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Lessons Learnt: Pentane Hammer in a Geothermal Power Generation Facility

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ABSTRACT

The Te Huka 3 binary plant was the largest unit of its kind when commissioned in 2025, generating 58 MW of power and incorporating reinjection of carbon dioxide and other non-condensable gases to the geothermal reservoir. The power plant is located on the Tauhara geothermal reservoir in Taupo, New Zealand. Geothermal steam and brine from two production wells are used to heat and boil the motive fluid, cyclopentane, with the vapour flowing through a turbine and being condensed in a closed circuit, to generate power. Cooled geothermal fluid and carbon dioxide are reinjected at a single reinjection well.

Pentane hammer occurred in 3 separate locations in the plant during commissioning and operation, resulting in damage to equipment and downtime but no loss of containment. The hammer mechanisms include horizontal subcooled liquid and vapour mixing hammer and vapour pocket collapse hammer.

Root cause analysis was completed following each incident, to understand the chain of events, determine the root causes(s) and identify potential solutions. This was essential to enable appropriate inspection, repairs and modifications, so the unit could be safely returned to service. The incidents and the root causes of the hammer will be presented, together with the solutions developed to eliminate or reduce risk of damaging pentane hammer, thereby improving process safety and reliability. The solutions include physical modifications, control changes and improved procedures.

Anticipation of pentane hammer in design has proven challenging and the learnings from these events have been collated to inform an approach for engineers screening new and existing designs for hammer hazards.

KEY WORDS

Pentane; hammer; geothermal; binary; energy; power

BIOGRAPHY

Sophia Richardson joined the power industry in New Zealand in 2021 following an upstream oil & gas career. Her team's mission is safe and sustainable maximisation of power generation

value by improving efficiency and reliability. Geothermal power generation optimisation is core to this work, with Contact Energy generating over 600 MW in New Zealand.

Sophia has previously presented the Tauhara slug hammer commissioning incident at the Worksafe Geothermal workshop 2025 and the Scaling Rate Reduction at Wairakei Binary Through Application of Scale Inhibitor by Sophia Richardson, Alan Ferguson and Karl Barrie at the New Zealand Geothermal Workshop 2022.

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