

EXCELLENCE IN P&A PLANNING

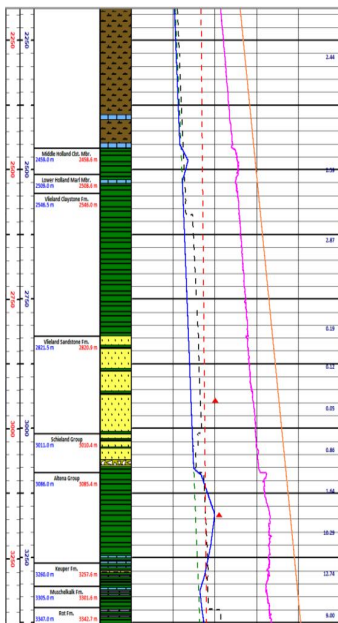
GEM

GEOLOGICAL ENGINEERING MODEL



Operational safety, the reduction of liability to ALARP, and the identification of appropriate work scope all begin with a Basis of Well Abandonment Design which identifies the widest possible barrier scope, supports engineering decisions on barrier placement and type, and is consistent, replicable and auditable. The **GEM** is a graphical, per-well basis of design which is described by our clients as a '**Comp Log for Decom**'. With P&A teams now using the GEM to prepare the abandonment of over 57 wells, it is the industry-leading basis of design.

A GEM is not a recycling of information culled from existing well documents. Instead it is a complete technical reinterpretation of the whole well in order to maximize the P&A value of all available information, including new learnings from later wells and wider offset experience in the basin or area. All GEM models are validated against downhole and regional data to ensure accuracy and replicability across a field or campaign stock.



There are no raw logs requiring the user to 'read' and interpret data, but a set of new and consistent interpretations made in four key Geological Models (Stratigraphy, Lithology, Pore and Fracture Gradient, and Fluid Model), all of which are bespoke to the well and all of which are prepared from surface to TD. Partial or generic models are never used in the GEM.

The geological models are drawn to scale against a precise wellbore and completions schematic and key engineering models (Drilling Incident and Performance, Mud System and Cementing, and Pipe and Formation Bond). This means that the geology, cement bond and former drilling environment around a preferred barrier location can be assessed at a glance, and candidate barrier locations can be immediately ranked.

The goal of the GEM is not to simply derive and present the geological and engineering models, but to interpret them for the end user and achieve a **P&A Zonation** of the well which meets the required planning criteria of the relevant National guidelines. The workflows in the GEM meet all the requirements of all presently published National guidelines (OGUK, NOGEPa, NORSOK etc) for this purpose. The P&A zonation is graphically indicated on the GEM alongside the Geological and Engineering models from which it is derived.

Flow Zones are areas of the well where the geological models identify permeability together with hydrocarbons or brine overpressure.

"In P&A you need to know what you need, not what you have got."

GEM ADVANTAGE

A full understanding of every well, from surface to TD- no 'blind spots' before operations

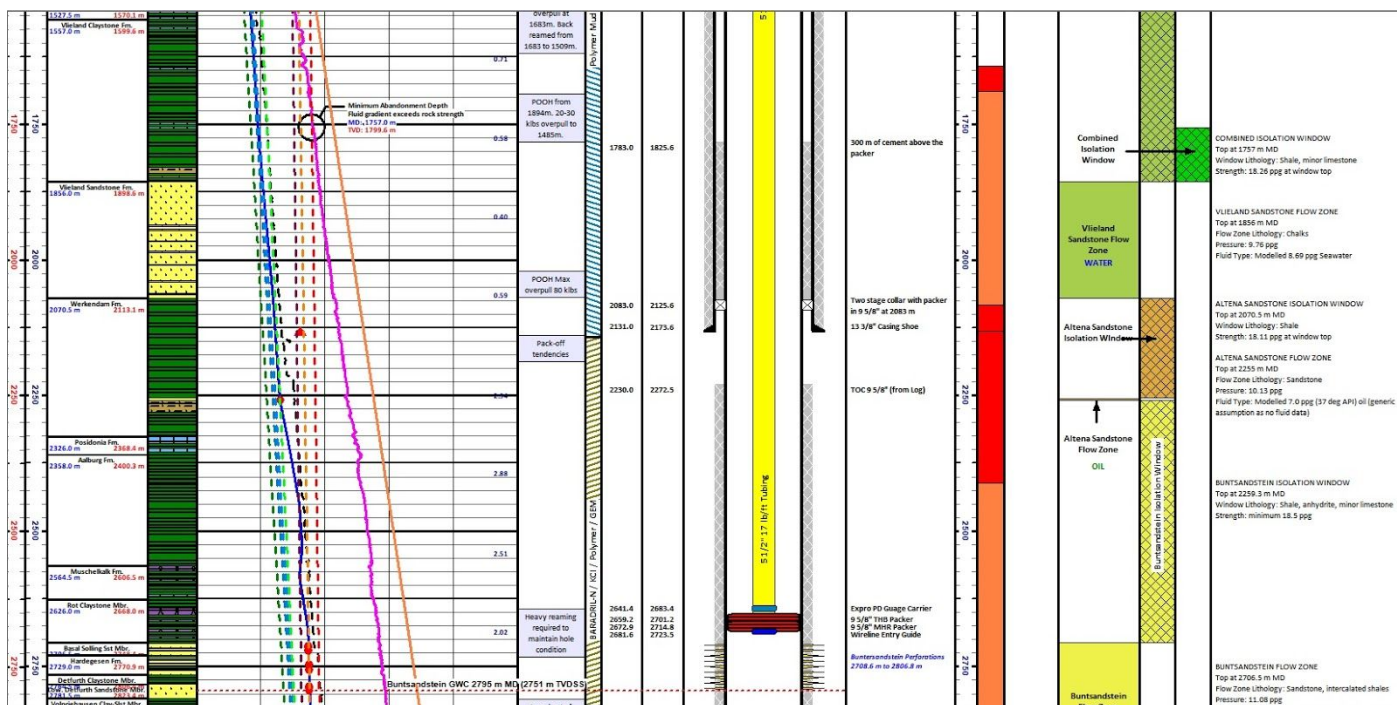
Reduce your planning risk to ALARP from project start

Resolve the minimum necessary number of barriers and achieve appropriate operational scope

Plan a confident combined barrier strategy by understanding crossflow

Ensure adherence to national guidelines and achieve class-leading practice

Permeable Zones are areas of the well where the geological models identify permeability together with normally pressured brine.



Primary Isolation Windows are areas of the well where impermeable rocks have sufficient strength to retain a fluid column of hydrocarbons or brine from a given Flow Zone.

Combined Isolation Windows are areas of the well where impermeable rocks have sufficient strength to retain a mixed fluid column of hydrocarbons and/or brine from multiple deeper Flow Zones. Combined Isolation Windows must be identified to achieve the cost efficiency of a combined isolation barrier.

Intended barrier locations can be drawn onto the GEM for planning purposes and adjusted after the P&A to reflect operational changes. The GEM can form part of the permanent record of the well as submitted to National Authorities.

GEM Summary

The only planning tool developed specifically to answer the needs of well P&A teams in both Wells and Subsurface disciplines

All key geological and engineering planning criteria, as required by all present National guidelines (OGUK, NOGEP, NOROK) are captured and delivered in a series of auditable, repeatable and comprehensive workflows

Every Flow Zone and Permeable Zone identified and delimited at scale, with the lithology, pressure and fluid type described

'Combined Isolation Windows' show where barriers which isolate multiple Flow Zones may be set

Immediately achieve planning ALARP with key geological and engineering risks identified and mitigated

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