

PXP Improves Oilfield Operation by Optimizing Steam Injection with Emerson Smart Wireless

RESULTS

- Increased production
- Optimized steam-to-oil ratios
- Reduced cut liners at a cost of \$90k to \$500K each
- Reduced instrumentation maintenance and calibration
- Higher operator productivity and better response times to field problems
- Improved reservoir modeling



APPLICATION

Oilfield surveillance of remote production and injection wells

CUSTOMER

Plains Exploration & Production Company (PXP) is an independent oil and gas company.

CHALLENGE

Thermal energy is commonly used in oil extraction to stimulate production. Thermal energy is also the greatest cost of oil production for many tertiary recovery projects. The heat injected in the form of steam commonly accounts for 40 to 65 percent of a producer's costs and is responsible for much of the revenue derived from production of a well. On the Hopkins lease property 35 miles north east of Bakersfield in California, there are close to 171 producing wells. The wells are concentrated in a one square mile area, producing approximately 3,200 barrels of oil per day. This field also has 120 steam injection wells, each of which heat and push oil toward a pattern of producing wells. In order to meet the production goal and optimize SOR (steam to oil ratio), it is critical to measure injected steam rate, total injected steam, and water and oil production to optimize the effect of thermal stimulation on production.

Because there was no power or communications in the vicinity of the wells, the field was monitored by mechanical chart recorders and operator trips to as many wells as possible in a day. The daily readings by operators were summarized once a day. The data was then sent to the office in Bakersfield where it was used to make business decisions.

"This technology has opened up new possibilities for us. We plan to continue utilizing wireless technology to improve our oil production, improve our cost position, and make our people more productive."

Michael Fischback
Facilities Engineer



Cut liners from over-injection of steam is one of the hazards of poor steam injection control

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EMERSON
Process Management

Manual monitoring methods were not the most effective method to prevent over-injection of steam that caused breakthrough and cut liners in producing wells. Cut liners would take a well out of production for months at a time, losing an average of around 20 barrels per day. If a new liner could be installed, the cost of repairing the damage was roughly \$90,000. If there was a dogleg in the well, however, it would have to be idled and a new well would have to be drilled, for a total cost as high as \$500,000. The company was averaging 10 cut liners per year. Furthermore, for each month each well was not producing because of a cut liner, an average of 600 barrels of production was foregone.

Manual monitoring methods also led to under-injection, which meant foregone production. Part of the problem was lack of timely information. With 120 wells to visit the operators could, at most, get one data point per well per day. The data then had to be manually entered into a database quickly and accurately. Even if the data was accurately gathered and entered, the data collection rate of once per day led to lag time in responding to issues that impacted costs and production.

Another part of the problem was the technology itself. The accuracy of metering with an orifice and a chart recorder was a concern. For one thing, PXP was dependent on a contractor to provide the proper coefficient for the orifice plate to get an accurate flow reading. For another, they had to be sure the orifice was installed properly and remained intact. Finally, the charts had to be read accurately, with the chart recorder properly calibrated (a task done every three months) with no plugged tubing.

SOLUTION

Steam Injection Wells

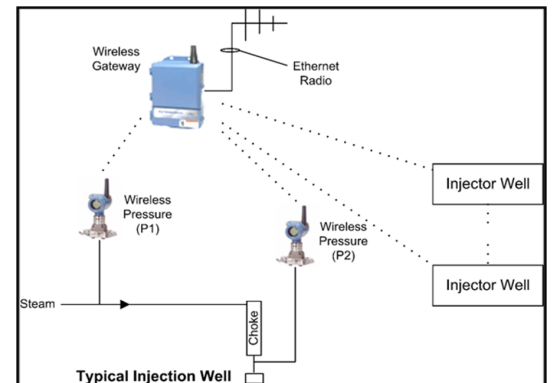
PXP looked at wireless technology to provide real-time information to optimize steam injection rate. The mesh technology from Emerson combined with ProSoft Ethernet radios provided a robust, reliable solution across the one square mile property. PXP chose the Emerson wireless solution because of the security built into the network and the reliability of the robust, self-organizing mesh that is easy to install and expand. The solution from Emerson opened a new pathway to capture realtime, accurate, and nearly maintenance-free well test data. “When weighted against what was to be gained from this project, the \$750K total project cost, including installation services and customized user interface software, seemed quite reasonable given the project’s payback”, said Michael Fischback, Project Facilities Engineer, PXP.

The solution began with a pilot project to test the technology on four injection wells. Ten 3051S WirelessHART™ pressure transmitters were purchased and installed; one on the upstream side of a fixed bean choke to calculate flow rate (upstream pressure and bore size from the fixed bean choke determine the flow rate) and another on the downstream side to help with troubleshooting. Two wells were dual-stream, utilizing a single upstream transmitter.

A Smart Wireless Gateway, where process variables as well as process and instrument diagnostics are converted to Modbus TCP/IP data, was installed as well. A ProSoft Technology 802.11 industrial broadband radio provided a backhaul network, or a robust wireless network for long distances, to connect the gateway to an industrial PC in the office a mile away.



3051S WirelessHART pressure transmitters on a dual injection stream well.



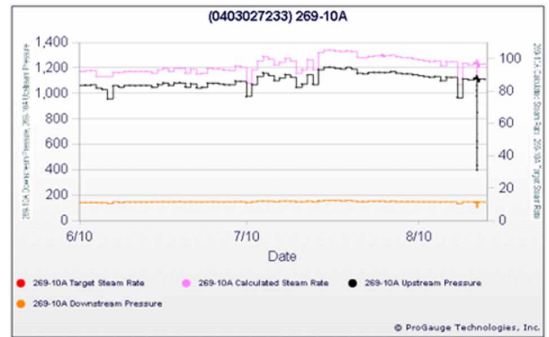
3051S WirelessHART monitoring of steam pressure upstream of the choke bean is used to calculate steam injection rate; meeting steam-to-oil ratios is key in reservoir management. Downstream measurements help troubleshoot downhole issues.

Once communications were established and tested, the first step was complete. However, the company still had to find a convenient way to make the real-time wellhead data accessible company-wide so that it could be stored, trended and analyzed to solve problems before production could be impacted. The customer also wanted to test the performance of the instruments. A 3rd party was brought in to test the true steam injection levels and compare them with the chart recorders and the new high performance 3051S wireless pressure transmitters. “We found the steam measurements using the pressure transmitters from Emerson to be ten times more accurate, on average, than the chart recorders,” said Fischback. “It is even more accurate when we know the steam quality”. Other advantages to using the (3051S) wireless transmitters were further explained, “They come factory calibrated and only need to be recalibrated every 10 years instead of 3 months (as with the chart recorders), they give early notification of downhole issues, we eliminated human error in entering data, we increased the efficiency of our operation concerning trips to the field, we have increased efficiency of our data management, and better accuracy has led to better modeling of our operation.” That means PXP is not over-injecting wells, which leads to cut liners, and are not losing production from under-injection of steam into the viscous oil.

Once Emerson wireless technology proved it could handle the sparse distribution of transmitters on the large area that incorporated the four wells (spaced 150 feet apart and located 0.25 miles from the nearest gateway), PXP rolled out the bulk of the project, implementing a total of 249 WirelessHART transmitters and 4 WirelessHART gateways on 120 wells across an area of one square mile. Three industrial radios provide the backhaul to reliably communicate data to the office a mile away. Deployment of the wireless technology was made easy with Emerson’s AMS Suite. Emerson’s highly engineered tools take the complexity of configuration, installation, and startup out of the user’s hands. “Users can set up instrument mesh networks quickly. Out of a project cost of \$750,000, only \$10,000 was spent on installation,” said Fischback.

Oil Production Wells

The project paid for itself in months. With this success, PXP continued to invest in wireless by adding twenty seven 8800 MultiVariable™ Vortex meters with WirelessHART THUMS to the network to measure the mixture of oil and water out of the producing wells. These low-maintenance devices update production data for operators every minute on every well instead of once a day only on those wells that are in test. Therefore, they are no longer blind to what the majority of the wells which are not in test are doing. Now operators get flow rate, flow total, and temperature for each of the wells. The temperature is used to determine how hot the production is emerging to indicate not only that steam is reaching the well, but to provide further field intelligence on whether the pattern injection wells are being over- or under-injected. For diagnostics, the shedder bar frequency is also monitored. This provides intelligence to the operators if any process disruptions are affecting the meter, so maintenance can remedy the problem and minimize the impact on production.



Customized software utilizes field intelligence from the wireless devices so steam injection rates can be monitored continuously and compared to the targets.



A ball trap connected to a turbine meter was used to measure oil flow from one of seven producing oil wells on any given header. A Rosemount 8800 MultiVariable vortex meter with a WirelessHART THUM now provides a low-maintenance option that gives continuous, one-minute updates for each individual well.

Customer Impact

Operators can now monitor wellhead status, respond to alarms immediately if parameters deviate from pre-determined limits, and problem solve by analyzing data on historical trends. Overall, operations have improved their productivity with better response times and smarter decision-making. This has led to improved productivity of the field, since operators can prioritize wells that need attention and visually monitor the others simply by driving by and looking for steam or oil leaks. This has translated to improved SOR or steam-to-oil ratios. The number of cut liners has been reduced, which has further increased profitability.

The results for Field Operations are reduced maintenance and calibration, elimination of manual data collection and manual entry, more effective use of vehicles, quicker response times to field problems and better prioritization of daily activities. Production Engineering experienced fewer lost wells to steam cutting, and live data at their fingertips leads to better decisions. Operators have additional time to “pump” the wells (onsite testing) to make them more productive. Reservoir Engineering has a more accurate reservoir model, target steam rates are being achieved, and they are no longer reliant on the field for data. The Corporate Data System Management group has data fed automatically from the field now with no interface to a data clerk. This has increased accuracy by eliminating human error. It has also enriched the information being sent from the field as more data can now be gathered by the field instruments.

“This technology has opened up new possibilities for us,” concluded Fischback. “We plan to continue utilizing wireless technology to improve our oil production, improve our cost position, and make our people more productive.”

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Michael Fischback
Project Facilities Engineer, PXP

RESOURCES

Emerson Process Management Oil and Gas Industry

<http://www.emersonprocess.com/solutions/oilgas/>

Rosemount Smart Wireless

<http://www2.emersonprocess.com/en-US/brands/rosemount/Wireless/Pages/index.aspx>

Rosemount 3051S

<http://www2.emersonprocess.com/en-US/brands/rosemount/Pressure/Pressure-Transmitters/3051S-Series-of-Instrumentation/Pages/index.aspx>

Rosemount Vortex Flowmeters

<http://www2.emersonprocess.com/en-US/brands/rosemount/Flow/Vortex-Flowmeters/8800-MultiVariable/Pages/index.aspx>

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