

What happened?

On 17 May 2023, while preparing for cut out and replacement of some of the welded hollow structural tubing of the turbine condenser at the Mercury Kawerau geothermal power station, a contractor drilled a hole to check the atmosphere inside the tubing. Once the tube wall was breached there was a sudden release of pressure. Within seconds of this release, a gas detector detected 72 ppm CO.

The incident investigation identified the formation of hydrogen inside the stay bars as the root cause of the pressure build up.

The team is currently assessing methods to measure the internal pressure and / or depressurise the condenser stay bars, including options for redesign.

What did we learn?

Hydrogen formation mechanism:

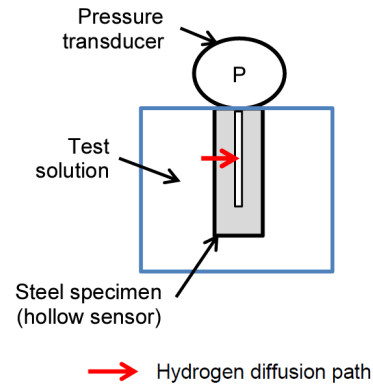
- External corrosion of the carbon steel stay bar tubing generates atomic hydrogen
- Normally the atomic hydrogen combines to form H₂ which blows away or dissolves, but
- Hydrogen sulphide, present in geothermal steam, is a “cathodic poison” which causes the atomic hydrogen to instead diffuse into the steel
- Hydrogen atoms which diffuse to the void inside of the pipe recombine to form H₂
- The pressure which can be generated is extremely high
- The CO gas detector was confirmed to be cross sensitive to hydrogen explaining the CO gas detector alarm



What did we learn?

The hollow stay bars resemble the experimental set up to measure hydrogen permeation through steel, the so-called 'hollow sensor' method, hence confirming the hydrogen diffusion and pressure build up mechanism. Sources: "Evaluation of the Interactions Between Hydrogen and Steel in Geothermal Conditions with H₂S", J. Kittel et al. 2021. "Hydrogen in steel exposed to geothermal fluid", G. McAdam et al. 1981.

Although the presence of H₂S is typical for geothermal power plants, the presence of moisture, trapped in hollow structures, can lead to similar hydrogen formation and build up and is applicable to a wider range of industries and applications. Source: "Fire ignites after worker drills into a sealed void", Australia NSW Mine Safety Alert 2014



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Shared Learning

Flammable Gas | Hydrogen release while carrying out condenser repair works | Kawerau site

Generator Side

Turbine Side

