

Safety guidelines for operators working on or near biogas capture, storage and combustion systems

The collection and handling of biogas is accompanied by a number of hazards, the most significant of which include:

- toxicity of hydrogen sulphide gas (H₂S);
- flammability of biogas when mixed with air in specific proportions; and
- suffocation due to the exclusion of air, especially in confined spaces.

It is very important that you understand and can identify potential hazards and know the correct procedures for normal practice and in the event of an emergency.

Safe operating practices are organized as Work Instructions specific to the needs of your plant. Always follow work instructions.



Exclusion signage
Image: Teys, Beenleigh

The risk associated with biogas hazards can be reduced by safe operating practices. A hazard analysis should have been undertaken by your plant to identify the dangers of specific tasks in order to reduce the risk of injury to you or any personnel working on or near CAL and their associated infrastructure. Operators should know and understand these safe operating practices.

Access to the CAL and biogas train area should be restricted to authorized personnel only and appropriate exclusion signage displayed.

General Safe Operating Practices to Protect Infrastructure

The following safe operating practices are recommended to protect infrastructure associated with the CAL from damage.

Safe operating practices to protect infrastructure

- Do not inflate covers more than 2 metres above top of wall (TOW) during normal operation. If significant storage of biogas is desired (for example to carry biogas over a weekend), purpose built gas storage systems are available and are a safer option.
- Avoid operating a CAL under vacuum (negative pressure) unless specifically designed to do so. Negative pressures under the cover risk oxygen and nitrogen ingress.
- Undertake regular inspection of the overpressure relief system for blockages and other issues. Inspect at least weekly where pre-treatment of effluent is rudimentary and/or scum is observed accumulating under the cover.
- Inspect the CAL cover, the anchor perimeter and the biogas line at least weekly to check for:
 - biogas leaks
 - physical damage to the cover (for example animal damage, tears around spears or stormwater removal sumps, etc) or piping
 - excessive foam or crust in outlet weirs
 - structural deterioration of the cover
 - excessive stormwater sitting on the cover
 - unusual movement or dislocation of weighting pipes or system.
- Remove accumulated stormwater as quickly as possible to reduce the risk of cover damage and interference with overpressure relief systems, inlets and outlets.
- Report damage to the appropriate company official immediately to ensure problems are rectified promptly.
- Remove condensate accumulation in the biogas train regularly (preferably by automatic devices) to prevent blockages and corrosion.
- Minimise vehicular traffic in the area and strictly control the speed to avoid loss of the vehicle and occupants into the deep tanks and/or damage to the CAL components from collision with the vehicle (for example the vehicle hitting the biogas piping).
- Do not operate the flare during total fire ban days (except for totally enclosed flares).



Checking for leaks in the CAL wall
Image: NB Foods, Oakey



Turning on stormwater pump
Image: Teys, Beenleigh

General Safe Operating Practices when working on the CAL Cover

From time to time, personnel need to access the floating CAL cover for maintenance or monitoring reasons. While the likelihood of cover failure is very low, the severity associated with a person falling through the cover is high. For this reason, access onto the cover should be minimised and any access treated with due care.

An appropriate hazard analysis is recommended prior to entry. Most sites have their own safety requirements in this regard. Recommended as a minimum to protect personnel working on the cover and reduce the risk to human health and safety.

The following checklist of safe operating practices is recommended as a minimum to protect personnel working on the cover and reduce the risk to human health and safety. Note that some companies have elected to ban work on covers.

Safe operating practices when working on CAL covers

- Limit access to the CAL and biogas train area to authorized persons only. Train authorised person to understand the potential hazards and the correct procedures to adopt when working in the zone or in the event of an emergency.
- Ensure footwear and clothing do not contain sharp components that might damage the cover.
- Inspect the cover carefully prior to access to ensure that it is structurally sound and contains no areas of deep water.
- Avoid access to the cover when inflation is substantial e.g. more than 2 m above the top of the lagoon wall.
- Do not carry excessively heavy equipment on to the cover and ensure equipment does not possess surfaces, protrusions or edges likely to damage the cover. Do not drop heavy equipment or packages from standing height on to the cover surface.
- Ensure a personal gas detector capable of detecting methane and H₂S is worn by personnel working on the cover of a CAL.
- Consider carefully the possession of mobile phones, laptops and other electronic equipment on the cover for its potential as an ignition source.
- Take care near wet areas to avoid slippage injury.
- Ensure sample/inspection port on the cover is only opened when the surrounding cover area is at the water level to avoid excessive biogas release.
- Ensure a spotter is always located off the cover and is equipped with communication equipment to contact emergency services when persons are working on the cover.
- Ensure care is taken to avoid persons getting heat stress when working on the cover for long periods of time.
- Strictly control any 'Hot' work carried out on the CAL and consideration of the likelihood of ignition of biogas releases.



Walking on the CAL cover
Image: NB Foods, Oakey

General Safe Operating Practices: Working near the CAL

Under normal operation, biogas concentrations beyond the edge of the CAL cover are likely to be negligible since the system is tightly sealed. Nevertheless, the confinement of the biogas under the cover and in biogas piping means that there is the possibility of local release in the event of a problem.

The following safe operating practises will reduce the risk to human health and safety for personnel working near the CAL.

Safe operating practices when working near CAL covers

- Limit access to the CAL and biogas train area to authorized persons only. Train authorised person to understand the potential hazards and the correct procedures to adopt when working in the zone or in the event of an emergency.
 - Ensure a personal gas detector capable of detecting methane and H₂S is worn by personnel working on the cover of a CAL.
 - Consider carefully the possession of mobile phones, laptops and other electronic equipment on the cover for its potential as an ignition source.
 - Ensure appropriate safety precautions are implemented prior to accessing inlet and outlet pits that are designated confined spaces.
 - Take extreme caution when opening any valve or piping to access the contents of the CAL. These may include emergency biogas venting mechanisms; sludge removal piping valves and biogas condensate drain valves.
 - Strictly control any 'Hot' work carried out on the CAL and consider the likelihood of ignition of biogas releases.
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Taking a sample for a port
Image: NB Foods, Oakey

Emergency Situations

Key biogas hazards relate to biogas releases and possible fires and explosions. The most serious impacts relate to:

1. large releases of biogas from CALs, for example by a significant rupture of the cover when over-inflated; and
2. explosion impacts from enclosed space ignition of biogas in generator set installations.

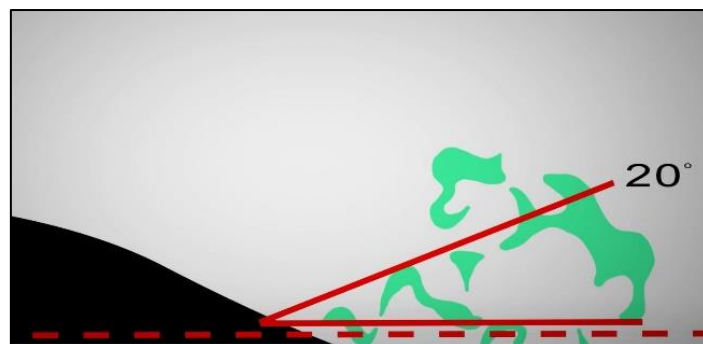
The impact of biogas releases from small leaks in the cover, or from releases from biogas transmission pipelines between the CAL and flare are considered low due to the low operating pressures in the system.

1. Large Releases from CALs

The most probable releases are likely to be due to:

- over-pressure in the CAL leading to large release via the overpressure protection system;
- a significant rupture or tear in the CAL cover; and
- a significant failure of gas tightness in the cover anchoring system.

Large-scale releases 20°C above the horizontal are buoyant and disperse rapidly with little impact at the ground level. In contrast, large gas releases from the cover that are near horizontal in orientation can have significant ground interaction and travel substantial distances at ground level. This form of release poses a suffocation and H₂S toxicity hazard to personnel and animals and a flash fire risk with sufficient energy to seriously injure or kill personnel nearby.



Near horizontal in orientation biogas releases may pose a suffocation and H₂S toxicity hazard to personnel and animals and a flash fire risk.

In the event of a large release with a near horizontal orientation

- Declare an immediate exclusion zone of at least 50 metres around the CAL.
- Evacuate all personnel and animals from an area within at least 100 metres of the release point.
- Deactivate all potential ignition sources within 50 metres of the release point including vehicles, mobile phones, electronic controls, stormwater removal pumps, biogas flare etc.
- Maintain the exclusion zone until the gas release has reduced the pressure under the cover to less than 0.05 kPa.
- Access to the damaged CAL (once the cover pressure has fallen to less than 0.05 kPa) should be only by authorised persons equipped with suitable gas monitoring and other personal safety equipment to assess repair
- Minimise wastewater flow to the damaged CAL until repairs are affected to the extent that this is practicable.

2. Enclosed Space Ignition

The impacts of an explosion of biogas in an enclosed space are sufficiently severe to warrant careful attention to ensuring that the risk is mitigated through the use of well-designed ventilation systems, interlocks and gas detection so that the initial biogas release event is unable to propagate to an explosive situation.

Safety Management Plan

A site-specific safety management plan (SMP) should be developed covering the risks and management associated with the biogas system. Some States, such as Queensland and WA have prescriptive safety management plan requirements with clear guidelines as to the content of the SMP. All meat processing plants have formal workplace health & safety management systems in place and as much as practicable, the biogas SMP should be consistent and integrated within this system.

Minimum inclusions in a biogas system SMP

- A description of the biogas system including plant layout, a process flow diagram, a scaled map indicating distance to nearest receptors and location of critical isolation equipment.
- The organisational structure and safety appointees and responsibilities. Some States have specific requirements regarding responsibilities pertaining to biogas installations.
- Operator(s) of the system.
- A formal safety or risk assessment of the biogas system. This should include hazard identification, assessment of possible risks and associated control measures to eliminate or minimise the risk as low as reasonably practicable.
- Documented standard operating and maintenance procedures. All meat processing sites operate formal OH&S systems which can be expanded to include the CAL and biogas train. This should include interactions with external contractors who may need to work on or near the system so that all work is performed in a controlled and safe manner.
- Description of control systems. These should be clearly identified and the personnel responsible trained in their use.
- Emergency response procedures. These identify the response required for given events, allocate responsibilities and identify equipment, evacuation areas and training required.

Personnel should refer to the AMPC Biogas Capture, Storage and Combustion Manual for guidance on safety practices during construction and decommissioning phases

To ensure your own safety and the safety of others working on or near CALs and biogas trains ensure you know and follow your plants' Safety Management Plan. If you have any concerns always seek the advice of your supervisor.



Ensure you know and follow your plants' Safety Management Plan
Image: JBS, Dinmore