies between emissions-reporting to the National Pollutant Inventory (NPI) and emissions-reporting required under Environment Protection Licence (EPL) 228 for the year 2023/24. It is understood that this, and broader public interest in pollutant emissions, prompted INPEX to conduct an internal review of its estimation methodology, which led to the discovery of errors and revised estimates.

In response to this new information about the magnitude of potentially harmful emissions to the Darwin airshed, the Northern Territory Environment Protection Authority (NT EPA) initiated a range of measures to ensure public health is protected, future reporting is accurate and environmental regulation of the industry is effective and contemporary (NT EPA, 2026). One of these measures is a review of environment protection licences that regulate the operation of the two LNG facilities in the Darwin airshed, INPEX's Ichthys LNG facility (EPL228) and Santos' Darwin LNG facility (EPL217).

### 2.2. Stakeholder consultation

The terms of reference<sup>1</sup> (ToR) for this review were published on the NT EPA website in March 2026 (NT EPA, 2026). Following the publication of the ToR, meetings were held with representatives from the Environment Centre NT, No New Gas Coalition and the Climate and Health Alliance in March and April 2026, to discuss the ToR and process for the review.

The ToR were also discussed with representatives from INPEX and Santos during routine meetings in April 2026.

The NSW Environment Protection Agency (NSW EPA) provided a peer-review of a draft of this document (Appendix 1). Its assessment stated that:

*The EPA has reviewed the document titled "Darwin Airshed LNG Licence Review – A review of current Environment Protection Licences under the Waste Management and Pollution Control Act 1998 (NT) for liquefied natural gas (LNG) facilities in the Darwin airshed June 2026" (the Review) and believes that the recommendations of the Review are sound and based upon modern regulatory best practice.*

Affected licensees (Santos and INPEX) were provided with a summary of the recommendations of this report at face-to-face meetings for information. Further detailed consultation with licensees will be conducted before licence amendments are implemented.

The sections of this report considering human health have been provided to NT Health for comment. No concerns were raised by NT Health during this consultation.

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<sup>1</sup> [https://ntepa.nt.gov.au/\\_data/assets/pdf\\_file/0005/1594958/terms-of-reference.pdf](https://ntepa.nt.gov.au/_data/assets/pdf_file/0005/1594958/terms-of-reference.pdf)

## 3. Background

### 3.1. NT Environmental Regulatory Framework

#### ***Licensing Requirements***

LNG facilities in the NT that produce, store or despatch more than 500,000 tonnes of LNG per year must hold an Environment Protection Licence (EPL) under the *Waste Management and Pollution Control Act 1998 (NT)* (WMPCA). EPLs are granted by the NT EPA and administered by the Environmental Regulation Division of the Department of Lands, Planning and Environment (DLPE).

In accordance with the WMPCA, licence conditions can require operators to meet specified environmental outcomes, comply with standards, implement pollution control and management measures, undertake monitoring and testing, report results and other information to the NT EPA, and prepare and implement environmental management plans.

EPLs primarily regulate pollutant discharges and emissions to protect local environmental values and human health. Greenhouse gas emissions are primarily addressed under the Commonwealth regulatory framework.

#### ***Interaction with environmental impact assessment***

Projects with the potential for significant environmental impact must also undergo impact assessment under the *Environment Protection Act 2019 (NT)* and previously the *Environmental Assessment Act 1982 (NT)*. As part of the assessment process, proponents must consider air quality, atmospheric processes and human health impacts. An Environmental Approval is granted by the Minister if impacts are considered to be manageable and risks are reduced to an acceptable level.

Licensing under the WMPCA operates alongside the environmental impact assessment process and EPLs must be consistent with the recommendations or approval conditions from the assessment.

#### ***NPI reporting***

Large emitters that meet relevant thresholds must also report emissions to the National Pollutant Inventory (NPI). The NPI is Australia's legislated, public source of information on emissions and waste transfers of potential pollutants.

The NPI is legislated under the *National Environment Protection Measure (National Pollutant Inventory) Measure 1998 (Cth)* (NPI NEPM) and was established under the *National Environment Protection Council Act 1994 (Cth)*. In the NT, the NPI NEPM is implemented in the form of an Environment Protection Objective under the WMPCA.

A more detailed description of the NT's regulatory framework is provided in Appendix 2.

### 3.2. Pollutants of concern from LNG processing

Atmospheric emissions from LNG facilities are primarily produced by fuel combustion for power generation, removal of undesirable components from feed gas during gas processing, flaring of gas and from fugitive emissions (leaks).

Appendix 3 provides details on major common pollutants of concern that are regulated by current LNG EPL conditions and provides a short description of potential impacts from these pollutants.

The presence and quantity of pollutants in emissions will depend on the feed gas quality. Provided that feed gas sulfur content is low, the pollutants of major concern for gas turbine generators are oxides of nitrogen (NO<sub>x</sub>) and carbon monoxide (CO) (Advisian, 2017). Pollution controls typically focus on minimising NO<sub>x</sub> in the exhaust gas stream, however, concentrations of CO in the exhaust gas will be a consideration in the selection of NO<sub>x</sub> pollution control measures.

Volatile organic compounds (VOC), including benzene, toluene, ethylbenzene and xylene (BTEX), are present in much smaller quantities in emissions and are mostly present in exhaust streams from feed gas processing, where they are removed before liquefaction. However, due to the potential health impacts, BTEX emissions are of high concern.

### 3.3. Licence history

Both LNG facilities went through environmental impact assessment under the *Environmental Assessment Act 1982* prior to construction and had environment protection licences granted following the completion of the environmental impact assessment process.

Licence conditions were based on the recommendations from Assessment Reports 24 and 39 (ConocoPhillips, now Santos) and Assessment Report 65 (INPEX), respectively.

Since the original EPLs were granted, both licences have undergone multiple amendments to accommodate administrative and operational changes or streamline conditions to reflect actual practice where appropriate. A detailed description of the licence history for both INPEX and Santos is provided in Appendix 4.

The versions of the licences current during this review were EPL228-05 (Ichthys LNG) and EPL217-05 (Darwin LNG). The most recent versions of the licences are available on the NT EPA register.

### 3.4. Scope

The ToR for the review were published on the NT EPA website in March 2026. In accordance with the ToR, the review comprises the following:

1. Benchmarking environmental licence conditions for comparable hydrocarbon facilities across Australian jurisdictions to inform consideration of contemporary practice and identify potential for improvement, having regard to local operating contexts and risk profiles.
2. Assessing the adequacy of EPL conditions to address human health risks from air emissions, including review of requirements for ambient air quality monitoring.
3. Assessing the adequacy of EPL requirements for community engagement and information dissemination.
4. Assessing consistency of regulatory requirements between the Santos and INPEX EPLs, having regard to differences in facility characteristics and risk profiles.
5. Considering whether EPL conditions appropriately reflect contemporary best practice in air quality management, including requirements for monitoring, quality assurance and quality control, data verification, and independent review of management and monitoring systems, having regard to risk, feasibility, and regulatory context.
6. Considering enforceability of conditions.

7. Providing recommendations in relation to EPL228 (Ichthys LNG) and EPL217 (Darwin LNG), which may include confirmation of the adequacy of existing conditions, or recommendations for amendment.

## 4. Benchmarking licence conditions across Australian jurisdictions

### ToR scope requirement:

*Benchmarking environmental licence conditions for comparable hydrocarbon facilities across Australian jurisdictions to inform consideration of contemporary practice and identify potential for improvement, having regard to local operating contexts and risk profiles.*

This section provides a summary of the findings of the comparison of hydrocarbon processing licences in Australia. A more detailed description of the jurisdictional analysis is provided in Appendix 5.

### 4.1. Inclusion criteria

Five Australian jurisdictions currently have operating LNG facilities: Western Australia (WA), New South Wales (NSW), Queensland (QLD), South Australia (SA) and the Northern Territory (NT).

The jurisdictional analysis was limited to licences which met at least one of the following criteria:

- The licence is issued to a currently operating facility
- The licence applies to the operational phase of an LNG processing facility
- The licence covers processing raw feed gas into LNG, or
- For NSW, the licence is a hydrocarbon processing licence with air emission limits.

The following licences were considered out of scope:

- Licences which did not contain any mention of air emissions
- Licences related to the following activities:
  - Regasification facilities
  - Coal seam gas extraction and transport facilities
  - Works approvals for the construction of hydrocarbon facility infrastructure
- Superseded, revoked or expired licences.
- Licences associated with LNG facilities in Karratha (WA), as the licences are not contemporary and are being revised.

In accordance with the above criteria, LNG processing licences selected for inclusion in the jurisdictional analysis are listed in Table 1. The NSW hydrocarbon processing facilities with air emissions are listed in Table 2.

Table 1 Interstate LNG facility licences analysed for the jurisdictional analysis.

| Jurisdiction | Facility                     | Operator                             | Licence number      | Licence Link         |
|--------------|------------------------------|--------------------------------------|---------------------|----------------------|
| QLD          | Queensland Curtis LNG        | BG Group/QCLNG Operating Company P/L | EPPG00711513        | <a href="#">Link</a> |
|              | GLNG: Gladstone LNG          | Santos Ltd                           | EPPG00712213 (2021) | <a href="#">Link</a> |
|              | APLNG: Australia Pacific LNG | ConocoPhillips and Origin Energy     | EPPG00715613        | <a href="#">Link</a> |

|     |                                       |                     |              |                      |
|-----|---------------------------------------|---------------------|--------------|----------------------|
| WA  | Pluto LNG                             | Woodside Energy     | L8752/2013/2 | <a href="#">Link</a> |
|     | Wheatstone LNG                        | Chevron Corporation | L9225/2019/1 | <a href="#">Link</a> |
|     | Gorgon LNG                            | Chevron Corporation | L9102/2017/1 | <a href="#">Link</a> |
| NSW | Newcastle Gas Storage Facility (NGSF) | AGL                 | 20130        | <a href="#">Link</a> |
| SA  | Moomba plant                          | Santos Ltd          | 2569         | <a href="#">Link</a> |

Table 2 Non-LNG licences in NSW which contain air emission limits.

| Facility                      | Operator                      | Licence number |
|-------------------------------|-------------------------------|----------------|
| Vopak Terminals Australia     | Vopak Terminals Sydney        | 6007           |
| Bituminous Products           | Bituminous Products Pty Ltd   | 5267           |
| Southern Oil Refining         | Southern Oil Refining Pty Ltd | 11408          |
| Valvoline (Australia) Pty Ltd | Valvoline (Australia) Pty Ltd | 3182           |

## 4.2. Methods

The jurisdictional analysis focussed on air emissions regulation, monitoring, reporting and governance. Conditions related to water quality, terrestrial ecology or other environmental factors were not included, as they were considered out of scope of this review.

### Desktop analysis

Licences for operational LNG processing facilities were obtained from their respective regulators' public registers on 18 February 2026. Any potential changes to licence conditions after this date have not been considered.

The qualitative desktop analysis compared licence conditions across 12 broader themes:

1. Emission points
2. On-site air emissions monitoring requirements
3. Emissions limits
4. Flaring
5. Fugitive emissions
6. Ambient air quality monitoring requirements
7. Reporting requirements
8. Conditions requiring "best practice"
9. Greenhouse gas (GHG) emissions
10. Cumulative emissions
11. Community consultation and transparency requirements
12. Outcomes-based conditions and conditions requiring reducing pollution

### Interviews

In addition to the desktop analysis, interviews were conducted with regulatory officers from NSW, WA and QLD to gain insights into the performance of their regulatory regimes. Comment was taken in writing

from SA regulatory officers. Interviews were also used to clarify the background and rationale for certain conditions and to better understand other jurisdictions' regulatory frameworks and the nature of issues of public and community concern. Information was provided by officers in good faith and to the best of their knowledge at the time the conversations took place and was not considered formal regulatory advice from the respective agencies.

### 4.3. Results

A detailed analysis of the results is provided in Appendix 5. Table 3 below provides a comparative overview of licence requirements in each jurisdiction.

With regard to air emissions, LNG facility licences across the country are consistent in the following areas:

- All licences are risk-based and reflect the outcomes of environmental impact assessment and approval processes.
- All licences require that regulated air emissions can only occur at specified (point) sources.
- All licences require some on-site monitoring of pollutant emissions, with NO<sub>x</sub> being the primary pollutant subject to emission monitoring and limits.
- All licences require emission reporting.
- All licences specify standards for monitoring which must be adhered to.

Licences vary considerably in the following areas:

- The range of pollutants that are regulated through the licence. Most interstate facilities focus primarily on regulation of NO<sub>x</sub> and SO<sub>2</sub> emissions, while the NT regulates a broader range of pollutants including BTEX.
- Only some licences include numerical emission limits.
- Requirements for the installation and use of pollution reduction equipment such as acid gas incinerators (AGIs) are not included in all licences. Many interstate facilities are not required to operate AGIs.
- The extent of on-site and off-site monitoring requirements (parameters and frequency).

### Risk-based regulation

Regulatory requirements of each LNG facility depend on a number of risk factors, including feed gas quality, the age and design of each facility and the proximity of facilities to population centres. Consequently, licences vary considerably across jurisdictions due to the unique risk profile of each facility.

SA's LNG processing facilities are located at Moomba (remote), Port Bonython and the South East. Each holds a licence for hydrocarbon processing and/or storage. The risks associated with air emissions from these facilities are considered low because the distance between the facilities and the nearest sensitive receptor is large and pollution controls such as vapour-recovery systems and floating-roof storage tanks are in place. Consequently, the licences contain no specific air quality monitoring or regulation conditions.

Darwin facilities are close to sensitive receptors, located approximately 6-10 km from widely dispersed population centres. Queensland's LNG facilities are also 6-12 km from Gladstone but prevailing winds direct air emissions away from this population centre. WA facilities with contemporary licences and SA facilities are generally at least 100 km from sensitive receptors. Darwin's population centres are in

relatively close proximity to LNG facilities, necessitating the more stringent air quality protection requirements in the current EPLs.

Feed gas quality also impacts the processing of gas and the risk posed by emissions. Darwin-based LNG facilities process gas from offshore gas fields. This gas contains relatively high volumes of pollutants (Advisian, 2017). These pollutants need to be removed from the gas to prepare it for liquefaction and transport. The gas processed near Gladstone, in comparison, is coal seam gas, which has negligible levels of BTEX and other hydrocarbon pollutants (Advisian, 2017). As a result, QLD LNG facilities do not contain and are not required to operate pollution reduction equipment such as AGIs. Darwin's facilities are designed to include pollution reduction and control equipment as a direct result of the risks associated with the composition of the feed gas.

Overall, the risk profile of the NT's LNG facilities has resulted in the NT's EPLs for LNG facilities being more comprehensive, integrated and stringent than licences from most other Australian jurisdictions reviewed. While QLD and WA licences tend to rely on narrower, parameter-specific or equipment-based controls, NT licences contain conditions covering a wider range of operational requirements and combine prescriptive requirements with broader outcome-focused obligations.

Compared to other Australian jurisdictions, the NT LNG EPLs generally contain more stringent requirements in that they:

- Regulate a wider range of pollutants
- Require more monitoring
- Include requirements related to regional air quality outcomes, not just point source compliance
- Include conditions to regulate flaring, fugitive emissions and emissions reporting
- Are explicit about continuous improvement and implementing best practice.

## Improvement opportunities

While the NT currently has some of the most stringent licence conditions for LNG facilities in Australia, there are opportunities to streamline and strengthen conditions. These are discussed in detail in sections 5–9.

The NT could look to other jurisdictions to improve licence conditions in the following areas:

- Best practice flaring regulation in QLD
- Best practice ambient air trigger-response frameworks from Wheatstone LNG
- Considering different monitoring method requirements based on Australian standards or United States Environment Protection Agency (US EPA) methods
- Best practice data access and transparency from QLD and NSW.

Table 3 Comparison of licence requirements between Australian jurisdictions.

| Requirement                                                                                                                                                 | NT                                                                                                                     | WA                                                                                                 | QLD                                                                                        | NSW                                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| <b>1. Emission Points</b>                                                                                                                                   |                                                                                                                        |                                                                                                    |                                                                                            |                                                                                                         |
| Regulated emissions restricted to specified release points                                                                                                  | Yes                                                                                                                    | Yes                                                                                                | Yes                                                                                        | Yes                                                                                                     |
| <b>2. On-site air emission monitoring</b>                                                                                                                   |                                                                                                                        |                                                                                                    |                                                                                            |                                                                                                         |
| Stack emission monitoring                                                                                                                                   | Monthly, quarterly or annual                                                                                           | Quarterly or annual                                                                                | Annual                                                                                     | 5-yearly                                                                                                |
| Standards applied to monitoring methods                                                                                                                     | Approved methods for sampling and analysis of air pollutants in NSW or US EPA methods. AS 4323.1 is an approved method | Australian Standard AS 4323.1 or US EPA methods                                                    | Australian Standard AS 4323.1 or Queensland Air Quality Sampling Manual                    | Approved methods for sampling and analysis of air pollutants in NSW. AS 4323.1 is an approved method.   |
| Conditions requiring qualified monitors                                                                                                                     | Yes                                                                                                                    | Not specified                                                                                      | Yes                                                                                        | Not specified                                                                                           |
| Conditions to ensure monitoring is of a high quality (e.g. appropriate monitoring equipment, associated data collection, quality assurance/quality control) | Yes                                                                                                                    | Yes                                                                                                | Yes                                                                                        | Yes                                                                                                     |
| Parameters monitored at emission points                                                                                                                     | NO <sub>x</sub> as NO <sub>2</sub><br>CO<br>SO <sub>2</sub><br>Benzene/BTEX<br>H <sub>2</sub> S<br>Mercury             | Ranges from NO <sub>x</sub> only to NO <sub>x</sub> , CO and SO <sub>2</sub>                       | NO <sub>x</sub>                                                                            | NO <sub>x</sub><br>Solid particles<br>SO <sub>2</sub><br>Sulfuric acid mist and SO <sub>3</sub><br>VOCs |
| <b>3. Emission limits and maximum emission rates</b>                                                                                                        |                                                                                                                        |                                                                                                    |                                                                                            |                                                                                                         |
| Concentration limits applied to which parameters                                                                                                            | NO <sub>x</sub> for both facilities (70-350 mg/Nm <sup>3</sup> )<br>For EPL217 for some emission points:               | Some facilities for NO <sub>x</sub> (51-140 mg/m <sup>3</sup> )<br>Other LNG facilities have none. | NO <sub>x</sub> for all facilities<br>51-125 mg/Nm <sup>3</sup> (dry) @ 15% O <sub>2</sub> | NO <sub>x</sub> (190-250 mg/m <sup>3</sup> )<br>NGSF                                                    |

| Requirement                     | NT                                                                                                                                                     | WA                                                  | QLD                                                                            | NSW                                                                                                                                                                       |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                 | Benzene 306 mg/Nm <sup>3</sup><br>CO 32-145 mg/Nm <sup>3</sup><br>SO <sub>2</sub> 23-485 mg/Nm <sup>3</sup><br>H <sub>2</sub> S 362 mg/Nm <sup>3</sup> |                                                     |                                                                                | VOC as n-propane equivalent<br>5-20 mg/m <sup>3</sup><br>CO 100-125 mg/m <sup>3</sup><br>Solid particles 5-40 mg/m <sup>3</sup><br>SO <sub>x</sub> 5-60 mg/m <sup>3</sup> |
| Maximum emission rates applied? | EPL217 only:<br>NO <sub>x</sub> 1-25 g/s<br>Benzene 3.6 g/s<br>CO 0.4-5 g/s<br>SO <sub>2</sub> 0.2-11.1 g/s<br>H <sub>2</sub> S 4.3 g/s                | Applied at one facility only                        | NO <sub>x</sub> for all facilities<br>3-4 g/s                                  | No                                                                                                                                                                        |
| Load limits applied?            | Implied in EPL217 through application of a concentration limit and maximum emission rate                                                               | No                                                  | Implied through application of a concentration limit and maximum emission rate | For LNG processing: No.<br>For non-LNG hydrocarbon processing facilities: Yes                                                                                             |
| <b>4. Flaring</b>               |                                                                                                                                                        |                                                     |                                                                                |                                                                                                                                                                           |
| Flaring prohibited              | No                                                                                                                                                     | No (dark smoke events prohibited by one licence)    | No                                                                             | Not specified                                                                                                                                                             |
| Flaring duration limited        | No                                                                                                                                                     | Yes (one licence)                                   | Yes                                                                            | Not specified                                                                                                                                                             |
| Flaring monitoring required     | Yes for EPL228<br>No for EPL217                                                                                                                        | No                                                  | Yes                                                                            | Not specified                                                                                                                                                             |
| Flaring design conditions       | Yes                                                                                                                                                    | No                                                  | Yes                                                                            | Not specified                                                                                                                                                             |
| Flaring reporting conditions    | Yes for EPL228<br>No for EPL217                                                                                                                        | No                                                  | Yes                                                                            | Not specified                                                                                                                                                             |
| <b>5. Fugitive emissions</b>    |                                                                                                                                                        |                                                     |                                                                                |                                                                                                                                                                           |
| Fugitive emissions conditions   | Yes, with different requirements in each licence                                                                                                       | Wheatstone only: six-monthly Optical Gas Monitoring | Yes                                                                            | Not specified<br>New climate change requirements are being phased in from 2027 <a href="#">Climate change</a>                                                             |

| Requirement                                                                      | NT                                                                                                                                                                                                                                                                                       | WA                                                                                                                                                                                                                                                                                                  | QLD                                                                                                                                                                                                                                                                                     | NSW                                                                                           |
|----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
|                                                                                  |                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                         | <a href="#">requirements for licensees   EPA</a>                                              |
| <b>6. Ambient air quality monitoring</b>                                         |                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                         |                                                                                               |
| Ambient air quality monitoring required by the licensee                          | Yes for EPL228<br>No for EPL217.                                                                                                                                                                                                                                                         | Wheatstone only (NO <sub>x</sub> , SO <sub>2</sub> , CO, Ozone (O <sub>3</sub> ), NMVOC).                                                                                                                                                                                                           | Not specified                                                                                                                                                                                                                                                                           | Not specified                                                                                 |
| Ambient air quality monitoring in the receiving airshed funded by LNG facilities | No                                                                                                                                                                                                                                                                                       | Yes, for one facility through the licence                                                                                                                                                                                                                                                           | Yes, outside of licence framework                                                                                                                                                                                                                                                       | Yes, outside of licence framework                                                             |
| <b>7. Reporting</b>                                                              |                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                         |                                                                                               |
| Reporting frequency                                                              | Annually                                                                                                                                                                                                                                                                                 | Annually and quarterly                                                                                                                                                                                                                                                                              | Annually                                                                                                                                                                                                                                                                                | Annually                                                                                      |
| Reporting requirements related to air emissions                                  | Provide monitoring data.<br>Summarise performance of emissions to air compared to targets and limits.<br>Assess the contribution of emissions to Darwin ambient air quality.                                                                                                             | Varies between facilities.<br>Thermal oxidiser downtime.<br>Emission point utilisation.<br>NO <sub>x</sub> emissions<br>Monitoring data.<br>Emission limit exceedances.<br>Monitoring data.<br>Ambient air quality monitoring data and trend analysis.<br>Results of fugitive emissions monitoring. | Monitoring results from the annual reporting period.<br>A summary of the quantities of releases.<br>Equipment failures and actions taken in response to deficiencies identified by the monitoring programs.                                                                             | Operator must publish their pollution monitoring data.                                        |
| <b>8. Best Practice Requirements</b>                                             |                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                         |                                                                                               |
| Best practice conditions – examples                                              | The Operations Environmental Management Plan (OEMP) must include measures to ensure: <ul style="list-style-type: none"> <li>• application of best practice to the management of emissions, discharges and waste and to reduce emissions, discharges and waste disposal as far</li> </ul> | During normal operating conditions each gas turbine must be operated with: <ul style="list-style-type: none"> <li>• dry low emissions combustor system;</li> <li>• turbine inlet air humidification (when the GTG is being operated at &gt;70% load);</li> <li>• WHRU;</li> </ul>                   | “The flare must be equipped with a flare tip design to provide good mixing with air, flame stability and achieve a minimum Volatile Organic Compound (VOC) removal efficiency of 98 per cent under varied gas flow rate and meteorological conditions and meet the best practice design | Not specified in the licence. Best practice is regulated and required outside of the licence. |

| Requirement                                    | NT                                                                                                                                                                                 | WA                                                                                                                                   | QLD                                                                                                                                                                                                                                                                                                                                                                                                                           | NSW                                                           |
|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
|                                                | <p>reasonable and practicable for the Scheduled Activity.</p> <p>Annual monitoring of fugitive methane emissions from the Darwin LNG storage tank using best practice methods.</p> | <ul style="list-style-type: none"> <li>• a load balancing program; and</li> <li>• continuous fuel composition monitoring.</li> </ul> | <p>standards (e.g. NSW EPA: Protection of the Environmental Operations (Clean Air) Amendment Regulation 2005, or the US EPA Code of Federal Regulations: 40 CFR 60.18 and 40 CFR 63.11).</p> <p>Environmental Management Plan must state the environmental protection commitments the applicant proposes for the activities, to protect or enhance the environmental values under best practice environmental management.</p> |                                                               |
| <b>9. Greenhouse Gas Emissions</b>             |                                                                                                                                                                                    |                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                               |
| Greenhouse gas-related conditions              | Greenhouse gas management strategies must be included in the OEMP.                                                                                                                 | Not specified                                                                                                                        | A GHG reduction strategy, covering energy efficiency, continuous improvement and CO <sub>2</sub> recovery.                                                                                                                                                                                                                                                                                                                    | New climate change requirements are being phased in from 2027 |
| <b>10. Cumulative Emissions</b>                |                                                                                                                                                                                    |                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                               |
| Cumulative emissions considered in the licence | No                                                                                                                                                                                 | No                                                                                                                                   | No                                                                                                                                                                                                                                                                                                                                                                                                                            | No                                                            |
| <b>11. Transparency</b>                        |                                                                                                                                                                                    |                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                               |
| Community consultation required                | Yes for EPL217<br>No for EPL228                                                                                                                                                    | No                                                                                                                                   | No                                                                                                                                                                                                                                                                                                                                                                                                                            | No                                                            |
| Complaint management and recording conditions  | Yes                                                                                                                                                                                | Yes                                                                                                                                  | Yes                                                                                                                                                                                                                                                                                                                                                                                                                           | Yes                                                           |
| Public data sharing conditions                 | No, although monitoring report is made publicly available.                                                                                                                         | No                                                                                                                                   | Yes                                                                                                                                                                                                                                                                                                                                                                                                                           | Yes                                                           |

| Requirement                | NT  | WA   | QLD | NSW |
|----------------------------|-----|------|-----|-----|
| <b>12. Condition style</b> |     |      |     |     |
| Outcomes-based conditions  | Yes | Rare | No  | No  |

## 5. Protecting human health

### ToR scope requirement:

*Assessing the adequacy of EPL conditions to address human health risks from air emissions, including review of requirements for ambient air quality monitoring.*

The risk to human health from industrial air emissions arises from exposure to air toxics that may be inhaled by residents living in the vicinity of polluting facilities. To assess toxicity risk to human health, different standards are applied depending on long- or short-term exposure (SLR, 2026).

Ambient air quality is a function of multiple sources emitting pollutants to the atmosphere, including from transport (cars and trucks), power generation, industrial activities and natural events such as bushfires. It is difficult to directly link ambient air quality to exact quantities of emissions from individual polluters. Modelling is therefore primarily relied upon to determine the potential risk to the community from the Darwin LNG facilities and other activities.

By requiring emitters to minimise their emissions and setting emission limits and monitoring requirements, the regulator aims to reduce risks and obtain accurate data to assess exposure risk.

### 5.1. Goal

To protect human health, licence conditions should aim to:

- Ensure industry emissions are reduced as far as reasonably practicable
- Provide public assurance that ambient air quality in the Darwin airshed is safe and does not impact human health.

### 5.2. Current licence conditions

Both EPL217 and EPL228 contain conditions to ensure emissions are minimised for the protection of air quality and human health. Across both licences, this includes requirements to:

1. Do all things reasonable and practicable to ensure that ambient air quality is not adversely affected (requires strengthening in EPL217)
2. Incorporate design features to minimise benzene emissions (EPL228 only)
3. Design flares to minimise emissions of VOCs (EPL217 only)
4. Design authorised emission points for maximum dispersion of pollutants
5. Operate pollution control equipment (e.g. an acid gas incinerator or thermal oxidiser) (EPL228 only)
6. Limit disposal of acid gas by hot venting through time limits (EPL217 only)
7. Monitor point-source emissions at least annually
8. Comply with concentration limits and mass emission rates for acid gas venting (H<sub>2</sub>S and benzene) and other emission sources (SO<sub>2</sub>, NO<sub>x</sub>, CO) (EPL217 only).
9. Monitor the quantity and quality of gas flared (EPL228 only)
10. Implement leak detection and repair programs for fugitive emissions
11. Have a monitoring program capable of detecting impacts from the activity to Darwin region ambient air quality (EPL228 only).

## 5.3. Issues, gaps and improvements

### Outcomes-based and pollution control equipment requirements

Conditions that require an environmental outcome to be achieved are an effective way to put the onus on operators to consider environmental impacts across their operations and implement appropriate controls. For example, EPL228-05 meets this requirement by imposing conditions to do all things reasonable and practicable to not adversely affect ambient air quality. The equivalent requirement in EPL217 is currently located in the “Information about this licence” section.

Similarly, requirements to install, operate and maintain pollution control equipment provide an obligation for licensees to ensure equipment is functional.

This has been approached differently for each facility. EPL228 requires INPEX to *incorporate design features to minimise emissions of benzene to the maximum extent practicable*, and ensure equipment is maintained and fit-for-purpose. The construction Environment Protection Approval (EPA) 378, granted under the WMPCA, required Santos to install a thermal oxidiser. While Santos operates a thermal oxidiser to manage acid gas emissions, EPL217 does not explicitly require its maintenance; including such a requirement would provide greater clarity regarding operational expectations.

**Recommendation 1:** Align and strengthen outcomes-based and pollution control conditions in both licences to require licensees to minimise pollution to air, and install, operate and maintain pollution control equipment.

### Acid gas incineration and hot venting

Conditions requiring the effective operation of acid gas incineration are a crucial element of emission minimisation. Acid gases, such as carbon dioxide, volatile organic compounds (benzene, toluene, ethylbenzene, xylene [BTEX]) and hydrogen sulfide (H<sub>2</sub>S), are removed from feed gas through chemical processes. These are then combusted in acid gas incinerators to transform some of the pollutants into less harmful substances, primarily CO<sub>2</sub> and SO<sub>2</sub>. When operating correctly, this process substantially reduces the emission of air toxics into the environment. When incinerators are not operating, acid gases are vented into the atmosphere directly (“hot venting”), increasing emissions of potentially harmful substances.

#### 5.3.1.1. Hot venting limits

The licence conditions differ for each facility. EPL217 limits hot venting to 36 days per year (equivalent to 90% availability). By contrast, EPL228 states that, “*venting of AGRU acid off gas will be infrequent and only when the incinerator is shut down for maintenance*” (EPL228-05, p. 19).

Including clear limits on hot venting duration in both licences will provide certainty and clarify the regulator’s expectation that all reasonable and practicable measures are taken to ensure the pollution control equipment is operational. Best practice for the operation of AGIs is to have the equipment operational for 99.5% of the time.

**Recommendation 2:** Include clearer hot venting duration limits in EPL228 and specify the expected availability of incineration equipment in both licences with a view to reach 99% availability.

### 5.3.1.2. Cumulative impacts of hot venting

There are currently no provisions to avoid concurrent hot venting from both facilities or both trains at the Ichthys facility. Available data indicate that there may be a risk of exceeding short-term air quality guideline values<sup>2</sup> for benzene if both facilities hot vent at the same time. It should be noted that guideline values are set conservatively and exceedances do not automatically indicate a health risk but should trigger further investigation. However, where concurrent hot venting is unavoidable, mitigation measures should be considered, including a reduction in plant throughput to reduce emissions.

**Recommendation 3:** Include provisions in both licences to avoid cumulative impacts from concurrent hot venting from both facilities.

### 5.3.1.3. Hot venting notification and reporting

EPL228 requires that the regulator be notified when the acid gas incinerators are offline. However, the licence does not require the licensee to report on the overall downtime each year or how this downtime has affected the volume of pollutants emitted to air. EPL217 also does not contain requirements to report on the downtime of the thermal oxidiser. Requiring such information would enhance regulatory oversight and transparency.

**Recommendation 4:** Require reporting of AGI/thermal oxidiser downtime in the Annual Environmental Monitoring Report (AEMR).

## Emission limits

Emission limits specify the maximum concentrations of pollutants that may be released from an industrial source and are set at levels intended to protect human health and the environment.

The advantage of applying emission limits in licensing is that they are unambiguous and compliance with limits is relatively easy to assess. Therefore, they provide an effective and enforceable regulatory mechanism to limit pollutant emissions.

There are multiple approaches to setting emission limits, depending on the purpose and desired outcomes. While some jurisdictions have limits prescribed in legislation (e.g. NSW Clean Air Regulations), others rely more heavily on air dispersion modelling and risk assessment frameworks to set limits.

EPL217 currently contains concentration and mass emission limits. The current air emission limits were informed by the expected quality of feed gas from the Barossa gas field, where feed gas has been sourced from since 2025, and air dispersion modelling provided by the operator. Full details of the derivation and changes to emission limits in EPL217 are provided in Appendix 4.

EPL228 currently contains emission concentration limits only for NO<sub>x</sub>. These limits are based on NSW Clean Air Regulations limits for Group 6 facilities. Group 6 applies to the most modern facilities that commenced operations after 1 September 2005. Extending limits to other pollutants of concern would provide improved confidence that air quality in the Darwin airshed is protected.

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<sup>2</sup> 24-h guideline value from *Victorian Guideline for assessing and minimising air pollution in Victoria* (EPA VIC 2025) as quoted in SLR, 2026.

While available modelling, human health risk assessments and ambient air quality monitoring data indicate that the risk to human health from the current level of BTEX emissions is low, limitations to this modelling mean that the information is insufficient to assess whether current licence limits are adequate.

The NT EPA has recently requested updated modelling of air emissions from INPEX which will include a more comprehensive suite of pollutants, revised emissions estimates and cumulative emissions. This modelling should inform any future emission limits.

The solvent aMDEA is used in the amine “sweetening” process to remove acid gas. It is recycled during this process but losses to the environment can occur. If emitted to the environment at unacceptable concentrations, aMDEA and in particular its degradation products can pose risks to human health. Currently there are no emission limits for aMDEA in the LNG licences.

**Recommendation 5:** Apply numerical emission concentration limits and maximum mass emissions rates to pollutants of concern in both licences.

**Recommendation 6:** Investigate loss of aMDEA and other solvents from gas processing and consider inclusion of this pollutant in emission concentration limits and maximum emissions rates.

## Flaring

Flaring contributes to air emissions and affects amenity and wildlife through light pollution and noise. Flaring also reduces greenhouse gas emissions by converting methane to CO<sub>2</sub>. It is best practice to eliminate flaring where possible (Yukon, 2019). Both licences require the licensees to minimise flaring. The licensees should be required to demonstrate steps taken to minimise flaring.

## Monitoring and Reporting

Monitoring and reporting conditions have an important role in emissions management. While modelling provides valuable information about potential impacts, it is based on multiple assumptions and should be validated through real-time monitoring. A lack of accurate data also limits the ability of both the operator and the regulator to determine an appropriate, risk-based response to community and environmental concerns.

### 5.3.1.4. Point source (stack) emissions

The main sources of pollutant emissions from LNG facilities are gas turbine and diesel generator exhaust streams, flaring, and incineration or hot venting of acid gas removed from LNG during the production process. Of these, the acid gas hot venting stream is potentially responsible for a large proportion of air toxics emissions, including BTEX. To provide confidence in emissions estimates, accurate monitoring of pollutants in stack emissions is essential.

Both licences contain monitoring requirements for all authorised emission points. Table 4 provides a summary comparison of monitoring requirements between the two facilities.

Table 4 Summary of stack emission monitoring requirements in Darwin LNG EPLs.

| Source               | EPL217 Santos |                                                              | EPL228 INPEX |                                       |
|----------------------|---------------|--------------------------------------------------------------|--------------|---------------------------------------|
|                      | Frequency     | Parameters                                                   | Frequency    | Parameters                            |
| Power Generation     | Biannual      | NO <sub>x</sub><br>CO<br>SO <sub>2</sub>                     | Annually     | NO <sub>x</sub><br>CO<br>Flow rate    |
| Acid gas hot vent    | Quarterly     | Benzene<br>H <sub>2</sub> S                                  | Monthly      | BTEX<br>H <sub>2</sub> S<br>Flow rate |
| Thermal Oxidiser/AGI | Quarterly     | NO <sub>x</sub><br>CO<br>SO <sub>2</sub><br>H <sub>2</sub> S | Annually     | NO <sub>x</sub><br>CO<br>Flow rate    |

Under EPA378, Santos was required to install real-time monitoring of the acid gas waste stream when the thermal oxidiser was replaced. A continuous analyser has been installed, measuring pollutants and flow rate in real time. However, EPL217 does not reflect this change and currently only requires quarterly monitoring of the acid gas (hot venting) stream.

The installation of this equipment at DLNG provides high confidence in the emissions estimates from the facility's acid gas stream. Requiring the installation of similar equipment at Ichthys LNG to monitor acid gas emissions would bring the facility in line with best practice emissions monitoring and provide consistency in requirements between operators.

**Recommendation 7:** Require the installation of continuous monitoring equipment for the acid gas stream at Ichthys LNG, capable of measuring benzene and other pollutants of concern in real time.

**Recommendation 8:** Update monitoring requirements to reflect current operations and ensure that required monitoring frequencies and parameters are consistent between facilities and sufficient to provide a comprehensive understanding of pollutant emissions.

**Recommendation 9:** Require the use of continuous data for emissions estimation where available.

#### 5.3.1.5. Ambient air quality monitoring

Ambient air quality monitoring refers to the monitoring of pollutants in outdoor air to understand the quality of air in areas where people live and work. Ambient air quality is affected by both natural and anthropogenic (man-made) emission sources. Ambient air quality monitoring is distinct from industrial point source emissions monitoring, which measures the volume and quality of emissions directly at a pollution source, such as an industrial exhaust stack.

Monitoring of ambient air quality is a requirement under Australian law and provides assurance to the public that emissions are not adversely affecting residents' health. NT government air quality monitoring stations currently monitor some common pollutants, including NO<sub>2</sub>, SO<sub>2</sub>, O<sub>3</sub>, CO, PM<sub>2.5</sub> and PM<sub>10</sub>, but this monitoring does not cover all industrial emissions. Data is provided to the public in real time via the NT EPA website.

DLPE recently commissioned a review of the ambient air quality monitoring network that recommends an expansion of the network and the formal incorporation of BTEX monitoring into the program (Zephyr 2026).

In many Australian jurisdictions industry contributes to the monitoring of ambient air quality through a variety of mechanisms. The NT Government has recently announced that it will legislate a framework for industry to contribute to the cost of the ambient air quality monitoring network. This framework is intended to recover the cost of monitoring from industries that are major contributors to air pollution. The monitoring stations will continue to be operated by government, independent of industry.

This legislative change will enable the expansion of the existing monitoring network, the inclusion of BTEX in the suite of parameters being monitored and the publication of data in real time.

#### *Licence requirements*

EPL228 contains a requirement for a Receiving Environment Monitoring Program (REMP, Condition 65) including monitoring that, "is capable of detecting any impact as a result of carrying out the licensed activity on the Darwin region ambient air quality." There is currently no equivalent requirement in EPL217. Similar conditions requiring ambient air quality monitoring and reporting should be incorporated into EPL217 for consistency.

**Recommendation 10:** Require all licensees to implement ambient air quality monitoring in the receiving airshed, unless required through other legislative mechanisms.

#### *Publication of results*

INPEX undertakes monthly BTEX monitoring at NTG air quality monitoring stations in accordance with EPL228. Additional continuous monitoring of BTEX by INPEX commenced in July 2025 at the three NTG stations and has recently been extended to three more locations in 2026. As the continuous monitoring is currently conducted outside of REMP requirements, there is no requirement to include the monitoring data in the AEMP or otherwise publish the results. While the regulator currently has access to the data on request, to improve transparency, data should be made publicly available.

**Recommendation 11:** Require licensees to provide continuous ambient air quality monitoring data required under the licence to the public in real time, unless provided through other legislative mechanisms.

#### *Adequacy of current monitoring requirements in EPL228*

The current monitoring requirements in the REMP for EPL228 are partly based on modelling that was conducted prior to INPEX's upward revision of emissions estimates in October 2025. The REMP should be updated to reflect this new information. EPL228 allows the NT EPA to request a revision of the REMP.

**Recommendation 12:** Require an update of the Receiving Environment Monitoring Program Plan (REMP) for EPL228 which incorporates modelling based on revised emissions estimates and considers any additional requirements resulting from this review.

#### 5.3.1.6. Cumulative emissions

Cumulative impacts of air emissions are generally considered through modelling as part of the impact assessment stage of licensing. Once these potential impacts are assessed, licence conditions are set to ensure emissions remain within predicted levels. One measure of relative contribution to airshed pollution is to estimate the percentage of the airshed's capacity for a pollutant that is taken up by one emitter.

The original EPL228 required INPEX to verify that they were not contributing more than 27% of nationally recognised standards for air pollutants to the airshed. Given the revised emissions estimates that were recently published, a requirement for licensees to demonstrate what percentage of the airshed capacity their emissions constitute should be reintroduced. This would also assist in future assessments of additional developments in the airshed.

|                                                                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Recommendation 13:</b> Require licensees to estimate their annual average contribution to the total airshed capacity for recognised pollutants under national and NT EPA defined standards.</p> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## 6. Community engagement and consultation

### ToR scope requirement:

*Assessing the adequacy of EPL requirements for community engagement and information dissemination*

### 6.1. Goal

To ensure the public is informed of relevant issues and developments at LNG facilities, the licences should aim to:

- Ensure licensees proactively communicate to the public about issues that may affect human health, amenity or other matters of public concern
- Ensure operators listen and respond to community concerns about their operations in an effective and accessible forum.

### 6.2. Current NT regulatory requirements and framework

While the regulator is responsible for communicating about regulatory compliance and regulatory action taken, regulated entities are responsible for communicating with the public about their licensed activities and potential or actual impacts of the activities.

Both INPEX and Santos take voluntary measures to share information with the community. For instance, Santos voluntarily provides updates to a mailing list and on Facebook and operates a shopfront in Darwin city for the public to drop in. INPEX also provides updates and data on its website.

EPL217-05 (Santos) has recently been amended to include a requirement to establish and convene a community consultative committee. The purpose of this committee is to further facilitate the sharing of information from Santos to the broader community.

EPL228-05 does not contain an equivalent condition mirroring the community consultation requirements in Santos's licence.

### 6.3. Issues, gaps and improvements

Recent events including the publicity surrounding the methane emissions from Darwin LNG's storage tank and the under-reporting of BTEX emissions from the Ichthys LNG facility have highlighted a gap in the community engagement being conducted by LNG facility operators in Darwin. This gap has been addressed by recent amendments to EPL217 (Santos), but not in EPL228 (INPEX). The requirement in EPL217-05 for a community consultative committee is currently being implemented by Santos and the efficacy of this new measure has not yet been assessed.

The regulator has also recently received multiple complaints regarding flaring at LNG facilities in Darwin Harbour. Current notification requirements do not appear to be meeting the needs of the community.

Following the recognition that emissions from the Ichthys LNG facility were much higher than previously estimated, INPEX implemented continuous BTEX monitoring at sites around Darwin. However, the data collected is not publicly available. Making the data publicly available would improve transparency and provide assurance that ambient air quality in Darwin and Palmerston remains below relevant health guidelines.

**Recommendation 14:** Align licence conditions to require both licensees to convene community consultative committees and review community consultative committee performance and efficacy every two years.

**Recommendation 15:** Amend licence conditions to ensure that information of interest to the public, including flaring activities, is made available by licensees and can be shared by the regulator (see also **Recommendation 11**).

## 7. Best practice and quality assurance

### ToR scope requirement:

*Considering whether EPL conditions appropriately reflect contemporary best practice in air quality management, including requirements for monitoring, quality assurance and quality control, data verification, and independent review of management and monitoring systems, having regard to risk, feasibility, and regulatory context.*

### 7.1. Goal

Best practice refers to the application of the most modern and effective technologies and techniques for the control of pollutant emissions. The licence conditions should aim to:

- Ensure that licensees consider and implement best practice in all aspects of environmental and air quality management
- Encourage continuous improvement and adjustment of environmental management methods as best practice evolves over time
- Ensure that licensees apply sufficient quality control and quality assurance measures to provide confidence in data and information provided to the NT EPA.

### 7.2. Best Practice

#### Current licence requirements and framework

Best practice requirements are currently included in both LNG EPLs.

**EPL217** requires the licensee to use best practice methods to measure fugitive emissions from the Darwin LNG storage tank (Condition 44.2) and includes conditions which point towards best practice such as by:

- Requiring the licensee to do all things reasonable and practicable to ensure the Licensed Activity does not adversely affect the relevant beneficial uses (Condition 15) and minimise emissions, discharges and wastes (Condition 23.3)
- Ensuring plant and equipment is maintained (Condition 16.2)
- Prohibiting replacing equipment if the replacement increases the risk of environmental harm from the activity (Condition 18)
- Describing how waste must be managed, which is consistent with best practice approaches (conditions 20-22)
- Requiring the OEMP to include measures to ensure
  - continuous improvement of environmental management practices and
  - the minimisation of emissions, discharges and wastes as far as is reasonable and practicable for the licensed activity (Condition 23.3).

**EPL228** requires the licensee to implement an OEMP which includes measures to ensure:

- continuous improvement in environmental management practices and environmental performance for the Scheduled Activity;

- the application of best practice to the management of emissions, discharges and waste and to reduce emissions, discharges and waste disposal as far as reasonable and practicable for the Scheduled Activity (Condition 27).

It also includes conditions which facilitate best practice by:

- Requiring the licensee to do all things reasonable and practicable to ensure the Licensed Activity does not adversely affect the relevant beneficial uses (Condition 15), the air quality of the Darwin region (Condition 16) and minimise discharges (Conditions 36)
- Ensuring plant and equipment is maintained (Condition 17)
- Prohibiting equipment replacement if the replacement increases the risk of environmental harm from the activity (Condition 18)
- Describing how waste must be managed, which is consistent with best practice approaches (Conditions 20–22)
- Requiring the licensee to maintain procedures and records demonstrating that all reasonable and practical recovery methods for excess isopentane and gas are maximised before resorting to flaring (Condition 47)
- Requiring industry-standard management procedures for fugitive emission management and reduction (condition 49).

## Issues, gaps and improvements

Both EPL217 and EPL228 were informed by a 2017 review commissioned by the NT EPA (Advisian, 2017) and include conditions that require the implementation of best practice in environmental management. Many of the best practice requirements are specified for inclusion in the OEMP, rather than being stand-alone conditions. The benefit of containing requirements in the OEMP is that facilities can improve operations and innovate and adapt to best practice over time, without having to adjust licence conditions. On the other hand, this may complicate enforcement when OEMPs are not updated to include technological advancements or changes in best practice.

There is currently no requirement to review an OEMP at fixed time intervals. This may risk OEMPs becoming outdated.

**Recommendation 16:** Require an audit every 5 years to verify that facilities are implementing best practice for pollution control.

**Recommendation 17:** Require regular review of the Operations Environment Management Plan (OEMP) to ensure best practice is incorporated.

## 7.3. Quality assurance

### Current licence requirements

The conditions currently included in the LNG EPLs related to quality assurance and quality control (QA/QC) of data and information include requirements to:

- Ensure sampling ports are installed in accordance with Australian Standards (EPL228-05)
- Ensure that approved test methods specified in the NSW Department of Environment and Conservation Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (both EPLs), or US EPA Method 30B for mercury emissions are used (EPL228-05)
- Ensure appropriate ancillary information is collected (such as production rate, raw material and fuel used and number of plant and equipment operating at the time of sampling and the test methods used and accuracy of the analytical methods) (EPL228-05)
- Have a 'Qualified Person'<sup>3</sup> conduct an audit of compliance with the licence every 2 years (both EPLs)
- Have the OEMP and any changes to the OEMP prepared (EPL217) or endorsed by a qualified professional (EPL228-05 condition 28)
- Have qualified samplers and professionals to conduct sampling and prepare management plans and monitoring reports (both EPLs)
- Have the AEMP prepared (EPL217) or reviewed and certified (EPL228) by a qualified professional.
- Have the REMP endorsed by qualified professional and material changes to REMP must be reviewed and certified by qualified professional (EPL228).

## Issues, gaps and improvements

QA/QC is a licensee responsibility and should be applied to all data and information provided to the regulator, whether this is explicitly stated in the licence or not. However, the recent under-reporting of emissions by INPEX has highlighted that QA/QC of emissions calculation and estimation methodology was insufficient to detect the errors that occurred over several years of reporting.

The licences do not currently require the licensees to maintain documentation for emission calculation methodology. While the methodologies are specified under the NPI NEPM and NPI Objective, the licences could ensure that licensees maintain a basis of preparation, standard operating procedure or other similar document which records how emissions are calculated. Existing conditions are considered sufficient, as they allow the NT EPA to request any document relevant to the licence. No changes are recommended.

### 7.3.1.1. Third party review of licence documents

Currently management plans and reports (OEMP, REMP, AEMR) are required to be prepared and/or certified by a qualified professional. There are inconsistent requirements between licences to have these documents reviewed by an independent third party to provide additional quality assurance. EPL228 includes third party review for the OEMP, REMP and AEMR, while EPL217 does not. Including consistent requirements, in particular for the OEMP, would strengthen oversight and confidence in the plan, in particular where specialist expertise is not readily available to the regulator.

**Recommendation 18:** Strengthen requirements for independent (third party) reviews of OEMPs.

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<sup>3</sup> defined in the licence as a person registered under Section 68 of the WMPCA, i.e. an auditor registered under another Australian jurisdiction's auditor scheme

**Recommendation 19:** Align requirements for review and certification of REMP, AEMR to ensure plans and reports submitted are quality controlled.

#### 7.3.1.2. Independent audits

Licence audits have been completed in accordance with licence conditions by both licensees. However, the recent underreporting against EPL228-05 indicates that these audits have not been undertaken to the required level of depth necessary to verify the quantities of pollutant emissions reported. Both licences require the scope for these audits to be approved by the NT EPA. It is implied that the NT EPA has the ability to include any specific component of interest to the audit, however, this is not clearly stated. Improved wording to explicitly require the inclusion of NT EPA request to the audit scope would strengthen this condition.

**Recommendation 20:** Align audit requirements across licences and strengthen the ability of the NT EPA to define scope items.

## 8. Consistency of licence conditions

### ToR scope requirement:

*Assessing consistency of regulatory requirements between the Santos and INPEX EPLs, having regard to differences in facility characteristics and risk profiles.*

Consistency of licence conditions for specific themes is considered within the other relevant sections of this report. This section provides a general overview of how the licences compare to each other.

### 8.1. Goal

Licence conditions should aim to:

- Place a consistent expectation of environmental protection on licensees and avoid providing an advantage or disadvantage to one licensee over another
- Be proportionate to the risk posed by each facility
- Reflect the characteristics of each facility and have regard for the feasibility of implementation and regulatory context.

### 8.2. Current EPLs, issues, gaps and improvements

It is common practice for each facility licence to have both generic licence conditions which appear on all licences issued within a jurisdiction and bespoke conditions which are applied to manage particular risks or operational requirements associated with the facility.

Generic conditions are drawn from a set of standard licence conditions which have been refined and reviewed over time to enhance their enforceability. Standard conditions are updated in the NT EPA Online licensing system from time to time but are not automatically incorporated into existing licences. Standard conditions predominantly pertain to administrative matters, as well as some generic reporting, waste management, monitoring and sampling requirements.

**Recommendation 21:** Update standard licence conditions in both licences to current wording.

In general, the conditions of both licences are consistent in the broad themes they address. Both licences contain bespoke conditions that relate to:

- Doing all things reasonable and practicable to not adversely affect ambient air quality
- Installing and operating pollution control equipment
- Authorised discharge locations
- Physical design and operation of emissions points
- Fugitive emissions
- Avoiding creating environmental nuisance
- Monitoring and monitoring standards
- Flaring management
- Reporting requirements
- Definitions of non-compliances.

Differences of substance within these themes have been largely addressed in the preceding sections and recommendations and will not be discussed further here.

One remaining area of inconsistency that was identified is the management of fugitive emissions. EPL217 was recently amended to include detailed requirements for a Fugitive Emissions Management Plan (FEMP) that includes a leak detection and repair (LDAR) program. While EPL228 has similar requirements, aligning the conditions would ensure that both licensees use best practice for LDAR with an emphasis on environmental risks.

|                                                                                             |
|---------------------------------------------------------------------------------------------|
| <b>Recommendation 22:</b> Update EPL228 fugitive emissions conditions to align with EPL217. |
|---------------------------------------------------------------------------------------------|

Any final licence amendments made in response to this review should revisit this assessment and consider the wording of both licences.

## 9. Enforceability

### ToR scope requirement:

*Considering enforceability of conditions.*

### 9.1. Goal

The NT EPA and Environmental Regulation Division aim to:

- Ensure that conditions in licences are worded in ways that allow for enforcement action to be taken in the event of a non-compliance in accordance with the Environmental Regulation Division's Compliance and Enforcement Policy and relevant statutes.

### 9.2. Assessing enforceability

Enforceability considers how readily a licence condition can be demonstrated to have been met or breached, and whether non-compliance can be substantiated with a reasonable prospect of regulatory or legal action. Conditions are generally most enforceable where they are clear, precise, and objective, with defined limits, locations, methods, frequencies, or timeframes.

Administrative and procedural obligations (such as reporting, record-keeping, notifications, audits, and numeric discharge or emission limits) tend to be strongly enforceable because compliance can be established through documents, monitoring data, or inspection evidence with little scope for interpretation.

By contrast, enforceability is less straightforward where conditions rely on subjective or outcome-based language, such as requirements to take "reasonable and practicable" measures, "avoid adverse impacts", or achieve as low as reasonably practicable (ALARP)-type outcomes without quantified benchmarks.

These conditions are important because they remain relevant over time, for instance when technology changes, but they typically require expert judgement, modelling, and impact attribution to prove a breach, increasing evidentiary burden and enforcement risk.

The use of management plans can both support and dilute enforceability: obligations to submit, maintain, implement, or audit plans are enforceable, but performance expectations embedded only within plans are less so unless clearly tied back to licence conditions. Overall, a licence is considered robust where higher-risk activities are controlled through objective limits and monitoring, supported by clear reporting and audit mechanisms, rather than relying primarily on broad outcome statements.

### 9.3. Issues, gaps and improvements

Overall, EPL217-05 is strongly enforceable for administrative, monitoring, and reporting obligations. Conditions relating to:

- licence administration
- fee payment
- audits
- record keeping
- incident notification
- numeric discharge and air-emission limits (Appendix B of EPL217).

are clear, objective, and supported by measurable criteria, providing a strong evidentiary basis for compliance action.

However, several operational and environmental performance conditions may lack sufficient precision to support consistent compliance monitoring. For example, where conditions:

- require the licensee to achieve outcomes such as “no adverse impacts”, “no unreasonable interference”, or “reasonable and practicable measures”
- rely on ALARP / so far as is reasonably practicable (SFAIRP)-type framing (notably for fugitive emissions)
- depend on the adequacy of management plans rather than licence-embedded performance thresholds.

In these areas, enforcement may require expert evidence, modelling, and evaluative judgement. Exemptions or contextual qualifiers (e.g. steady-state operation) further reduce certainty unless tightly defined.

Conversely, for EPL228-05, administrative, monitoring, reporting, and numeric discharge and emission limit conditions set clearer thresholds and criteria. In addition, EPL228-05:

- clearly mandates regular, independent environmental audits
- embeds more operational requirements directly in licence conditions, rather than deferring to “acceptable” plans
- relies to a greater extent on quantified limits, specified methods, and table-based controls.

While EPL228 still contains outcome-based duties (e.g. protection of beneficial uses, ambient air quality), these are offset by stronger audit, monitoring, and verification mechanisms, reducing enforcement uncertainty in practice.

Plan-based conditions (e.g. OEMP, waste management, PFAS controls) are supported by endorsement requirements, publication obligations and audit verification. Together, these requirements provide clear compliance levers even where environmental outcomes are complex or contested.

No major issues were identified that would suggest that conditions are not enforceable. The level of evidence required to prove an offence varies in accordance with the condition type, which is not unexpected. Any future amendments should aim to adhere to the principles outlined above.

**Recommendation 23:** Ensure any amendments use unambiguous language, provide compliance thresholds where possible and clearly define requirements and exemptions.

## 10. Implementation and Next Steps

This report makes recommendations to improve the existing LNG industry environment protection licences in the Darwin airshed. To implement many of the recommendations of this review, amendments to EPL217 and EPL228 will be required.

Section 38 of the WMPCA) currently provides for amendments to EPLs under specified circumstances (see Box 1).

Once the appropriate amendment process has been established, the following steps will be taken to implement the review recommendations:

1. Draft licence amendments for EPL217 and EPL228
2. Provide proposed amendments to licensees for consultation
3. Approval of amendments by NT EPA
4. Publication of revised licences on the public register (NT EPA website).

#### **Box 1: Amendment provisions of the WMPCA**

##### **38 Amendment or revocation of conditions**

- (1) *The NT EPA may:*
  - (a) *amend a condition of an environment protection approval or a licence; or*
  - (b) *subject to section 36, impose a new condition on an environment protection approval or a licence.*
- (2) *The NT EPA may only amend a condition or impose a new condition if:*
  - (a) *the amendment or condition is requested by the holder of the approval or licence;*
  - (b) *the holder of the approval or licence has contravened or failed to comply with a provision of this Act;*
  - (c) *there is a risk of pollution resulting in material environmental harm or serious environmental harm;*
  - (d) *it is necessary or desirable for the purposes of an environment protection objective;*
  - (e) *the NT EPA is permitted or required to do so by or under this Act;*
  - (f) *a licence has been or is to be downgraded or upgraded under section 44; or*
  - (g) *the approval or licence is to be transferred.*
- (3) *The NT EPA may revoke a condition of an environment protection approval or a licence as it thinks fit.*
- (4) *The NT EPA must have regard to:*
  - (a) *the matters specified in section 32(1); and*
  - (b) *in relation to a best practice licence – the matters specified in section 33, in determining whether to amend or revoke a condition or to impose a new condition on an approval or licence.*
- (5) *The NT EPA must give notice of the amendment or revocation of a condition of, or the imposition of a new condition on, an environment protection approval or a licence to the holder of the approval or licence.*
- (6) *An amendment or a revocation of a condition under subsection (1) or (3), and the imposition of a new condition under subsection (1), takes effect:*
  - (a) *on the date on which notice is given to the person under subsection (5); or*
  - (b) *where a later date is provided for in the notice – on the later date.*

## 11. References

Advisian, 2017. *Best Practice Environmental Management of LNG Processing Facilities*, Report to the NT Environment Protection Authority. NTG file reference [NTEPA2017/0044-004~0003](#).

NT EPA, 2026. *Darwin Airshed Emissions Management*, <https://ntepa.nt.gov.au/your-environment/air-quality/darwin-airshed-emissions-management>.

SLR, 2026. Independent Preliminary Human Health Risk Assessment of Emissions from Ichthys Liquefied Natural Gas (ILNG) Acid Gas Removal Unit Hot Venting (AGRU HV), [https://ntepa.nt.gov.au/\\_data/assets/pdf\\_file/0004/1594948/prelim-hhra-inpex-emissions-2026.pdf](https://ntepa.nt.gov.au/_data/assets/pdf_file/0004/1594948/prelim-hhra-inpex-emissions-2026.pdf).

Yukon, 2019. Guidelines: Flaring, venting reduction, and fugitive emissions, Available online: <https://yukon.ca/sites/default/files/emr-guidelines-flaring-venting-reduction-fugitive-emissions.pdf>

Zephyr, 2026. *Review of Darwin ambient air quality monitoring (AAQM) network*. Report to NT Department of Lands, Planning and Environment. Zephyr Environmental, NSW. NTG file reference 33-D26-7752.

# Appendix 1: NSW review report



Our ref: DOC26/284903-2

10 June 2026

Department of Lands, Planning and Environment  
Northern Territory Government  
PO Box 3675  
DARWIN NT 0810

Attention: Julia Schult - Director Air Quality Policy

### Peer Review of Darwin Airshed LNG Licence Review

Dear Julia

I refer to the Northern Territory Government Department of Lands, Planning and Environment (**DLPE**) request for the NSW Environment Protection Authority (**EPA**) to undertake a peer review of the Darwin Airshed LNG Licence Review dated 22 May 2026.

The EPA has reviewed the document titled "*Darwin Airshed LNG Licence Review – A review of current Environment Protection Licences under the Waste Management and Pollution Control Act 1998 (NT) for liquified natural gas (LNG) facilities in the Darwin Airshed June 2026*" (**the Review**) and believes that the recommendations of the Review are sound and based upon modern regulatory best practice.

I advise you that a technical review from our specialised Air Technical Advisory Services Unit was unable to be undertaken within the timeframe and the EPA's review consists solely of the opinion of operations officers who are responsible for planning, licensing and compliance activities rather than air technical advice.

The Review highlights the difficulty in undertaking a "like for like" comparison of environment protection licences across differing jurisdictions, operations and feedstocks. Accordingly, we would advise caution when interpreting benchmarking undertaken as part of the Review. I have provided an overview of the way NSW regulates under our broader regulatory framework below.

### NSW Licences – Part of a Broader Regulatory Framework

In NSW, conditions of an Environment Protection Licence (**EPL**) exist within a broader regulatory environmental framework consisting of:

- Legislative requirements that the EPA is responsible for including:
  - *Protection of the Environment Operations Act 1997 (POEO Act); and*
  - *Protection of the Environment Operations (Clean Air) Regulation 2022.*
- Legislative requirements that other NSW agencies are responsible including:

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NSW Environment Protection Authority

As the environmental steward and regulator of our State we are committed to a sustainable future. Join us on our mission to protect tomorrow together.

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- requirements under the development consent approved under the *Environmental Planning and Assessment Act 1979*. The development consent includes commitments made within any Environmental Impact Assessment submitted as part of an approved development application, including predicted impacts from any modelling undertaken.
- Approved statutory methods for assessing and sampling air pollutants in NSW;
- National Environment Protection (Ambient Air Quality) Measure (NEMP) used to set standards for ambient air quality at the national scale and implemented within NSW; and
- Ambient air quality monitoring networks established under the NEMP framework or industry levy contributions.

The absence of a particular condition on an EPL within NSW does not necessarily equate to an absence of regulation. Best practice for the EPA is to not replicate a legislative requirement as a condition of an EPL.

### NSW Air Emission Limits

Air emission limits set by the *Protection of the Environment Operations (Clean Air) Regulation 2022* (the **Air Regulation**) should be viewed as the *minimum* requirement within NSW. A new industry in NSW is required to undertake an Air Quality Impact Assessment (**AQIA**) prior to obtaining development consent as part of the Environment Impact Assessment in accordance with the requirements of the EPA's *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*.

As part of the AQIA information submitted by the proponent or licensee in the impact assessment is used to set the emission limits in either the consent and/or EPL. This includes the emission concentration and rates used in the dispersion modelling.

The setting of emissions limits for a development consent or EPL includes consideration that:

1. **The emissions limits reflect reasonably available technology and good environmental practice.** The Air Regulation sets the maximum emissions permissible for an industrial source located anywhere in NSW. The Air Regulation limits are based on levels that are achievable through the application of reasonably available technology and good environmental practices. In determining reasonable available technology and environmental performance, consideration is made to developments in international best practice such as the World Health Organisation ambient air quality standards and industry programs such as the US EPA Tier 4 standards for non-road diesel emissions.
2. **The emissions limits reflect proper and efficient operation.** Consistent with the requirement of s 124 of the POEO Act, it is EPA policy to prescribe emission limits that are consistent with the proper and efficient operation of plant and equipment. Depending on the plant and equipment, these levels can be lower than those prescribed by the Air Regulation.
3. **The emissions limits protect the health and amenity of the surrounding community by:**
  - a) Adhering to prescribed health and amenity-based impact assessment criteria for the protection of ambient air quality; and
  - b) Adhering to a defined process for assessing the impacts of air pollutant emissions on ambient air quality and the surrounding community.

Proponents of new or expanding developments must use these principles to demonstrate that a proposed development will not adversely affect human health and amenity or the surrounding air quality.

By using the above three criteria, emission limits in an EPL can be even more stringent than the requirements of the Air Regulation.

EPA establish more frequent air monitoring within new EPL's or modifications and decrease monitoring over time if the licensee can demonstrate uniformity in air emissions.

### **Jurisdictional Comparisons may not be “Like for Like”**

Care should be taken when comparing licences of differing operations and selecting licences only within the Liquefied Natural Gas industry may not provide for a suitable basis of comparison. For instance, the Newcastle Gas Storage Facility (**NGSF**) only liquifies already processed natural gas directly from the consumer pipeline and in quantities orders of magnitude lower than what is typically processed at the other facilities benchmarked against.

As the feedstock to NGSF is significantly different to the other facilities a direct comparison of emissions criteria could lead to misleading conclusions. Additionally, as the proximity of sensitive receptors plays a significant role in the setting of emissions criteria a “like for like” comparison becomes problematic.

An alternative approach could be to review similar case studies of existing industries with air emissions issues that are located in close proximity to sensitive receptors outside of the LNG industry. A NSW example of this would be the 95% reduction in PM<sub>2.5</sub> emissions from Orica Kooragang Island.

In the case above, ambient air quality monitoring identified the impact of the existing industry and a combination of consultation and regulation was used to obtain the environmental improvements. We note that continuous air quality monitoring (recommendation 8) and updating the air impact assessment (recommendation 9) form a key part of the Reviews recommendations.

### **NSW Legislates for Industries to Contribute to Costs for Government to Install and Operate Continuous Ambient Air Quality Monitoring Networks**

Where there is a cluster of industry within a local or regional air shed area and community concern about ambient air quality from fugitive or direct air emissions, the EPA has amended the *Protection of the Environment Operations (General) Regulation 2022* to facilitate levy contributions for industries that pollute. This funds the NSW Government to install, operate and maintain continuous air quality monitoring networks such as the Upper Hunter Air Quality Monitoring Network for coal mining in the upper Hunter Valley and the Lower Hunter Air Quality Monitoring Network for the Port of Newcastle.

If you have any questions about this review, please contact us via email at [info@epa.nsw.gov.au](mailto:info@epa.nsw.gov.au).

Yours sincerely

**NATASHA RYAN**  
**Compliance Program Coordinator – Operations**  
**NSW Environment Protection Authority**

## Appendix 2: NT Environmental Regulatory Framework

### Northern Territory Legislation

#### *Environment Protection Act 2019*: Environmental impact assessment and Environmental Approvals

Under the *Environment Protection Act 2019 (NT)*, activities which are likely to have a significant impact on the environment must be referred to the NT EPA for assessment.

Proponents must assess their proposals' potential to have a significant impact on 14 environmental factors. Environmental factors are parts of the environment which the NT EPA assesses as part of their environmental impact assessments. Each factor has an associated objective that reflects the expected outcome for that part of the environment. The environmental factors and associated objectives relevant to LNG facilities and the current review include:

- Air quality: Protect air quality and minimise emissions and their impact so that environmental values are maintained.
- Atmospheric processes: Minimise greenhouse gas emissions so as to contribute to the NT Government's goal of achieving net zero greenhouse gas emissions by 2050.
- Human health: Protect the health of the Northern Territory population.

Environmental impact assessment is the primary means of assessing and managing significant environmental impacts, including impacts on human health. This is the stage of the development process where the significance of impacts is assessed and determinations are made regarding the acceptability of the risks associated with a development when weighed against the potential benefits of the development. If the measures outlined in the referral documentation are not considered complete, the NT EPA can make recommendations or set conditions requiring proponents to take steps to reduce impacts on human health (or any environmental factor) to an acceptable level.

From 1982-2019, referrals were assessed under the *Environmental Assessment Act 1982 (NT)*. Under this act, the Environment Minister made recommendations which could then be taken into account when licences were issued under other legislation for the approved project.

Since 2019, referrals are assessed under the *Environment Protection Act 2019 (NT)*. Under the new regime, the NT EPA issues conditions of approval that can either be stand-alone or feed into licences issued under subordinate legislation.

#### *Waste Management and Pollution Control Act 1998*: Environment Protection Licensing

The *Waste Management and Pollution Control Act 1998 (WMPCA)* objectives include the prevention of pollution, and the effective management of waste disposal. Schedule 2 of the WMPCA lists activities that are regulated by approvals or licences.

Activities which require an Environment Protection Licence (EPL) include *operating a premises to produce, store and/or despatch more than 500,000 tonnes annually of LNG*. Section 34 of the WMPCA allows the NT EPA to grant EPLs for these activities.

Section 35(3) of the WMPCA provides that EPLs can include conditions requiring the licensee to:

- i. achieve specified results necessary to effectively manage wastes or control pollution;
- ii. conform to specified standards in the conduct of an activity;
- iii. carry out specified measures that are necessary to effectively manage wastes, prevent, reduce, control, rectify or clean up pollution or environmental harm resulting from pollution or to protect the environment;
- iv. carry out specified testing or monitoring;
- v. provide the results of specified testing or monitoring to the NT EPA;
- vi. provide specified information to the NT EPA; and
- vii. prepare, review, update or implement a plan for environmental management to the satisfaction of the NT EPA and make, as specified, all or part of the plan available for public viewing.

EPLs are issued and regulated by the NT EPA, with assistance from the Environmental Regulation Division of the Department of Lands, Planning and Environment. They regulate discharges and emissions of pollutants to land, water and air. Greenhouse gas emissions are not explicitly included in the EPL framework as there is a Commonwealth regulatory regime for these.

The licences in this review are issued under this regime.

If the EIA process triggers referral under the EP Act, a licence under the WMPCA cannot be issued until this process is complete.

## Commonwealth Regulation

### National Greenhouse and Energy Reporting Act 2007: NGER Scheme and Safeguard Mechanism

The Commonwealth Government has an economic regulatory regime for greenhouse gas emissions, administered by the Clean Energy Regulator (CER). The Commonwealth regime involves:

- The National Greenhouse and Energy Reporting (NGER) scheme, which requires the reporting of greenhouse gas emissions; and
- The Safeguard Mechanism, which requires a company to keep carbon emissions at or below the baseline for a safeguard facility, with the baseline reducing each year in line with Australia's net zero commitments. If emissions exceed the baseline, the company needs to manage this using the ways specified under the Safeguard Mechanism.

Facilities need to report to the scheme if they meet certain emissions thresholds. Both the Ichthys and Darwin LNG facilities are subject to NGER scheme reporting.

Under the Commonwealth regime, fugitive emissions need to be reported, appropriately managed within the business and offset as required. The regime does not mandate that a company reduce any particular source or type of emission.

### Environment Protection and Biodiversity Conservation Act 1999: Environmental impact assessment and approvals

The *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) is Australia's main national environmental legislation. Further information is available at:

<https://www.dcceew.gov.au/environment/epbc>.

Both Ichthys LNG and Darwin LNG have been assessed under the EPBC Act or its predecessor the *Environmental Protection (Impact of Proposals) Act 1974*.

## Joint regulation: National Environment Protection Measures

The *National Environment Protection Council (NEPC) Act 1994* (Cth) (NEPC Act) allows for the establishment of National Environment Protection Measures.

### National Pollutant Inventory

The National Pollutant Inventory (NPI) is Australia's legislated, public source of information on emissions and waste transfers of potential pollutants. The NPI database is publicly accessible.<sup>4</sup> Any facility emitting or transferring any of the 93 specified pollutants at a level that exceeds a reporting threshold must report to the NPI annually.

The NPI is legislated under the *National Environment Protection Measure (National Pollutant Inventory) Measure 1998* (Cth) (NPI NEPM) and was established under the NEPC Act. While the NPI NEPM is administered by the Commonwealth, each jurisdiction is responsible for implementing the NPI NEPM under their own legislative frameworks. In the NT, the NPI NEPM is implemented in the form of an Environment Protection Objective under the WMPCA.

Both the Ichthys LNG and Darwin LNG facilities are required to report pollutants to the NPI.

### Ambient air quality

The *National Environment Protection (Ambient Air Quality) Measure* (AAQ NEPM) is the Commonwealth framework that sets national standards for ambient air quality. The national environment protection goals of the AAQ NEPM are to achieve the national environment protection standards specified in the AAQ NEPM.

In the Northern Territory, the AAQ NEPM is given effect through the WMPCA. To monitor compliance with the national environment protection standards, DLPE oversees a network of ambient air quality monitoring stations. Air quality monitoring in the Darwin airshed comprises three monitoring stations which monitor particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>), ozone (O<sub>3</sub>), sulphur dioxide (SO<sub>2</sub>), oxides of nitrogen (NO<sub>x</sub>) and carbon monoxide (CO). These parameters are required to be monitored by the AAQ NEPM. Data is available in real time on the NT EPA website.

Compliance with the AAQ NEPM standards and goals is reported on each year in a compliance report which is published on the NT EPA website.<sup>5</sup> The standards are commonly used in the assessment and modelling of potential impacts from air emissions that inform licence conditions.

### Air toxics

The *National Environment Protection (Air Toxics) Measure* (Air Toxics NEPM) is the Commonwealth framework for improving information regarding ambient air toxics within the Australian environment to facilitate the development of standards. The air toxics included in the measure are benzene, formaldehyde, benzo(a)pyrene (a marker for polycyclic aromatic hydrocarbons), toluene and xylenes (combined isomers). While it sets investigation levels for these substances, the Air Toxics NEPM does not set standards for levels of air toxics in ambient air.

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<sup>4</sup> <https://www.npi.gov.au/npidata/action/load/advance-search>

<sup>5</sup> <https://ntepa.nt.gov.au/your-environment/air-quality/ambient-air-quality-reports>

When assessing impacts from air toxics in the NT, the NT EPA applies ambient design criteria from the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW.<sup>6</sup> Under the Guidance for Modelling Dispersion of Air Pollutants in the NT,<sup>7</sup> proponents of new or existing facilities must use these NSW criteria when conducting air quality impact assessments.

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<sup>6</sup> <https://www.epa.nsw.gov.au/Your-environment/Air/industrial-emissions/Approved-methods-for-the-modelling-and-assessment-of-air-pollutants>

<sup>7</sup> <https://environment.nt.gov.au/media/docs/environment/documents/guidance-for-modelling-dispersion-of-air-pollutants-in-the-nt.pdf>

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## Appendix 3: Common Pollutants of Concern from Hydrocarbon Processing Facilities

| Substance                   | Chemical Symbol                          | Approx. annual emissions (to Darwin airshed (tonnes) | Significance/Health effects                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------|------------------------------------------|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Carbon dioxide              | CO <sub>2</sub>                          | 6,100,000                                            | A colourless, odourless greenhouse gas essential for life, yet a driver of climate change.                                                                                                                                                                                                                                                                                                                                   |
| Methane                     | CH <sub>4</sub>                          | 4,000                                                | A potent greenhouse gas, colourless, odourless, highly flammable and a major component of natural gas, but not classified as a volatile organic compound (VOC). Not toxic to humans unless at extremely high concentrations.                                                                                                                                                                                                 |
| Particulate Matter (10 µm)  | PM <sub>10</sub>                         | 6,000                                                | Produced from dust emissions or combustion activities, airborne particles 10 micrometres in diameter or less, referred to as PM10, can be hazardous to human health or cause a nuisance when present in the air at elevated levels. They can penetrate the lower airways of humans and cause possible negative health effects.                                                                                               |
| Particulate Matter (2.5 µm) | PM <sub>2.5</sub>                        | 150                                                  | Produced from combustion activities, airborne particles 2.5 micrometres or less in diameter, referred to as PM2.5, can be hazardous to human health or cause a nuisance when present in the air at elevated levels. They can penetrate the lower airways of humans and cause possible negative health effects.                                                                                                               |
| Oxides of nitrogen          | NO <sub>x</sub><br>(NO <sub>2</sub> /NO) | 13,000                                               | Two of the most toxicologically significant compounds of oxides of nitrogen (NO <sub>x</sub> ) are nitric oxide (NO) and nitrogen dioxide (NO <sub>2</sub> ). Oxides of nitrogen are critical components of photochemical smog. Nitrogen dioxide (NO <sub>2</sub> ) is an acidic and highly corrosive brown gas. Long-term exposure to high levels of nitrogen dioxide can cause chronic lung disease and affect the senses. |
| Carbon monoxide             | CO                                       | 65,000                                               | A colourless, odourless gas formed when substances containing carbon (such as petrol, gas, coal and wood) are burned with an insufficient supply of air. It has serious health impacts on humans and animals, especially those with cardiovascular disease.                                                                                                                                                                  |
| Sulfur dioxide              | SO <sub>2</sub>                          | 800                                                  | A colourless gas with a sharp, irritating odour. It is produced by burning fossil fuels and by the smelting of mineral ores that contain sulfur. Exposure to concentrations of 10 to 50 parts per million for 5 to 15 minutes causes irritation of the eyes, nose and throat, choking and coughing.                                                                                                                          |
| Hydrogen sulfide            | H <sub>2</sub> S                         | 150                                                  | Lower concentrations may irritate the eyes, nose and throat (5 to 50 parts per million). Concentrations of 100 to 200 parts per million for one to eight hours may cause sleeplessness, blurred vision, haemorrhage and death. Collapse, coma and death from respiratory failure may come within a few seconds after one or two inspirations, at high levels (1000 to 2000 parts per million).                               |

| Substance                                                                  | Chemical Symbol                | Approx. annual emissions (to Darwin airshed (tonnes) | Significance/Health effects                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------------------------------------------------------|--------------------------------|------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Total Volatile Organic Compounds</b>                                    | TVOC                           | 11,000                                               | The health effects depend on the specific composition of the volatile organic compounds (VOCs) present, their concentration and the length of exposure. General effects of exposure to VOCs include irritation to the eyes, nose and throat; headaches; loss of coordination; nausea; and damage to the liver, kidney and central nervous system. VOCs emitted by hydrocarbon industries would have a high content of non-toxic hydrocarbons. |
| <b>Benzene</b>                                                             | C <sub>6</sub> H <sub>6</sub>  | 700                                                  | An organic compound occurring naturally in fossil fuels and entering the atmosphere from both natural processes and human activities that involve the combustion of organic matter. Long-term exposure results in an increased incidence of blood and immune system disorders, including anaemia and leukaemia.                                                                                                                               |
| <b>Toluene (methylbenzene)</b>                                             | C <sub>7</sub> H <sub>8</sub>  | 750                                                  | Short-term exposure to high levels of toluene results first in light-headedness and euphoria, followed by dizziness, sleepiness, unconsciousness, and in some cases death.                                                                                                                                                                                                                                                                    |
| <b>Ethylbenzene</b>                                                        | C <sub>8</sub> H <sub>10</sub> | 24                                                   | Inhalation of gasoline fumes, tobacco smoke, and evaporation from paints/coatings are the primary exposure routes. Long-term exposure can result in hearing loss (ototoxicity) and damage to the central nervous system.                                                                                                                                                                                                                      |
| <b>Xylenes (individual or mixed isomers-ortho, meta or para)</b>           | C <sub>8</sub> H <sub>10</sub> | 190                                                  | They may irritate the eyes, nose and throat, cause stomach problems, drowsiness, loss of memory, poor concentration, nausea, vomiting, abdominal pain and incoordination. High levels may cause dizziness, passing out, and death. Repeated exposures may damage bone marrow, which causes a low blood cell count. Xylenes may damage a developing foetus.                                                                                    |
| <b>Mercury &amp; compounds</b>                                             | Hg                             | 0.04                                                 | The nervous system is very sensitive to all forms of mercury. Exposure to high levels of any types of mercury can permanently damage the brain, kidneys, and developing foetus.                                                                                                                                                                                                                                                               |
| <b>Polycyclic aromatic hydrocarbons (Benzo[a]pyrene (B[a]P) as marker)</b> | PAHs                           | 1.30                                                 | Comprises of several compounds formed by the incomplete combustion of organic material. Exposure can irritate the eyes, nose, throat and bronchial tubes. Skin contact can cause irritation or a skin allergy. Very high levels may cause headaches, nausea, damage the red blood cells, damage the liver and kidneys, and may even cause death. Benzo[a]pyrene (B[a]P) is used as a marker for PAHs.                                         |

## Appendix 4: LNG Facilities Licence Histories

There are two major LNG processing facilities in the Darwin airshed: Darwin LNG, which is owned and operated by Santos, and Ichthys LNG, which is owned and operated by INPEX. Both facilities are located on the Middle Arm peninsula in Darwin Harbour. Since their original licences were issued, both entities have gone through multiple licence amendments and renewals. The following provides an overview of the original assessments, rationale for conditions and changes to these licences since they were first issued.

### Darwin LNG (ConocoPhillips/Santos)

Darwin LNG is a single-train LNG production facility which processed feed gas from the Bayu-Undan gas field from 2006-2023. Darwin LNG began receiving feed gas from the Barossa gas field in December 2025.

The initial environmental assessment for Darwin LNG was completed in 1998 under the *Environmental Assessment Act 1982*. A subsequent assessment for a proposed facility expansion was completed in 2002. The outcomes are recorded in Assessment Reports 24<sup>8</sup> and 39<sup>9</sup>, respectively.

The 1998 assessment was completed prior to the introduction of the WMPCA and the adoption of the national environment protection measure (NEPM) for ambient air quality. The assessment of impacts to air quality was based on air dispersion modelling. The modelling was used to determine predicted ambient concentrations of CO, NO<sub>x</sub>, PM<sub>10</sub> and SO<sub>2</sub> at sensitive receptors. The modelling indicated that maximum ground level concentrations for all pollutants were expected to be below the expected NEPM guidelines. Nonetheless, the report recommended:

*The proponent shall consult with DLPE regarding preparation of the atmospheric emissions inventory and any related monitoring. Both the inventory and any monitoring shall be implemented to the satisfaction of the DLPE. The proponent shall verify, by monitoring for NO<sub>2</sub>, that there will be no exceedances, arising from atmospheric emissions, of the standards contained in the proposed Ambient Air Quality NEPM. Monitoring procedures and data reporting must meet the NEPM requirements and Australian Standards. Monitoring points shall be determined in consultation with DLPE. (Recommendation 13, Assessment Report 24)*

Table 5 provides an overview of licence amendments since the first licence was issued.

ConocoPhillips Australia Pty Ltd was issued Environment Protection Licence LNG-01 on 9 December 2005. This licence contained a broad suite of annual air emission limits which reflected their predicted design limits. Emission rate and total annual emission release volume limits were included for PM, SO<sub>2</sub>, NO<sub>x</sub>, CO, CO<sub>2</sub>, CH<sub>4</sub>, and nitrous oxide (N<sub>2</sub>O).

In 2009, the licence was amended twice but no changes were made to emissions limits.

On 7 October 2010, the licence was re-coded EPL54-02 and issued again maintaining the original emission limits. However, a number of conditions, such as flaring limits, were removed because of the introduction of reporting under the National Greenhouse and Energy Reporting Scheme. Duplicative requirements in NT-issued EPLs were no longer considered necessary.

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<sup>8</sup> <https://ntepa.nt.gov.au/your-business/public-registers/environmental-impact-assessments-register/completed-assessments/register/lng-plant-and-subsea-pipeline>

<sup>9</sup> <https://ntepa.nt.gov.au/your-business/public-registers/environmental-impact-assessments-register/completed-assessments/register/darwin-10-mtpa-lng-facility-wickham-point>

A series of subsequent amendments were issued (EPL54-03 to EPL54-08) that did not change the original emission limit suite.

EPL54 was renumbered to EPL217 when a renewal issued to Santos on 19 September 2017, for a period of 5 years. In this revision of the licence, air emission limits outlined in previous EPLs were replaced with concentration limits for NO<sub>x</sub>, CO and SO<sub>2</sub> for emissions from the power generation turbines, compressor turbines and boiler (Table 6). This licence also authorised a hot venting trial, ceasing operations of the AGI for a trial period of 2 years, and introduced limits for: H<sub>2</sub>S and benzene emitted from the acid gas removal unit vent; and NO<sub>x</sub>, CO, H<sub>2</sub>S and SO<sub>2</sub> from the acid gas incinerator.

The next set of amendments and renewals focused on water quality and general licence amendments.

- EPL217-01 was issued on 18 July 2018 with amendments to condition wording.
- EPL217-02 was issued on 4 August 2019 and introduced a mixing zone for jetty outfall discharges.
- EPL217-03 was a renewal and issued on 16 September 2022 for a period of 3 years. At this time, Darwin LNG was preparing to cease processing gas from the Bayu-Undan gas field and to undertake the Darwin Life Extension Transition Works Program. Due to uncertainty surrounding the operation of the plant following this transition program, EPL217-03 was issued on the same terms as EPL217-02. The term of 3 years was to facilitate the production of hydrocarbons from the Bayu-Undan field until its cessation and the storage of LNG during the Darwin Life Extension Transition Works Program.

EPL217-04 was an amendment initiated by Santos issued on 9 January 2025. The licence was amended to incorporate the operation of a thermal oxidiser which had been approved for construction through Environment Protection Approval 378 on 9 April 2024. Changes included altering licence conditions to read “thermal oxidiser” in place of “acid gas incinerator” and amending the air emission monitoring program. To assist the NT EPA, DLPE commissioned an independent consultant to independently review relevant application documents. The licence set concentration limits and mass emissions rates for the thermal oxidiser (Table 6).

EPL217-05 was a renewal issued on 19 September 2025 for a period of 5 years. The renewal included amendments to contemporise licence conditions and align with other, similar licences by including recent standard conditions and revise the water quality monitoring program.

The renewal was considered in the context of public and media attention on the leak in the Darwin LNG storage tank. No changes to the emissions monitoring program were made. Rather, EPL217-05 included conditions requiring Santos to:

- Reduce fugitive emissions to a level which is as low as reasonably practicable (ALARP) and acceptable
- Implement a fugitive emissions management plan and report on the results of fugitive emissions monitoring
- Stand up a community consultative committee to facilitate the sharing of information.

Table 5 Overview of licence amendments for Darwin LNG since commencement of operations.

| Licence number            | Date              | Major changes                                                                                                                                                                                                                                                                                                                                                                                     | Supporting references                                             |
|---------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| LNG-01                    | 9 December 2005   | Original operating licence issued with annual air emission rate and total annual emission volume limits for PM, SO <sub>2</sub> , NO <sub>x</sub> , CO, CO <sub>2</sub> , CH <sub>4</sub> and N <sub>2</sub> O, reflecting predicted design limits.                                                                                                                                               | Assessment Report 24; original licence issue.                     |
| LNG-01 (revised)          | 12 May 2009       | Licence reissued with the original air emission standards maintained.                                                                                                                                                                                                                                                                                                                             | 2008 amendment application; agency decision.                      |
| LNG-01 / subsequent issue | 25 September 2009 | Licence reissued with the original emission standards maintained.                                                                                                                                                                                                                                                                                                                                 | July 2009 amendment application.                                  |
| EPL54-02                  | 7 October 2010    | Licence re-coded to EPL54-02. Original emission limits were maintained, but some conditions such as flaring limits were removed because reporting under the National Greenhouse and Energy Reporting Scheme was considered to cover those matters.                                                                                                                                                | Licence amendment record                                          |
| EPL54-03 to EPL54-08      | 2010–2017         | Series of amendments that did not alter the original emissions limit suite.                                                                                                                                                                                                                                                                                                                       | N/A                                                               |
| EPL217                    | 19 September 2017 | Renewal replacing earlier annual air emission limits with concentration limits for NO <sub>x</sub> , CO and SO <sub>2</sub> for turbines and boiler. Also authorised a 2-year hot venting trial, introduced limits for H <sub>2</sub> S and benzene from the acid gas removal unit vent, and limits for NO <sub>x</sub> , CO, H <sub>2</sub> S and SO <sub>2</sub> from the acid gas incinerator. | 2017 amendment application, Air Quality Assessment. <sup>10</sup> |
| EPL217-01                 | 18 July 2018      | Amendments to condition wording only.                                                                                                                                                                                                                                                                                                                                                             | Licence amendment record                                          |
| EPL217-02                 | 4 August 2019     | Introduced a mixing zone for jetty outfall discharges; no air-related change described.                                                                                                                                                                                                                                                                                                           | Licence amendment record                                          |

<sup>10</sup> Katestone, 2022. *DLE - Air Quality Monitoring Report*. Report to Santos for DLNG Life Extension Project. Katestone Global. NTG file reference 33-D26-5583.

|           |                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                             |
|-----------|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| EPL217-03 | 16 September 2022 | Renewal issued on the same terms as EPL217-02, with a 3-year term to cover cessation of Bayu-Undan production and the Darwin Life Extension Transition Works Program.                                                                                                                                                                                                                                                                                                                           | Licence amendment record; transition works program.                                         |
| EPL217-04 | 9 January 2025    | Amended to incorporate operation of a thermal oxidiser approved under Environment Protection Approval 378. Replaced references to the acid gas incinerator with thermal oxidiser, amended the air emission monitoring program, and adopted new concentration limits and mass emission rates for the thermal oxidiser, acid gas vent and boiler.                                                                                                                                                 | EPA378; 2024 amendment application; DLPE independent consultant verification. <sup>11</sup> |
| EPL217-05 | 19 September 2025 | Renewal contemporising licence conditions, aligning with similar licences, and revising the water quality monitoring program. In light of public and media attention on the Darwin LNG storage tank leak, added conditions requiring fugitive emissions to be reduced to ALARP and acceptable levels, implementation of a fugitive emissions management plan with reporting, and establishment of a community consultative committee. No changes were made to the emissions monitoring program. | Renewal assessment; public/media attention on storage tank leak.                            |

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<sup>11</sup> Air Environment, 2024. *Air Quality Model Review and MASDP Air Quality Model Revision*. Report to NT Department of Environment, Parks and Water Security for the Santos Darwin LNG Life Extension Project. Air Environment Consulting Pty Ltd. NTG file reference 33-D24-7673.

Table 6 Origin of current emissions limits in EPL217-05.

| Source                    | Pollutant                          | Concentration limit (mg/Nm <sup>3</sup> ) | Maximum mass emission rate (g/s) | History/derivation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------|------------------------------------|-------------------------------------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Power generation turbines | SO <sub>2</sub>                    | 23 @ 15% O <sub>2</sub> dry               | 0.2                              | Introduced in EPL217 in 2017.<br>Annual limits were replaced with concentration limits designed to protect ambient air quality and ensure efficient operation of DLNG. Concentration limits were considered more closely related to ambient air quality in the receiving environment. Nonetheless, an emission rate was included to impose an implied limit on absolute emissions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                           | NO <sub>x</sub> as NO <sub>2</sub> | 70 @ 15% O <sub>2</sub> dry               | 1                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                           | CO                                 | 32 @ 15% O <sub>2</sub> dry               | 0.4                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Compressor turbines       | SO <sub>2</sub>                    | 65 @ 15% O <sub>2</sub> dry               | 4.7                              | Where appropriate, limits for stationary source emissions were taken from the NSW <i>Protection of the Environment Operations (Clean Air) Regulation 2022</i> using the most stringent (Group 6) emission standards. The NSW Approved Methods were considered to be the best available air quality assessment framework in the absence of NT EPA statutory methods or guidelines for modelling and assessing emissions of air pollutants from stationary sources. Where NSW limits did not exist or could not be reasonably applied to plant and equipment, specific limits were derived based on DLNG's history of performance and consideration of the low risk of exceeding the <i>National Environmental Protection (Ambient Air Quality) Measure</i> (Air Quality NEPM) standards.<br>Where the NSW limits were considered to be excessive compared to measured DLNG emissions, more stringent limits were proposed rather than allowing the licensee opportunity to lower operational performance. |
|                           | NO <sub>x</sub> as NO <sub>2</sub> | 212 @ 15% O <sub>2</sub> dry              | 25                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                           | CO                                 | 70 @ 15% O <sub>2</sub> dry               | 5                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Thermal oxidiser          | SO <sub>2</sub>                    | 485 @ 7% O <sub>2</sub> dry               | 11.1                             | Introduced in EPL217-04 in 2025. The numbers were adopted to account for the new equipment (thermal oxidiser) and new feed gas from the Barossa field. The new feed gas was predicted to have a higher H <sub>2</sub> S concentration than previous feed gas.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                           | NO <sub>x</sub> as NO <sub>2</sub> | 350 @ 7% O <sub>2</sub> dry               | 1.5                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                           | CO                                 | 145 @ 7% O <sub>2</sub> dry               | 3                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                           | H <sub>2</sub> S                   | 5 @ 7% O <sub>2</sub> dry                 | 0.1                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Acid gas vent             | H <sub>2</sub> S                   | 362 dry                                   | 4.3                              | The adopted limits for NO <sub>2</sub> and H <sub>2</sub> S at the thermal oxidiser are consistent with the NSW <i>Protection of the Environment Operations (Clean Air) Regulation 2022</i> .<br>Where limits vary from the NSW <i>Protection of the Environment Operations (Clean Air) Regulation 2022</i> , modelling was used to demonstrate that the application of these limits would not unreasonably impact on ambient air quality at nearby sensitive receptors. This modelling was commissioned by Santos and independently verified by a Department-commissioned consultant.                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                           | Benzene                            | 306 dry                                   | 3.6                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                           | SO <sub>2</sub>                    | 84 @ 7% O <sub>2</sub> dry                | 0.25                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Boiler                    | NO <sub>x</sub> as NO <sub>2</sub> | 244 @ 7% O <sub>2</sub> dry               | 0.7                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                           | CO                                 | 54 @ 7% O <sub>2</sub> dry                | 0.2                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

## INPEX Ichthys LNG (INPEX)

The NT EPA assessed the Ichthys LNG project, proposed by Ichthys LNG Pty Ltd (hereafter referred to as INPEX), in 2011 under the former *Environmental Assessment Act 1982*. Assessment Report 65 was issued in May 2011 making 24 recommendations to ensure environmental protection.<sup>12</sup>

<sup>12</sup> [https://ntepa.nt.gov.au/\\_resources/documents/eia/inpex/assessment\\_report\\_nretas.pdf](https://ntepa.nt.gov.au/_resources/documents/eia/inpex/assessment_report_nretas.pdf)

In December 2017, Ichthys LNG Pty Ltd was issued EPL228 under the *Waste Management and Pollution Control Act 1998* (WMPCA) for the operation of the facility. The licensed activity commenced on 14 September 2018 after receipt of offshore Ichthys Field gas to the licensed premises.

Recommendations from assessment report 65 were incorporated in EPL228. With regard to air quality requirements, EPL228 reflected the recommendation to include an air monitoring program including NO<sub>x</sub> from turbine stacks and SO<sub>2</sub> from the acid gas incinerator stacks. EPL228 also included mercury, particulate matter and carbon monoxide monitoring from the turbine and boiler stacks and BTEX and H<sub>2</sub>S monitoring from the acid gas removal unit hot vent release points.

Air emissions monitoring was required to be conducted in accordance with the *NSW Protection of the Environment Operations (Clean Air) Regulation 2022* Schedule 5 test methods, specifically the *NSW EPA Approved methods for the sampling and analysis of air pollutants in NSW*. These remain the approved methods.

In addition to monitoring, EPL228 contained targets and limits for emissions to air. These numerical targets and limits have been retained through subsequent versions of the EPL and are still in force today. The origin of these targets and limits is described in Table 7.

Table 7 Origin of current emissions limits in EPL228-05.

| Source                                                                         | Pollutant                          | Concentration target (mg/Nm <sup>3</sup> ) | History/derivation                                                                                                                                                                                                                                 | Concentration limit (mg/Nm <sup>3</sup> ) | History/Derivation                                                                                                                                                                                               |
|--------------------------------------------------------------------------------|------------------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| LNG refrigerant compressor driver gas turbines                                 | NO <sub>x</sub> as NO <sub>2</sub> | 50 @15% O <sub>2</sub> dry                 | The emission <b>targets</b> in column 4 of Table 5 of the EPL are the INPEX basis of design values, provided during the application for the EPL.<br><br>The licence requires remedial action to be taken if emissions exceed the emissions target. | 70                                        | The emission <b>limits</b> in column 5 of Table 5 of the EPL are the NSW Clean Air Regulations limits for Group 6 facilities.<br><br>Non-compliance with the licence occurs if the emission limits are exceeded. |
| CCPP gas turbine generators                                                    | NO <sub>x</sub> as NO <sub>2</sub> | 50 @15% O <sub>2</sub> dry                 |                                                                                                                                                                                                                                                    | 70                                        |                                                                                                                                                                                                                  |
| CCPP Gas turbine generators also burning vaporised iso-pentane in duct burners | NO <sub>x</sub> as NO <sub>2</sub> | 150 @15% O <sub>2</sub> dry                |                                                                                                                                                                                                                                                    | 350                                       |                                                                                                                                                                                                                  |
| AGRU incinerators                                                              | NO <sub>x</sub>                    | 320 @3% O <sub>2</sub> dry                 |                                                                                                                                                                                                                                                    | 350                                       |                                                                                                                                                                                                                  |
| Heating medium furnaces                                                        | NO <sub>x</sub>                    | 160 @3% O <sub>2</sub> dry                 |                                                                                                                                                                                                                                                    | 350                                       |                                                                                                                                                                                                                  |

The limits specified in the EPL apply to steady state operation. Steady state is defined as the, “normal operating phase of the Ichthys LNG which includes production, storage and despatch of hydrocarbons with the design rates and specifications of the plant. Steady state operations commence once First Start-up or subsequent Plant Restart are complete.”

EPL228 required quarterly calculation of estimates for release of total particulates, CO, CO<sub>2</sub>, non-methane volatile organic compounds (NMVOC) and CH<sub>4</sub> from each authorised stationary source emission point. This requirement has also been maintained and remains in force.

As part of their EPL requirements, INPEX is required to minimise pollutant emissions to air. Methods to minimise pollutant emissions include:

- Mercury removal prior to acid gas incineration
- The selection of a solvent to remove CO<sub>2</sub> from the feed gas that does not co-absorb as much CH<sub>4</sub> as other solvents, which in turn reduces the quantities of CH<sub>4</sub> and other hydrocarbons flashed or vented from the flash vessels and regenerator column during the regeneration process. INPEX estimated during their original EPL application that using this solvent rather than other possible solvents would reduce CO<sub>2</sub> emissions by 0.2 Mt/annum of CO<sub>2</sub> per Mt/annum of LNG produced
- Operation of the acid gas incinerators, which use high temperatures to change harmful substances such as H<sub>2</sub>S and hydrocarbons to less harmful compounds prior to release to the atmosphere
- An inspection program to detect gas hydrocarbon leaks at the facility.

EPL228 required INPEX to “verify by ground level measurements, during the first 24 months of commencement of operations, when both LNG trains and the CCPP are operating at steady state, that the licensed activity does not cause ground level concentrations of contaminants to contribute to more than 27% of the standards for pollutants specified in the *National Environment Protection (Ambient Air Quality) Measure* and monitoring investigation levels for air toxicants specified in *National Environment Protection (Air Toxicants) Measure*.”

Table 8 provides a summary of amendments and renewals that have occurred to the Ichthys LNG EPL.

Table 8 Overview of licence amendments to EPL228 since first issue (air quality monitoring requirements only).

| Licence number | Date             | Major changes                                                                                                                                                                                                                                                                                                                                                                                    | Supporting references                                                 |
|----------------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| EPL228         | December 2017    | Original operating licence issued for the facility. Incorporated recommendations from the 2011 environmental assessment, including an air monitoring program for NO <sub>x</sub> , SO <sub>2</sub> , mercury, particulate matter, carbon monoxide, BTEX and H <sub>2</sub> S. Also included numerical targets and limits for emissions to air that have largely been retained in later versions. | Assessment Report 65; original EPL application; NSW approved methods. |
| EPL228-01      | 22 June 2018     | Updated sampling locations, including the addition of four sampling locations to accommodate a temporary power plant.                                                                                                                                                                                                                                                                            | Licence amendment record.                                             |
| EPL228-02      | 3 July 2019      | Added US EPA Method 30B for mercury monitoring.                                                                                                                                                                                                                                                                                                                                                  | Licence amendment record; US EPA Method 30B.                          |
| EPL228-03      | 8 November 2019  | Made typographical and error corrections and removed the requirement to monitor combined cycle power plant utility boiler emissions because those boilers were not commissioned.                                                                                                                                                                                                                 | Licence amendment record.                                             |
| EPL228-04      | 6 May 2020       | Amended the requirement to verify the proportion of air quality standards for pollution by instead requiring ground level measurements for pollutants and air toxicants during the first 24 months of operations when both LNG trains and the CCPP were operating at steady state.                                                                                                               | Licence amendment record; amended ground level monitoring condition.  |
| EPL228-05      | 13 December 2022 | Renewal removed start-up conditions already met and associated monitoring frequencies and programs, with no changes to steady-state monitoring requirements. Also removed the requirement for ground level monitoring and removed particulate matter, mercury and nitrous oxide monitoring from turbine stacks at the licensee's request.                                                        | Renewal record; licensee request.                                     |

## Appendix 5: Benchmarking Desktop Analysis

The information in this appendix provides additional detail on the methods and findings used to support the analysis in Sections 4-9. It is summarised in Section 4.

### Method

Licences for operational LNG processing facilities were obtained from their respective regulators' public registers on 18 February 2026. Each licence was assessed against each theme and research question listed below. Themes and questions for the analysis were derived from discussions with the NT EPA, existing feedback from community stakeholders and the published terms of reference for the EPL review. The themes relate to air emissions and human health. The assessment did not include conditions related to water quality, terrestrial ecology or other environmental factors. Notes against the themes and responding to the questions were compiled in a single document and qualitatively assessed for similarities and differences.

1. On-site air emissions monitoring requirements
  - What parameters are required to be monitored?
  - What frequency of monitoring is required?
  - What sampling methods must be employed?
  - Where must monitoring occur?
  - What standards are applied to monitoring activities?
  - What pollution reduction equipment is required on-site?
2. Air emissions limits
  - Which parameters are limits applied to?
  - Under which circumstances are limits applied?
  - How are limits derived?
  - Are there any considerations of cumulative emissions?
3. Air emissions reporting requirements
  - What must the licensee report?
  - When is reporting required? (Yearly, monthly, real-time data availability?)
  - What quality assurance/quality control conditions are applied to ensure accuracy of reporting?
4. Ambient air quality monitoring requirements
  - What parameters are required to be monitored?
  - Where must monitoring occur?
  - What standards are applied to monitoring activities?
  - Are there obligations to contribute funding to monitoring activities?
5. Flaring governance and limits
  - What conditions are in place to govern flaring?
  - Are limits applied to flaring (duration, timing, wind direction)?
  - Monitoring requirements for emissions from flaring?
6. Conditions requiring "best practice"
  - How are requirements to implement best practice conditioned?
  - What is "best practice" applied to? (e.g. emissions reduction, spill containment)
7. Conditions requiring reducing pollution
  - How do the licences compel the licensee to reduce pollution?
8. Community consultation requirements

- How are community consultation requirements conditioned?
- Are community consultation requirements shared with other licensees? If so, how?
- 9. Fugitive emissions
  - How are fugitive emissions conditioned?
  - What requirements are in place for leak detection and repair programs?
- 10. Greenhouse gas (GHG) emissions
  - What governance requirements are set for GHG emissions?
- 11. Outcomes-based conditions
  - Are they included in the licence?
  - If yes, how are they phrased?
- 12. Population around the facility
  - What are the sensitive receptors?

## Results

### General observations

With regard to air emissions, LNG facility licences across the country are consistent in the following senses:

- Licences are risk-based and contain conditions which reflect the outcomes of environmental impact and approval processes which are separate from the licensing process.
- Licences require that air emissions can only occur at specified sources.
- Licences require some on-site monitoring of pollutant emissions, with NO<sub>x</sub> the primary pollutant subject to emission monitoring and limits.
- Licences require emission reporting.
- Licences specify standards for monitoring which must be adhered to.

Beyond these broad similarities, licences vary considerably across jurisdictions, as will be set out in the analysis below. The variation is attributable to the unique risk profile of each facility. The risk profile, and therefore regulatory requirements, of each LNG facility varies depending on a number of factors, including the siting of each facility, feed gas quality and the design of each facility.

Darwin facilities are close to sensitive receptors, located approximately 6-10 km from population centres. Queensland's LNG facilities are also 6-12 km from Gladstone but prevailing winds direct air emissions away from this population centre. WA facilities with contemporary licences and SA facilities are generally at least 100 km from sensitive receptors. Darwin's relative proximity to LNG facilities necessitates more stringent air quality protection requirements and these are reflected in the current EPLs.

Feed gas quality also impacts the processing of gas and how much risk the emissions pose. Darwin LNG facilities process gas from offshore gas fields. The feed gas contains high volumes of pollutants which need to be removed from the gas to prepare it for liquification and transport (Advisian, 2017). The gas processed near Gladstone, however, is coal seam gas which has negligible levels of BTEX and other hydrocarbon pollutants. As a result, QLD LNG facilities do not contain and are not required to operate pollution reduction equipment such as acid gas incinerators. Darwin's facilities are designed to include pollution reduction and control equipment as a direct result of the risks associated with the composition of the feed gas. The maintenance and operation of this equipment are regulated by the EPLs.

Overall, the risk profile of the NT's LNG facilities has resulted in the NT's EPLs for LNG facilities being more comprehensive and stringent than most other Australian jurisdictions reviewed. While QLD and WA

licences tend to rely on narrower, parameter-specific or equipment-based controls, NT licences contain conditions covering a wide range of operational requirements and combine prescriptive requirements with broader outcome focused obligations.

Compared to other Australian jurisdictions, the NT LNG EPLs:

- Regulate a wider range of pollutants
- Require more monitoring
- Include requirements related to regional air quality outcomes, not just point source compliance
- Include conditions for flaring, fugitive emissions and emissions reporting
- Are explicit about continuous improvement and implementing best practice.

Nonetheless, the NT could look to other jurisdictions to improve licence conditions in the following areas:

- Best practice flaring regulation in QLD
- Best practice ambient air trigger-response frameworks from Wheatstone LNG
- Considering different monitoring method requirements based on Australian standards or US EPA methods
- Best practice data access and transparency from QLD and NSW.

## Air emission monitoring and regulatory limits

### Why are pollutant emissions to air monitored and limited?

The operation of the facilities for production, storage and despatch of LNG produces several atmospheric pollutants, including carbon dioxide (CO<sub>2</sub>), carbon monoxide (CO), oxides of nitrogen (NO<sub>x</sub>), sulphur dioxide (SO<sub>2</sub>), particulate matter smaller than 10 µm (PM<sub>10</sub>), and volatile organic compounds (VOCs including benzene, toluene, ethylbenzene and xylene (BTEX)).

The presence and emission rate of pollutants will depend on the feed gas quality. Facilities focus monitoring on pollutants which are present in the feed gas and removed from the feed gas through processing and those pollutants produced during feed gas processing.

Provided that fuel sulfur content is low, the pollutants of major concern for gas turbine generators are oxides of nitrogen (NO<sub>x</sub>) and carbon monoxide (CO) (Advisian, 2017). Pollution controls typically focus on minimising NO<sub>x</sub> in the exhaust gas stream, however, concentrations of CO in the exhaust gas will be a consideration in the selection of NO<sub>x</sub> pollution control measures.

Emissions monitoring and emissions limits are applied to ensure that:

- equipment is operated efficiently and that appropriate technology is used in the plant and
- ambient air quality in the receiving environment is maintained.

In the case of the NT, the WMPCA prohibits pollution including emissions to air; it is the licence that authorises facilities to emit pollution from specified locations and according to the conditions of the licence. EPLs and licences across the country limit the amount of emissions, based on the findings of the environmental impact assessment process.

The most stringent monitoring requirements are found in the NT licences, WA's Wheatstone facility and NSW's Newcastle Gas Storage Facility.

## Licence similarities

All licences prescribe that all emissions to air must come from authorised release points specified in the licence. Most licences contain minimum stack heights, minimum release velocities and require emissions to be released freely and without hindrance. The stacks referred to are generally the compressor turbine and power generation turbines. Where pollution control equipment (such as thermal oxidisers or acid gas incinerators) is installed (such as at Ichthys LNG, Darwin LNG, Pluto LNG and Wheatstone LNG) monitoring at the specified equipment stacks or release points is also required.

Licences across jurisdictions generally require point-source, stack-based monitoring on an annual basis, using specified standards such as the Australian Standard AS 4323.1 or US EPA methods. Monitoring must be undertaken by suitably qualified personnel. Table 9 summarises these monitoring conditions across jurisdictions.

Table 9 Summary of monitoring conditions across jurisdictions.

| Requirement                                                                                                                                                 | NT                                                                                                                            | WA                                              | QLD                                                                     | NSW                                                                                                          | SA            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|---------------|
| Emissions limited to specified release points                                                                                                               | Yes                                                                                                                           | Yes                                             | Yes                                                                     | Yes                                                                                                          | Not specified |
| Stack emission monitoring required                                                                                                                          | Yes                                                                                                                           | Yes                                             | Yes                                                                     | Yes                                                                                                          | Not specified |
| Standards applied to monitoring                                                                                                                             | <i>Approved methods for sampling and analysis of air pollutants in NSW. AS 4323.1 is an approved method or US EPA methods</i> | Australian Standard AS 4323.1 or US EPA methods | Australian Standard AS 4323.1 or Queensland Air Quality Sampling Manual | <i>Approved methods for sampling and analysis of air pollutants in NSW. AS 4323.1 is an approved method.</i> | Not specified |
| Conditions requiring qualified monitoring personnel                                                                                                         | Yes                                                                                                                           | Not specified                                   | Yes                                                                     | Not specified                                                                                                | Not specified |
| Conditions to ensure monitoring is of a high quality (e.g. appropriate monitoring equipment, associated data collection, quality assurance/quality control) | Yes                                                                                                                           | Yes                                             | Yes                                                                     | Yes                                                                                                          | Not specified |

## On-site monitoring – frequency

Monitoring is usually required annually. EPL217 (Santos) and the Wheatstone LNG licence in WA are the only licences nationally which require quarterly monitoring. EPL228 (INPEX) requires monthly monitoring at the acid gas removal units only. Interviews with regulators from other jurisdictions indicated that the infrequent monitoring at most facilities (annually) is not ideal and that more frequent monitoring would be preferred.

Table 10 compares stack emission monitoring frequency across jurisdictions.

Table 10 Stack emission monitoring frequency.

|                                         | NT                           | WA                  | QLD    | NSW      | SA            |
|-----------------------------------------|------------------------------|---------------------|--------|----------|---------------|
| Frequency for stack emission monitoring | Monthly, quarterly or annual | Quarterly or annual | Annual | 5-yearly | Not specified |

## On-site monitoring – parameters

In QLD's licences and at WA's Pluto LNG monitoring is limited to oxides of nitrogen (NO<sub>x</sub>). Other licences require more pollutant monitoring.

NT licences require monitoring of a more comprehensive suite of parameters than other jurisdictions. This is at least partly because the feed gas which flows to the two Darwin facilities contains elevated levels of contaminants compared to the feed gas flowing to facilities in other jurisdictions (Advisian, 2017).

Table 11 compares on-site pollutant monitoring requirements across jurisdictions.

Table 11 On-site pollutant monitoring requirements.

|                                                  | NT                                                                                                                                      | WA                                                                                                              | QLD             | NSW                                                                                                     | SA            |
|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------|---------------------------------------------------------------------------------------------------------|---------------|
| Pollutants required to be monitored at the stack | (Across the two licences)<br>NO <sub>x</sub> as NO <sub>2</sub><br>CO<br>SO <sub>2</sub><br>Benzene/BTEX<br>H <sub>2</sub> S<br>Mercury | Varies between facilities. The most comprehensive requirements are:<br>NO <sub>x</sub><br>CO<br>SO <sub>2</sub> | NO <sub>x</sub> | NO <sub>x</sub><br>Solid particles<br>SO <sub>2</sub><br>Sulfuric acid mist and SO <sub>3</sub><br>VOCs | Not specified |

## Emission limits

Some facilities in WA (Gorgon and Wheatstone) have no limits on the concentration or maximum emission rates applied to stack emissions. Interviews with regulators indicate that this is due to their distance from population centres. The findings of risk assessments performed at the project approval and assessment phase determined that there was not sufficient risk to the environment or people to justify prescribing emissions limits.

Monitoring and emissions limits, if applied, are generally applied to oxides of nitrogen (NO<sub>x</sub>) only. The actual NO<sub>x</sub> limit varies between licences and jurisdictions (Table 12). With the exception of the Newcastle Gas Storage Facility and Darwin LNG, most facilities do not apply numerical limits to any other parameters. Emissions limits are often only applied during steady-state operations and licences contain clauses to exempt operators from complying during start-up and shut-down procedures. Interviews with other jurisdictions indicated that limits were derived using risk assessment frameworks and during environmental impact assessments required by the relevant state legislation.

Table 12 NO<sub>x</sub> limits at Australian LNG facilities.

| Facility                       | Concentration limit                                                                                                        | Maximum emission rate limit |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| QLD Curtis LNG                 | 61 mg/Nm <sup>3</sup> (dry) @ 15% O <sub>2</sub>                                                                           | 4.0 g/s NO <sub>x</sub>     |
| Gladstone LNG                  | 51 mg/Nm <sup>3</sup> (dry) @ 15% O <sub>2</sub>                                                                           | 3.0 g/s NO <sub>x</sub>     |
| Australia Pacific LNG          | 51 - 125mg/Nm <sup>3</sup> @ 15% O <sub>2</sub>                                                                            | 1-4 g/sec/stack             |
| Pluto LNG                      | 100-140 mg/m <sup>3</sup>                                                                                                  | No limit                    |
| Newcastle Gas Storage Facility | 190-250 mg/m <sup>3</sup>                                                                                                  | No limit                    |
| Ichthys LNG                    | Targets - 50-320 mg/Nm <sup>3</sup> for NO <sub>x</sub> or 25-160 ppmv<br>Limits - 70-350mg/Nm <sup>3</sup> or 35-175 ppmv | No limit                    |
| Darwin LNG                     | 70-350 mg/Nm <sup>3</sup>                                                                                                  | 1-25 g/s                    |

Santos' licence also contains concentration limits for SO<sub>2</sub>, NO<sub>x</sub>, CO, H<sub>2</sub>S and Benzene. The closest equivalent limits are applied to NGSF (Table 13).

Table 13 Emission limits at Newcastle Gas Storage Facility (NGSF) and Darwin LNG.

| Parameter                   | NGSF Emission limit range | Santos NT concentration limit range | Santos NT mass emission rate |
|-----------------------------|---------------------------|-------------------------------------|------------------------------|
| VOC as n-propane equivalent | 5-20mg/m <sup>3</sup>     | N/A                                 | N/A                          |
| Benzene                     | N/A                       | 306 mg/Nm <sup>3</sup>              | 3.6 g/s                      |
| Carbon monoxide             | 100-125 mg/m <sup>3</sup> | 32-145 mg/Nm <sup>3</sup>           | 0.4-5 g/s                    |
| Solid particles             | 5-40 mg/m <sup>3</sup>    | N/A                                 | N/A                          |
| Sulfur oxides               | 5-60 mg/m <sup>3</sup>    | N/A                                 | N/A                          |
| Sulfur dioxide              | N/A                       | 23-485 mg/Nm <sup>3</sup>           | 0.2-11.1 g/s                 |
| Hydrogen sulfide            | N/A                       | 362 mg/Nm <sup>3</sup>              | 4.3 g/s                      |

Load limits and emission limits for non-LNG hydrocarbon processing in NSW are summarised in Table 14 and Table 15. NSW uses load-based licensing (LBL) to both limit the absolute quantity of pollutants

emitted as well as charge polluters for their emissions. Load limits are determined based on Clean Air Regulations, dispersion modelling and load based licensing protocols in the assessment phase of a project. However, while numerical load limits are applied at other hydrocarbon processing facilities, such as Vopak terminals and Valvoline, numerical load limits do not appear to be applied at the NGSF.

Table 14 Load limits for hydrocarbon facilities in NSW.

| Facility                  | Load limits and/or mass emission limits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Vopak terminals Australia | <p>Annual load limit on Benzene and VOC emissions to air:<br/>Benzene – 1500 kg<br/>VOC – 125000 kg</p> <p>100<sup>th</sup> percentile concentration limits:<br/>Organic vapours – 4 “Measure 1”<sup>*</sup><br/>Nitrogen Oxides – 350 mg/m<sup>3</sup><br/>VOCs – 20 mg/m<sup>3</sup><br/>Residence time lower limit – 0.4 seconds<br/>Temperature lower limit – 760 °C</p> <p><sup>*</sup> “Measure 1” means where organic vapours is [sic] recovered, the total concentration of unrecovered vapour emitted to the atmosphere during any period of four hours does not exceed 4 milligrams per litre of volatile organic liquid passing out of the plant during that period.</p>                                                                        |
| Bituminous Products       | <p>100<sup>th</sup> percentile concentration limits:<br/>Sulfuric acid mist and sulfur trioxide (as SO<sub>3</sub>) - 100 mg/m<sup>3</sup><br/>Nitrogen Oxides – 350 mg/m<sup>3</sup><br/>VOCs – 40 mg/m<sup>3</sup><br/>Solid particles – 50 mg/m<sup>3</sup></p> <p>For each monitoring/discharge point or utilisation area specified in the table below (by point number), the parameter must be equal to or greater than the limit specified for that parameter in the table:<br/>Temperature lower limit – 760 °C</p> <p>The bitumen blowing vessel and thermal oxidiser must be interlocked in such a way that power to the blowing vessel cannot be initiated until the operating temperature reaches and is maintained at no less than 760 °C.</p> |
| Southern Oil Refining     | <p>100 percentile Concentration limits:<br/>Dioxins and Furans – 0.1 ng/m<sup>3</sup><br/>Mercury – 0.0002 g/m<sup>3</sup><br/>Hydrogen chloride – 0.1 g/m<sup>3</sup><br/>Solid particles – 0.50 g/m<sup>3</sup><br/>Total fluoride 0.05 g/m<sup>3</sup><br/>Nitrogen oxide 0.3 g/m<sup>3</sup><br/>Sulfuric acid mist and sulfur trioxide (as SO<sub>3</sub>) – 0.1 g/m<sup>3</sup><br/>Hydrogen sulfide – 0.005 g/m<sup>3</sup></p>                                                                                                                                                                                                                                                                                                                     |

|                               |                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                               | Cadmium<br>Chlorine<br>Hazardous substances 0.001 g/m <sup>3</sup><br>PCBs 1 ug/m <sup>3</sup><br>Hydrogen Sulfide 0.001 g/m <sup>3</sup><br>VOCs – 40 mg/m <sup>3</sup><br>Dioxins and Furans 0.1 ng/m <sup>3</sup>                                                                                                                                                                                 |
| Valvoline (Australia) Pty Ltd | Annual load limits in kg<br>Benzene (Air) 20.00<br>Benzo(a)pyrene (equivalent) (Air) 10.00<br>Fine Particulates (Air) 10.00<br>Hydrogen Sulfide (Air) 200.00<br>Lead (Air)<br>Mercury (Air)<br>Nitrogen Oxides - Summer (Air) 150.00<br>Nitrogen Oxides (Air) 600.00<br>Sulfur Oxides (Air) 590.00<br>Volatile organic compounds - Summer (Air)<br>112.50<br>Volatile organic compounds (Air) 450.00 |

Table 15 Emission Limits.

|                                                   | NT                                                                                                            | WA                                                                   | QLD                                                                            | NSW                                                                               | SA            |
|---------------------------------------------------|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------|
| Concentration Limits applied to which parameters? | NO <sub>x</sub> for both facilities<br>For EPL217: SO <sub>2</sub> , CO and Benzene for some emission points. | Some facilities for NO <sub>x</sub> .<br>Other facilities have none. | NO <sub>x</sub> for all facilities                                             | NO <sub>x</sub>                                                                   | Not specified |
| Maximum emission rates applied?                   | EPL217 only                                                                                                   | Applied at one facility only                                         | NO <sub>x</sub> for all facilities                                             | No                                                                                | Not specified |
| Load limits applied?                              | Implied in EPL217 through application of a concentration limit and maximum emission rate                      | No                                                                   | Implied through application of a concentration limit and maximum emission rate | For LNG processing: No.<br><br>For non-LNG hydrocarbon processing facilities: Yes | Not specified |

## Flaring

Flaring is a source of pollutant emissions and can also impact the visual amenity of an area.

One WA licence (Gorgon) and licences from NSW and SA do not regulate flaring through licence conditions. On the other hand, QLD licences, one WA licence (Wheatstone) and NT licences contain extensive conditions to regulate flaring. Interviews with QLD regulators indicated that flaring conditions were primarily designed to prevent impacts to visual amenity. Table 16 summarises the presence of flaring conditions across jurisdictions.

Table 16 Flaring conditions.

|                              | NT                              | WA                                               | QLD | NSW           | SA            |
|------------------------------|---------------------------------|--------------------------------------------------|-----|---------------|---------------|
| Flaring prohibited           | No                              | No (dark smoke events prohibited by one licence) | No  | Not specified | Not specified |
| Flaring duration limited     | No                              | Yes (one licence)                                | Yes | Not specified | Not specified |
| Flaring monitoring required  | Yes for EPL228<br>No for EPL217 | No                                               | Yes | Not specified | Not specified |
| Flaring design conditions    | Yes                             | No                                               | Yes | Not specified | Not specified |
| Flaring reporting conditions | Yes for EPL228<br>No for EPL217 | No                                               | Yes | Not specified | Not specified |

The strictest flaring governance conditions include:

- Limits on visible smoke duration (for example: “a total of 5 minutes in any two-hour period during normal operating conditions” or “30 minutes of continuous visible smoke during daylight hours except under authorised conditions”) or prohibition of black smoke events
- Annual caps on non-emergency flaring hours and events (for example: 7 hours per annum during daylight hours, 14 times per annum during daylight hours)
- Allowing flaring only during specific operating conditions, such as equipment downtime
- Monitoring during flaring including visual recording, temperature, gas flow rate and gas composition
- Mandatory record-keeping of flaring events
- Notification of the regulator for extended flaring events.

Some Queensland licences require best practice flare design with the following condition:

“The flare must be equipped with a flare tip design to provide good mixing with air, flame stability and achieve a minimum volatile organic compound (VOC) removal efficiency of 98 per cent under varied gas flow rate and meteorological conditions and meet the best practice design standards (e.g. NSW EPA:

Protection of the Environment Operations (Clean Air) Amendment (Industrial and Commercial Activities) Regulation 2005, or the US EPA Code of Federal Regulations: 40 CFR 60.18 and 40 CFR 63.11).

Unlike QLD licences, NT licences do not limit the duration or occurrence of flaring events.

NT licences contain flaring governance conditions, which require the licencees to:

- Design, operate and maintain the flares to minimise emissions of VOCs and smoke
- Equip flares with a continuously burning pilot or other automatic ignition system that ensures gas ignition and provides immediate notification to appropriate personnel when the ignition system ceases to function
- Ensure the flares are designed to handle large fluctuations in both the volume and the chemical content of gases
- Design the flares to not cause excessive radiant heat, light or noise beyond the boundary of the premises.

EPL228-05 (INPEX) contains additional conditions requiring the licensee to:

- Maintain procedures and records to demonstrate that all reasonable and practical recovery methods for excess isopentane and gas are maximised before resorting to flaring
- Monitor dark smoke in accordance with their onshore environmental management plan (OEMP)
- Install a monitoring system to manage and record the operation of all flares, including:
  - continuous flow meters to measure the volumetric flowrate of hydrocarbons combusted in the flare system;
  - the source of hydrocarbons combusted in the flare system;
  - measurement and/or calculation of the quality and quantity of volatile organic compounds and particulate emissions as a result of flaring.
- Provide the NT EPA with an annual record of flaring events to demonstrate compliance with the licence.

## Fugitive emissions

Fugitive emissions are unintended, unplanned releases of gas or vapour to the atmosphere from pressurised or contained equipment, rather than from a designed exhaust point (like a stack or vent). In an LNG processing facility, fugitive emissions usually come from leaks at valves, flanges and other connections, pump/compressor seals, pressure-relief devices, instrument lines, drains/vents, and storage tanks (including roof seals, fittings, and hatches). Fugitive emissions represent both a loss of economically valuable product and an environmental risk. Table 17 summarises how fugitive emissions are conditioned in LNG facility licences across jurisdictions.

Table 17 Fugitive emissions.

|                               | NT                                               | WA                                                           | QLD | NSW           | SA            |
|-------------------------------|--------------------------------------------------|--------------------------------------------------------------|-----|---------------|---------------|
| Fugitive emissions conditions | Yes, with different requirements in each licence | Two licences have no specified conditions.<br>At Wheatstone, | Yes | Not specified | Not specified |

|  |  |                                                 |  |  |  |
|--|--|-------------------------------------------------|--|--|--|
|  |  | six-monthly optical gas monitoring is mandated. |  |  |  |
|--|--|-------------------------------------------------|--|--|--|

Two of three WA licences, as well as all NSW and SA licences, contain no fugitive emission management conditions.

QLD licences include explicit and comprehensive conditions related to fugitive VOC emissions. These conditions require all reasonable and practicable measures to minimise fugitive VOC emissions, including a monitoring program to leak test pumps, piping and controls, vessels and tanks, constructing transfer ducting and extracting systems to minimise leaks of VOCs and vapours, correcting faults which cause emissions as well as implementing maintenance and management practices to mitigate fugitive VOC sources.

The operator of Wheatstone LNG in WA is required to undertake six-monthly optical gas imaging surveys and detailed annual reporting of leaks and corrective actions.

EPL228 (INPEX) requires leak detection and repair and mandates industry-standard management procedures for inspection, maintenance and replacement of flanges for pressurised systems.

EPL217 (Santos) contains the most extensive fugitive emission management conditions requiring:

- A Fugitive Emissions Management Plan
- Formal Leak Detection and Repair (LDAR) programs
- Annual testing of accessible components likely to leak
- Annual testing of the Darwin LNG storage tank
- Defined methodologies (e.g. US EPA methods, optical gas imaging)
- Repair thresholds and timeframes
- Annual reporting of findings and corrective actions.

## Ambient air quality

While emissions limits at industrial facilities are set to ensure equipment is operated efficiently and appropriate technology is used, the protection and measurement of ambient air quality is critical for protecting the environment and people (Advisian, 2017, p.9). Ambient air quality should be used to demonstrate that air quality remains safe for humans. Monitoring is conducted in areas near sensitive receptors.

Table 18 summarises the conditions of LNG licences related to ambient air quality protection across jurisdictions.

Table 18 Conditions of LNG licences related to ambient air quality protection

|                                | NT                                  | WA                                                          | QLD           | NSW           | SA            |
|--------------------------------|-------------------------------------|-------------------------------------------------------------|---------------|---------------|---------------|
| Ambient air quality monitoring | Yes for EPL228, via the requirement | Yes for Wheatstone (NO <sub>x</sub> , SO <sub>2</sub> , CO, | Not specified | Not specified | Not specified |

|                                                                                  |                                                                   |                                                                    |                                   |                                   |                |
|----------------------------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------------------------------|-----------------------------------|-----------------------------------|----------------|
| required by the licence                                                          | for a receiving environment monitoring program.<br>No for EPL217. | Ozone (O <sub>3</sub> ), NMVOC).<br>No for the other two licences. |                                   |                                   |                |
| Ambient air quality monitoring in the receiving airshed funded by LNG facilities | No                                                                | Yes, for one facility through the licence                          | Yes, outside of licence framework | Yes, outside of licence framework | Not applicable |

### Ambient air quality monitoring and modelling

Most jurisdictions do not require LNG facility operators to conduct routine, continuous ambient air quality monitoring through their licences. This includes the QLD licences for the three LNG facilities located within 6-12km of Gladstone (population: approx. 45,000).

Wheatstone LNG is a national exception. The holder of the Wheatstone LNG licence is required to conduct continuous ambient monitoring at the Onslow townsite, approximately 20 km north-east of the facility, for NO<sub>x</sub>, SO<sub>2</sub>, CO, Ozone (O<sub>3</sub>), NMVOC and meteorology. Sampling is continuous for all parameters except NMVOC for which one 7-day sample is collected every calendar month. The licence defines investigation concentrations for each monitoring parameter. The licence specifies actions which the licensee must take when a parameter exceeds the defined concentration, including: validation of data, reviewing meteorological conditions, reviewing operational conditions if it could be attributed to the facility and taking corrective actions.

Queensland's Australia-Pacific LNG uses an alternative model to ensure that ambient air quality remains protected based on a combination of air dispersion modelling and verification modelling (see Box 2).

#### Box 2 Australia-Pacific LNG requirements for ambient air quality modelling and verification monitoring

This licence requires the licensee to, “conduct air dispersion modelling to calculate the ground level concentrations of emissions from the fuel burning or combustion equipment under maximum operating conditions within the relevant airshed and identify any potential impacts to air quality within the study area.”

The licensee is then obliged to ensure that the calculated maximum ground level concentrations do not exceed criteria for NO<sub>x</sub> and CO and undertake verification monitoring of the air dispersion modelling post commissioning of fuel burning equipment that is capable of burning at least 500 kg of fuel in an hour.

If the verification monitoring demonstrates exceedances of the modelled concentrations, the licensee has to take several measures including notifying the regulator, re-modelling and implementing pollution control to reduce the ground level concentrations.

NT licences contain a statement that the licensees should do all things reasonable and practicable to ensure the licensed activity does not adversely affect the ambient air quality in the Darwin region.

The NT licences link licensed emissions to regional ambient air quality outcomes. NT licences require:

- Conceptual modelling to identify exposure pathways and sensitive receptors (EPL228)
- Monitoring designed to detect impacts to the Darwin region ambient air quality, including during periods unaffected by bushfire smoke (EPL228)
- Assessment of facility contributions to regional air quality in annual reporting (both licences).

### Ambient air quality funding

No licences reviewed mandate licensee funding of regional ambient monitoring networks. However, a number of regions have industry-funded air quality monitoring arrangements outside of licensing frameworks. Industry-funded monitoring is usually arranged with a regional industry council rather than individual companies. A full review of operating arrangements for government-run, industry-funded monitoring regimes is not within the scope of this review; the following information is provided for illustrative purposes only.

Industry operators in Gladstone voluntarily fund four government-run air quality monitoring stations (in addition to three government-funded stations) which were introduced for the 2010/2011 “Clean and Healthy Air for Gladstone” initiative. Despite air quality meeting standards, the community opted to keep the extra stations, which are now supported by industry contributions through the regional industry council.

In NSW, the Hunter Valley Region has an industry-funded, government-run ambient air quality monitoring program for particulate matter related to coal mining operations. Interviews with regulatory officers from NSW indicated that this model works well, with industry often conducting their own monitoring in addition to the government-run monitoring to ensure worker health is protected and provide confidence to the public.

The Newcastle Local Air Quality Monitoring Network is administered by the NSW EPA, operated by Office of Environment and Heritage, and funded by industry. Industries in the Newcastle local government area that hold an EPA environment protection licence and emit particulate matter, sulfur dioxide, or oxides of nitrogen pay for the construction and operation of the network via a levy. The annual levies are calculated in accordance with the NSW Protection of the Environment Operations (General) Regulation 2009. There are three stations that monitor SO<sub>2</sub>, NO<sub>x</sub>, PM<sub>10</sub> and PM<sub>2.5</sub>.

In Kwinana in WA, the Kwinana Industries Council runs and pays for SO<sub>2</sub> monitoring stations.

In Port Hedland, the Department of Water and Environmental Regulation oversees a monitoring network for dust which is paid for by the Port Hedland Industries Council. Monitoring data is available online in real time.

## Reporting

Reporting provides the regulator with information needed to determine compliance with licences and make recommendations for licensing requirements. Reporting is also important to ensure that the public has access to information about industry operations and environmental performance.

Licences nationally require an annual report to the regulator which must include the results of air emission monitoring.

NT licences require data analysis and interpretation in the annual report which is not conditioned in other jurisdictions, such as by requiring:

- total emissions to air in tonnes for specified parameters
- interpretation and evaluation of collected monitoring data
- the licensee to use monitoring data to make an assessment of environmental impact
- an analysis of how emissions impact the broader airshed.

Reporting requirements across jurisdictions are summarised in Table 19.

Table 19 Reporting requirements.

|                                                 | NT                                                                                                                                                                        | WA                                                                                                                                                                                                                                                                          | QLD                                                                                                                                                                                                   | NSW                                                    | SA            |
|-------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|---------------|
| Reporting frequency                             | Annually                                                                                                                                                                  | Annually and quarterly                                                                                                                                                                                                                                                      | Annually                                                                                                                                                                                              | Annually                                               | Not specified |
| Reporting requirements related to air emissions | Provide monitoring data. Summarise performance of emissions to air compared to targets and limits. Assess the contribution of emissions to ambient air quality in Darwin. | Varies between facilities. Thermal oxidiser downtime. Emission point utilisation. NO <sub>x</sub> emissions Monitoring data. Emission limit exceedances. Monitoring data. Ambient air quality monitoring data and trend analysis. Results of fugitive emissions monitoring. | Monitoring results from the annual reporting period. A summary of the quantities of releases. Equipment failures and actions taken in response to deficiencies identified by the monitoring programs. | Operator must publish their pollution monitoring data. | Not specified |

## Best practice and pollution reduction

Many licences across jurisdictions include high-level obligations to prevent or minimise environmental harm, but few define “best practice” clearly for air emissions. Best practice requirements, if they are defined, are often limited to specific equipment (e.g. flare design, turbine technology).

Environmental Management Plans are commonly required to include continuous improvement commitments or propose activities in line with best practice environmental management, but these are generally procedural rather than enforceable performance standards.

EPL228 is the only licence among those sampled which imposes best practice management of emissions through the OEMP. EPL217 requires “best practice” for fugitive emission monitoring of the DLNG storage tank.

Best practice conditions across jurisdictions are provided in Table 20.

Table 20 Best practice conditions.

|                                     | NT                                                                                                                                                                                                                                                                                                                                                                                     | WA                                                                                                                                                                                                                                                                                                                                                                                                                         | QLD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | NSW                                                                                                     | SA                   |
|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|----------------------|
| Best practice conditions – examples | <p>The OEMP must include measures to ensure:</p> <p>application of best practice to the management of emissions, discharges and waste and to reduce emissions, discharges and waste disposal as far as reasonable and practicable for the Scheduled Activity.</p> <p>Annual monitoring of fugitive methane emissions from the Darwin LNG storage tank using best practice methods.</p> | <p>During normal operating conditions each gas turbine must be operated with:</p> <ul style="list-style-type: none"> <li>• dry low emissions combustor system;</li> <li>• turbine inlet air humidification (when the GTG is being operated at &gt;70% load);</li> <li>• WHRU; [not in abbreviation list in licence]</li> <li>• a load balancing program; and</li> <li>• continuous fuel composition monitoring.</li> </ul> | <p>The flare must be equipped with a flare tip design to provide good mixing with air, flame stability and achieve a minimum Volatile Organic Compound (VOC) removal efficiency of 98 per cent under varied gas flow rate and meteorological conditions and meet the best practice design standards (e.g. NSW EPA: Protection of the Environmental Operations (Clean Air) Amendment (Industrial and Commercial Activities) Regulation 2005, or the US EPA Code of Federal Regulations: 40</p> | <p>Not specified in the licence. Best practice is regulated and required through other legislation.</p> | <p>Not specified</p> |

|  |  |  |                                                                                                                                                                                                                               |  |  |
|--|--|--|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
|  |  |  | CFR 60.18 and 40 CFR 63.11).                                                                                                                                                                                                  |  |  |
|  |  |  | Environmental Management Plan must:<br>State the environmental protection commitments the applicant proposes for the activities, to protect or enhance the environmental values under best practice environmental management. |  |  |

## Greenhouse gas emissions

The major sources of direct (Scope 1) greenhouse gas (GHG) emissions from LNG facilities are the removal of CO<sub>2</sub> from feed gas and the production of electricity for refrigeration of natural gas to -162 °C so that it condenses into a liquid. Best practice guidelines for LNG state that technically feasible and cost-effective attempts should be made to optimise energy efficiency and to design facilities to reduce energy use. Such measures to reduce electricity consumption in the plant benefit both the operator, by reducing electricity generation costs, and the environment.

The National Greenhouse and Energy Reporting (NGER) scheme is the Commonwealth legislative framework requiring corporations exceeding specific thresholds to report greenhouse gas emissions, energy production, and consumption annually. Submissions are provided to the Clean Energy Regulator (CER). The safeguard mechanism is used to compel high-emitting operators to reduce emissions. Nonetheless, some state-based licences contain GHG-related conditions, as summarised in Table 21.

Table 21. Greenhouse gas emission conditions

|                                   | NT                                                                 | WA            | QLD                                                                                                        | NSW           | SA            |
|-----------------------------------|--------------------------------------------------------------------|---------------|------------------------------------------------------------------------------------------------------------|---------------|---------------|
| Greenhouse gas-related conditions | Greenhouse gas management strategies must be included in the OEMP. | Not specified | A GHG reduction strategy, covering energy efficiency, continuous improvement and CO <sub>2</sub> recovery. | Not specified | Not specified |

Greenhouse gas regulation through licences is limited. Western Australian, NSW and SA licences reviewed mostly exclude GHG conditions entirely.

Queensland licences generally require a GHG reduction strategy, covering energy efficiency, continuous improvement and CO<sub>2</sub> recovery.

The NT licences both require a greenhouse gas management or reduction strategy. EPL228 requires energy efficiency and continuous improvement programs, while EPL217 includes conditions requiring estimation of methane losses from fugitive leaks and a plan for continual improvement in reducing fugitive emissions.

## Cumulative impacts

There is little explicit treatment of cumulative air emissions across licences, with regulation largely framed around individual facilities and emission points rather than airshed-wide impacts.

Interviews with other regulators indicated that cumulative impacts were not generally addressed by licences but were assessed and considered during the environmental impact assessment processes prior to project approval. Most LNG facilities in other jurisdictions are more isolated from both each other and from sensitive receptors, meaning cumulative impacts are less of a concern.

While the QLD Government has conducted airshed modelling to consider cumulative impacts in Gladstone, this is not directly reflected in licence conditions.

An example of addressing cumulative impacts to an airshed is the management of SO<sub>2</sub> in Kwinana. For this region, there are airshed thresholds for SO<sub>2</sub> and dust because there are many industry emitters in a confined airshed. A probabilistic approach is used to determine how long each licence can emit at particular levels and licences incorporate these limits. Interviews with WA regulators indicated that this model works for SO<sub>2</sub>, but it would not work well for NO<sub>x</sub> or other parameters.

## Transparency

Transparency-related conditions ensure that companies are making information about their operations and environmental protection measures available to the public. Community relations conditions across jurisdictions are summarised in Table 22.

Table 22. Community relations conditions

|                                               | NT                                                         | WA  | QLD | NSW | SA            |
|-----------------------------------------------|------------------------------------------------------------|-----|-----|-----|---------------|
| Community consultation required               | Yes for EPL217<br>No for EPL228                            | No  | No  | No  | Not specified |
| Complaint management and recording conditions | Yes                                                        | Yes | Yes | Yes | Not specified |
| Public data sharing conditions                | No, although monitoring report is made publicly available. | No  | Yes | Yes | Not specified |

## Community consultation

No interstate licences impose proactive community consultation requirements. All licences, except SA licences, include complaint management and recording conditions.

The community consultative committee required by EPL217 is unparalleled in any other licence analysed.

In other industries, companies convene stakeholder meetings to share information and updates on operations and environmental performance. For example, the McArthur River Community Reference Group was established following a recommendation from the NT EPA in their 2018 overburden management project environmental impact assessment.

## Data access

Queensland licences contain a statement indicating that monitoring information held by regulators may be released to third parties: "Information and results held by the administering authority in relation to this approval may be used for any purpose including supply to third parties."

In NSW, pollution monitoring data that is required to be collected by a licence condition must be published by the licensee in accordance with section 66(6) of the Protection of the Environment Operations Act 1997 (NSW) and with the written requirements issued by the Environment Protection Authority (EPA). For example, the most recent air quality monitoring for the Newcastle Gas Storage Facility is publicly available.<sup>13</sup>

## Condition style: Prescriptive vs outcomes-based

Licences rely primarily on prescriptive conditioning, such as setting numeric limits on specified pollutant emissions, requiring particular methods for monitoring on-site and requiring inputs such as operational plans and equipment maintenance to reduce pollution.

Outcomes-based conditions are rare for air emissions. An exception is Wheatstone LNG in WA, where there is an ambient air quality trigger response framework applied at a sensitive receptor (see section 0). Some licences also contain outcomes-based requirements to be demonstrated through receiving environment management plans. However, the outcomes-based conditions for these plans more commonly relate to the protection and maintenance of water quality rather than air quality.

In the NT licences, there are obligations to ensure the ambient air quality of the Darwin region is not affected by the licensed activity. This demonstrates that the NT licences already adopt an outcome-based approach in addition to the prescriptive conditions such as emissions limits.

|                           | NT  | WA   | QLD | NSW | SA |
|---------------------------|-----|------|-----|-----|----|
| Outcomes-based conditions | Yes | Rare | No  | No  | No |

<sup>13</sup> <https://www.agl.com.au/content/dam/digital/agl/documents/about-agl/operations-docs/250731-air-monitoring-report-june25.pdf>