



THE WORLD'S FIRST INSTALLATION OF A CASING CONVEYED DTS SYSTEM, UTILISING ORIENTED TCP IN A THERMAL PRODUCTION AND INJECTION WELL

Sensornet provided Digital Well Integrity monitoring in a high temperature well for a client in the Middle East. The system was based on fibre optic distributed temperature sensing (DTS) and utilised Sensornet's high temperature (300°C) sensing cable, used in conjunction with a Tubing Conveyed Perforating (TCP) gun. This was the world's first example of such a casing conveyed DTS system run with Sensornet's Oriented Perforating System. Such an advanced solution drew from Sensornet's deep experience of engineering in-well solutions and required close co-ordination with the customer.

CLIENT REQUIREMENTS

A thermal recovery process had to be fully optimised in the pursuit of a low cumulative Steam Oil Ratio (SOR). As 80% of operating costs are attributed to the steam generation and injection process, understanding the steam placement, and steam chest growth, in addition to understanding the production profile, is crucial to minimising the SOR. Ensuring that the casing integrity was not breached by steam breakthrough was another key objective.

THE MONITORING GAP

In this particular well, the steam injection cycle was approximately 6 weeks and once steaming was halted then the oil was produced through the same well. During the steam stage, as the steam chamber grew there was great uncertainty of the conformance of the steam – when, where and how much steam was present around the reservoir during injection. During production there is uncertainty of flow distribution across the producing zones. Steam breakthrough from adjacent injection wells puts the well at risk of catastrophic failure. A continuously available, temperature profile of the complete well was required to close this Monitoring Gap.

THE SENSORNET SOLUTION

Intelligent reservoir management requires real-time, continuous downhole monitoring systems to optimize the operational performance of the injection/producing cycle. The permanently installed DTS provides continuous information on which zones are contributing to production, where the steam chest growth is occurring, and where the steam front is liable to break through. A reliable, life of well, high performance system was critical as the injection/production cycle will exceed several years.

In this installation, the high temperature DTS sensing cable was installed on the outside of the 7" casing string and cemented in position. The advantage of installing the sensing cable behind the casing was to protect the DTS fibre from direct exposure to the steam and the mechanical thermal stress effects of the steam injection cycle.

Once the casing conveyed DTS sensing cable was installed, the well had to be perforated using TCP guns. In order to prevent damage to the sensing cable during perforation Sensornet used its Oriented Perforating System to provide a mechanical orientation system that ensured the lower section of the sensing cable was away from the gun orientation and integrity of the sensing cable was not risked during perforation. The Oriented Perforating System was designed by Sensornet's experienced well engineering team who have an extensive track record in developing oilfield fiber optic deployment technology. This unique system continues to be used with a 100% success rate in avoiding cable damage while perforating, providing a reliable alternative for cable deployment.

SUBSTANTIAL BENEFITS

Installing the DTS based Digital Well Integrity system provided complete security for the well and all thermal events were monitored. This provided an accurate understanding of which zones are taking the most steam, the relative production from different zones and integrity monitoring of the casing to provide early warning of the onset of steam breakthrough. This continuous monitoring provided crucial information to control where the steam was injected and at what pressure.

By optimizing this steam process, the SOR can be minimized resulting in improved recovery. There is an additional benefit to the environment because water usage is also reduced.

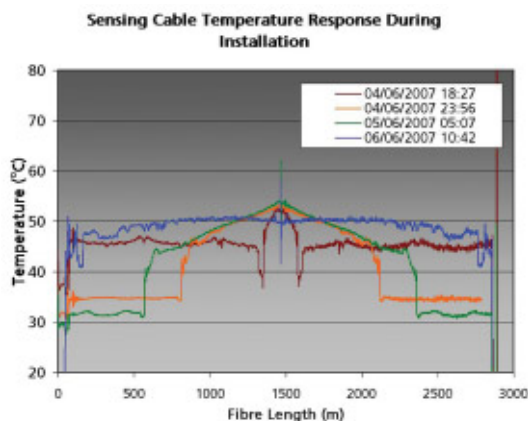
The 300°C rated sensing cable consists of high temperature coated fibres contained in multi layer hermetically sealed metal tubes. This rugged design protects the sensing fibre during installation and ensures long term protection against hydrogen ingress. Monitoring of the well begins as soon as the sensing cable is connected to the casing.



Sensing cable attached to the outside of 7" casing with a metal cross-coupling protector



Casing TCP orientation sub



DTS baseline traces prior to steaming

To close your monitoring gap,
call +44 20 8236 2550
or visit www.sensor.net.co.uk