

CRITICAL FAILURE & EMERGENCY RESPONSE PLAN– OFFSHORE WELLS

OVERVIEW

This case study looks at a process that was developed for the purpose of identifying and assessing all the potential integrity failures within a well envelope to determine what the most likely failure or series of combined failures could be and what impact and consequences those failures could have.

The assessment was the foundation to develop an Emergency Response Plan (ERP) for the well as a proactive approach so that in the event of any high potential failure evolving there would already be safe guarding instructions in place to action on.

THE CHALLENGE

An independent Oil & Gas operator requested Opus Integrity to develop a process for performing well integrity based assessments to identify and evaluate the most probable failure modes within a well envelope and prepare responses for them.

The process design had to be practical and versatile so that it could suit the overall asset well portfolio where possible. A key requirement was so the operator could generate a comprehensive output from the assessment that would be delivered to the regulator to demonstrate that all probable failure modes, severity, consequences and subsequent responses to them had been identified, considered and evaluated.

The process had to include the development and implementation of an ERP for the well. The ERP had to be generic so that it could be utilised to other similar asset wells in terms of type, status and condition. The objective of the ERP was to identify safeguarding controls that would provide proactive measures for any potential situation or condition identified in the assessment.

THE SOLUTION

The process development was aligned with the operators Well Integrity Management Standards (WIMS), relevant industry standards, and local regulator requirements for well integrity.

Primary guidance to develop the process was obtained from:

- **NTNU Trondheim** – An introduction to Well Integrity Study 2012
- **NTNU Trondheim** – Reliability Assessment of Subsea Xmas Tree Configurations Study 2015.
- **NTNU Trondheim** – Subsea Production Systems (Master Thesis) FMECA - Application of failure mode, effects and criticality analysis (Ref to ISO 14224, SINTEF 2015a&b).
- **MIL-STD 1980** – Procedures for performing failure mode, effects, and criticality analysis.
- **HSE UK** – Xmas tree component reliability, failure mode identification, determination of the leak frequencies and leakage rates study - (multiple ref).
- **OREDA** – Industry data on component failure stats.

Development and qualification of the process included:

Review supplied well and asset data to determine suitability and value for CFI/ERP assessment



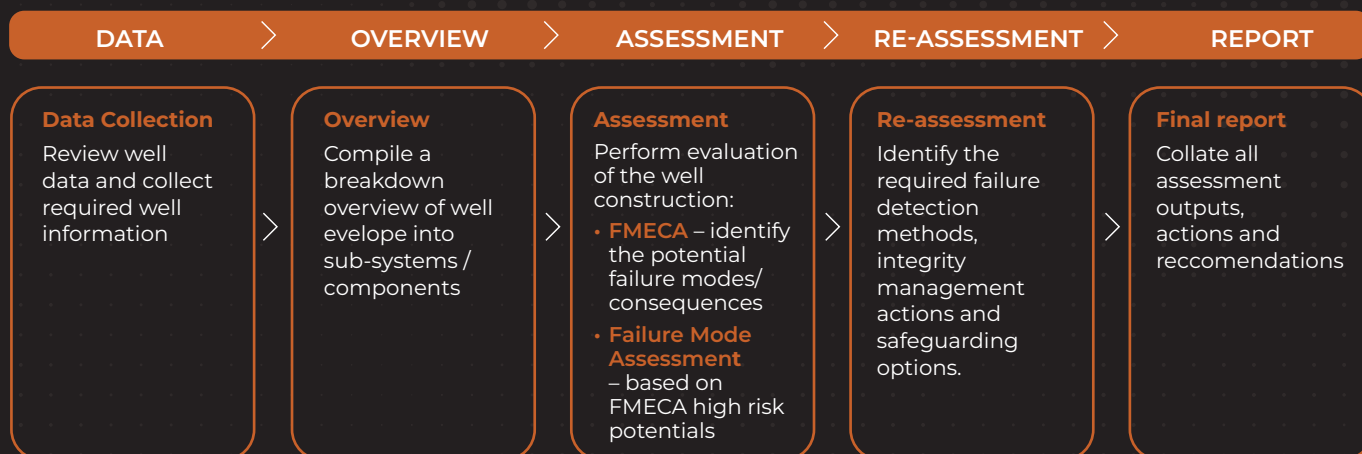
Development of the process with an assessment of the example well to support the methodology in cognisance with other considerations



Output review of the well assessment, ERP and methodology overview.

CRITICAL FAILURE ASSESSMENT

- **Data Collection** – Review and collate well information.
- **Overview** – Break down of the well structure systems / sub-systems / components.
- **Technical Assessments** – Evaluation of the well construction:
 - **FMECA** – identify the potential failure modes and consequence.
 - **Failure Mode Assessment** – based on FMECA high risk potentials.
- **Re-Assessment** – Identify the required failure detection methods, integrity management actions and safe guarding options.
- **Report** – collate assessment findings, outputs, actions and recommendations.



CFI & ERP DEVELOPMENT

The CFI & ERP process has since developed into one of the main Opus Integrity - Asset Integrity Assessment options and has been utilised to assess a variety of offshore and onshore wells in different areas of the world further qualifying its process, versatility and adaptability.

- **Total CFI & ERP Assessments** – 12
- **Total CFI & ERP / LES Assessments** – 4

CFI & ERP is generally used to assess individual ageing wells or wells with integrity concerns where ERP is the main focus. It has also been utilised in tandem with the Asset Integrity Assessment -Lifecycle Extension Study to provide additional value in qualifying the well for safe operations beyond design life.

EMERGENCY RESPONSE PLAN

The ERP was developed on the complete well system (downhole & XMT) and made specific to the highest potential failure mode for each section from the CFI assessment (loss of containment).

The highest potential leak points were listed against each potential leak severity and leak type (well fluid or gas). The leak severity ranking was defined by leak type (well fluid or gas) and where it was only gas the leak rate determined the severity.

Fluid Leak (Any) Any rate of leak	Significant Leak rate measured less than (<3600scf/hr Gas)	Major Leak rate measured greater than (>3600scf/hr Gas)
Moderate Leak rate is measured less than (<900scf/hr)	Small Leak rate measured less than (<450scf/hr)	Minor Leak rate measured less than (<37.5scf/hr)

For each level of leak severity the ERP provided guidance on the immediate action plan relating to the operational status (flowing or shut-in) of the well with the primary aim of regaining control of the leak or reducing the severity and gathering information to aid with the forward well management plan or remediation planning.

The ERP was completed with an assessment of the conditions (leak severity) which considered probability of condition, consequence and risk.