Real-Time Surveillance Optimizes Production at Black Hills E&P

Customer: Black Hills Exploration and Production
Location: Denver

**CHALLENGE** – Dependence on spreadsheets inhibiting knowledge transfer; difficult and time-consuming to maintain; challenging to monitor hundreds of wells, quickly identify significant variances, or predict reservoir performance using traditional tools and techniques

**SOLUTION** – Installed real-time electronic data collection system in important gas field; implemented Landmark’s DSS™ (Dynamic Surveillance System™) software; linked to ARIES™ application for monthly production data and OpenWells® database for drilling and completion data using Engineer’s Data Model™ (EDM) software

**RESULTS** – Enhanced ability to monitor production volumes in near real time, optimize well performance, minimize lost production, better predict reservoir performance to guide drilling and completion activity; quickly identified problem delivering 50 percent of gas from new wells to sales point, enabling timely corrective action

Black Hills E&P’s development strategy is focused primarily on natural gas. This year, the company expects to bring on line about 10 horizontal and 40 vertical wells in its largest gas field (shown here). Photo courtesy of Charles A. Maybee, Black Hills E&P.

interest in more than 500 wells in 8 states and the Gulf of Mexico. In March 2003, the company acquired another independent, increasing its gas and oil production by nearly 50 percent and more than doubling proven reserves. Those reserves consisted mostly of natural gas located in the East Blanco Field of the San Juan Basin, northwestern New Mexico. Black Hills planned to launch a drilling and workover program to boost production and more fully develop the field.

When the company moved its E&P office to Denver in June 2003, Maybee was hired to cover western Colorado and New Mexico. One of the first things he wanted to do was to review East Blanco’s production. “Unfortunately, that data was on a spreadsheet somewhere out on the network, and I couldn’t find it,” Maybee recalls. “For a new person coming into a job, inheriting spreadsheets can be a nightmare. Often you can’t tell what the formulas do, and you don’t know which version is correct. Dependence on spreadsheets is one of the biggest problems in petroleum engineering today. I knew there had to be a better way to work.”

Just after joining Black Hills Exploration and Production Company as senior petroleum engineer about two years ago, Chuck Maybee ran into his first problem: he couldn’t find critical production data required to manage one of the company’s most important assets.

Black Hills E&P operates more than 450 wells in Colorado, Nebraska, New Mexico, and Wyoming, and holds a working
AN ALTERNATIVE TO SPREADSHEETS – Like many other independents, Black Hills’ petroleum engineers relied almost exclusively on spreadsheets. “Many engineers subscribe to the philosophy that the person who feels the pain should solve the problem,” says Maybee. “So if bad data is causing you pain, you’re going to fix it: by creating a simple spreadsheet and populating it with the right data. That solves your immediate problem. But while that may work for companies of a certain size, it can actually hinder your growth.”

When engineers change jobs or new personnel are hired, for example, the sheer number of spreadsheets can be daunting to sift through. “Knowledge transfer is usually not very good,” Maybee notes. “What’s more, spreadsheets are difficult and time-consuming to maintain. File naming is rarely standardized, and spreadsheets may be stored in a dozen different directories. So you can lose data very easily. That’s why one of my overriding goals here has been to get our data populated into a digital database environment, instead of all these separate spreadsheets.”

One of the first things Maybee did after joining Black Hills E&P, therefore, was to obtain Landmark’s DSS software, an integrated visualization environment for reservoir and production engineering information. Having used DSS software extensively for more than a decade, he saw an opportunity to implement more effective tools for production monitoring and reservoir performance prediction in the East Blanco field.

Because the field is about 80 miles from Black Hills E&P’s production office in Farmington, New Mexico, and 400 miles from Denver, the company installed Totalflow, a “real-time” electronic data collection system, on all of the wells. Black Hills set the meters to store well pressures, temperatures, and volumes every hour, to relay that information via satellite to Farmington every six hours, and replicate data every night in Denver. In addition, at any time, engineers in either office can access current production data on-demand.

Prior to implementing the DSS applicant, engineers compared actual production to forecast by exporting Totalflow data to a spreadsheet, downloading the latest forecast from ARIES—monthly allocated production database and economics application—and plotting out the combined data. To identify changes in pressure or production volumes from day to day, they had to print the latest 24-hour report from Totalflow and scan the list of some 150 wells for meaningful variances. “Except for the top 10 or 20 percent of the wells,” Maybee says, “you can’t tell if those volumes are much different than they were yesterday—unless you have a remarkable memory.”

Maybee knew that DSS software could link to any number of digital databases that are compliant with ODBC (Microsoft® Open Database Connectivity), including Totalflow’s SQL database and ARIES database. DSS software was installed in Farmington and Denver, and he created a shared DSS project for the East Blanco Field.

Today, Black Hills uses DSS software for two essential and complementary purposes. One is day-to-day production monitoring, to identify wells with problems and address those as rapidly as possible. The other is as a reservoir engineering tool, to better understand and predict performance from specific wells, selected areas, or the entire field.

ADVANTAGES OF DYNAMIC SURVEILLANCE – “DSS software offers two main advantages to me, as a petroleum engineer,” he explains. “First, especially with an electronic metering system, it keeps me extremely well connected to the field, even though I’m 400...
“A lot of our wells here are on artificial lift, mainly to remove water so the gas can flow better. If a sucker rod pump is beginning to wear down, you’ll see a more rapid change in well performance over time. It’s pretty difficult for a pumper, who only sees production once a day, to tell when a well on 10 percent decline has changed to 12 or 15 percent. So you can lose a lot of production without even realizing it. With the visualization tools in DSS software and hourly data, you can tell much sooner when something has altered the slope of your decline curve. It helps you identify quick ways of optimizing production.”

In one horizontal well, for example, the monthly and daily decline curves appeared fairly smooth. However, as soon as Maybee started visualizing hourly rates, it became evident the well was suffering transient water problems. “Production was very erratic,” he says. “We’d make 1.8 million per day for two hours, then it would drop to 400 mcf for a couple hours, then jump back up again. I realized the well needed some sort of artificial lift.”

Doing that removed the water more efficiently, flattened the monthly decline, and increased production about 70 mcf per day. “Incrementally, that’s not a lot of gas. But, when you’re optimizing 100 or 200 wells, the aggregate value can be substantial.” Optimization of that well alone, he notes, covered the cost of DSS software.

As interested as he is in day-to-day operations, Maybee is even more concerned with “the big picture:” comparing actual with forecasted rates, and predicting reservoir performance to guide new drilling activity.

The East Blanco field not only has a complex 22-mile long gas-gathering system, but reservoir geology is complicated. Production comes from four stratigraphic intervals, which vary in different parts of the field. “Using DSS software, I’ve identified which horizons produce in all 250-odd completions here,” he says. “That enables me to predict how many intervals we’re likely to encounter at any proposed drilling location. By grouping all wells that produce from those horizons, accessing historic production data from ARIES software, and normalizing the data, I can see how those wells behave as a group. Then, I can generate a type decline curve in DSS software to forecast well performance prior to drilling.”

Maybee also used DSS software to determine that nearly 50 percent of the field’s total gas production was not making it to the sales point...
due to new drilling, which had serious implications for both cash flow and NPV. Infill wells were coming on at higher rates, creating back-pressure throughout the system and suppressing production from lower-pressure wells. “DSS software provided the tools to quickly identify this anomaly and take corrective action,” he says. “Engineers justify capital expenditures based on predicted well performance, but seldom consider the impact of new wells on the total producing system.” Subsequently, Black Hills contracted Landmark Consulting & Services to model the entire gas gathering system and recommend viable interventions.

INTEGRATED ENGINEERING VISION – This year, Black Hills E&P expects to bring online about 10 horizontal wells and 40 vertical wells in the East Blanco field. Also, there are 10 completion rigs in operation. Black Hills, in fact, was one of the first companies in the world to implement OpenWells, and EDM applications. While not all of the capabilities between DSS, ARIES, OpenWells and EDM applications are implemented at this time, Maybee sees integrated petroleum engineering as the way of the future, even for small independents.

“From a corporate standpoint,” he explains, “accessing all this information through DSS software makes your engineers much more efficient, and enables them to focus on activities that go straight to the bottom line. Having fewer data sources means you have fewer errors. And engineers spend more of their time doing what they’re paid to do: analyzing data and optimizing production.

“My goal,” he concludes, “isn’t a paperless office. I’m shooting for a spreadsheet-less office.”

“With so much drilling and completion activity,” says Maybee, “we also decided to implement Landmark’s OpenWells system, their new drilling data management and operations reporting application. It’s built on the EDM, integrated database that is robust enough to capture all of our engineering data needs from the field and the office: drilling, completions, production, and, eventually, accounting and certain geological data.”

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—Chuck Maybee, senior petroleum engineer, Black Hills E&P

The El Blanco Field has about 150 wells, 250 completions, and a complex gas-gathering system roughly 22 miles long from N to S. With DSS, engineers can look at the entire field and see immediately which wells have dropped in production (red) and which have increased (green).

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