**Common Differences**

Heavy oil is different. Dense and viscous, heavy oil difficult and costly to develop and produce. As a result, the price of heavy oil is typically discounted in the market. There are also vast differences among heavy oil deposits from field to field and recovery factors vary greatly. Recovery methods that work well in one area may not work in another. After production begins, operators may see a wide range of results from individual wells.

Such differences among individual heavy oil deposits make it necessary to customize solutions that maximize the value of the hydrocarbons while overcoming issues associated with drilling and producing heavy oil. At Halliburton, our approach integrates advanced planning, modeling and evaluation capabilities with industry-leading technologies for drilling, completion and production, to deliver the right heavy oil solution for the application at hand.

**Heavy Oil Challenges/Issues**

Despite the differences among individual heavy oil deposits, most are found in poorly consolidated sands. This type of formation imposes specific technological challenges, requiring extra precautions to maintain wellbore integrity and manage sand production and disposal.

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**Classifying Heavy Oil**

Heavy oil is characterized by:
- Asphalitic content and usually with sulfur and metals entrained in the oil molecules
- Gravity below 22 API, and in the case of extra-heavy oils, below 10 API
- Viscosity of 100 centipoise to greater than $10^4$ centipoise
- Reservoirs often have low pressure at some time during the value cycle

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**Identify & Plan**

Viable economic development of heavy oil requires a well-engineered drilling and completions plan, including determining appropriate production technique. The most common techniques employed today are either steam assisted gravity drainage (SAGD) or cyclic steam simulation (CSS).

From the start, Halliburton brings to bear the most advanced modeling and evaluation capabilities to maximize the potential of a specific heavy oil application. In the early phase of development, simulation can help engineers optimize the design of the production system and evaluate various well trajectories and drainage patterns. In addition, Halliburton can provide accurate reservoir modeling to help optimize production throughout the life of the well.

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**Drill & Evaluate**

Halliburton has the proven drilling and evaluation technology to achieve optimal wellbore placement while overcoming the challenges of working in unconsolidated formations.

We have the technology and expertise to optimize mud and casing programs, bit and drilling system design, and fluids program to maintain borehole stability and mitigate stuck pipe.

During operations, our extensive experience in real-time data acquisition and communications provides more complete, timely reservoir information to improve decision-making.

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**Complete & Produce**

Heavy oil reservoirs challenge cement and wellbore integrity, and impose increased demands for pressure maintenance, controlling heat transfer and loss, and monitoring steam efficiency and coverage. And in almost every case, economic heavy oil production depends on effective sand control.

From managing water and gas breakthrough for correct zonal isolation during completion, to total flow assurance during production, Halliburton solutions meet the full scope of technical challenges to heavy oil production. Our proven technologies have been used worldwide to successfully curtail excessive sand production, and our cementing technologies and expertise leads the world for effective zonal isolation and engineering for the life of the well.

In addition, Halliburton’s long term approach minimizes intervention and maintenance costs, further improving economics of heavy oil.
**The Halliburton Advantage**

Halliburton customizes solutions for the wide range of heavy oil applications, regardless of size of asset or field. We can provide the right mix of products, services, expertise and knowledge, as well as the ability to manage the entire project from design through production to maintenance.

At Halliburton we employ a vast range of technologies that help find and produce heavy oil efficiently. These include large-scale well planning, modeling and simulation capabilities; multilateral drilling tools and expertise, active magnetic ranging capabilities and advanced formation testing to define crude and reservoir quality. We also offer an extensive range of completion technologies, insulating packer fluid, life-of-the-well cementing solutions, as well as intervention services, processing and pipeline maintenance.

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**Heavy Oil Solutions**

**Challenge: Combat Severe Lost Circulation Events While Drilling Through Depleted Reservoir**

Wells drilled in the Cold Lake area of Alberta, Canada have a history of lost circulation events caused by depleted gas thief zones above the primary heavy oil objective. Lost circulation is exacerbated by tight equivalent circulating density (ECD) tolerances, which can be resolved by drilling an enlarged hole. Traditional bi-center bit technology required back reaming and multiple trips to accomplish the objective, which increased operating costs and compromised hole quality.

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**Solution**

Halliburton engineers recommended use of the near bit reamer (NBR) technology, which was capable of enlarging an 8 1/2 in. hole to 9 7/8 in. in a single bit run. This allowed the operator to complete the drilling and hole enlarging operation in a single bit run while simultaneously ensuring hole integrity and efficiency of drilling operations through fast penetration rates and reduced trip times. The NBR tool can also be used inside casing when drilling cement plugs, can ream a pre-drilled pilot section and performs well in directional applications where bi-center bits can induce damaging vibrations and spiraled wellbores.

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**Results**

NBR technology was employed in three types of wells in the Cold Lake region: control infill wells, cyclic steam stimulation (CSS) wells and in Resdeln field tar sand wells. In all applications, the NBR provided significant benefits over traditional bi-center bit technology. ROP increases of up to 90% were realized in some wells. All horizontal liners were run with minimal drag and without the need for an additional trip to change bits. Improved NBR tool durability in the erosive conditions also lowered the operator’s bit costs.

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**Technologies Applied**

Near Bit Reamer (NBR*) Tool
**Challenge: Reduce Environmental Impact and Lower Waste Disposal Costs in a Venezuela Heavy Oil Field**

Drilling heavy oil wells in the Venezuela’s Orinoco Belt produce various waste streams such as drill cuttings, drilling fluid, industrial water, completion fluids and oily fluids from production and storage facilities. Halliburton’s customer wanted to find a way to lower disposal costs, while providing sustainable environmental solutions and associated economic and social benefits.

**Solution**

Halliburton engineers proposed a central treatment facility to provide better control over waste management processes and to reduce waste handling activity at each rig site. Based on Halliburton’s pollution prevention concept and strategy, the operation was designed to reduce waste generation while drilling, reuse waste in its original form, convert waste into recycled materials, extract materials from waste for other uses and minimize the amount of waste requiring final disposal. The waste products were recycled and used in innovative ways, such as dewatering of drilling fluid, water treatment and reuse, cleaning and spreading of drill cuttings for use in road building and other construction activities, and recovery of crude oil from oily production residue.

**Results**

Halliburton’s customer estimates that the centralized treatment facility has reduced treatment costs by up to 30%, while improving regulatory compliance with provisions set by the Venezuelan government. The treatment center has also provided additional crude oil into the production cycle by recovering salable oil during the recycling process.

**Technologies Applied**

Ground Control™ treatment center

**Conclusion: The Best Solution is Specific.**

Heavy oil deposits present specific challenges that require custom solutions to maximize recovery in each application. With extensive technological resources and experience, the people at Halliburton are equipped to design solutions that meet the challenges of heavy oil production and optimize performance over the life of your reservoir. With a history of operational excellence, technological leadership and innovation, Halliburton is well positioned to respond to ever-changing dynamics of the heavy oil market, where economic viability depends on timely, cost-effective solutions.

For more information on our products and services, go to www.halliburton.com/HeavyOil