

Building blocks to see the bigger picture

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In the current oil and gas environment there is a renewed focus on well integrity to safeguard production, reduce the risks associated with field operations and ensure sound environmental stewardship. Simon Copping, from Expro's EGIS (Expro Group Integrated Services) product line, explains the importance of collating, analysing and sharing valuable well integrity related information in planning production, monitoring well status and ensuring compliance to company and industry requirements.

Operators producing brown or mature fields, typically face numerous challenges maintaining production levels and optimising the recovery of reserves. When these fields were typically developed back in the 1980s, or earlier, there would have been significantly less focus on longevity and well lifecycle management, a term more commonly used in recent years.

What we have subsequently seen in these fields, as we extend field producing life, is an increasing range of well integrity issues that need to be managed. These issues are compounded by more demanding well integrity legislation, following high profile related incidents.

Whilst mature brownfield assets are the traditional focus for such issues, the well integrity of new wells is of equal importance - particularly in challenging HP/HT or deepwater environments. After all, integrity spans the whole lifecycle of a well. Hence, even before a well can be drilled, there is need to assess future well integrity risks and to ensure that appropriate integrity policies and engineering solutions have been considered and factored into the well design and operating procedures. In fact, how a well is drilled greatly affects the nature of issues that can arise during production.

By NORSOK definition, well integrity is the: 'Application of technical, operational and organisational solutions to reduce risk of uncontrolled release of formation fluids throughout the life cycle of a well.' In more simplistic terms, it is about identifying and eliminating potential leaks. Well integrity management systems are therefore designed to prevent formation fluids breaching barriers and moving to where they shouldn't be.

Recent studies have shown that 760,000 wells globally are affected by well integrity related problems – resulting in 19% of these wells being shut-in. (*OTM Consulting 2009*). In purely economic terms, these issues currently cost operators \$1.1bn per day in lost production revenue (*BP Statistical review of world energy 2010; US EIA-28, 2009; OTM Consulting 2011*).

An earlier study carried out by SINTEF, the Norwegian Scientific Research Organisation, in 2006 found that between 40% and 50% of wells in the North Sea and Gulf of Mexico have integrity problems.

However, globally, this is a mixed and often incomplete picture. In an academic paper from the Durham Energy Institute last year, the authors highlighted that global datasets on well integrity vary considerably in terms of the number of wells examined, their age and their designs. Therefore meaning the overall percentage of wells that have some form of well barrier or integrity failure is ‘highly variable – from 1.9% to 75%’. (*Oil and gas wells and their integrity; Davies et al; 2014*)

Key challenges observed by operators and service companies in managing well integrity usually relate to data accessibility and accuracy. For well integrity risks to be understood and known, it is essential that correct information about the well is recorded throughout its life and that operating parameters be reviewed and updated on a regular basis.

Software systems provide an excellent platform to share such information across an organisation, but also provide engineers and managers with a tool to make informed decisions. With the current economic climate and the impact of the oil price on our industry, the value of understanding and proactively addressing well integrity issues has never been so important.

Systems and solutions

The overarching drivers behind ensuring well integrity are typically related to safety, environmental stewardship, compliance to legislation and risk mitigation. A management system that identifies issues, recommends solutions, and creates a clear audit trail of documentation that meets company and regulatory requirements satisfies these needs.

Expro's tailored software system, SafeWells™, was developed directly with clients to support their well integrity management processes and provides a technical, operational and organisational solution to reduce well integrity risks.

By openly collaborating via a regular User Forum, SafeWells™ has been developed in line with operator requirements, legislation and industry best practices. This collaboration between operators and Expro has ensured that the resulting system is fit for purpose, practical and user friendly.

SafeWells™ monitors and reports well integrity performance and has been successfully deployed by a wide range of independent and major operators across the globe. The flexible software allows the monitoring of maintenance and associated remedial actions, risk assessment needs, dispensations and changes in the well operating envelope.

For management reporting, SafeWells™ provides an on-screen 'traffic light' display of well status according to designated well failure models, with specific parameters set by the operator. SafeWells™ also has the ability to communicate via email details of the well status to any number of chosen personnel.

Operators can therefore anticipate and plan intervention activities safe in the knowledge that they are compliant with their policies, while being able to demonstrate effectiveness at monitoring and tracking their wells' status.

Collaboration via data sharing

In recent years there has been a shift in collaboration between software vendors and operators towards data sharing. This is a vital step forward for the security of the industry - it is important to work together in synergy to gather data, analyse information, and apply solutions in terms of tools, technology and people, in a streamlined process.

The SafeWells™ Integration Framework has been developed to easily allow data to be shared between SafeWells™ and third-party software systems. This framework utilises a service-oriented architecture approach to allow data to be shared between software systems that specialise in completion design, annulus pressure monitoring, reliability and maintenance.

The key to the SafeWells™ Integration Framework is the use of web services. Web services provide a standardised way of integrating software applications online. Unlike traditional models, web services do not provide a graphical user interface, but rather share information through a standardised interface across a network. Developers can then add the web services to their own programmes to leverage functionality of the service provider. This allows different applications to communicate with each other without time-consuming custom coding.

It is essential that data sharing continues on a partnership basis to ensure alignment. Operators need assurances that solutions can be provided that will fill demand, and software vendors in turn look at working collaboratively to provide world class solutions to their customers.

The value

Sound well integrity is not just important to our communities to operate safely, but it also has a very clear business case. There is a clear line between safely operated wells and the bottom line profitability. Software systems collate and analyse data, monitor wells and maintain production levels by minimising unplanned production downtime. By reviewing trends in SafeWells™ it is possible to see if the overall 'big picture' is improving.

SafeWells™ technology allows operators to manage their well integrity data first-hand to reduce the risk of uncontrolled releases of formation fluids. It also helps improve operations specifically through its visualisation and reporting components. The system can form an integral part of a comprehensive in-house well integrity management system (WIMS). For example, Tullow Oil (SPE 142449) evaluated well integrity processes against defined fundamental requirements of an ideal system, namely the 'Seven Pillars of Well Integrity Management.'

Like many operators, Tullow Oil works in a range of environments each with diverse well types and requires a centralised process that can also be run by each asset to suit local requirements. As part of Tullow Oil's well integrity policy, each asset undertakes annual independent well audits to compare actual well status in all operated fields against policy. This process provides management with a clear understanding of the integrity status of all wells and, in effect, raises the bar on the operating standards of each operating asset. Safety improves because there is up-to-date knowledge of well integrity status, and shut-in

times can be reduced by identifying recurring well integrity issues and putting corrective actions/targeted maintenance plans in place.

Several operators have also seen a significant benefit in terms of time spent with well examiners by using SafeWells™. In the past, when a well examiner was required to undertake quarterly reviews, hard copies of data and a significant portion of an engineer's time was needed. However, with SafeWells™, all of the well data is already in place. Several operators have provided their well examiners with a SafeWells™ log-in so that they can do their work remotely. One major operator that utilises the software also saves over \$150K/year in their annual insurance premiums because they have the SafeWells™ system in place and are open with well examiners in how they monitor well integrity data.

In terms of management reporting, SafeWells™ is being used to report the well integrity status of assets to the executives and board of directors at one operator. The board, aware of specific issues, maintains visibility of critical risks and remedial work plans i.e. what is being done to fix critical or 'red' wells? The same board is then able to challenge their organisation on what is being done to ensure the medium-concern or 'amber' wells do not deteriorate further. In essence, SafeWells™ provides an overall, easy to digest snapshot of the entire company broken down by asset.

Other examples include analysing valve failures recorded in SafeWells™ to determine the most suitable type of grease to use when performing leak tests and avoiding pressure-related incidents via pressure limit alerts. This was recognised by Marathon Oil UK when implementing SafeWells™ successfully for the Brae (UK North Sea) and Alvheim (Norway) assets (SPE 123201). Auditing, trending and summary reporting became a major task due to important integrity related data being scattered across the company in individual departments. However, by taking a systematic approach using SafeWells, office and worksite personnel gained access to the same dataset in real time, stored in a central location and segregated by asset.

Incorporating an auditable trail of operations and documentations on wellhead activities from field to well level, pressure data and equipment information provided increased visibility and consistent assessment of well integrity status. Furthermore, SafeWells™ was integrated with production pressure recording systems utilised in the Brae and Alvheim fields. Maximum pressure service limits were set with corresponding email alerts to appropriate personnel in event of a breach. In this case, pressure issues were immediately recognised, informed decisions made and the situation controlled.

This systematic approach ensures the identification and resolution of issues before they become long-term problems.

A holistic picture

Within Expro, SafeWells™ is part of a larger end-to-end integrated well integrity solution. The recent re-launch of our Expro Group Integrated Services (EGIS) product line adds value to customers' operations by bringing together our software, subsurface engineering, well integrity, well service supervision and project management capabilities.

Well integrity management requires an understanding of the well, and the ability to provide in-well analytical and remedial services. This process begins with well integrity consulting and engineering with the resulting information feeding into SafeWells™. The well integrity services and technologies Expro provide can help isolate specific issues i.e. run a caliper log to obtain data about condition of tubing, leak detection tools to identify tubing leaks, or using our Cableless Telemetry System (CaTS™), gauges to test integrity of plugs.

Wellhead maintenance services can help repair and maintain wellheads, which are often the sources of failed integrity tests i.e. valves on the wellhead. A range of slickline capabilities can also be used for routine mechanical intervention work but also to provide a range of cased hole services that could include production logging, pressure surveys, etc., which are all important for understanding well integrity issues. Supplementing this, Expro's Well Services group can provide well engineering, training and wellsite manpower for field operations and wellsite.

Conclusions

Software systems such as SafeWells™ are an important component of any Well Integrity Management System. However, these systems are only as good as the data they contain. It is therefore essential that operators have well defined policies and procedures to manage well integrity and gather essential data.

It is then vital that offshore technicians have the knowledge and expertise to process this data accordingly, understand that the data is constantly changing throughout the lifecycle of the well, and where possible, that data should be validated via cross referencing with handover documentation, modelling and intervention work. This may include acquiring

production logging tools, caliper and video to help get an accurate understanding of the condition of the well. Expro's experience in providing such holistic well integrity services has been a key factor in keeping SafeWells™ robust and fit-for-purpose.

If real collaborative efforts are made, the significant risk to software vendors - that research and development spend will not realise a return on investment – would be reduced. For the operating community, this approach would also ensure optimal technology is delivered to successfully ensure well integrity is maintained.

This is an ethos echoed by Sir Ian Wood in the UKCS Maximising Recovery Review Final Report (Feb 2014) which pinpointed a lack of co-operation in the industry as a key issue leading to increased costs and delays, calling for a regulator that would be the catalyst for 'facilitating, co-ordinating, mediating and promoting collaboration' to take the industry forward positively.

The flexibility of software systems such as SafeWells™ allows customers to customise the information they need to see. The way the data is visualised means it is easy for companies to turn their well integrity status into a real-time picture that improves decision-making and helps operators and associated service companies to achieve targets, key performance indicators and standards in well integrity.

Together, service companies and operators are collectively responsible for ensuring that the systems knowledge, competency and technology to achieve this is available and deployed to manage well integrity as professionally, safely and environmentally responsibly as possible.