

## Lowering Well P&A Costs by Qualifying Alternative Well Abandonment Designs

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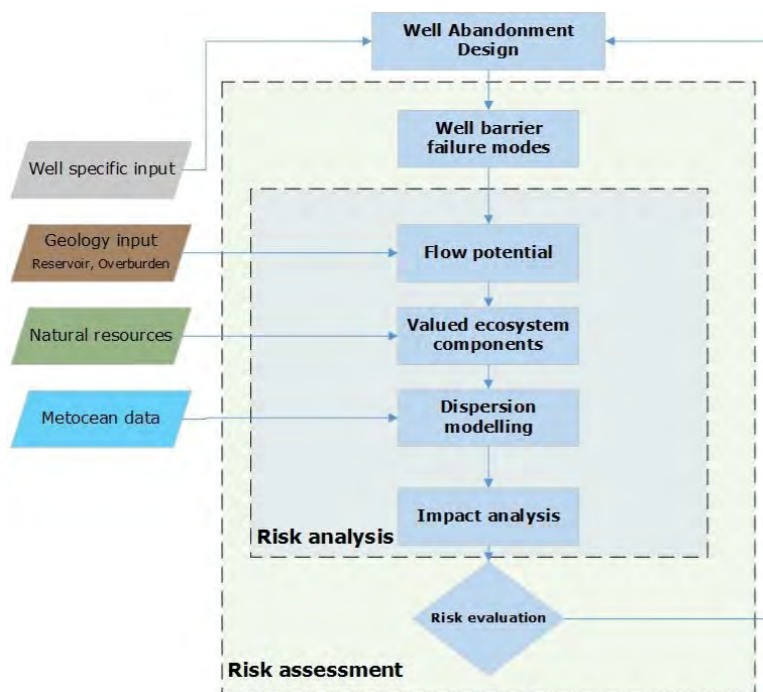
The major need for well plug and abandonment has been a highlight at numerous industry conferences over the past few years. Studies performed by Norsk Olje og Gass show that there will be a large rig activity devoted solely to well P&A in the North Sea alone. The Oil & Gas UK agrees, having shown that well P&A is the highest single expenditure in decommissioning budgets.

Major cost savings can be realized by performing fit-for-purpose well abandonment. While global operators and regulators ensure that wells are abandoned successfully and securely, well designs and thus operational savings can be achieved by having well-specific and site-specific well abandonment designs.

Today, well plug and abandonment jobs for both platform wells and subsea wells are planned and performed using prescriptive regulations, such as NORSOK D-010. These requirements prescribe the well abandonment

method and details such as the number, type and length of well plugs. Current regulations imply a ‘one-size-fits-all’ approach. By executing well P&A operations based on the current prescriptive regulations, the industry is in jeopardy of over spending on well abandonment, especially on subsea wells.

Alternative to today’s regulations, DNV GL have released a new, risk-based Recommended Practice (RP) for performing and qualifying well abandonments, entitled DNVGL-RP-E103 “Risk-based abandonment of offshore wells.” The RP was released in May 2016 and specifies a systematic process for assessing and controlling subsurface pressures and thus preventing the free flow of pore fluids to the environment. The RP’s intention is to provide well operators with an alternative, risk-based method for designing and carrying out well abandonment operations. The ultimate objective of the RP is to protect the environment and ensure safety standards are upheld.



Risk context

Elements in Well Abandonment Risk Assessment

### Method

The background for the new DNV GL RP on well abandonment is existing risk management theories and practices, commonly applied in offshore safety risk management and environmental risk management. The RP provides a step-by-step approach, where risks are identified and analyzed individually. Using these techniques, well-specific acceptance criteria for the environment and safety are established, setting the abandonment requirements for each well.

The methodology for performing risk-based assessments of well abandonment designs is composed of five steps. The steps are:

- Establishing the risk context
- Identifying well barrier failure modes
- Performing a risk analysis
- Performing a risk evaluation
- Conducting qualification for well abandonment design.

An important part of establishing the risk context is inspecting the flow potential



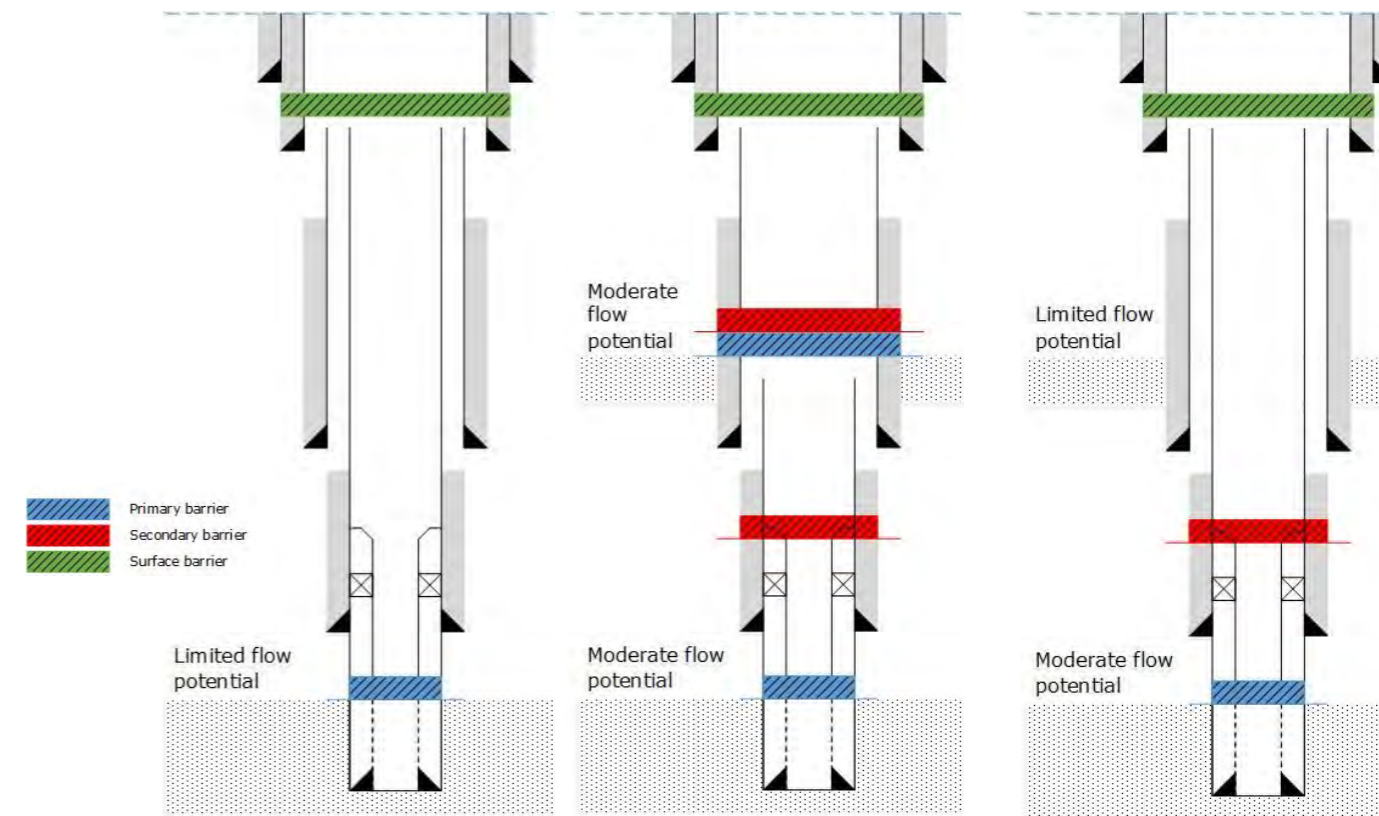
sources. An assessment of the flow potential of individual formations penetrated by the well is key to the well abandonment design. A flow potential, in this context, is defined as a hydrocarbon-bearing formation containing moveable hydrocarbons large enough to have a potential environmental or safety impact. The well P&A design is an application of the well specific requirements for each hydrocarbon bearing flow potential formation and the permanent barriers required. The specification of the permanent well barrier requirements is a function of the well barrier failure modes

and their resulting risk, both in terms of likelihood and potential consequence. The resulting risk may be in the form of operational risk, safety risk or environmental risk. With the risk analysis of the P&A design performed, decision making and comparison of the well abandonment design relative to the risk acceptance criteria can be performed.

### Case Studies and Summary

DNV GL has assisted in case studies where significant saving potential has been realized

in well abandonment projects. On one specific case study, the well operator was able to save approximately 100 MNOK per well by analyzing their wells up for abandonment from a risk-based perspective. When establishing new well abandonment plans, the overall approach has been to qualify wells to be abandoned for their use and secure long-lasting integrity. Using the risk-based methodology, ‘fit-for-purpose’ well abandonment designs can be used rather than the current ‘one-size-fits-all’ approaches.



Example of permanent abandonment for one hydrocarbon-bearing formation with limited flow potential.

Example of permanent abandonment for two hydrocarbon-bearing formations with moderate flow potential in overburden.

Example of permanent abandonment for hydrocarbon-bearing formation with moderate flow potential and with limited flow potential in the overburden.