



Essential guide: our Critical Risk expectations

Geothermal Gases

The word **MUST** means it is a mandatory requirement. Where you see the words **YOUR CALL** it means you are strongly advised to do this, but you can use your judgement.



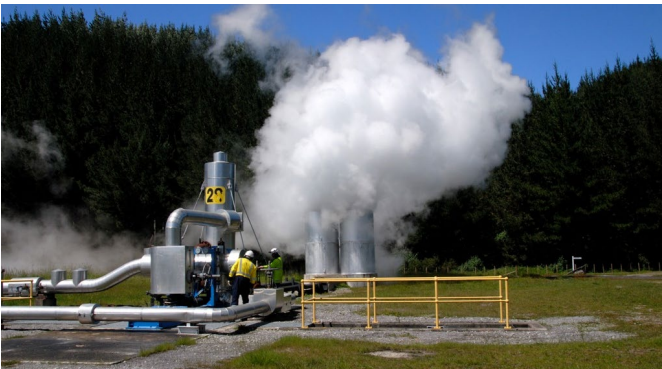
Our most prevalent geothermal gases

Hydrogen Sulphide (also known as H₂S, sewer gas, swamp gas, stink damp, and sour damp) is a colourless gas known for its pungent 'rotten egg' odour at low concentrations. At high concentrations H₂S has no smell.

Carbon Dioxide (also known as CO₂) is a colourless, odourless gas.

H₂S and CO₂ are heavier than air and can accumulate in low lying or unventilated areas. They are fast-acting gases, impacting many systems within the body.

The health effects of H₂S and CO₂ depend on how much you have been exposed to. Extreme exposure to both gases can be fatal, mild exposure to both gases can cause some respiratory difficulty. The mild symptoms of CO₂ are very similar to that of H₂S.



Where you might find H₂S and CO₂

H₂S and CO₂ are naturally occurring within the steamfield reservoir and brought to surface saturated within the steam phase.

As the pressure and temperature drops in steam, the steam becomes oversaturated with H₂S, and CO₂ and is released into the atmosphere.

Remember, if steam is present so will H₂S and CO₂ in varying concentrations.

Within the geothermal process non condensable gases (NCG'S) including H₂S and CO₂ are collected and discharged through high level stacks then dispersed and diluted into safe concentrations.

Locations where you may encounter raised levels of H₂S and CO₂:

- vents or drains.
- pits, cellars, and cableways.
- adjacent to NCG handling equipment.
- ponds and low-lying depressions in the ground.
- unventilated or poorly ventilated compartments.
- fumaroles.
- confined spaces
- a failure of machinery seals or pipework may release H₂S and CO₂ into the atmosphere.

Remember H₂S and CO₂ will always be present at various levels within the geothermal environment.

During normal operations H₂S and CO₂ is released at known locations (stacks, vents and drains).

When changes occur in the steam field reservoir, both naturally and intentionally, levels of H₂S and CO₂ can increase or decrease without warning.

When carrying out maintenance tasks accumulated H₂S, and CO₂ may be disturbed and released outside of the process.

Atmospheric conditions, including wind direction and ambient temperature changes, can affect dispersion of gases.



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What controls do I need to consider?

Prior to accessing geothermal operational sites, you **MUST** identify hazards. Information is available from:

- relevant hazard registers
- temporary / unusual hazard boards
- Contact supervisors, nominated supervisors or operational staff.

Areas requiring the use of personal gas monitors are clearly identified on our operational geothermal sites through signage. Where a dedicated person **MUST** be assigned to monitor gas levels, you **MUST** either carry a gas detector or work within a gas monitored area.

When accessing geothermal operational areas:

- you **MUST** be trained and competent in the use of the specific gas detectors being used or be supervised
- you **MUST** identify potential sources of H₂S or CO₂
- you **MUST** establish and maintain clear access and egress to the work area.

When completing hazard IDs or risk assessments, the presence of H₂S and CO₂ **MUST** be considered.

It's **YOUR CALL** on the requirement for these additional controls:

- establish an evacuation / muster location, ensure that your chosen location is upwind of the potential gas source
- maintain a record of personnel working within the work area and make it available at the evacuation / muster location
- consider placing a windsock in a visible location when working outside.

All visitors to site **MUST** be made aware of the hazards.

If there is a requirement for the use of Self-Contained Breathing Apparatus (SCBA) or Emergency Life Support Apparatus (ELSA)'s, location / task specific work plans **MUST** be approved.



Where do I measure for gas?

To ensure your gas readings are reliable you **MUST** identify at least two locations to place the gas detectors.

Consideration **MUST** be given to the following factors when placing gas meters:

- the working environment
- wind direction
- numbers of people within the work party
- where people will be located when they are working.

Although individuals may carry personal gas detectors, you may still need to rely on fixed detectors in a high-density work area instead of individual detectors (e.g., outage, well pad).





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What do I do if there is gas?

Because of its inherent danger, it's important to respond appropriately if your monitor alerts you to the presence of this gas.

Can I work when gas is present at low levels (below alarm)?

- Yes, if you can identify / manage the source, you can continue to work although you **MUST** monitor gas levels continuously. If gas levels rise, identification and management of the source **MUST** be re-assessed.
- Work times **MUST** be limited to below Time Weighted Averages (TWA) and Short-Term Exposure Limits (STEL).

If your gas monitor alarms, you **MUST**:

- stop work and exit the immediate area moving upwind
- account for all the people in your work party
- let others in the area know that you have had a gas monitor alarm, and that gas may be present
- follow your emergency response plan if someone has been affected by the gas (remember you **MUST** not place yourself at further risk to rescue anyone who has been affected)
- notify your immediate supervisor or manager.