Vysus Group

Whitepaper

How to avoid costly mistakes in your well designs

Over the past decade, three mega-trends have fueled a boom of well construction regulations.

The first, hydrocarbon exploration and production in remote locations and/or in deeper and hotter reservoirs. The second comes along the technology developments that have gradually redefined the boundaries of "conventional" in the different codes of practice, and the third, and perhaps the most important, is the renewed and urgent focus on environmental impact and sustainability, hastened by major preventable incidents and the rise of renewables.

For well construction, one of the key industry initiatives to address system-level risks relies on independent Well Design Verification & Assurance. Under this scheme, subject matter experts examine a given design and analytically and systematically determine conformity with approved engineering methods and requirements, including mechanical integrity, life cycle service, and other survivability loads. This is done at the design phase, prior to project execution. In other words, well design verification is a tool to demonstrate to interested parties such as regulators, insurers and operators that the uncertainties introduced by a well design and its technology and equipment selection have been considered, and that major risks have been mitigated. In the UK and EU, such assessments come as a requirement within the Well Examination schemes, but what if it's not mandated? What is the importance and benefits of having your well design independently verified?

This white paper looks at best practice and why you should always implement an independent well design verification, whether regulatory or not, and how to ultimately avoid costly mistakes in your well designs.

Well Design

In its simplest form, a well asset should be reliable to accomplish its intended use. This means that it should perform its required function under the forecastable loads during its lifecycle (after ISO 14224). The reliability of each component and its integration as the well is drilled, operated and maintained, determine the well system reliability. This is challenging, as reliability is not only affected by each specific component failure mode, but the potential for common modes of failures reduces the effectiveness of the system barrier redundancy (ISO 14224).

As with many complex systems, a large percentage of failures and anomalies that occur in the execution of well construction programs can be rooted back to planning errors or omissions originated during the design phase. The interactions and variety of well construction technical solutions have gradually increased in complexity, making them virtually impossible to exhaustively verify and validate without expert resources on a systematic method.

Confidence in your well design: Design verification

In view of the large amount of local regulations, industry recommended practices, and operator's own specifications, it is not realistic to expect that lean well project teams with limited resources can fully assess the risks of non-conformance to requirements at a well system level. Not only regulators, for instance in the UK and the European Parliament EU (see Directive (2013/30/EU) on Safety of Offshore Oil and Gas Operations), but also insurance companies and operators have identified the need to perform an independent assessment so that wells are designed, constructed and maintained in such repair and condition that:

Elements common to all phases

- Well integrity
- Well integrity management
- Well integrity policy
- Risk assessment
- Organisational structure
- Well barriers
- Performance standards
- Well barrier verification
- Reporting & documentation
- Management of change
- Continuous improvement
- Auditing

Well integrity life cycle phases

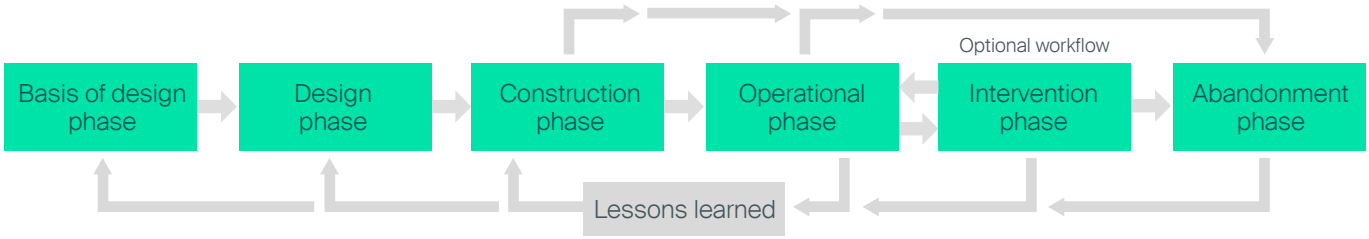

Figure 1 – Phases of well integrity management (ISO 16530-1)

a) So far as in reasonably practicable, there can be no unplanned escape of fluids from the well; and,
b) Risks to the health and safety of persons from it or anything in it, or in strata to which it is connected, are as low as in reasonably practicable[1].

The objective of an independent Well Design Assurance scheme is to provide a verification process that uncovers unidentified integrity and safety technical risks, so that they can be prevented or the cause corrected as early in the well design cycle as possible. This is a formal, systematic process that augments the design effort and increases the probability of well design conformance to requirements and objectives. It is a compliance tool against local regulations, industry practices and operator's own specifications.

Why is it important to cover all phases of design?

A design assurance program typically covers all phases of design. From the risk mitigation perspective for all interested parties, these assessments are usually more useful at the completion of the Basis of Design phase as shown in Figure 1. This phase identifies the probable safety and environmental exposure to surface and subsurface hazards and risks that can be encountered during the well life cycle (ISO 16530-1). The most likely design concept can then be thoroughly analyzed and risk assessed early enough in the project by an independent competent party, so that control methods of design and operation can be developed in subsequent phases of the well life cycle*.

Why is independence important?

Being independent means that the third party has a direct duty with the Operator and an indirect duty with the Regulator to evaluate a well design. This requires unbiased judgement, competent personnel, latest industry standards adoption and the use of overall sound engineering criteria to assure that a design has adequate well integrity considerations.

A focus on Integrity

An independent and competent Well Design Review / Assurance for operators, insurers, regulators and any other interested party should follow the approach that has well integrity as its main foundation, and leverages technology qualification procedures to allow for systematic analysis and identification of risks, for detailed analysis as shown in Figure 2.

What entails a verification/assurance study?

Performing a verification/assurance study is not as simple as knowing the standards and verifying compliance to what it says. It is not just a peer review, which is usually completed within the party responsible for the operation. In addition to checking conformance to codes of practice, the verification is a process that includes one or more of the following:

[1] Oil and Gas UK, 2017.
* Depending on the country, such as in the UK and EU, such assessments come as a requirement within the Well Examination schemes.

a) Design Review, with a formal process answering questions such as: does the well design satisfy the objectives and requirements? Do the assumptions appear to be reasonably? Are there areas in the design where the risks seem to higher than usual? Have any items of consequence been omitted from the design? Is there a combined compliance assessment? Do the methods used for design seem appropriate for this application? What problems or concerns must still be solved? Is there reasonable assurance these open items can be resolved in an appropriate manner in the time remaining? Do the design output reports make sense? Is there a barrier plan throughout the well life cycle with a minimum of two barriers? What dispensations are in place? What equipment will be used and is there any better available technology in the market? If applicable, is there configuration / version control?
b) Design analysis: major issues seldom come from mathematical inaccuracies; they rather come from improper methods, invalid assumptions or incorrect modelling techniques. It answers questions such as: What is the purpose and scope of the calculations? What methods are used? What are the key assumptions or limiting conditions? What units are used? Who performed the calculations? What is the accuracy of design results? Is there a need for alternative calculations? How do the calculations compare to similar proven designs?
c) Alternative testing: usually not common, but depending on the criticality it may be required, especially for permanent barrier components (e.g. production tubulars, cement, etc.).

A system to trust

This assists the different parties (operators, insurers, regulators, etc.) in methodically assessing designs at an early stage and determine conformity with requirements: local regulations, industry recommended practices and company's specifications. Giving confidence to you, insurers, and stakeholders that the right decisions are being made, and those projects are being delivered safety, on time and to budget.

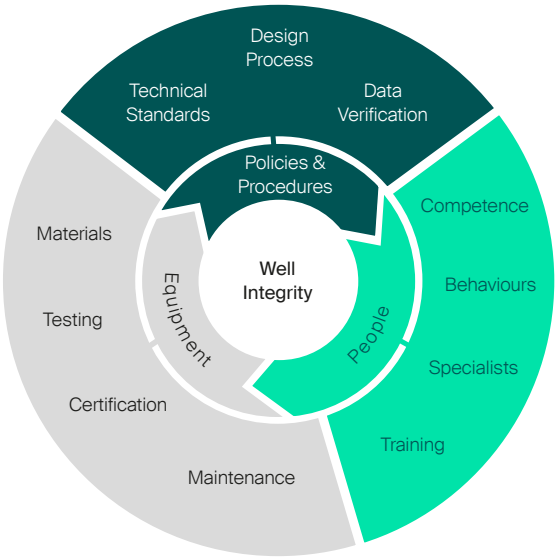

Figure 2 – Well verification approach (Vysus Group, 2016)

Conclusion

Upon implementation of any Well Design Assurance scheme, the main benefit is to have an auditable and independent process for demonstrating full compliance with local regulations, company policies, industry standards and recommended practices. An efficient verification/assurance scheme measures the design effectiveness so that the pressure boundary of a well is controlled by means of suitable use of equipment, procedures and competent personnel during the life-cycle. By focusing on Well Integrity at design phase and through a well design assurance scheme, taking a holistic view of your well design, not only ensures compliance with regulations and standards but ensures your wells are design to optimum efficiency, alternately safer and reducing costs from reworks.

Vysus Group Wells Project Management and Engineering

At Vysus Group, our goal is for you to exceed your wells objectives, cost effectively and safely. We help quantify the risk, and safely manage the design, integrity, performance and reliability of your wells.

Vysus Group verification and assurance systems provide an independent, objective view of project delivery at the right time, by the right experts, with the correct methods. Through our experienced engineering expertise across a wide range of disciplines, we provide safe and efficient engineering for your well projects, including well design, construction and drilling operations management. Through our combination of first hand operator experience, extensive engineering expertise and established well integrity procedures, we help you understand and mitigate risks of your operations.

To learn more about how we can help you, or to speak to one of our experts click here, get in touch info@vysusgroup.com.

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