NZ Geothermal Week

1-6 July 2024 | Taupo

Proudly brought to you by

Event Host

Amplify

nzga New Zealand Geothermal Association

Gold Sponsor

contact

Silver Sponsors

MB Century

GNS Science Te Pū Ao

Mercury

Sponsors and Partners

cheal

Worley energy | chemicals | resources

HATCH. Consulting

Phoenix Recycling Group

NZ Technical Partners Pump & Machinery

Nikkiso

Western Energy

Eastland Generation

WING

mtl

Ara Ake Future Energy Development

OMV

ASMUSS Steel & Flow Control

Ormat

Sumitomo Corporation

LFF New Zealand

SEEQUENT

MERCURY WORKSHOP
ROTOKAWA STEAM HAMMER INCIDENT

LESSONS LEARNED

Mercury Workshop - Lessons Learned: Rotokawa Steam Hammer Incident

- Steam hammer events continue to happen in the New Zealand Geothermal power generation sector.
- As an industry, we need to get better at learning from past incidents.
- This workshop is an opportunity to uplift our collective understanding in relation to the identification, prevention, and management of steam hammer, and associated health and safety risks.
- We will share lessons learned from the Rotokawa Steam Hammer Incident, helping others to improve the safety of their designs and operation.
- The workshop will also provide the opportunity for sharing of incidents, lessons learned, and best practices within the geothermal community

WHAT IS WATER HAMMER / STEAM HAMMER?

Water Hammer / Steam Hammer is a broad term that covers various scenarios that can occur where steam and liquid water interact in piping and equipment of our geothermal assets

1. **Condensation Induced Water Hammer (CIWH, Steam Hammer)**
   A pocket of saturated steam suddenly collapses due to steam condensing as it comes in contact with sub-cooled liquid, generating an overpressure shock wave that travels the length of the liquid-filled portion of the line. Overpressure may be sufficient to rupture pipe elements or dislodge pipe from its support.
   For example: start up of steam field and re-injection system. Hot brine bypass operation and / or too low re-injection backpressure). Continued occurrence of less severe CIWH events can cause fatiguing due to vibrations

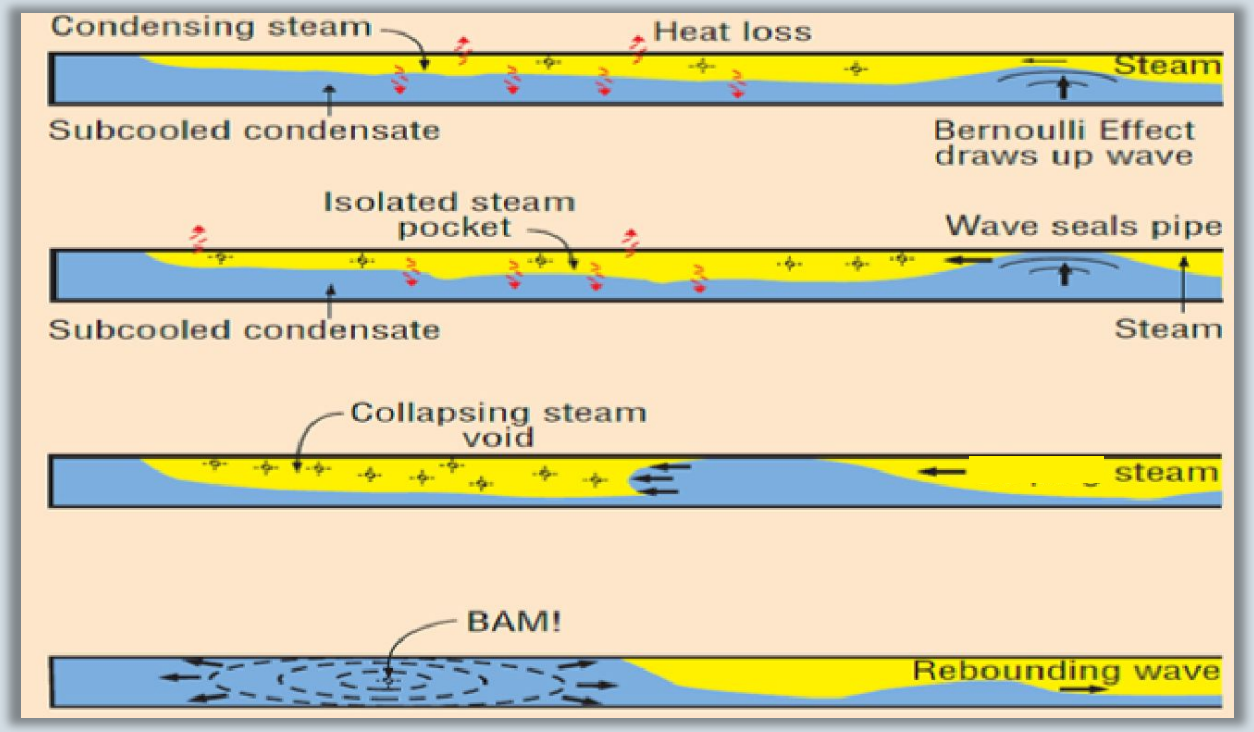
2. **Slug flow**
   Two-phase flow where a slug of condensate is being propelled at the speed of the steam flow and hits the pipe wall at a T-piece or elbow. This may dislodge pipes from its supports or cause, over time, fatiguing due to vibrations
   For example: steam field production header, re-injection header operating in 2-phase flow regime

3. **Pressure Surge (Joukowsky effect, Water Hammer)**
   Usually in liquid filled systems, a sudden stop of the flow, for example by a fast-closing valve at the end of a pipeline system or trip of a pump, can lead to a pressure surge and a shock wave propagating through the pipe. This may cause rupture of pipe elements but can normally be prevented by increasing valve closing time and/or installing air vents on high points.
   (For example: pumped condensate re-injection system)

CONDENSATION-INDUCED WATER HAMMER/ STEAM HAMMER

Condensation Induced Water Hammer (CIWH) can generate severe overpressures and can cause catastrophic failure of equipment and piping

‘Condensation-Induced Water Hammer’ occurs when a pocket of steam suddenly collapses when it meets cooler liquid water.



When the steam collapses it generates shock waves which cause a ‘hammer’ effect that can damage pipework and equipment.

Steam Hammer can result in the uncontrolled release of hazardous energy – in the form of hot water and steam – which can potentially cause serious injury or death. Steam Hammer events can be prevented with proper job planning, adequate procedures, correctly designed and maintained equipment, and a sound understanding of steam and water conditions.

CONSEQUENCES OF CIWH / STEAM HAMMER

Condensation Induced Water Hammer / Steam Hammer can result in ‘Loss of Containment’ of geothermal fluid and the uncontrolled release of hazardous energy (hot water and steam), potentially causing serious injury or death.

These types of events can be prevented with proper job planning, adequate procedures, correctly designed and maintained equipment, and sound understanding of steam and water conditions.

It is important that we 'get it right' and prevent these incidents from happening