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By Joe Gross and Justus Hinks

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Unocal's Monopod platform in Alaska's Cook Inlet with the 11,070-foot Mt. Spurr volcano as a backdrop
Photo courtesy Lew Dennis

Oil produced by Monopod's wells does not flow to the surface naturally but requires artificial assistance from the platform facilities. Although there are different technologies that can be used to accomplish this, the Monopod employs the conventional gas lift method. This technique supplies highly compressed natural gas thousands of feet down to the bottom of the well. The gas bubbles up through the fluid column, making the liquid lighter and allowing the reservoir pressure to deliver more fluid to the surface. The components of the produced fluid oil, water, natural gas are separated at the surface. The natural gas is then recompressed and reused in the gas lift cycle.

Traditionally, lift gas flow is not actively controlled. However, it was suspected that stability could be brought to the unstable well by using a control valve to precisely regulate its gas flow. Most gas lift applications use manual choke valves to control lift gas to the well. This means that most operators can only estimate the flow rate being delivered to the bottom of the well. They don't have the ability to accurately control it. Many people mistakenly believe that manual valves control flow. If a manual valve is set to a certain position, the desired rate of flow is only maintained when the differential pressure, or difference between the upstream and downstream pressure, is constant. This is rarely the case. Although the well's gas lift header pressure is relatively constant, the pressures within the well vary widely, resulting in large swings in the lift gas flow rate.

Space is precious in the Monopod well room
Photo courtesy Flowserve Corp.

In addition, changes in the gas rate at the surface cause dynamic changes in the well starting at the bottom and working their way up to the surface. Since the typical oil reservoir can be more than a mile below the wellhead, many subsequent and sequential upsets can be induced before the previous ones reach the surface. As a result, the well is in a constant state of instability. And, fluid production is always less than optimal in an unstable well.

One goal when operating a gas lift system is to maximize total fluid production in order to maximize revenue. The key is to keep the well stable at its optimized rate by making as few changes as possible on the surface. This is accomplished by identifying and maintaining the optimal gas rate via precise, automatic control.

The “intelligence” embedded in the StarPac intelligent control valve was seen as the solution for this application. The valve integrates a variety of process sensors, a microprocessor-based controller, and a high-performance digital positioner a complete PID control loop between flanges. One of Monopod’s 16 wells was selected to test the idea of using this valve to control the gas flow on the surface and thus improve the performance of the well. The well, which had been drilled in 2001, was known to perform inconsistently. It was not reaching its production rates, required excessive lift gas, and experienced multi-phase slugging, which was affecting the process stability of the entire platform. Modifying the well’s internals to fix these problems was dismissed because it would cost millions.

After baseline performance metrics were collected and a service and maintenance check was completed on the well, the valve was installed. Initially, it was operated in manual mode to mimic the performance of the former manual choke valve. As soon as the new valve offered performance similar to the choke valve, flow rates were altered and the valve was set up to maintain those rates automatically. Performance data were collected again and analyzed against the baseline data.

StarPac® intelligent control valve installed in the Monopod well room Photo courtesy Flowserve Corp.

The well is now much more stable. Although its lift gas usage has remained essentially the same because of the well’s design, more oil is being produced. In addition, the StarPac valve, which is more a flow control solution, is providing a remote status and control tool for well operators and an analytical tool for production engineers. With data available in real time, problems are more obvious, potential upsets can be spotted and controlled quickly, and analysis can be done on well status, performance, throughput, and operational efficiency.

The return on investment for this installation was between one and two months. The overall costs, including labor, were less than $40,000. The changes to the well, which was producing 340 barrels of crude per day and now is producing 382, will boost profitability for the well by 12 percent. In addition, remote diagnostics and control features allow Unocal operators to monitor the well from the comfort of the control room.

Additional information about intelligent control valves is available by contacting Flowserve Flow Control at 801-489-8611 or sending an e-mail to clarsen@flowserve.com.

Editor's Note: Joe Gross will tell you that years of experience with offshore oil wells have taught him that the oil production process can be a demanding master. “Oil wells are sensitive creatures,” he says. “They are subject to upset at the slightest provocation.” An upset oil well led Gross, the president of Alaskan-based Alpine Valve & Control Systems, to Unocal Alaska’s

Monopod offshore platform in the Upper Cook Inlet. Unocal is a leading natural gas and crude oil exploration and production company. Installed in 1967, its Monopod platform was one of the first deployed in the Cook Inlet. Gross worked closely with Justus Hinks, a Unocal production engineer, to stabilize the well's performance and thus increase revenue. In the following article, they share their experience determining what was behind the well's production problems and how they developed a solution.