Initial costs for intelligent completions tend to be higher than traditional completions. However, the benefits of their use can more than make up for the outlay, as a recent project in Saudi Arabia proves as Muhammad Shafiq and Athar Ali of Schlumberger explain.

Realising the full potential of intelligent completions

For several years, leading oilfield services provider Schlumberger has been working with Saudi Aramco to help the Saudi Arabian national oil company realise the full potential of intelligent completions. Schlumberger defines the role of intelligent completions thus: “Intelligent completions obtain downhole pressure and temperature data in real time to identify problems in the reservoir or wellbore and optimize production without costly well intervention”.

Initial costs for intelligent completions tend to be higher than traditional completions. However, both Saudi Aramco and Schlumberger are learning that excellent return on investment can be achieved through optimised production, improved reservoir recovery and mitigation of costly problems like water breakthrough – and that intelligent completions can play a major part in achieving these goals.

In fact these were the goals underlying the use of intelligent completion in the project discussed here. In this example, slim intelligent completions were installed in expandable liners for multilateral maximum reservoir contact (MRC) workover wells in the Shaybah Field in Saudi Arabia’s Rub’ al-Khali desert – the Empty Quarter.

The completion design in this case includes: a fully hydraulic tubing-retrievable advanced completion system with variable-position flow control valves; remote control completions technology implemented through a SCADA system and operated from a site 20-km from the well; a digital downhole temperature and pressure monitoring system; and reservoir monitoring.

The variable-position flow control valves allow individual testing of each lateral, and allocation of production rates to optimize each lateral’s contribution and overall commingled well rate. Along with real-time monitoring, well production rates can be sustained and extended by timely reaction to changes in reservoir or well conditions.

The variable-position flow control valves also help to delay early water breakthrough thereby increasing the recovery factor. Monitoring flow pressure in real time means wells can be operated at optimum rate, above bubblepoint pressure, to maintain gas pressure and ensure optimum oil recovery. Ultimately intelligent completions will limit the water handling at the surface and minimise future intervention and operating expenditures, while increasing the recovery factor for these MRC wells.

Because of the added expense and complexity, it is paramount that these completions be installed and that they operate correctly the first time, every time.

Quality, reliability and safety are always explicit goals. Many factors contribute to the successful installation and operation of intelligent completions; these are discussed below. In the event, the project team encountered no issues that affected the safe and successful installation of these intelligent completions.

As for the field in which these intelligent completions were employed, the Shaybah Field, which was discovered in 1968 and brought into production in 1998, is approximately 13-km wide and 64-km long. The surface terrain includes salt flat areas known as sabkhas and mountainous sand dunes up to 200 m high.

The oil in the Sha’aiba formation is Arab Extra Light with an average API of 42° and a solution gas-oil-ratio (GOR) of 750 scf/stb. Matrix porosity is generally high, with an average of 25 per cent, and does not vary laterally. Permeability is facies dependent and exhibits some spatial variability. Typical permeabilities in the area of the case study well range from 5 to 10 mD. The reservoir has a large overlying gas cap and a relatively weak aquifer.

As for well design and equipment, extended reach horizontal wells were required because of the rough surface terrain and need to drill from the flat sabkhas (Figure 1). Horizontal completions were required to minimize the occurrence of early gas breakthrough, maintain reservoir pressure (a concern due to overlying gas cap and weak aquifer) and achieve optimum production rates.

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These are workover MRC wells with 5 ½ -inch expandable liners set horizontally into the Shu’aiba producing interval. The quad-lateral well was created as follows: A 5 ½ -inch horizontal open hole was drilled out from the bottom of the 5 ½ -inch expandable liner. Then the four 5 ½ -
inch horizontal sidetracks were drilled from the 5 ½-inch liner (Figure 2).

All completion equipment was qualified for the production life of the well. The intelligent completion was designed with four TRFC-HN AP multi-positioned downhole tubing-retrievable flow control valves to provide inflow control from each of the four openhole laterals.

These valves operate as downhole chokes to restrict or shut off production from an interval that encounters early water breakthrough. The valves feature 11 positions, one fully closed, one fully opened (equivalent to the tubing flow area) and nine incremental positions, which were individually designed and adjusted for optimum rates for each of the laterals, according to production requirements in Figure 3.

Multiport packers were used and a digital permanent downhole monitoring system (PDHMS) was placed above the top packer to monitor flowing and shut-in pressures and temperatures (Figure 4).

In addition to the completion design, many other factors were considered, analyzed and resolved.

Some of the primary factors were: tubing movement calculations; intervention requirements; control line protection; personnel training; assembly testing and completion sub-assemblies; trial fitting of third-party components; installation procedures and associated documents; packing and shipping of assemblies; and complete the well on paper (CWOP).

However, along with these primary factors there were a number of key success factors. For example, to realize maximum value, intelligent completions must be correctly installed and operational, the first time, every time. Crucial factors for achieving this goal include: exemplary communication, coordination and project management; sufficient time for design, preparation and testing; and perhaps, most important, proper hole cleaning before installing the completions.

To ensure communication and coordination, the operator and service company each designated a single point of contact, in addition to a dedicated project manager.

These company contacts were responsible for facilitating and streamlining all communications. One key communication area was between the rig foreman and the company man on the rig to ensure proper final hole cleaning and testing before installation of the completions, which is discussed below.

The importance of CWOP and allocation of sufficient time for preparation and testing cannot be stressed enough. On this project, everything that was to happen on the rig was planned, staged and tested, resulting in no issues that affected the successful and safe installation of these completions.

Because of the added expense and complexity, it is paramount that these completions be installed and that they operate correctly the first time, every time.
New batch control software designed to increase efficiency

GE FANUC INTELLIGENT Platforms recently announced the newest version of its batch control software, Proficy® Batch Execution 5.5. An ISA-88 standard compliant batch product, Proficy Batch is focused on reduced costs, efficiency and just-in-time production by allowing process engineers to define truly generic recipes that are separate from the plant floor equipment. Such recipes can be reused all across the production facilities, and allow the users to reduce the effort to develop and maintain their recipe library. This separation makes it easy to add new products to a production line, improve the quality of products produced, and reduce the risk of operator error.

“In this economy, it is imperative for manufacturers to be flexible in their production to take advantage of market conditions,” said Claire Cerrato, general manager of GE Fanuc Intelligent Platforms’ Automation Software group. “Changing production often means reprogramming controllers. Proficy Batch 5.5 gives customers flexibility in what they produce and how they produce it.”

Batch operators typically rely on proprietary controllers and custom software systems to operate their batch production lines. Proficy Batch can help these operators increase efficiency and profits by replacing custom batch operations with a robust off-the-shelf batch platform that results in increased flexibility, uptime, and reliability. The ISA-88 model and SFC (Sequential Function Chart) programming language makes writing new recipes a snap, therefore allowing an increase in product mix without expensive controller re-programming. Proficy Batch also offers MES integration with Proficy Plant Applications’ Batch Analysis module and GE Fanuc’s breakthrough solution Proficy Process Systems, enabling a complete end-to-end batch solution.

This open and layered approach to software allows customers to select components that match their needs or combine the products to achieve higher value and a total solution. Proficy Batch allows for archival of batch data that can later be analysed by the Batch Analysis tools. This information can then be used to update Proficy Batch recipes so that the highest quality product can consistently and easily be reproduced.

In addition, Batch 5.5 includes a Campaign Manager allowing operators to better manage process orders that typically require multiple batches to fulfill. The Campaign Manager and its supporting Campaign Wizard, permit the operator to define a single batch and scale it up to the size of a process order. Proficy Batch 5.5 provides a new Batch Breakpoint feature permitting operators to set temporary pauses within running batches, and perform just-in-time maintenance, quality testing, and equipment change-out without modifying recipes.

Proficy Batch 5.5 also includes:
- formulation support for recipe parameters
- improvements to Batch Server
- up to 15 Terminal Server Clients supported
- improved Performance of Recipe Verification
- enhanced DCOM Support
- the ability to run under Microsoft Windows® VISTA operating system as well as Microsoft Windows 2008
- expanded terminal server support
- improved Batch runtime support.

For more information: www.gefanuc.com/batch