Reference document

Gas emissions

- Gas emissions include 'fugitive emissions' and 'gas seeps'.
- Monitoring and measuring these emissions is important for:
  - Protecting the safety of workers and others in areas with oil and gas industry operations.
  - Monitoring environmental impacts, including greenhouse gas (GHG) contributions.
  - Improving the design and operation of equipment.
  - Validating and improving subsurface oil and gas reservoir models.
- In Australia, fugitive emissions are very low, and compare well to overseas operations.
- Measuring gas seeps and fluxes helps monitor potential impacts of oil and gas operations.

1. Introduction

Gas emissions from oil and gas operations can occur through equipment leaks, or planned releases such as venting from pressure safety valves. These are referred to as 'fugitive emissions'.

Gas can also find its way from gas reservoirs below the ground to the surface, either naturally or via paths inadvertently created by industry operations. These types of emissions – whether caused by natural or human factors – are referred to as 'gas seeps'.

Monitoring and measuring these emissions is important for:

- Identifying potential fire or explosion hazards.
- Monitoring environmental impacts, including greenhouse gas (GHG) contributions.
- Improving the design and operation of equipment.
- Validating and improving subsurface reservoir models

2. Gas emission safety

Under certain conditions, gas emissions may be a fire or explosion hazard to workers and people near oil and gas operations. If certain gases are present, they can also be a toxic hazard.

2.1 Fire or explosion hazards depend on the composition of the gas. In many gas wells, including coal seam gas (CSG) wells, the gas is almost pure methane. Methane is not toxic, but when mixed with air it can be flammable or explosive[1] within a narrow window of 5% to 15% concentration. Below 5% there is too little methane to burn; and above 15% there is not enough oxygen in the air for a flame. This narrow window is why natural gas can be used safely in homes. However, when other gases, such as propane or butane, are mixed with the methane the ignition characteristics can be different.

2.2 Toxicity can be introduced when other gases are mixed in the methane gas stream. Methane is not toxic, but if other gases are present toxic conditions can arise. One such gas, which is not uncommon in the industry, is hydrogen sulphide or H_2S, which has a distinctive rotten egg smell. In Australia, high concentrations of H_2S are unusual. Standard tests generally detect this gas so that precautions can be taken.

[1] http://www.chiefscientist.nsw.gov.au/__data/assets/pdf_file/0006/38337/NSW-Chief-S-and-E-Methane-Origins-28_11_13_LS-v2.pdf

3. Fugitive emissions

Fugitive emissions can occur through equipment leaks, or planned releases such as venting to atmosphere from pressure safety valves.

Minimising fugitive emissions is good oil and gas field practice as it reduces safety risks and captures a valuable resource for sale.

It also lowers GHG emissions as methane in natural gas has a global warming potential 21 times that of carbon dioxide (CO_2) [2].

Australia has relatively modern oil and gas industry practices.

(Above) Locating equipment leaks at a CSG well (CSIRO)[4]

In North America it is not uncommon to release methane directly to the atmosphere – this is called cold flaring.

But in Australia the methane is either captured or burnt in a flare, which reduces the GHG impact.

The volume of fugitive emissions escaping gas wells is actually very small.

In June 2014 CSIRO released a report[3] — *Field Measurements of Fugitive Emissions from Equipment and Well Casings in Australian Coal Seam Gas Production Facilities* — for the Commonwealth Department of the Environment.

Methane emissions were measured at 43 CSG wells – six in NSW and 37 in Queensland.

CSIRO found that the median CO_2 emissions from these gas wells was 0.6 grams per minute – about the same amount of methane emitted by four cows.

CSIRO noted that 'these emission rates are very much lower than those that have been reported for US unconventional gas production', and 'were very low, especially when compared to the volume of gas produced from the wells'.

[2] http://www.environment.gov.au/system/files/resources/b24f8db4-e55a-4deb-a0b3-32cf763a5dab/files/national-greenhouse-accounts-factors-2014.pdf
[3] https://www.environment.gov.au/system/files/resources/57e4a9fd-56ea-428b-b995-f27c25822643/files/csg-fugitive-emissions-2014.pdf

4. Gas seeps

For thousands of years, it has been known that natural gas can seep naturally from the ground[4].

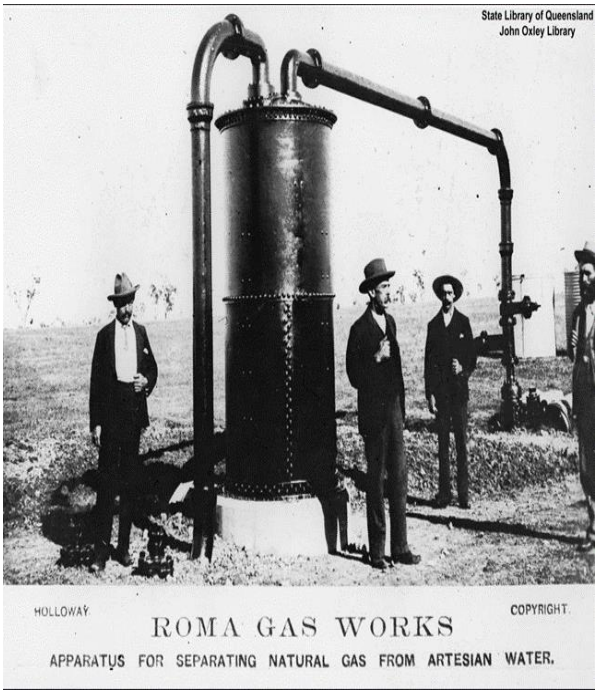
Measurements over the Queensland coal and gas fields dating back to the early 1980s have shown elevated methane measurements[5].

Many of these measurements were taken before any material gas exploration and development had occurred.

Indeed, natural gas has been recorded in Australian water bores as early as 1889.

One such bore in the Great Artesian Basin was used to supply the town of Roma's gas works (see below).

Year	Discovery	Source
1889	Eagle Farm water bore gas at 1500 feet	EAGLE FARM BORE. (1889, August 23). The Brisbane Courier (Qld: 1864 - 1933), p. 5.
1900	Roma natural gas entered a water bore at 1.1km deep	GAS FROM BORE WATER. (1900, December 8). The Brisbane Courier (Qld: 1864 - 1933), p. 11.
1927	Gas flowing from Joulnie Station water bore, Broken Hill	JOULNIE STATION BORE. (1927, November 3). Barrier Miner (Broken Hill, NSW : 1888 - 1954), p. 2.
1928	Gas from water bore in Longreach and continuous flame 6 feet	LONGREACH BORE. (1928, September 13). The Brisbane Courier (Qld: 1864 - 1933), p. 16.
1930	Gas explosion during water bore drilling at Kilmorey Station, Mitchell	FLOW OF GAS IGNITES. (1930, October 17). The Longreach Leader (Qld: 1923 - 1954), p. 10.



CSIRO is researching[6] gas seeps and methane emissions over Australia's most active onshore gas region – Queensland's Surat Basin (see below).

It is monitoring the methane emissions as the fields are developed and production increases.

The research is still in its early days, but CSIRO has noted that 'methane emissions from these seeps are very small and pose no health concerns to humans'.

[4] http://www.science20.com/news_articles/natural_gas_seeps_eternal_flames_of_ancient_times_interest_modern_geologists-155613

[5] http://www.gasfieldscommissionqld.org.au/resources/gasfields/fact-sheets/historical-evidence-of-landscape-gas-seeps-in-qld.pdf

[6] http://www.gisera.org.au/publications/tech_reports_papers/ghg-emission-proj-methane-seeps.pdf

The researchers found Surat Basin methane concentrations were close to the background measurements at other reference stations such as Cape Ferguson in North Queensland.

However, they did note higher localised concentrations near some coal sampling bores, a known Condamine River seep location, and agricultural activities such as cattle feed lots.

A low-resolution satellite mapping of Australia did not reveal any unusual methane concentrations associated with oil and gas activities.

Methane monitoring container (left) and concentration instruments (inset); flux tower (right) and meteorological instruments (inset) [CSIRO]

The CSIRO research is a good basis for measuring changes in the gas seep rates of the Surat Basin as the oil and gas industry develops.

5. Conclusion

Gas emissions are of concern to the oil and gas industry. Measuring these emissions and undertaking and applying ongoing research ensures that the potential impacts are understood and appropriate responses to minimise the impacts can be implemented.