Optimizing bitumen recovery by automating reservoir simulations

AOC maximizes net present value and reduces uncertainty with solutions from IBM and CMG

Overview

The need

Athabasca Oil Corporation (AOC) needed to determine the optimal configuration of Thermal Assisted Gravity Drainage wells to recover bitumen from an asset estimated to contain 16 billion barrels of oil.

The solution

CMG STARS and CMOST, running on multiple IBM® BladeCenter® servers, generated an optimal pattern configuration of wells, based on subsurface uncertainty and a range of economic considerations.

The benefit

AOC avoided expensive trial and error, performing 250,000 simulations to develop an optimal well arrangement, and assign a net present value to each.

Alberta-based Athabasca Oil Corporation (AOC) was founded in 2006 and focuses on the sustainable development of oil sands and carbonates in the Athabasca region in northeastern Alberta and light oil resources in northwestern Alberta.

A new opportunity in oil extraction

AOC holds over 4.3 million acres of leases in the northwestern and Athabasca regions of Alberta, including the northern-most part of the Leduc carbonate-reef fairway. AOC's Leduc holdings contain an estimated 16 billion barrels of heavy oil, called bitumen. At initial reservoir temperature, the bitumen is immobile. Recovering it required AOC to develop a commercially unproven technology, called Thermal Assisted Gravity Drainage (TAGD), to heat the bitumen and surrounding rock.

Complex, high volume simulation requirements

TAGD requires both electrical heating and pumping wells simultaneously. Determining the optimal well configuration and operating strategy requires AOC to consider numerous variables, including the bitumen's depth and thickness, location and spacing of each heater/pump well relative to the 'pay zone' and amount of heat required at each well site to extract the bitumen. Tens of thousands of simulations must be done, to arrive at an optimum for one particular set of reservoir conditions.

"If we place these wells too close together, we'll get high rates of recovery, but we'll end up drilling more wells than is optimal," says Bruce Roberts, chief reservoir engineer for AOC. "If they're too far apart then the whole extraction process slows down."

"We've attracted the best and brightest people and technology in the industry to help us determine the best way to recover this oil. This could be a game changer for the company and for the industry."

—Bruce Roberts, chief reservoir engineer, Athabasca Oil Corporation

Automating and accelerating reservoir optimization processes

AOC looked to Computer Modelling Group Ltd. (CMG), an IBM Business Partner, to provide software solutions to automate the simulation process, streamline the analysis of the resulting data, and thus determine the maximum net present value and yield a reduction in the uncertainty in the forecast by considering multiple parameters.

"The fact that AOC will use TAGD to recover bitumen from a carbonate reservoir makes them a true innovator, and they're pushing the envelope to develop and commercialize that capability," says Ryan Schneider, vice president, marketing, CMG. "Several Canadian operators are investigating if carbonate bitumen recovery is economically viable. If AOC can, it opens up a lot of oil that was previously inaccessible."

AOC has been using CMG STARS, an advanced, thermal reservoir simulator, since 2006. STARS simulates recovery methods, allowing AOC to model the flow of heated bitumen through the complex Leduc carbonate geology as well as the propagation of heat throughout the reservoir and surrounding rock.

Until two years ago, AOC engineers built the STARS data sets by hand. They relied on experience and trial and error to decide which set of operating parameters and well configurations would generate an optimal solution. It would take the engineer a significant amount of time for each case, thus limiting the number of simulations AOC could run and ultimately compromising the company's ability to arrive at an ideal solution within a reasonable timeframe.

To eliminate that bottleneck, AOC deployed CMG CMOST, a reservoir engineering and optimization tool. "CMOST integrates with STARS and automates the optimization process," says Schneider. "As AOC builds their reservoir models, they execute multiple runs to determine the best way to recover the asset. CMOST automates the process of generating data sets, running the simulator, making decisions on additional runs, and organizing data for analysis. This transforms reservoir simulation from engineer-driven to computer-driven work, allowing engineers to focus on applying their judgment and interpreting results rather than generating all the models."

Solution components

Servers
- IBM® BladeCenter® HS22
- IBM System x®

IBM Business Partner
- Computer Modelling Group Ltd.

Pioneering a new technology for heavy oil extraction

Using CMOST and STARS, AOC now runs hundreds of thousands of simulations, a volume effectively impossible before. This accelerates the achievement of an optimal solution and reduces overall project risk. The implementation of CMOST allowed AOC to realize a step-change in productivity, providing AOC with additional confidence that TAGD is the optimal recovery method for the Leduc formation. This process is enhanced by a "learning" feature within CMOST, through which the application processes simulation data from the STARS solution and automatically develops additional simulations based on the results.

CMOST executes and repeats the process until it reaches a global optimum. This feature reduced the number of simulation runs needed to study the validity of a particular well configuration from more than 20,000 runs to approximately 2,000 runs.

The speed of optimization is a function of the high performance computing environment at AOC, which relies on IBM BladeCenter HS22 servers. The HS22 provides outstanding performance with support for the latest Intel Xeon processors, hi-speed I/O, and high memory capacity with fast memory throughput. Using a clustered hardware infrastructure consisting of 12 IBM System x® compute nodes and a management node, AOC has run more than 250,000 simulations to-date for Leduc, making the company a super-user of STARS and CMOST.

"In the absence of field data, we're relying on our modeling work to point us to which recovery processes are the best for Leduc, and none of it would be possible if we didn't have STARS and CMOST," says Roberts. "If we're successful, it positions us as the leader in commercial production of bitumen from carbonate. We've attracted the best and brightest people and technology in the industry to help us determine the best way to recover this oil. This could be a game changer for the company and for the industry."

For more information

To learn more about the IBM BladeCenter technology, please contact your IBM representative or IBM Business Partner, or visit the following website: **ibm.com**/systems/bladecenter

To learn more about CMGL, please visit: www.cmgl.ca

To learn more about Athabasca Oil Corp, please visit: www.atha.com

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