

# Wellbarrier Planning

Enhance operations planning and safeguard the execution of well activities



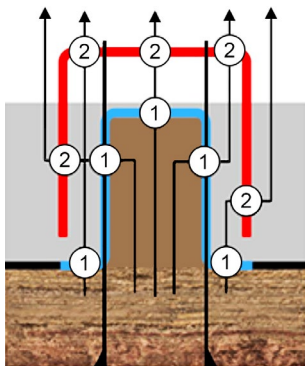
## Introduction

The Wellbarrier well integrity management solution provides a digital framework to enable a holistic view of well integrity and helps identify failure modes and possible consequences. It helps to assure the safety of people, assets, and the environment. Furthermore, engineers spend less time searching for well data and know exactly where to find the latest, most accurate well information.

The Wellbarrier solution consists of the following:

- Wellbarrier Planning supports decision-making during planning operations and safeguards the execution of well activities.
- Wellbarrier Integrity Management provides a digital framework to manage well integrity through drilling, well testing, completion, production, intervention, workover, plug and abandonment.

Wellbarrier Planning uses the barrier definition (ensuring the necessary barriers are in place and being able to test and verify them) as the basis to ensure that all stakeholders have a clear and common understanding of risk throughout the well life cycle.



Possible leak paths through primary barrier (1) and secondary barrier (2)

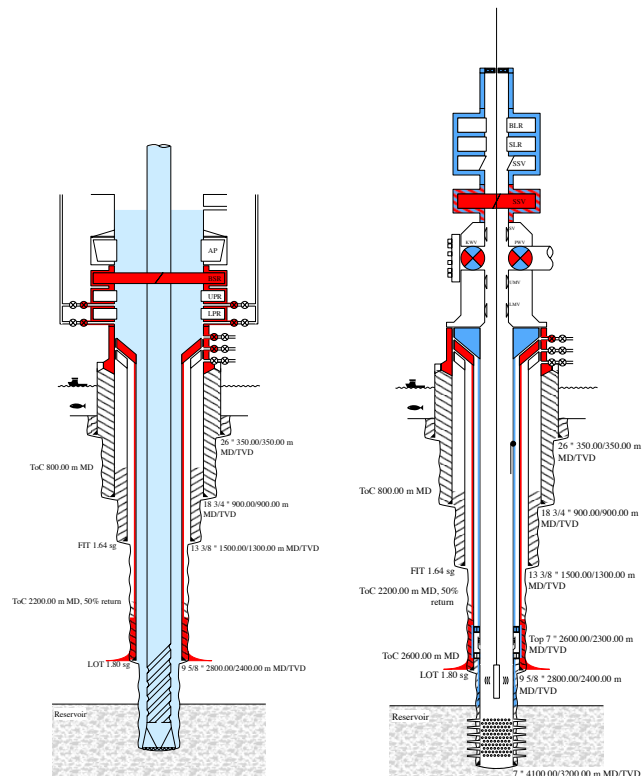
By establishing two independent barrier envelopes, a primary barrier, which is backed by a secondary barrier, operators safeguard well activities and reduce risk.

Where this is not available for legacy or technical reasons, it is equally important to communicate what well barriers are in place.

The advantage of a two-barrier philosophy is that no matter where the pressure might escape, there will always be a protective second barrier in place as backup.

## Applications













- Wellbarrier Planning improves decision-making during planning operations and safeguards the execution of well activities by using the barrier definition to support collaboration and mitigate vulnerabilities.
- The foundation of the solution is the well barrier schematic, it supports collaboration between stakeholders involved in well operations.
- Risk assessments are performed objectively and systematically using failure mode effect and criticality analysis (FMECA) methodology. Remediation of anomalies are proactively managed and allow prioritization of mitigating measures.
- Understanding of potential operational challenges is enhanced through visualization of the well inclination, knowledge of the formation strength, and provision of well control action diagrams to support response to unexpected events.

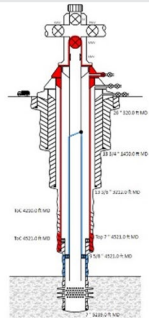


## Wellbarrier Planning

Both Wellbarrier Planning and Wellbarrier Integrity Management share the following five Wellbarrier solution features.

SECTION TYPE	HOLE		CASING	
	Size inch	Size inch	MD m	TVD m
Conductor	24.000	18.750	100.00	100.00
Surface casing	17.500	13.375	1200.00	1170.00
Production casing	12.250	9.625	2400.00	1900.00
Production liner	8.500	5.500	3600.00	2900.00





 Open well editor	 Downhole safety valve
 Casing cement	 Annulus safety valve
 Wellhead	 Storm choke
 Subsea tubing hanger	 Straddle
 High pressure riser	 Gas lift valve
 Reservoir section	 Chemical injection valve



Primary barrier elements			
Element	Qualification	Monitoring	
Downhole safety valve (121 150D)	ITF test to 5000 psi	Tubing pressure	OK
Tubing	Pressure tested to 5000 psi	A-annulus pressure	OK
Production packer (3220 955D)	Pressure tested to 5000 psi	A-annulus pressure	OK
Production liner cement	Logged Interval 400.0m	B-annulus pressure	OK
Secondary barrier elements			
Element	Qualification	Monitoring	
Surface access tree	Pressure tested to 3000 psi	Periodic testing	OK
Spot wellhead B-right access valve	Pressure tested to 5000 psi	External observation	OK
Spot wellhead B	Pressure tested to 5000 psi	External observation	OK
Casing hanger	Pressure tested to 5000 psi	A-annulus pressure	OK
Production casing	Pressure tested to 3000 psi	B-annulus pressure	OK
Production casing cement	ITF tested to 3000 psi	B-annulus pressure	OK

Healthy well, no or minor issue

BARRIER ELEMENT	FAILURE MODE	P <sub>r</sub>	CONSEQUENCE	C <sub>r</sub>	R <sub>r</sub>	MITIGATION	L <sub>r</sub>	R <sub>r</sub>	L <sub>r</sub>	R <sub>r</sub>
Downhole safety valve (3000 950D)	Burst	3	Containment by other technical barrier	1	None		0	3	3	3
	Collapse	2	Containment by other technical barrier	1	None		0	2	2	2
	Corrosion	2	Containment by other technical barrier	1	None		0	2	2	2
	Erosion	1	Containment by other technical barrier	1	None		0	1	1	1
	Leaking valve (3rd API test)	3	Containment by other technical barrier	1	None		0	3	3	3
Tubing	Burst	3	Containment by other technical barrier	1	None		0	3	3	3
	Collapse	2	Containment by other technical barrier	1	None		0	2	2	2
	Corrosion	2	Containment by other technical barrier	1	None		0	2	2	2
	Erosion	1	Containment by other technical barrier	1	None		0	1	1	1
	Leaking thread	1	Containment by other technical barrier	1	None		0	1	1	1
Wellhead	External impact	3	Full flow leak to atmosphere	5	15	Install physical collision barriers around wellhead	2	5	10	5
	Leaking connector seal	1	Small leak (fitting/jacking/Tangar)	4	4		0	4	4	4
	Substage	1	Full flow leak to atmosphere	5	5		0	5	5	5
Casing hanger	Leaking sack-off seal	3	Containment by other technical barrier	1	None		0	3	3	3
Production casing		0		0	0		0	0	0	0
Production casing cement		0		0	0		0	0	0	0
Normalized risk index							14	14	14	14

Date Raised	Observation Title	Component	Source
05-Aug-21	LMV Failure	 Lower master valve (LMV)	Monitoring
01-Aug-21	Ran wireline and detected degraded tubing	 4 1/2" Tubing	Manual
29-Jul-21	Leak in SSSV	 Downhole safety valve (150 ftMD)	Monitoring
01-Aug-20	Bleed down pressure	 A Annulus	Manual

## Well Data Integration

Defines the hole and casing configuration, completion components, reservoir sections, blowout preventer (BOP) configuration, and other well status information. Domain specialists can share, track, and augment data in real time. Built-in quality assurance continuously improves the data's richness and accuracy.

## Illustrations

Quickly generates illustrations using intuitive drag-and-drop functionality to represent the well at any stage of its life cycle, enabling the creation of consistent and accurate illustrations in minutes.

## Well Barrier Schematic

Conveys how the well activity should be safeguarded through easy-to-read schematics and summary tables of how to qualify and monitor the defined well barrier elements. The well barrier schematic is the foundation of the solution.

## Risk Assessment

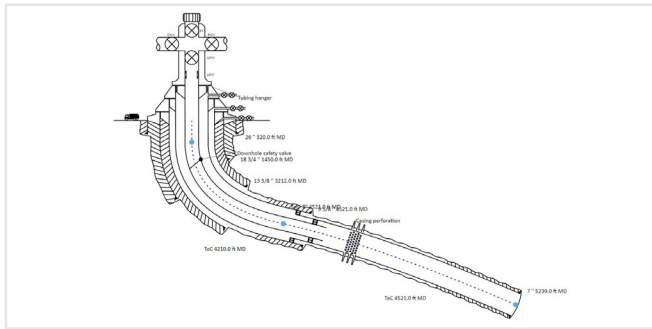
Enables performing objective failure mode effect and criticality analysis (FMECA) risk assessments for the well or specific operations. Systematic evaluation of failure modes and consequences supports understanding the risks and specifying mitigating measures to limit them.

## Well Integrity Anomalies Tracking

Provides an overview of well integrity incidents identified during the well's construction and lifetime. This feature is used to assign actions to colleagues, set deadlines, and take corrective action.

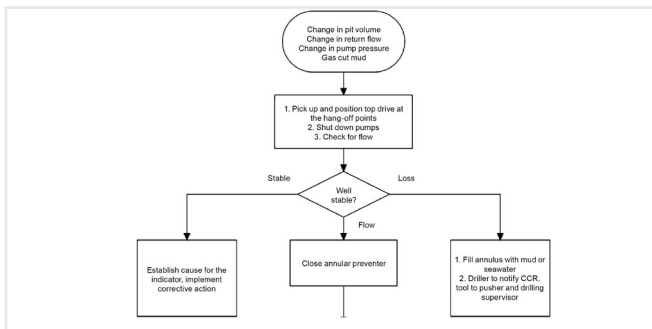
## Wellbarrier Planning

Understanding of potential operational challenges is enhanced through visualization of the well inclination, knowledge of the formation strength, and provision of well control action diagrams to support response to unexpected event



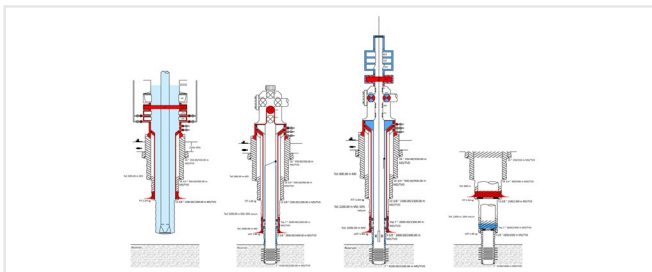
### Interactive Well Inclination Schematic

Provides a clear illustration of the curvature of the well and includes descriptions of the well components.



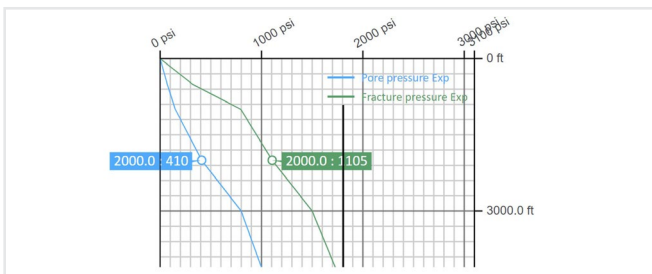
### Well Control Action Diagram

Displays the sequence of proposed actions in the event of an unforeseen incident. Particularly useful if the drilling or wellsite crew is using new or unfamiliar equipment.



### Sequence Diagram

Displays a step-by-step visual of how the well activity is progressing. Shows the well and well equipment (without any well barrier lines) and how the well barrier definition is changing as the well activity progresses.



### Pore and Fracture Pressure

Determines whether the formation strength is sufficient at critical points in the overburden where casing shoes, cement plugs, or other critical well components are placed.

## Industry recognized

The Wellbarrier user community comprises more than 5,000 registered users across 51 countries worldwide. They are using the Wellbarrier solution's user-friendly and intuitive digital tool to efficiently and effectively prepare more than 95,000 barrier schematics to bring them unique, reliable insight to safeguarding their well integrity.

[slb.com/wellbarrier](http://slb.com/wellbarrier)

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