Johanna Waldheim
Log Analyst, EV Offshore Ltd.

Geothermal well diagnostics with high temperature video technology
Geothermal Challenges

**Scale**
Nature of geothermal fluid
*Inevitable* challenge
Impacts production

**Well deformation**
Geologically active areas
Main reason for early abandonment

**Corrosion**
Corrosive composites in fluid
- Production well → High $\text{H}_2\text{S}$ and $\text{CO}_2$ content
- Injection well → High $\text{O}_2$ content
Manageable challenge
High Temperature Tools

Minimises the quenching requirements

Maximise accessibility to AOI

Maximise time efficiency

Minimises disruption in production

\[ \Delta \text{Time} = \Delta \text{Production Loss (€)} \]

39.04 hrs
1.63 Days

\[ \Delta \text{Risk} = \frac{\Delta \text{Production Loss (€)}}{\text{Labour Cost (€/hr)}} \]

\[ \Delta \text{Time} = \frac{\Delta \text{Cost (€)}}{\text{Labour Cost (€/hr)}} \]

Production revenue lost during intervention time - 200°C Tool vs. 125°C Tool

>£94,000
82%
Inspection of Deformation in Monitor Well

**Challenge**
Understand shallow restriction

**Objective**
Inspect restriction

**Results**
Liner breach

**Action**
Mechanical Swaging
Successful abandonment
Remedial Aid in Injection Well

**Challenge**
Plan and perform remedial intervention
Restore injectivity

**Objective**
Aid remedial decision making
Inspect well integrity

**Results**
Scale fragments confirmed
No significant corrosion in well

**Action**
Scale clean up
Injectivity better than before
Exploration of Hold Up Depth in Monitor Well

**Challenge**
Understand anomalous hold up
Confirm milling job

**Objective**
Identify the encountered obstruction
Assess milling job

**Results**
No new damage
Milling confirmed successful

**Action**
Place cement plug on top of liner
Successfully abandoned well
Fishing Operation in Production Well

**Challenge**
Recover anti-scale tubing
Recommence the production

**Objective**
Aid fishing operation
Explore for restrictions

**Results**
Discovery of unexpected scale
Real-time portrayal of fish

**Action**
Ramp up anti-scale program
Well back on production
Conclusions

High temperature cameras are an optimal diagnostic solution for geothermal wells.

Minimizing strain in well and on production.

High resolution data, minimising risk of missing small crucial details.

Proven geothermal track record.
Thank you!
EV High Temperature Cameras

**R200**

- **Diameter**: 2.125 in, 54.0 mm
- **Length**: 197.92 in, 5027.27 mm
- **Pressure rating**: 15,000 psi, 1034 bar
- **Temperature rating**: 392 °F (4 hours), 200 °C (4 hours)
- **Camera Type**: Downview (Monochrome)
- **Video Frame Rate**: Up to 4 fps
- **Orientation Senor**: High-side relative bearing and deviation from vertical
- **Field of View**: 112° (Water) / 135° (Gas)
- **Recording Capacity**: Continuous real-time transmission to surface with any mono-conductor and multi-conductor cable
- **H2S / CO2**: Compatible with corrosion resistant materials throughout

**R150**

- **Diameter**: 1.7 in, 43.0 mm
- **Length**: 207.2 in, 5263.0 mm
- **Pressure rating**: 13,000 psi, 1034 bar
- **Temperature rating**: 302 °F (6 hours/3 hours)*, 150 °C (6 hours/3 hours)*
- **Camera Type**: Downview (Monochrome) & 360° Motorised Sideview (Monochrome)
- **Video Frame Rate**: Up to 4 fps
- **Orientation Senor**: High-side relative bearing and deviation from vertical
- **Field of View**: 112° (Water) / 135° (Gas)
- **Recording Capacity**: Continuous real-time transmission to surface with any mono-conductor or multi-conductor cable
- **H2S / CO2**: Compatible with corrosion resistant materials throughout

*Example tool string

*Two sealed telemetry sensors exist. Type 1 is rated to 150°C for up to 6 hours. Type 2 is rated to 150°C for up to 3 hours.
Camera vs. Statical diagnostic tool

**4.5” 11.6# Tubing**

**24-MFC**

- **12% Pipe wall coverage**
  - Number of fingers: 24
  - Finger contact: 1.5”
  - Pipe circumference: 12.6”

**Camera**

- **Full 360° visibility**
  - Not Limited to pipe ID