

United States

Horizontal wells completed using enhanced geothermal recovery technique

Injector and producer lateral successfully completed to harness the earth's energy for a consistent heat source

CHALLENGES

- Provide equipment to withstand high temperatures and pressure post-stimulation operations
- Provide cement solutions to meet high-temperature tool operations and contingency planning

SOLUTIONS

- VersaFlex® XSLZE system
- Lead slurry with Thermavis additives

RESULTS

- Deployed liner system to depth
- Designed and pumped cement slurry with adequate safety factors
- ELH system provided hydraulically energized seal on set to fully isolate liner top

Overview

Halliburton worked closely with an operator to understand the challenges associated with enhanced geothermal wellbore conditions. Through iterative design and evaluation, Halliburton delivered a completion solution for the first greenfield development in the US. The completed wellbores enabled the operator to harness geothermal energy from a consistent heat source.

The successful completion of the wellbore construction phase post-drilling involved several key steps:

- **Liner Deployment:** After drilling the injector wellbore, the first completion phase focused on liner deployment.
- **Cementing for Zonal Isolation:** The second completion phase included cementing the wellbore to achieve zonal isolation across the liner.
- **Liner Hanger Installation:** The final phase consisted of setting the liner hanger. This hydraulically energized mechanical barrier and seal were positioned at the top of the liner hanger.

These steps were executed in both the injector and producer wellbores. The series of horizontal wells are installed alternating between injectors and producers.



VersaFlex® XSLZE system



CASE STUDY

After the wellbore construction phase, perforating and stimulation were performed at treatment pressures of more than 10,000 psi, which will allow the enhanced geothermal application to provide sustainable energy to a power plant. Additional wellbores are now planned to fully harness the formation's potential and keep the power plant running using geothermal energy.

Challenges

Based on the wellbore environment and the operator's vision for the completion design, the liner hanger team developed a well configuration capable of withstanding the high temperatures and pressure encountered post-installation and stimulation.

Solutions

A VersaFlex® XSL-ZE expandable liner hanger (ELH) with a lower polished bore receptacle (PBR) was selected for the wellbore configuration. Equipment was set to run with a VersaFlex HWE ELH casing wiper plug, VersaFlex ELH landing collar, and Halliburton float collar and shoe with a tapered offset down jet. This equipment was deployed on a VersaFlex ELH running tool capable of withstanding washing and reaming operations. Halliburton provided a redesigned lead slurry with Thermavis additive to provide viscosity and create a stable slurry that did not set up while pumping, but rather developed strength under static conditions.

Pre-job planning and design were performed by an experienced team of professionals.



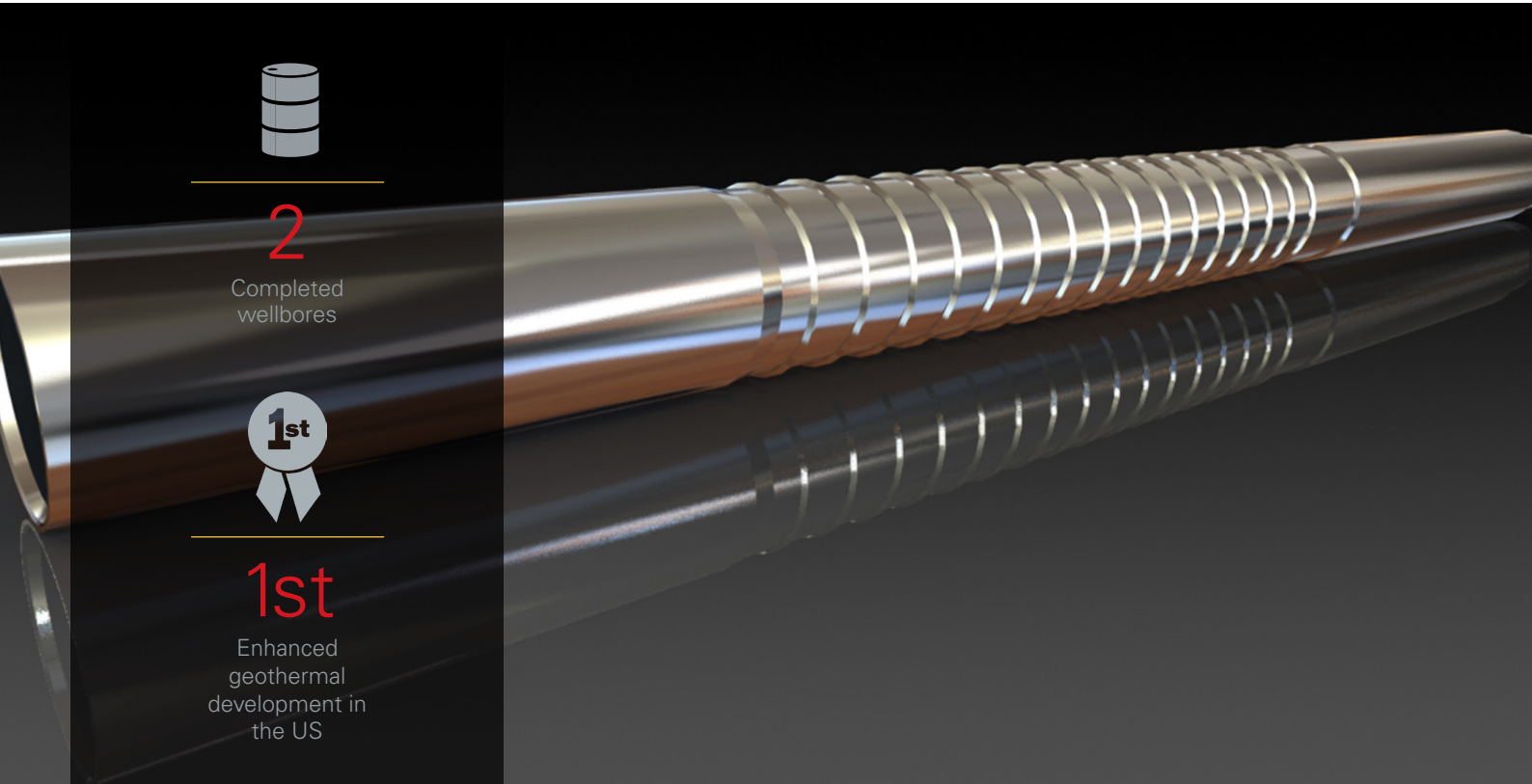
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Completed wellbores



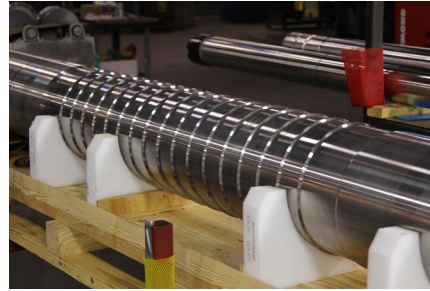
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Enhanced geothermal development in the US



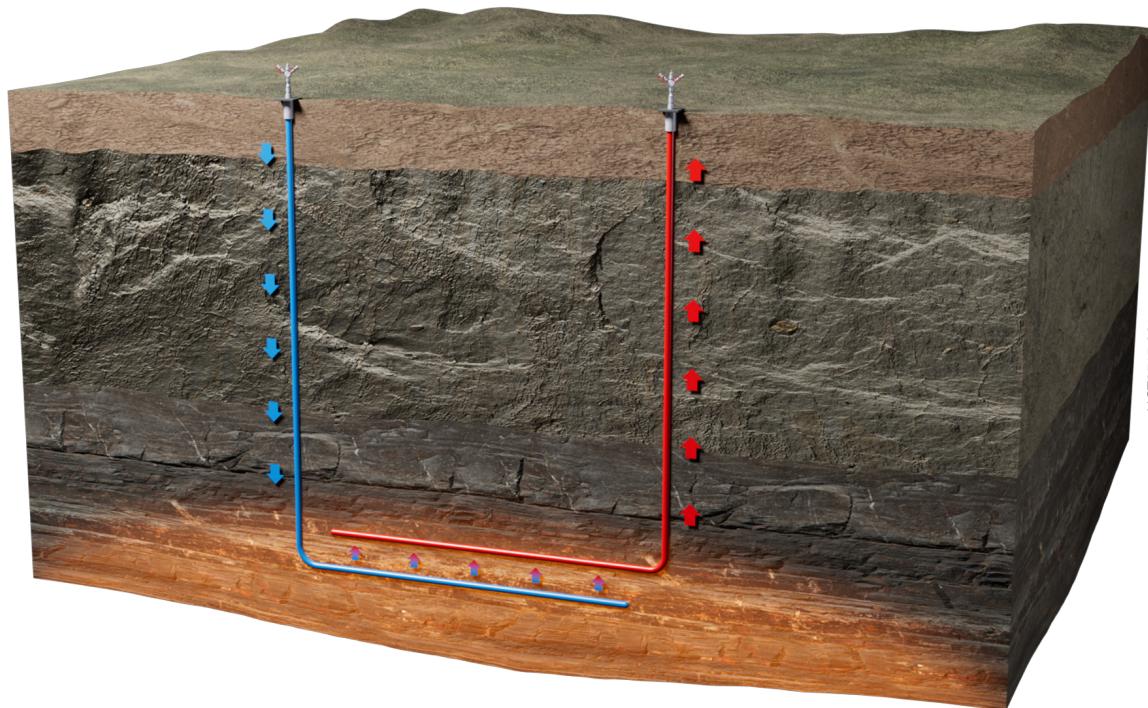
CASE STUDY

The producer and injector wells were constructed similarly, a 10 3/4-in. VersaFlex® XSL-ZE was used to hang 7-in. 35-ppf liner suitable for temperatures over 400°F. Below this, a lower PBR system was installed, which accepted a high-pressure/high-temperature (HP/HT) premium tieback seal unit deployed on a 7-in. tie-back string post-completion to withstand high-pressure stimulation operations performed across various temperature cycles.



» VersaFlex®
XSL-ZE system
for geothermal
application

The successful results paved the
foundation for this high-profile project



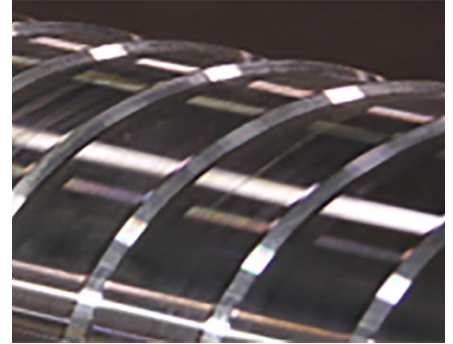
First-of-its-kind, large-scale geothermal application in the US; lower well drilled and completed first followed by second well

CASE STUDY

Results

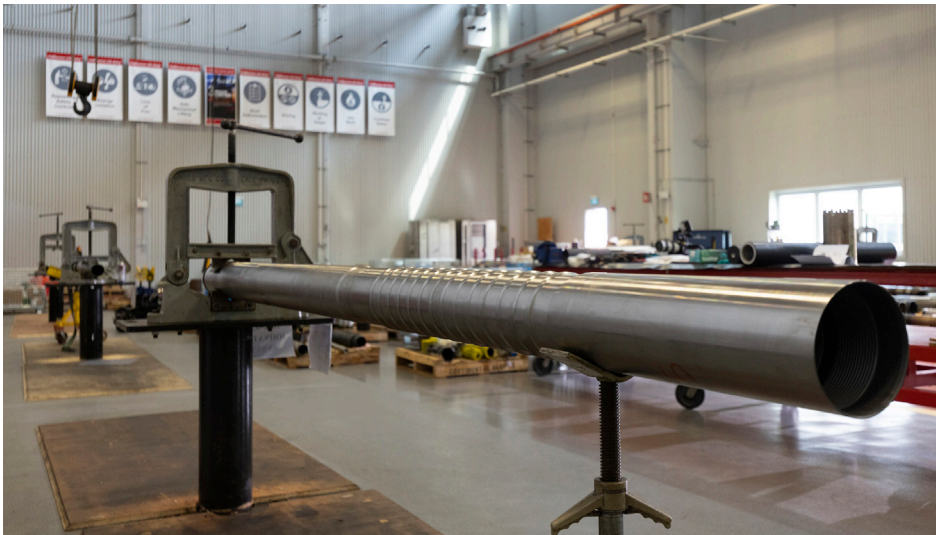
Halliburton delivered a completion solution for the first enhanced geothermal commercial project to deliver 24/7 non-intermittent geothermal energy from a consistent heat source. Pre-job engineering and collaboration allowed the successful execution of well design that enables a plug-and-perf stimulation strategy to create the engineered reservoir between the injector and producer wellbores.

Building on the success of the initial wells, additional wells have been drilled and completed by Halliburton to support the operator's goal of delivering sustainable power for the future.



» **FIGURE 1** - VersaFlex® XSL-ZE ELH system metal-to-metal ribs

» **FIGURE 2** - VersaFlex® XSL-ZE system in the Halliburton Completion Technology and Manufacturing Center, Singapore (Lion Facility)



For more information on Halliburton geothermal services, please go to halliburton.com/geothermal

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