Case Study

FIBERLINE INTERVENTION

FLI IDENTIFIES FIVE LEAK PATHS IN TWO HIGH TEMPERATURE SUSPENDED GAS WELLS AHEAD OF SCHEDULED P&A OPERATIONS.

THE CHALLENGE

Plug and abandonment (P&A) operations were scheduled to begin on two suspended gas wells located in South Australia as part of a multi-well campaign. The operator had set reservoir suspension plugs but had since observed sustained casing pressure (SCP) building in both wells. A rapid, offline well survey was required to investigate the source of the SCP so that rig-based P&A operations could be planned efficiently to minimise overruns and avoid impacting the wider campaign.

The wells were both high temperature, being around 200°C at the depth of the suspension plugs. This temperature is challenging for traditional well surveys because it can affect electronic sensors. The wellsite was also in a remote location, with no infrastructure on site other than a light tower with an auxiliary power supply.

THE SOLUTION

Given the time, temperature, resource and location challenges, FiberLine Intervention (FLI) offered the ideal solution and the operator commissioned Well-SENSE to provide a rapid distributed fibre survey on both wells. Well-SENSE quickly dispatched two engineers to the wellsite, with survey equipment and wellhead cross-overs in a lightweight vehicle.

FLI equipment was rigged up, then temperature and acoustic sensing fibres were deployed into the wellbore to deliver a dynamic, real-time picture of downhole activity. Each FLI rig-up, 3,000 m. depth survey and rig-down were completed within a single day shift.

The two leak detection surveys were supported by a wellhead crew who bled -off the annulus pressures and then allowed pressure to rebuild so that the source could be identified. The surveys were also supported by a real-time analyst in the UK monitoring the data via satellite.

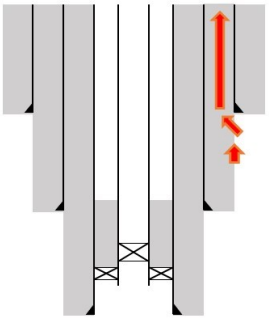
Distributed temperature sensing (DTS) and distributed acoustic sensing (DAS) fibres can monitor conditions at variable distances from the fibre - in the wellbore, in the annulus or in the formation. They monitor depths and distances simultaneously, creating a relative picture in and around the production tubing, production casing, intermediate casing and surface casing, enabling multi-annulus behaviour to be observed. The fibres naturally adhere to the wall of the well and are fixed at the wellhead, allowing precise location measurements to be obtained.

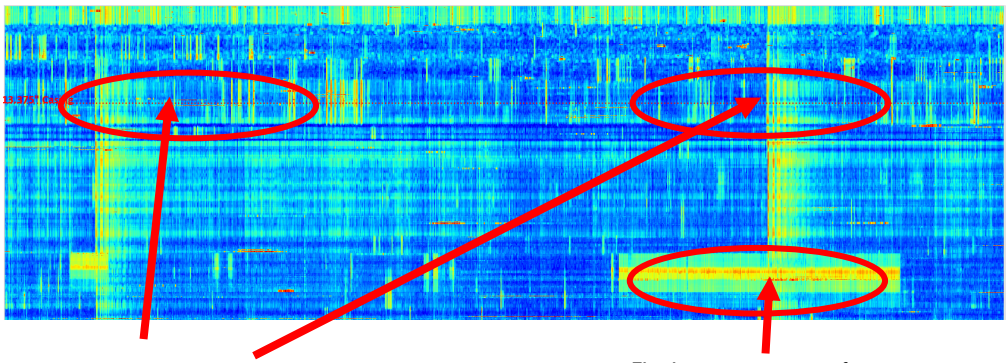
THE RESULTS

Well 1:

- Fibre was deployed to depth through the production tubing.
- Sequential annulus pressure manipulation:
  - Surface casing (SC) pressure of 123 PSI bled off.
  - Intermediate casing (IC) pressure of 587 PSI bled off.
  - Production casing (PC) pressure of 325 PSI bled off.
  - Tubing pressure of 168 PSI bled off.
- FLI identified three leak paths in this well: a) Below the SC shoe from the formation; b) Below the IC shoe from the formation; c) Through the PC from below the depth of the FLI probe.
- Surface casing and intermediate casing pressures are indicated to be reservoir fed.
- Production casing and tubing pressure is via a leaking packer and annular cement plug.
- A tubing leak was detected at 906m with no other indications of leaking tubing or casing.
- The tubing bridge plug is holding.

Well 1, Leak Path 1:

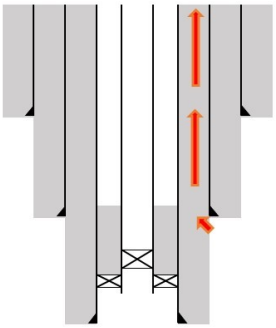


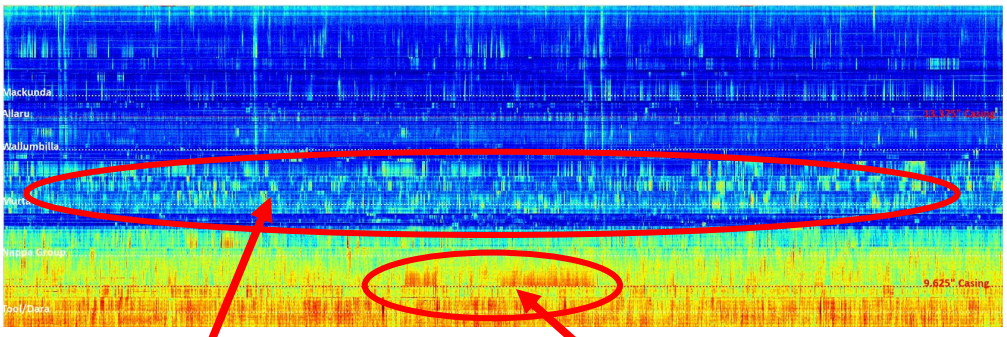


Events centred at SC shoe indicate flow

Fluid movement past formation shortly after SC bleed off

Well 1, Leak Path 2:

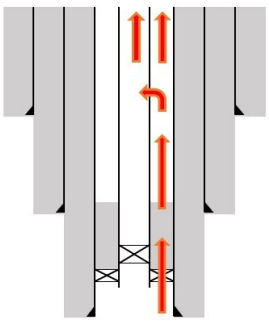


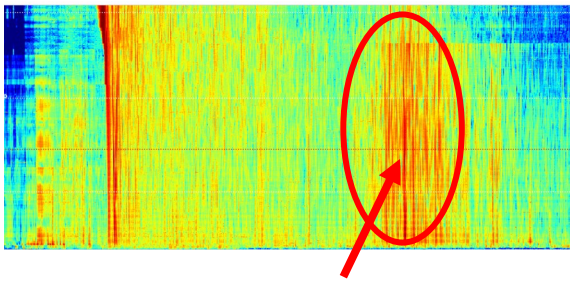


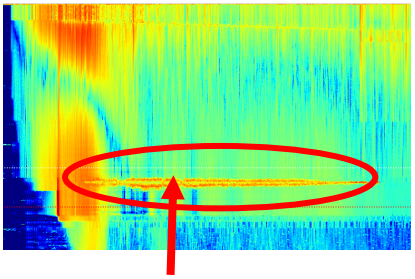
Signal from tortuous flow path above IC shoe

Activity at the IC shoe indicates leak entry point

Well 1, Leak Path 3:







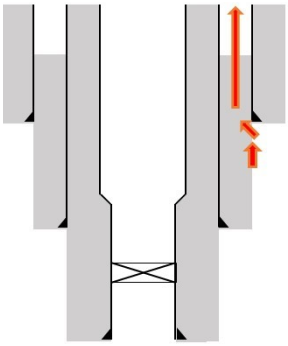
Leak through PC from below fibre depth shortly after PC bleed off.

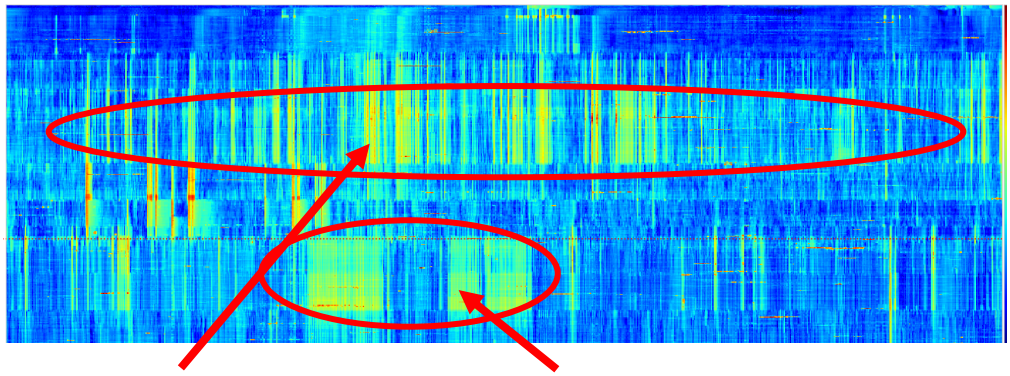
Tubing leak at 906m

Well 2:

- Fibre was deployed to depth through the production casing as the tubing had already been removed.
- SC pressure of 24 PSI was bled off.
- PC pressure of 95 PSI was bled off.
- FLI data identified two leak paths: a) A flow past the formation below the SC shoe and through cement channels above the SC shoe; b) From the formation upwards through the PC plugs.
- SC pressure was indicated to be reservoir fed via cement.
- Production casing plugs are leaking.
- No evidence of leaking tubulars.

Well 2, Leak Path 1:

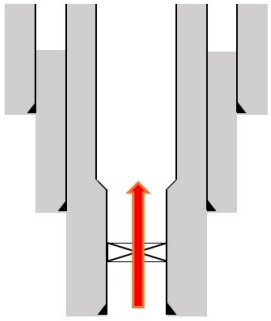


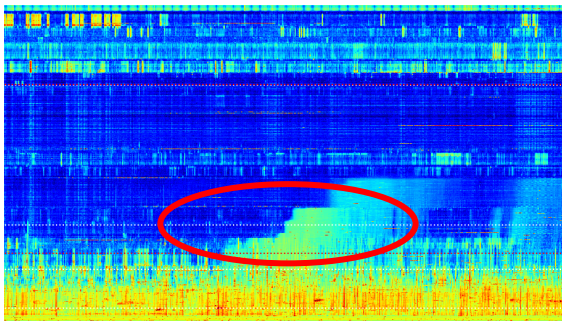


Signal indicating flow through cement channels above SC shoe.

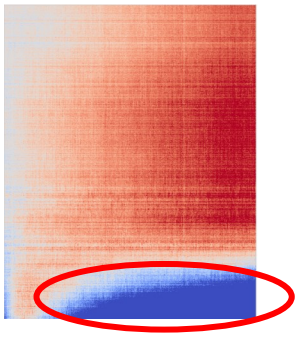
Signal indicating flow past formation below SC shoe shortly after SC bleed off.

Well 2, Leak Path 2:





Signal from logging depth showing upwards pressure plume through PC plugs.



Cooling effect above PC plugs due to gas expanding as it passes through plug leak path.

SUMMARY

The DAS and DTS data indicated that the source of SCP in both wells was the reservoir and not leaking casing strings or shallower gas producing formations. As a result, the P&A plan was developed to include remediation below the IC shoe, eliminating multi-string section milling or perforating and associated rig time and cost.

The operator was a new client for Well-SENSE and was impressed with the quality and accuracy of the data, especially given the project challenges. They plan to use FLI again for complex well abandonment and integrity issues.

VALUE

- Full well depth, multi annulus data acquired in a single day
- Ability to obtain data at 200°C and higher
- Lighter equipment rig up
- Less personnel
- No dynamic wellhead seal
- No downhole electronics (200C can cause a reliability issue for logging tools)
- FLI is well suited to land well integrity surveys, with minimal on-location support infrastructure required.
- Well-SENSE provides a fully integrated service which includes project planning, mobilisation to site, well deployment, data processing, analysis and reporting,