



**Resources Safety & Health**  
Queensland

# Code of Practice

For leak detection, management &  
reporting for petroleum operating plant

Petroleum and Gas Inspectorate

30 June 2022 | v6

This publication has been compiled by the Petroleum and Gas Inspectorate, Resources Safety and Health Queensland.

© State of Queensland, 2021

The Queensland Government supports and encourages the dissemination and exchange of its information. The copyright in this publication is licensed under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence.

Under this licence you are free, without having to seek our permission, to use this publication in accordance with the licence terms.



You must keep intact the copyright notice and attribute the State of Queensland as the source of the publication.

Note: Some content in this publication may have different licence terms as indicated.

For more information on this licence, visit <https://creativecommons.org/licenses/by/4.0/>.

The information contained herein is subject to change without notice. The Queensland Government shall not be liable for technical or other errors or omissions contained herein. The reader/user accepts all risks and responsibility for losses, damages, costs and other consequences resulting directly or indirectly from using this information.

Version number	Date of publication	Date of effect	Key changes
v1	April 2011	15 April 2011	
v2	23 June 2011	1 July 2011	Inclusion of landholder notification requirements
v3	1 July 2017	1 September 2017 <sup>1</sup>	Scope expanded from wells to include all exploration and production facilities
v4	1 September 2018	1 September 2018	Associated water removed from scope, reporting requirements changed and revised to align with the commencement of Petroleum and Gas (Safety) Regulation 2018
v5	27 September 2021	27 September 2021	Interface with prescribed incident reporting clarified  Updated to RSHQ template  Notifications about repair and remediation delays clarified
V6	30 June 2022	30 June 2022	Leak survey methodology, leak classification, repair and reporting processes updated and clarified.

**Table 1: Document history**

---

<sup>1</sup> Version 3 was not referenced in the Petroleum and Gas (Production and Safety) Regulation 2004.

## Contents

Summary .....	5
1.0 Overview .....	6
1.1 Background .....	6
1.1.1 Other relevant industry standards .....	6
2.0 Purpose and application .....	7
2.1 Objective .....	7
2.2 Application .....	8
2.3 General safety .....	8
2.4 Definitions .....	9
3.0 Code operational requirements.....	9
3.1 Risk assessment.....	9
3.2 Inspection frequency and procedure.....	10
3.3 Leakage Survey.....	10
3.3.1 Leak survey frequency and methodology.....	10
3.3.2 Tester and instrument certification .....	11
3.4 Leak classification.....	12
3.5 Repair .....	13
3.6 Notification.....	15
3.6.1 Prescribed Incident .....	15
3.6.2 Reportable leak.....	15
3.6.3 Notification of a prescribed incident or reportable leak to landowner .....	15
3.6.4 Liquid petroleum reportable leaks .....	16
3.6.5 Recording leaks for petroleum operators.....	16
4.0 Review of this Code.....	16
Appendix 1 — Gas comparison table.....	17
Appendix 2 — Reportable leak definition.....	18
Appendix 3 — Definitions .....	19
Appendix 4 — Petroleum and Gas Inspectorate contact details.....	20

## Summary

This document, the *Code of Practice – for leak detection, management, and reporting at petroleum operating plant* (this Code) is authorised by section 27 of the Petroleum and Gas (Safety) Regulation 2018 (PG Safety Regulation).

The Code sets out obligations to detect, monitor, and repair petroleum leaks and reporting requirements. These obligations apply to operators of petroleum operating plant which is defined in the PG Safety Regulation to include well sites, gathering systems and processing facilities located on petroleum tenure.

The obligations set out in this Code are in addition other statutory obligations and requirements for operators of petroleum operating plant but are designed for use in conjunction with the operator's safety management system requirements.

# 1.0 Overview

## 1.1 Background

Petroleum wells, gathering systems and their associated processing facilities are rated as low risk for leaks due to rigorous design standards, robust safety obligations and strong governance programs. While petroleum operators have their own operating procedures for leak detection and classification, this Code provides a consistent best practice minimum standards to detect, classify, monitor or repair and report leaks.

Petroleum is extracted from an increasing number of unattended wells connected to a network of gathering pipeline systems. The petroleum is then processed, compressed and dehydrated before being piped to market via cross country transmission pipelines or used on site. Liquid petroleum products may also be trucked to other processing facilities. As wells and gathering systems are generally located on grazing or cultivated land, land owners and occupiers have raised concerns about how the petroleum industry identifies and manages potential petroleum leakage at their facilities.

The *Petroleum and Gas (Production and Safety) Act 2004* (PG Act) requires petroleum operators to apply a rigorous, risk-based approach to the safety of operations and possess a comprehensive asset integrity regime to minimise risks associated with the development and operations of petroleum infrastructure. Compliance with this legislation will result in an extremely low level of risk from leaks at petroleum operating plant.

The reporting resulting from this Code will ensure that the Petroleum and Gas Inspectorate, as the safety and technical regulator, is appropriately informed and the petroleum industry's performance on petroleum leak management is appropriately measured.

### 1.1.1 Other relevant industry standards

There is currently no standard specifically for the identification and management of leaks on petroleum operating plant.

However, *AS/NZS: 4645.1:2018 'Gas distribution network - Network management'* standard describes operational and leakage management obligations for natural gas distribution networks in CBD and metropolitan areas of all Australian and New Zealand cities. This urban environment provides greater risks and consequences for leaks than the rural gas field environment and sets a high benchmark for the management of leaks for the production industry.

Therefore, this standard has been adopted as the basis for this Code, as it represents the most relevant and stringent standard to apply to detection, classifying and managing petroleum leaks in petroleum operating plant. This Code has been drafted to meet or exceed the requirements of the *AS/NZS: 4645.1:2018 'Gas distribution networks Part 1: Network management'* standard.

Similarly, this Code adopts a conservative approach to the classification of reportable leaks.

A standardised leak reporting methodology has been adopted for the industry under this Code.

## 2.0 Purpose and application

The Code is designed to be considered and used in conjunction with the petroleum operator's internal risk assessment processes and operating procedures under their safety management systems. The Code requires petroleum operators to develop a process for the systematic monitoring and management of leakage to mitigate risks from gas leaks. The processes should ensure an adequate and timely response to detect, classify, monitor, or repair and report leaks. The processes should also provide information that can analyse deterioration of the petroleum operators' assets.

Petroleum is defined under section 10 of the PG Act.

This Code will help to ensure that:

- a. risk to the public and production workers is managed to a level that is as low as reasonably practicable
- b. regulatory and applicable Australian Standard requirements, as well as the operator's internal requirements are understood and implemented
- c. the life of petroleum operating plant is managed effectively through timely leak repair and periodic survey

### 2.1 Objective

The objective of this Code is to set a requirement for the operator of petroleum operating plant to develop and implement a:

- a. methodology and system to detect petroleum leaks
- b. procedure to classify and action leaks
- c. notification procedure to the Petroleum and Gas Inspectorate for reportable leaks

## 2.2 Application

The Petroleum and Gas (Safety) Regulation 2018 (PG Regulation) requires operators of petroleum operating plant (referred to in this Code as 'petroleum operators') to comply with this Code to detect, classify, repair and report gas leaks at petroleum operating plant. This Code covers the petroleum operators' responsibilities for petroleum leaks as defined in section 10 of the PG Act and not leaks such as TEG, compressor oil or produced water (section 15A of PG Act).

## 2.3 General safety

Petroleum is a safe energy source that is a by-product of the natural conversion of plant material to coal. Natural gas, which is the main petroleum component produced in Queensland, can be used as a fuel in heaters, stoves and hot water systems in homes and businesses.

Methane is non-toxic and is only flammable when the gas concentration is between 5% and 15% of the total gas/air mixture.

Natural gas is lighter than air, meaning it will rise naturally and quickly dilute and dissipate into the air in an outdoor environment. In addition to its application in domestic and business environments, natural gas is safely used in many other areas including transport fuels and as feedstock or fuel for industrial plants.

Petroleum wells, gathering systems and processing facilities are constructed to Australian or international standards or codes of practices where applicable. These plants are pressure tested prior to commissioning to verify the integrity of the plant and the petroleum operators conduct routine monitoring to ensure ongoing safe operation of the operating plant.

This Code describes the minimum actions that petroleum operators shall undertake for all petroleum leaks. This covers all types of petroleum that is produced including oil, condensate and gas.

For methane to reach a flammable state, it must first form a concentration level of between 5% and 15% of gas in air. A typical potential gas leak at a well or processing facility is most likely to emanate from a gas flange or screwed joint.

The lower explosive limit (LEL) or lower flammable limit (LFL) of a combustible gas describes the smallest amount of gas that supports a self-propagating flame when mixed with air (or oxygen) and ignited. In gas-detection systems, the amount of gas present is specified as a percentage (%) LFL.

Zero percent (0%) LFL denotes an atmosphere that is free from a combustible gas. One hundred

percent (100%) LFL denotes an atmosphere in which the gas concentration has reached its lower flammable limit. The relationship between percentage LFL and percent by volume differs from gas to gas (for example liquid petroleum gas (LPG) has a different LFL to coal seam gas (CSG)).

In addition, the actions in this Code are required to be undertaken by petroleum operators for petroleum leaks.

Appendix 1 provides a comparison of the properties of CSG compared with LPG.

## ***2.4 Definitions***

Definitions for terms used in this Code are outlined in *Appendix 2 and Appendix 3*.

## **3.0 Code operational requirements**

At a minimum, petroleum operators shall comply with the following requirements to ensure that risks from gas leaks at petroleum operating plant are reduced to as low as reasonably practicable.

### ***3.1 Risk assessment***

Petroleum operators shall carry out a risk assessment to identify the risks posed by leaks from their operating plant and implement appropriate actions to reduce those risks to as low as reasonably practicable as required under the PG Act.

As part of their safety management system (SMS) as required under the PG Act, each petroleum operator shall develop a risk-based management system (Leak Management Plan) for leaks from wells, gathering systems and processing facilities, to ensure that leaks are:

- a. detected
- b. classified
- c. controlled (e.g., isolated, rectified, monitored) as determined by considering the risk and determining the appropriate controls
- d. reported if required

*Note: there shall be systems in place, and initiated, to ensure the control actions are completed.*

This Code does not remove the obligation to adequately assess and manage risk.

## 3.2 Inspection frequency and procedure

Petroleum operators shall ensure routine visits to–petroleum well sites, gathering systems and processing facilities are undertaken on a regular basis in accordance with their operating and maintenance plans. This requirement covers all petroleum plant that have not been abandoned or decommissioned including petroleum wells.

Petroleum operators shall at a minimum:

- a. ensure that petroleum production operators carry and monitor personal calibrated gas detectors during every routine operational visit to well sites, gathering systems and processing facilities
- b. ensure that petroleum production operators are properly trained and competency-assured to identify leaks detected by their personal gas monitors, and to take appropriate actions in line with this Code, during routine operational visits to operating plant
- c. ensure formal leak survey inspections are conducted at least on the minimum frequencies detailed in table 2 using calibrated gas detectors
- d. ensure that leaks detected at petroleum operating plant are classified in line with this Code
- e. ensure that appropriate remedial actions to manage leaks are taken in line with this Code
- f. undertake leak inspections of individual operating plant at an increased frequency as determined by the risk assessment and in consideration of previous audit/inspection findings for those specific facilities

## 3.3 Leakage Survey

### 3.3.1 Leak survey frequency and methodology

Leakage surveys are undertaken to achieve several outcomes including safe management of leaks, to reduce emissions and to gather evidence for integrity management programs.

The frequency and methodology of the leakage survey, shall be documented based upon consideration of the following:

- Characteristics of petroleum being produced (in particular, heavier than air versus lighter than air gas)
- Age-related deterioration
- Design aspects that may increase the likelihood or consequence of leakage
- Consequences from leakage, in particular, in locations where the landowners / public / workers may be impacted by leakage from the petroleum operating plant
- Leakage paths, i.e., the potential for gas to travel or be contained by sealed surfaces

- Proximity or interaction with other infrastructure
- Construction of buildings and other structures that could lead to the build-up of gas
- Areas of the petroleum operating plant that are more prone to leakage, both in number and classification
- Gas leakage detectability
- Safety of personnel in relation to other equipment
- Intervals for the calibration of the detection equipment and validation of the detection methods

The leak survey will ensure that a suitably trained and a competent person shall survey for leaks on all petroleum operating plant by using a method that is approved by the petroleum operator.

Facility or system	Minimum leak survey frequency
Petroleum well - subsurface	5 years
Petroleum well – surface equipment	5 years
Gathering system - subsurface	5 years
Gathering system – assemblies (HPV, LPD, Valves etc)	5 years
Processing facility	5 years

**Table 2: Leak survey frequency.**

Note - Petroleum gathering systems in CSG developments are generally installed with high point vents (HPV) at key locations. These HPVs are designed to release small quantities of gas when a buildup occurs in the gathering system. HPVs are not designed to release large quantities of gas over extended periods of time.

Note – The designated leak survey frequency period may be deferred by a maximum period of three months when exceptional issues have occurred. Some examples of these issues include significant weather events and pandemics. The justification for a deferral shall be documented by the operator of the petroleum operating plant. This justification shall confirm that there are no know defects present that will give rise to significant premature failure.

### 3.3.2 Tester and instrument certification

All gas leak surveys will be conducted by trained personnel using industry-accepted gas detection instruments calibrated in accordance with the manufacturer’s requirements. Gas detectors used for leakage surveys shall be maintained and tested in accordance with manufacturer’s instructions and

be capable of testing to a low reading of at least 10 PPM or equivalent. Gas detectors used in in gas surveys shall be suitable for the type of gas being produced.

### 3.4 Leak classification

The objective of a leak classification system is to ensure an effective response to leaks based on risk profile.

#### Class 1

- Class 1 leaks are leaks that should be actioned immediately until the risk has been eliminated or reduced to a level where it can be reclassified to a lower Class. The circumstances of each leak are unique and can only be properly assessed by reviewing all the specific factors, however any of the following situations would initially be categorized as a Class I leak:
  - A leak reported by the police, a public authority or member of the general public; this classification is allocated and retained until such time that the report has been investigated and the correct classification of the leak determined. (e.g., an HPV that is venting for an extended period and reported by the public) Note The investigation and prioritization for attending leaks may occur immediately by obtaining additional information from the reporter of the leak.
  - A leak detected inside an enclosed structure. <sup>Note 1</sup>
  - A leak in a duct or casing pipe that provides a leak path into an enclosed structure.
  - A leak close enough and large enough that gas is likely to enter the enclosed structure.
  - A leak that, based on all the pertinent factors, is or could be a danger to the safety of the general public or workers.
  - A leak that resulted in a gas ignition.
  - A leak that can be heard, felt, or seen. <sup>Note 1</sup>
  - A liquid petroleum / condensate loss of containment that exceeds 200 litres of hydrocarbons. <sup>Note 2, 3</sup>
    - Note 1 Leak requires immediate action to prevent a dangerous incident
    - Note 2 Leak not considered a class 1 if safety contained such as that of a banded area.
    - Note 3 Water content of the fluid may be excluded to determine the hydrocarbon volume.

## **Class 2**

- Class 2 leaks are leaks that pose little to no immediate threat at the time of classification but have the potential to deteriorate so should be scheduled for repair in a timely period
- A risk assessment shall be conducted to evaluate the potential threat and align the mitigation timeline accordingly
- Monitoring conditions shall be conducted in accordance with the risk assessment
- If the leak has minimal potential to deteriorate, work may be scheduled for the next outage period. Monitoring shall be conducted periodically at an interval not exceeding 12 months
- Class 2 leaks include any of the following situations:
  - A leak, or series of leaks, of size and position in relation to buildings and places where the public or landowners may assemble that warrants scheduled repair
  - A leak that, considering the likely source, the location, and the proximity of enclosed structures, is likely to deteriorate
  - A leak detected on the subsurface section of a petroleum well (if not significant enough to be classed as a class 1 leak)

## **Class 3**

- Class 3 leaks are leaks that pose no immediate threat and do not require scheduled repair. They should be recorded, and the classification confirmed at the next survey. Leaks in this category include any of the following:
  - A leak found remote from buildings that is considered safe to leave until the next survey
  - A leak that, based on all the pertinent factors, is not a danger to the safety of the public or persons working on the petroleum plant, and is not likely to deteriorate before the next survey

## ***3.5 Repair***

The repair of leaking or damaged plant shall be carried out in a safe manner and, where necessary, the plant shall be shut down, or the operating pressure reduced to a safe level.

The operator of the petroleum operating plant shall develop processes for the repair of any petroleum plant, based upon consideration of the following:

- Type of repair – temporary or permanent
- If a temporary repair how long will the temporary repair remain in place

- Age and deterioration of asset
- Criticality of asset for production, including requirements for a bypass or alternative supply
- Repair material and technique
- Location and magnitude of the leak
- ownership of the land on which the petroleum plant is located and accessibility of the operating plant by the public
- History of similar leaks and their repair
- Gas type being produced and transported
- Safety and environmental issues, i.e. staffing levels, resources, personnel protective equipment (PPE) and procedures to ensure safety while performing maintenance activities
- Monitoring and control of gas concentrations

In the event that a petroleum operator detects a leak at a petroleum site, the operator shall:

- Comply with the petroleum operator's safety management system requirements for risk assessment and emergency response

Repair work must consider the following specific issues:

- For leaks identified on well casings or adjacent to the well casing (where a work over rig is necessary to affect repair) - determine whether the leak requires immediate repair, or whether the risk can be adequately managed via other control measures until a work over of the well is scheduled for normal operational reasons. The risk assessment to determine the above shall consider the location of the well, likely access to the well from landholders or the general public, and landholder/community concerns in relation to the leak
- For leaks identified on gathering systems (where an excavation is necessary to affect repair) - determine whether the leak requires immediate repair, or whether the risk can be adequately managed via other control measures until a planned excavation can be undertaken. The risk assessment to determine the above shall consider the location of the site, likely access to the site from landholders or the general public, and landholder/community concerns in relation to the leak
- Consideration of establishing an exclusion zone around the leak and impose appropriate restrictions on access to the exclusion zone, along with any other necessary immediate controls

## 3.6 Notification

### 3.6.1 Prescribed Incident

The identified leak may be classed as a prescribed incident under the category of a dangerous incident. If the leak meets this criterion the process defined in section 10 of the Petroleum and Gas (Safety) Regulations 2018 for reporting shall be followed.

Note: If the leak is classed as a prescribed incident the leak does not need to be reported under the reportable leak process.

More information on reporting prescribed incidents and the guideline can be found [here](#).

### 3.6.2 Reportable leak

The identified leak may be classed as a reportable leak in this Code – see appendix 2 for definition of a reportable leak.

In the event that a petroleum operator detects a reportable leak at a petroleum site, the operator shall in addition to the requirements in section 3.5:

- i. Notify the Petroleum and Gas Inspectorate in writing within 5 business days of the detection of any leak within the reportable leak range (see Appendix 4) using the online form. This notification will provide relevant details including the date of identification, nature and level of leak, location and name of the operating plant, and the rectification actions taken. If the remedial work has not been completed the notification will provide details as to when the leak is planned to be repaired

The Petroleum and Gas Inspectorate may, upon review of the notification, require further information or action in accordance with its enforcement policy and regulatory role.

Reportable leaks identified in a planned leak detection survey requiring no immediate action may be reported at the finalisation of the survey or interval not exceeding two weeks

### 3.6.3 Notification of a prescribed incident or reportable leak to landowner

In the event that a petroleum operator detects a prescribed incident or a reportable leak at a petroleum site, the operator shall in addition to the requirements in section 3.5, immediately notify the land owner or occupier of the property on which these leaks are occurring if the leak cannot be repaired immediately and is likely to impact any of the land owner or occupier facilities or activities.

### 3.6.4 Liquid petroleum reportable leaks

Liquid petroleum reportable leaks may also be required to be reported to Department of Environment and Science (DES) in line with the production company's environmental approvals.

### 3.6.5 Recording leaks for petroleum operators

All leaks detected and classified will be recorded in the petroleum operator's records management system.

Records of leakage reports and surveys shall be periodically analysed to determine any change in leakage levels. Any increase in leakage trends shall trigger a review of the control measures for leakage management.

## 4.0 Review of this Code

This Code will be subject to regular review and revision or in the event of significant change to operations or regulatory requirements.

## Appendix 1 — Gas comparison table

The table below compares the specific gravity, energy content and the PPM (parts per million) values corresponding to 100%, 10%, 5% and 1% LFL readings for CSG (typically predominantly methane) and LPG respectively.

The table provides a comparison of the different measurement units (LFL and PPM) and demonstrates that compared to LPG, which is a gas in common domestic use, CSG/methane represents a much lower risk although both gases when managed appropriately are safe to use.

For example, the gravity for CSG/methane is much less than one, indicating that methane will rise and disperse into the atmosphere when released and will not form pools at ground level as in the case of LPG.

The heating value of LPG is much higher than CSG/methane, meaning LPG emits more energy per cubic metre of gas when it is burnt.

The PPM values indicate that LPG has a greater risk of flammability even at substantially lower levels of gas concentration in air.

This table is for informative purposes only.

Gas	Specific Gravity <sup>2,3</sup>	Heating Value (MJ/m <sup>3</sup> ) <sup>3,4</sup>	PPM at LFL	PPM at 10% LFL	PPM at 5% LFL	PPM at 1% LFL
Methane (CSG)	0.554	38.7	53,000	5,300	2,650	530
LPG typical	1.609	95.5	21,000	2,100	1,050	210

**Table 3: Gas comparison**

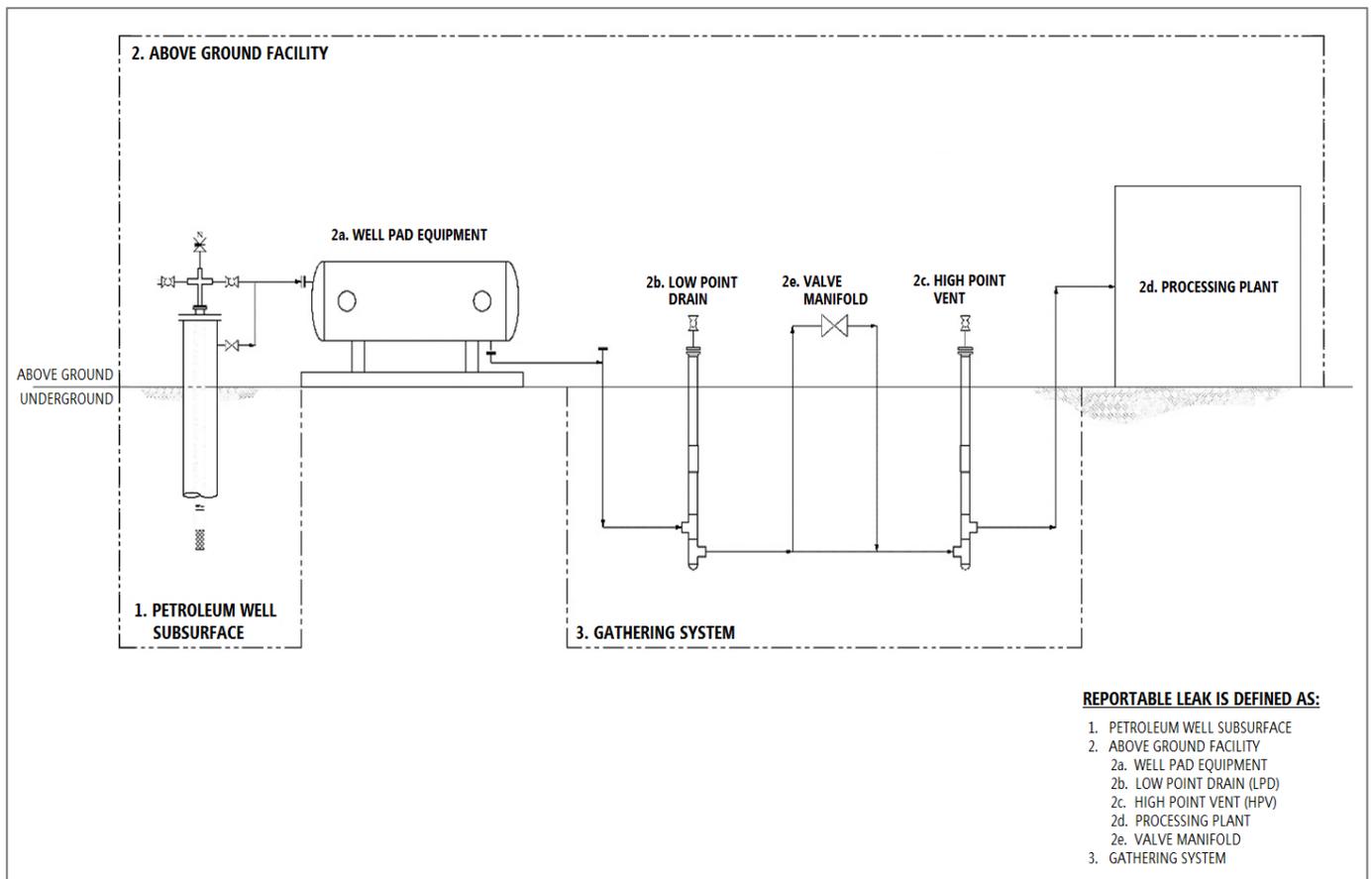
---

<sup>2</sup> Specific gravity is the density of the gas relative to air. Values greater than one indicate that the gas is denser than air and can accumulate at ground level to form pools. Values given are at normal atmospheric temperature and pressure — 20°C and 1 atmosphere respectively.

<sup>3</sup> Values in columns 2 and 3 are an average calculated from maximum and minimum Australian pipeline quality natural gas specifications.

<sup>4</sup> Approximate gross heating value.

## Appendix 2 — Reportable leak definition



### A reportable leak is defined as:

For petroleum facilities, surface equipment at a petroleum well and gathering systems – a Class 1 leak.

Subsurface leaks on a petroleum well located on a petroleum authority shall be reported as per the requirements of the *Code of practice for the construction and abandonment of petroleum wells and associated bores in Queensland*.

## Appendix 3 — Definitions

Term	Definition
Petroleum operator	The operator of petroleum operating plant.
Leak management plan	<p>A plan that is part of the petroleum operator’s safety management plan for leaks from petroleum operating plant to ensure that leaks are:</p> <ul style="list-style-type: none"> <li>a) identified</li> <li>b) classified</li> <li>c) controlled (e.g. isolated, rectified, monitored) as determined by considering the risk and determining the appropriate controls; and</li> <li>d) reported if required</li> </ul> <p><i>Note: there shall be systems in place and initiated to ensure the control actions are completed.</i></p>
Routine operational visit	<p>A routine check or visit by production operators to complete an operational check or complete planned or unplanned maintenance. These visits can include normal operational functions for example checking filters, drains etc.</p> <p>Petroleum production operators shall carry and monitor personal calibrated gas detectors during every routine operational visit to wells and processing site facilities.</p>
Leak survey inspection	A formal leak inspection of the petroleum operating plant. This inspection is required by the petroleum operator’s asset integrity process and should be completed by a competent person and would make observations on the integrity of existing petroleum operating plant. This inspection will include (as a minimum) a comprehensive leak survey of all components of the petroleum operating plant with an appropriate leak detector.
Field technician	Any person involved in the operations and maintenance of petroleum operating plant.
Liquid petroleum	Petroleum that is transported from a petroleum well to a processing facility in a liquid phase excluding associated water.
Enclosed structure	A structure with enclosed areas which are defined as those areas confined on more than four of their six possible sides by walls, floors, or ceilings which results in impeded gas dispersion.

**Table 4: Definitions**

## Appendix 4 — Petroleum and Gas Inspectorate contact details

### Telephone reporting

- The Queensland Government’s Petroleum and Gas Inspectorate emergency advice and notification hotline for petroleum or fuel gas incidents is **1300 910 933**
- This is a 24/7 hotline number and is to be used to report prescribed incidents via telephone

### Reporting in writing

- Written reports for reportable leaks are made using online [PG-Operating Plant Safety Information form](#) on the RSHQ website