Screening Study Determines Optimal Heavy Oil Recovery Technique

Case study: Schlumberger heavy oil technology and expertise helps BP optimize heavy oil development approach in Alaska

**Challenge**
Evaluate reservoir potential and identify optimal development approach for heavy oil reserves with minimal impact on environment.

**Solution**
Conduct three-phase screening study, including dynamic modeling examining several well and recovery processes, assessment of rock-mechanical properties, and sand management analysis to determine productivity and recovery potential.

**Results**
Study results including low steam/oil ratio revealed significant (up to 30% recovery) production potential using thermal recovery and combination techniques and enabled recommendations for basic pilot testing configurations.

**Performance / Knowledge**

<table>
<thead>
<tr>
<th>Performance / Knowledge</th>
<th>Excellent / Less Important</th>
<th>Fair / Important</th>
<th>Poor / Critical</th>
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</table>

**Viable EOR Techniques**

<table>
<thead>
<tr>
<th>Continuous Steam Flood Injection</th>
<th>Cyclic Steam Simulation</th>
<th>Steam Assisted G. Drain (SAGD)</th>
<th>Hot Water Flood Injection</th>
<th>Cold Oil Production (CHOPS)</th>
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**Lower Priority EOR Processes**

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<tr>
<th>Down Hole Heat / Steam Generation</th>
<th>Electrical Reservoir Heating</th>
<th>Chemical Injection &amp; Displ. (VAPEX)</th>
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Perform study to understand reservoir potential

The Ugnu formation is a shallow, cold, and viscous oil reservoir located under the north slope of Alaska. It has been a known resource for more than 20 years, but economical development has not been realized to date. The original oil in place for the entire reservoir is estimated to be more than 30 billion barrels. Economically producing this reservoir would monumentally impact operators as well as the state of Alaska.

BP Alaska Exploration (BPX) is a major interest owner and operator for the majority of the Ugnu formation leases. In 2005, BPX created the Viscous Oil Technology Team (VOTT) to perform a screening study of the Ugnu formation potential. To rapidly ramp up BP’s effort and to take advantage of worldwide heavy oil technology and experience, BP contracted Schlumberger for the initial screening study. The study would identify the development technique that would economically maximize oil production rates and recovery while minimizing impact to the environment through ensuring conformance with BP’s green agenda and the North Slope operating environment.

Identify development technique to economically maximize recovery

The project consisted of three main phases—data gathering, static model peer assist, and detailed dynamic model simulation runs on various recovery techniques. Static modeling reviews were made of the petrophysical summary, existing formation micro-imager logs, and comparisons with existing static models in other heavy oil reservoirs around the world, with an emphasis on Canadian heavy oil fields that have potential analog fields and successful, economical operations.

Enhanced oil recovery technique decision matrix.
Develop creative sand-management strategies

Rock-mechanical properties, a critical analysis factor, were assessed by core examination and analysis of DSI® Dipole Shear Sonic Imager logs. Ugnu sand has extremely low strength, indicating potential wellbore-stability and completion challenges. Two distinct peaks were noted on the sand size distribution. These would have to be managed with production.

To determine suitable drawdown pressures and a depth-stability envelope for production, estimations of mechanical property data and completion options served as input to the sand management advisor software. Initial calculations determined that any drawdown greater than 1 psi would cause complete sand failure. The recommendation was to anticipate sand production during drilling and completion and to develop creative sand-management strategies, such as the use of microslotted liners.

Establish basic pilot configuration to test thermal recovery technique

Single-well production rates were estimated to be in the hundreds of bbl/d range. The most exciting result was that the steam/oil ratio, or the equivalent amount of cold water in barrels required to produce steam per barrel of oil, was quite low, a factor that improves the performance of thermal recovery in the Ugnu formation. Finally, a basic pilot configuration was recommended in the form of vertical cyclic steam wells to test the thermal recovery technique. In conjunction with this it would also be possible to pilot several other techniques including primary recovery, hot water flood, and steam-assisted gravity drainage.

The overall results showed an excellent potential using thermal recovery techniques to produce at least 10 to 20% with an excellent possibility of achieving 30% reserve recovery.