



# PROLONGING RESERVOIR LIFE

Well integrity testing plays a crucial role in preventing disasters and reviving wells, not only at the well-head during production but also in earlier stages during workovers and cementing, as Heba Hashem reports

**M**any of today's oil and gas fields were not designed with the concept of well lifecycle risk management and were mostly constructed for a life of about 20 to 30 years. Yet it is still common to find much older wells in use: production in the North Sea started in 1975 and in the Middle East some fields are more than 40 or 50 years old.

A growing number of oil drilling companies are also considering extracting more crude

from older deposits — not the least due to the anticipated high price for crude oil over the long term. The risk of groundwater contamination from these decades-old wells is significant, as they were commonly lined with clay tiles and had poorly sealed casing joints. Some older wells were also installed prior to the introduction of minimum standards for construction, maintenance or abandonment.

In order to re-evaluate the processes in place and reduce the likelihood of well incidents, regional operators need a

fundamental shift in taking well-safety to another level.

## Well testing challenges in GCC

The testing of oil and gas wells is an integral part of reservoir management for both new and mature fields, onshore and offshore. Following the completion phase, and after the drilling of the well, securing the well comes into focus, which primarily involves inspecting the quality and structural integrity of cement and blow-out



An SPD onshore rig

preventers (BOPs).

The aim is to check the behaviour of the well after it has been completed and sealed, and to reduce the risk of uncontrolled release of formation fluids throughout the well's lifecycle. By predicting such problem areas, prevention budgets can be spent wisely and

“ Well integrity is a major challenge to oil companies in the Gulf... in the region there are hundreds, perhaps thousands of wells with well integrity issues ”

**Alistair Davidson, managing director – Middle East, SPD**

unanticipated expenses avoided.

“Well testing is the only accurate method to determine key reservoir characteristics which are critical for the complete drilling and production process”, explains Abdulbaset Elfandi, Sales Manager of Specialist Services’ Drilling Testing and Production.

Despite the considerable value of well testing, the process is still not considered

a priority for many operators. “In well testing regionally, we are behind the times in technology. This is because the vast majority of drilling in the region is development drilling with minimal requirement for well testing,” says Alistair Davidson, managing director - Middle East at SPD, a well construction and management specialist. He explains that as a result, the inventory of well-testing equipment kept in the region is also quite low and that “the specification of equipment here also tends to be low-end.”

### **The corrosion threat**

Managing a well's integrity generally involves three stages. The first is during well design, consisting of material selection, cement and engineering design, coating and inhibitors and cathodic protection. The second involves the monitoring of well integrity during the life of the well and locating possible leaks or



A Cansco team prepares a blow-out preventer for testing

loss of metal. And the third entails the management of well integrity issues using specialised services and systems.

One of the most important facets of well integrity is testing the reliability of production tubing, which is vulnerable to erosion and corrosion by production fluids that denude the steel. Tubing integrity is also threatened by pressure between the tubing and the 'A' annulus, which can lead to the burst or collapse of the tubing if it exceeds the rated tubing pressure. In wells with poorly sealed or corroded steel casings, foreign materials like surface water can easily leak through.

In the Arabian Gulf's brackish waters, where numerous wells are located in deep and remote areas and others are expected to have a long lifetime, wireline corrosion evaluation and control can be of extreme benefit, saving expenses throughout the well's life. It is estimated that 1 per cent of the total operating costs of the oil industry could be saved just by the correct application of corrosion protection technology.

"Well integrity is a major challenge to oil companies in the Gulf. Spread across all national oil companies (NOCs) in the region there are hundreds, perhaps thousands of wells with well integrity issues," says Davidson. "Some of these are in a serious

condition and a threat to environment and to the reputation of the companies involved. As yet, there has not been a serious, systematic approach to addressing well integrity."

#### Surviving well integrity loss

ADMA-OPCO's Umm Shaif oil field is currently undergoing a massive gas development project, in which the National Petroleum Construction Company (NPCC) will build a gas processing pipeline to transfer up to 1 billion cubic feet of gas a day from offshore fields to ADNOC's onshore operations. The project is expected to be complete mid-next year.

However, Umm Shaif was not always free of turbulence. The offshore field's first well was drilled back in 1958, making it one of the oldest oil fields in the country. In 1999, a major gas tower in the centre of Umm Shaif encountered severe integrity problems.

As reported by the Society of Petroleum Engineers, Tower US-A experienced a gas explosion while cementing the 20-inch casing of well US-AA and significant hydrocarbon gas bubbles were observed in the uncontained annulus, coupled with high pressures built up in the well's annuli. These pressures were close to or more than the maximum allowable

safe measures. On the other hand, well US-AB showed high sustained pressure in production annulus, which put both wells at risk and could have resulted in the loss of the tower and production.

A multi-disciplined approach was taken by ADMA-OPCO to restore the integrity of the challenging wells, leading to the salvage of the critical tower. The execution plan included a Cause Tree Analysis to identify root causes of the problems; an isotope analysis to pinpoint the source of leaking and safe-rate calculations using reservoir and drilling engineering concepts.

The ADMA-OPCO team also conducted high-resolution 2D seismic surveying to identify the presence of shallow gas, while using micro-fine cement for remedial work. The restoration of tower integrity, gas production and injection resulted in huge capital saving estimated at US \$150 million, in addition to an increase in oil and gas production.

#### ZADCO: a well integrity model

A market analysis by Schlumberger estimates the Middle East has 62 per cent of the world's proven oil reserves, and that more than 70 per cent of these lie in carbonate reservoirs. The region also has 40 per cent of the world's gas reserves, with 90 per cent lying in carbonate reservoirs.

Although carbonate reservoirs hold immense opportunities, they also present unique challenges in terms of fluid flow mechanisms and scale formation. Well integrity can play a significant role in controlling the production decline caused by scale.

At its offshore carbonate reservoirs, ZADCO initiated a successful strategy to manage the sulfate-scaling tendency in the completion tubing, by using software to identify wells early on as potential scale candidates. The software relies on real field measurements and analysis of injected and produced water data, and the results help in planning well monitoring and treatment.

Early corrective action was performed using a specialised sulfate scale-dissolving fluid pumped from the surface, while more complex treatment for larger scale accumulations was performed using a barge, coiled tubing unit and a downhole jetting system. Results showed that early diagnosis of the scale enables easier and far less expensive scale removal and reduces any overall production declines.

With over 300 wells in the Upper Zakum field, ZADCO needed to maintain the integrity of each one, implementing a Well Integrity Management System (WIMS) to identify, prevent, and solve problems with well integrity, with scale management an important part of this approach.

#### Global industry responds

Following recent unfortunate events in the upstream oil and gas industry, the International Association of Oil and Gas Producers (OGP) established a Global Industry Response Group, GIRG, to provide recommendations that raise the safety of well operations. The GIRG's Deepwater Wells Report No. 463 was released in May 2011.

"This report is a very important step for the industry as the operating companies of the OGP, which include regional operators, have established a common foundation on which to build greater integrity assurance into their high-risk well operations," says Mike Simpson, chief executive officer at Cansco, a specialist in

the supply of blowout preventer and well control technology.

Its facilities' test equipment includes data loggers to record and retain full pressure test histories, specialist test mandrels to ensure ram blocks are well bore tested before use along with powered torque units. Cansco's testing standards comply with the GIRG recommendations for pressure testing.



A below-ground testing facility

“A lot has changed since the early days of the industry in the region. The directional drilling capabilities are infinitely better and so are well evaluation techniques”

#### Expanded technology parameters

Technological advances have enabled manufacturers to develop more accurate well testing devices and software to monitor temperatures, surface pressure, rate and depth of leaks along with levels

of corrosive components.

"A lot has changed since the early days of the industry in the region. The directional drilling capabilities are infinitely better and so are well evaluation techniques, which are capable of giving not only more accurate information but data on more formation parameters," a spokesman from Gulf Keystone Petroleum told Pipeline. The independent oil and gas exploration and production company has operated in the Kurdistan region of Iraq since 2009.

According to Chris Ridley, sales and marketing director at Specialist Services, an engineering and fabrication firm that works closely with oil service providers, old reservoirs reaching their closure and others moving towards their plateau can both be found in the Middle East. "In countries like Iraq, most of the oil reserve data were acquired prior to the Gulf war. This resulted in a challenging environment for well testing service and equipment providers to operate in," he says.

Meanwhile, Brinker's Platelet technologies have demonstrated their ability to restore well integrity on shut-in holes and return leaking wells to full production. The company recently restored seven wells in eight days for an NOC in the Middle East, including a well that was shut-in for five years.

According to Kevin Stewart, CEO at Brinker Technology, "up to 40 per cent of the world's oil wells are shut in, or operating with dispensation, because of well-integrity problems". With a proportion that large, these wells collectively represent major potential for increasing production to meet oil demand - growing globally each year by 1 million barrels of oil per day. Ultimately, well integrity management can reduce the need to drill new wells.

Headquartered in Aberdeen with a regional office in Dubai, Brinker provides rigless thru-wellhead workover services for simultaneously finding and fixing well leaks using its patented Platelet barrier and is the only company that does this from the top of the wellhead down, without removing the wellhead itself.