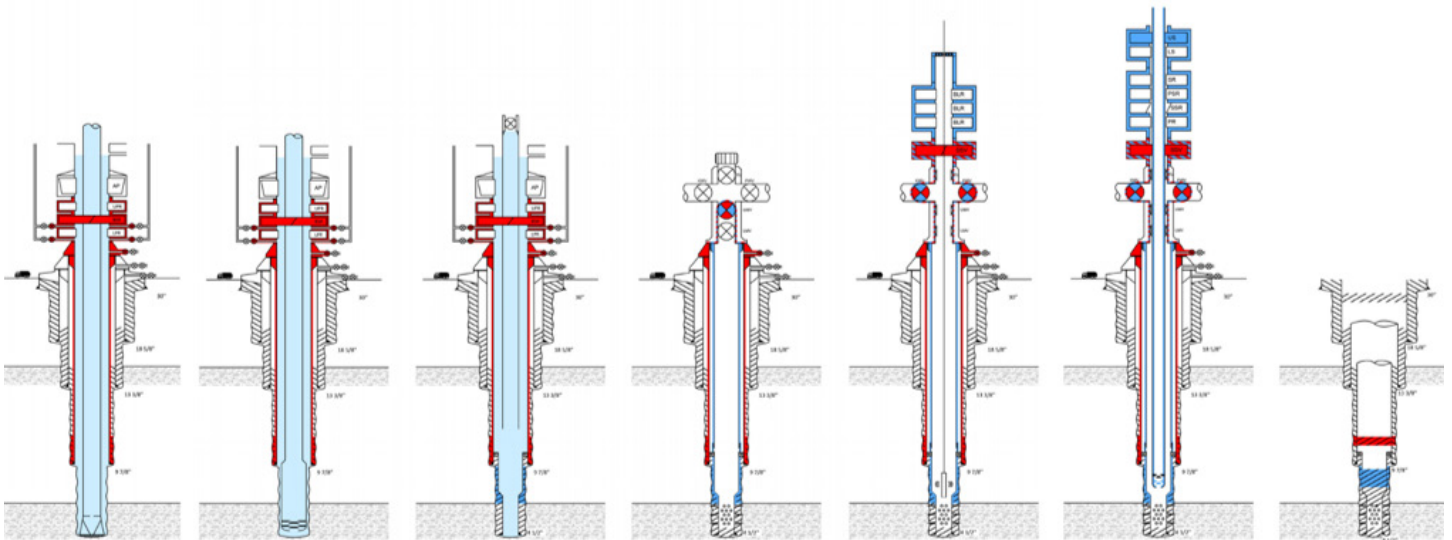


Well Integrity Solution Helps PETRONAS Carigali Visualize and Communicate Risk

Digitally integrated software solution monitors critical well barriers throughout the well life cycle



WellbARRIER solution schematics provide a robust way to ensure well integrity throughout the well life cycle.

PETRONAS Carigali used WellbARRIER* well integrity life cycle solution to securely manage more than 1,300 wells and enable 200 users to collaborate digitally by using well barrier schematics to measure risk in a systematic way.

A strong focus on well integrity and risk management

The oil and gas industry is embracing the digital revolution as it commits to making a positive environmental difference during the energy transition. This is achieved through an increased focus on managing well integrity with smarter, more integrated, and cost-effective tools, systems, and solutions.

PETRONAS Carigali, the largest producer in Malaysia, adopted the WellbARRIER well integrity life cycle solution for these purposes and has been using it since 2016 to support the preparation of high-quality barrier schematics throughout the well life cycle.

Application integration and connectivity

PETRONAS Carigali recently rolled out its corporate Well Integrity Management System (WIMS) across all assets. The WellbARRIER solution is a key component that builds on the requirements of WIMS and aligns with industry standards. The WellbARRIER solution is founded on the two-barrier principle, using a well integrity value chain that includes barrier definition, qualification and monitoring, risk assessment, and anomaly management to help ensure that well integrity data is

effectively managed in accordance with WIMS. The WellbARRIER solution also provides a common repository for well integrity data to ensure that all discipline engineers have a shared view of the barriers safeguarding their operations.

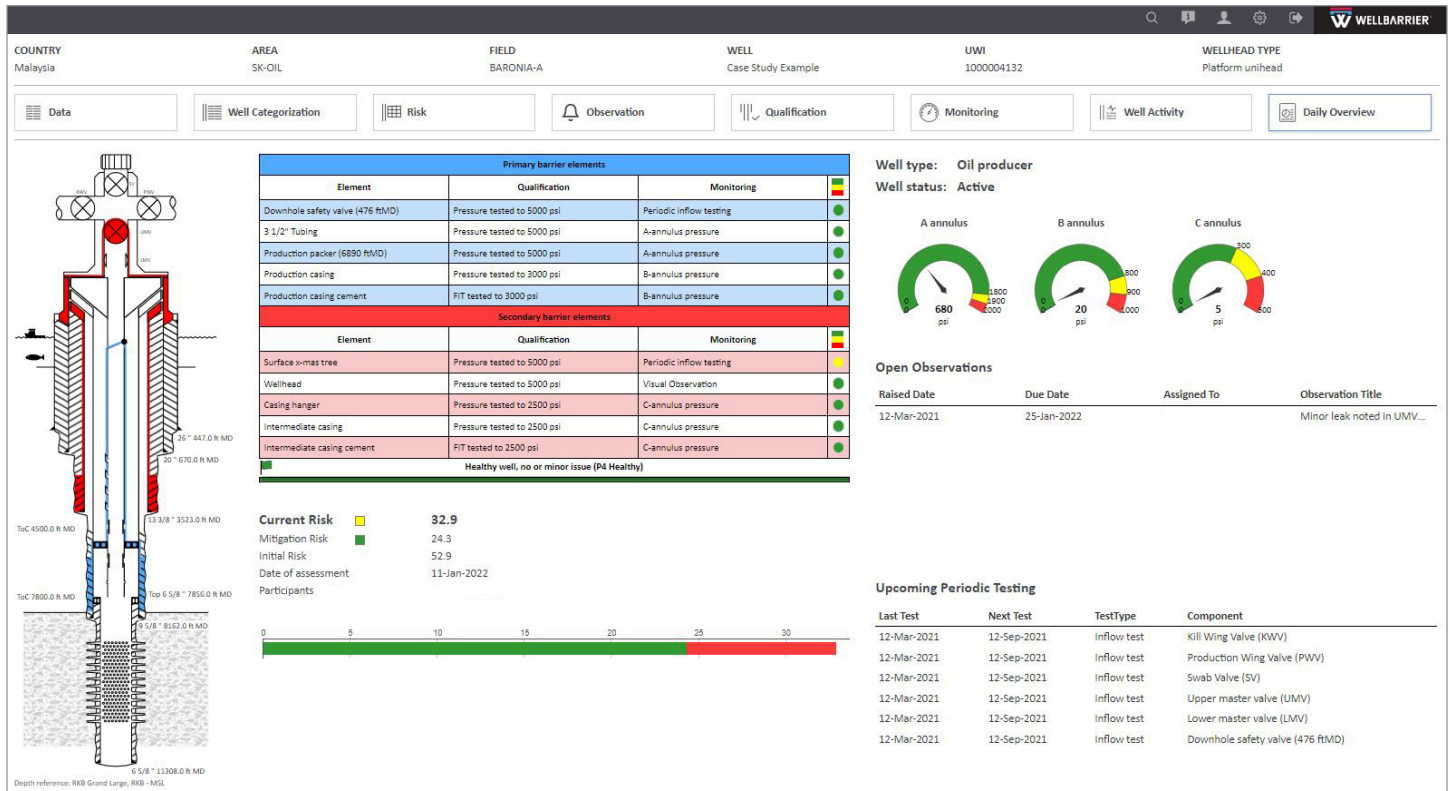
To create the well barrier schematics, well construction and production data are consolidated from various sources through a data orchestration tool and integrated with the WellbARRIER solution through its application programming interface (API).

Once created, the schematics are regularly updated to reflect the current condition of barrier elements based on periodic test results and annulus pressure monitoring. A quality assurance and quality control process is also used to ensure integrity of the data streaming into the WellbARRIER solution.

A consistent approach to risk management

As part of the WellbARRIER solution, risk assessments are performed on wells using failure model effect and criticality analysis (FMECA), which provides a systematic and objective way to measure well integrity risks. The barrier envelope is used as a basis to assess possible failure modes and consequences for each component. Measures taken to reduce the risks associated with any anomalies are proactively managed and reported through the software. Well integrity data is then consolidated and presented for management reporting.

Case study: Digital well integrity



Data provided by the Wellbarrier solution is consolidated and presented through interactive dashboards.

Interactive dashboards enable proactive management of well integrity through interactive filtering, sorting, and comparison of well integrity data. Information specific to well integrity—such as risk ranking, well integrity categorization, and failed components—is also made available through the Wellbarrier solution’s API to other digital initiatives within PETRONAS Carigali.

The value of this approach is that well integrity risk is now considered when evaluating the production potential of wells identified by the company’s Well Portfolio Optimization (WPO) system.

A collaborative platform for managing well integrity

Now that the Wellbarrier solution is fully integrated with their other systems, PETRONAS Carigali engineers have a consistent methodology they can use to prepare well barrier schematics and analyze risks in collaboration with other stakeholders. With more than 200 registered users collaborating, nearly 5,000 schematics generated, and 1,300 wells securely managed, the Wellbarrier solution proves its value to PETRONAS Carigali every day.

At PETRONAS Carigali, the journey to achieve well integrity excellence continues to evolve. Future improvements will automatically set the integrity status of the barrier elements based on data recorded by the assets, and then update the status via the Wellbarrier solution’s API. This will reduce some of the manual input required and help ensure efficiency and data accuracy, with the goal of eventually incorporating condition-based monitoring, advanced data analytics, and machine learning opportunities.