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Effects of Well Placement and Intelligent Completions on SAGD in a Full-Field Thermal-Numerical Model for Athabasca Oil Sands

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This paper presents results from a simulation study conducted to test the concept of smart completions in a SAGD recovery operation in Alberta's Athabasca Oil Sands. The study examined several completion strategies and tested, with the use of a simulation model, what the expected production, and steam requirements for these strategies would be in a heterogeneous reservoir with flow baffles and barriers. Three completion strategies were simulated for SAGD pad that consisted of 6 well pairs. A base project was built to calculate costs for a typical SAGD recovery process, and results for each of the completion strategies were calculated. Simulation was performed using Petrel software and the ECLIPSE* Thermal simulator. Financial analysis was performed using Merak Peep software running project data through an Oil Sands model. The three completion strategies and some results follow:

Conventional SAGD design: producers completed with tubing to the toe of the well and injectors completed with tubing half way through the horizontal length. The last 610 meters of both wells perforated. This design achieved the best SOR over a 5 year period however with the high cost of capital and operating expenditures resulted in the lowest ROR.

Simple completion design: producers and injectors cased to the toe of the wellbore and the entire horizontal section perforated. Tubing placed up to the heel of injector wells. This design provided the maximum recovery over the 5 year period but required more steam to be injected and resulted in high water production. This had an impact on the operating expenditures and the incremental earning from extra oil produced was unable to offset the increase in operating expenditures.

Smart completion design: producers and injectors completed with tubing to the toe of the well. For injectors, individual sections for steam injection created in the annulus with the help of ICDs and packers. Horizontal sections for both injectors and producers perforated only where a minimum of 5 meters of continuous sand detected. This design required a slightly higher capital but optimized the injected steam by placing it in areas with the least resistance and avoiding baffles, such as continuous zones of low permeability, and barriers, such as shale. The reduction in operating expenditure was able to easily offset the difference in income from oil produced.