SPECTRUM<sup>SM</sup> Diagnostic Services

RESERVOIR, WELLBORE, AND TREATMENT ASSESSMENTS THROUGH REAL-TIME, FIBER-OPTIC DISTRIBUTED SENSING

SPECTRUM<sup>SM</sup> Diagnostic Services delivers coiled-tubing-conveyed, fiber-optic distributed sensing to assess reservoir performance and completions effectiveness by monitoring fluid movement across the entire wellbore and visualizing treatment efficiency in real-time.

OVERVIEW

SPECTRUM Diagnostic Services utilizes coiled-tubing-conveyed, fiber-optic distributed sensing for real-time evaluation of completion and production effectiveness. This service leverages fiber-optic distributed temperature sensing (DTS) and distributed acoustic sensing (DAS) measurements to monitor fluid injection and profile production along the entire length of the wellbore. An alternative to traditional production logs, SPECTRUM Diagnostic Services, through coiled tubing, can be conveyed to total depth (TD) in order to simultaneously monitor several time series of data for evaluation, as opposed to single snapshots in time. For example, shut-in DTS data can provide information regarding the location of fracture initiation points, while steady-state flowing results can be used to determine production profiling.

APPLICATIONS
- Stimulation cluster efficiency
- Production profiling
- Injection profiling
- Leak detection
- Well interference
- Frac diversion design optimization
- Gas lift optimization

BENEFITS
- Provides analysis along the entire length of the wellbore
- Can improve well performance with real-time treatment optimization
- Delivers well production profile assessment on new or existing wells
- Can identify well integrity challenges to sustain long-term production
- Visualizes cluster efficiency across the wellbore through per-stage analysis

FEATURES
- Distributed temperature sensing (DTS)
- Distributed acoustic sensing (DAS)
HOW IT WORKS
Optical fiber cables can be installed inside several coiled tubing sizes, depending on the specific intervention requirements. SPECTRUM Diagnostic Services coiled tubing is deployed to the bottom of the well. The data gathered downhole is then transferred up the optical fiber to the surface acquisition system. At surface, data can be viewed in real time, using Halliburton’s FiberView™ software platform. DTS provides a thermal profile, tracking temperature response over time to evaluate real-time fluid distribution across the entire well. DAS technology adds an acoustic survey of the wellbore, providing a complementary result to characterize flow paths in the well, further enhancing analytic capabilities. The wellbore can be cleaned out as the coil is being run in the well. When combined with SPECTRUM Intervention Services, it is possible to achieve, in a single trip, wellbore evaluation and downhole tools intervention optimization, such as milling, perforating, or setting packers.

ADVANTAGES
By leveraging fiber-optic data, SPECTRUM Diagnostic Services can monitor the entire wellbore, vertical or horizontal, with high-precision spatial resolution to determine both stimulation fluid distribution and production contribution – in most cases, within a single run.

Cluster spacing is a critically important parameter that all operators focus on during the completion phase of a well. However, validation of actual performance is rarely available. Once a frac job has been completed, the DTS and DAS analysis allow operators to gain insight into the effectiveness of the stimulation treatment through the visualization of fluid movement into the perforations, and to compare those results along the wellbore. SPECTRUM Diagnostic Services provides valuable insight at per-stage resolution levels. This can enable customers and subject matter experts to benchmark completion practices and to optimize well performance based on accurate downhole data.

Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td>Available coiled tubing sizes</td>
<td>2 in., 2-3/8 in.</td>
</tr>
<tr>
<td>Temperature rating</td>
<td>350°F (175°C)</td>
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<tr>
<td>DTS spatial resolution</td>
<td>1 meter</td>
</tr>
<tr>
<td>DTS temperature resolution</td>
<td>Sample rate dependent</td>
</tr>
<tr>
<td>DTS sampling rate</td>
<td>10 seconds</td>
</tr>
<tr>
<td>DAS spatial resolution</td>
<td>1 meter</td>
</tr>
<tr>
<td>DAS sampling rate</td>
<td>10 kHz</td>
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</tbody>
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For more information, contact your local Halliburton representative or visit us on the web at www.halliburton.com.