



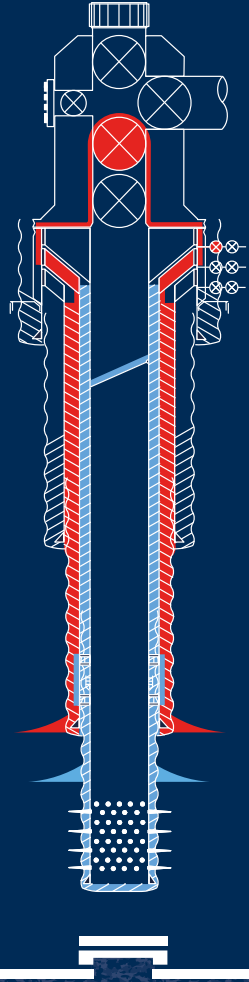
WELLBARRIER®

A Schlumberger Technology

Wellbarrrier® Illustration Tool

An element of safety

Reduce risk – prepare high
quality well barrier illustrations!



Wellbarrier[®] Illustration Tool

A web-based digital state-of-the-art application to document how wells are safeguarded.

How do you safeguard your wells?

The **Wellbarrier Illustration Tool** helps you visualize your wells and the well barrier elements, with related qualifying and monitoring requirements. It gives you a clear and common understanding on safeguarding and maintaining the integrity of your wells.

Visualise your well barriers

- Show clearly the elements used to build the barrier envelopes
- Make sure everyone sees the same picture
- Present high quality graphics and language in a consistent manner

Communicate

- Share well barrier information in one common well library
- Present information in morning and engineering meetings
- Discuss well barrier challenges in risk assessment meetings

Document

- Update the well barrier status in all stages from planning to P&A
- Verify the illustration using an electronic verification function

Make it a company commitment

Be prepared – use the Wellbarrier Illustration Tool

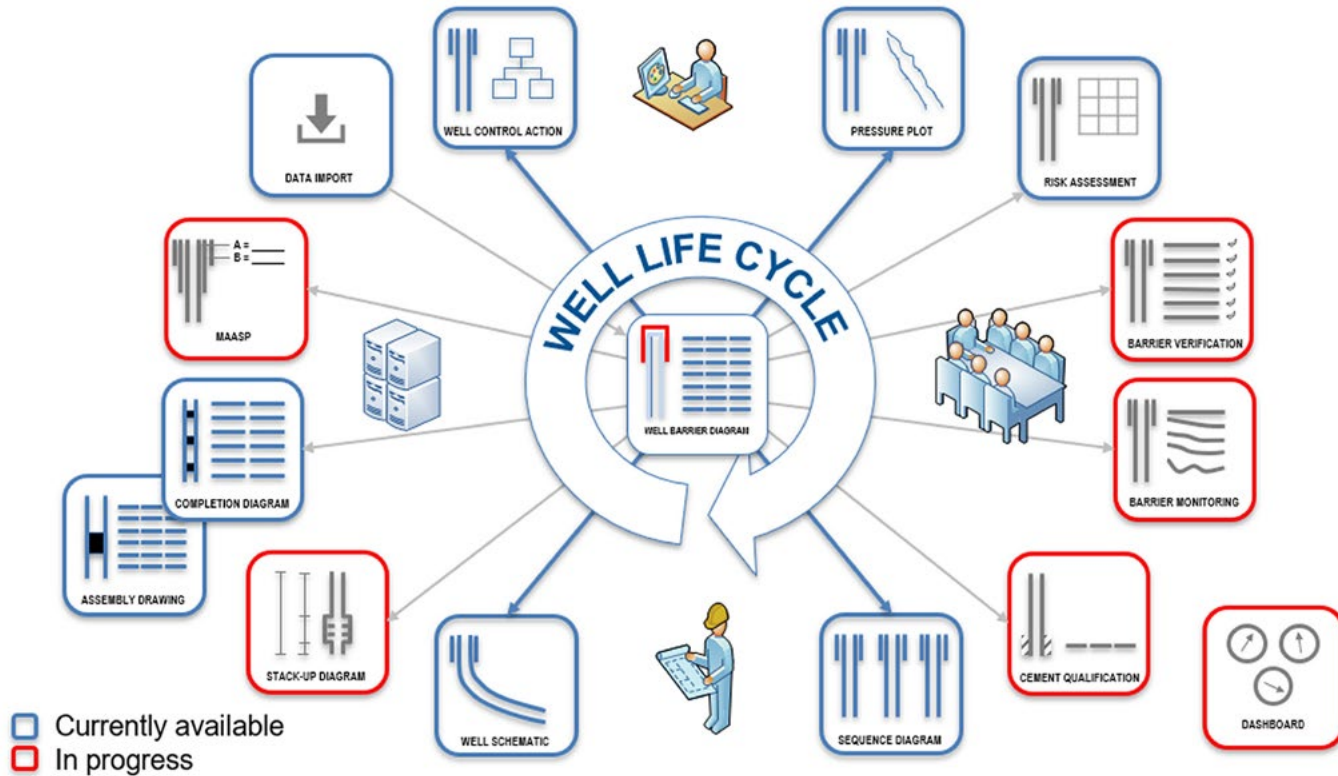
The industry standard, simplified and with less effort

- Create accurate illustrations in minutes, not hours
- Intuitive and easy to use
- Used by more than 3000 users in 45 countries worldwide
- Used for approximately 40,000 drilling and well operations
- Full well life cycle coverage
- More than 150 sample illustrations available
- Easy access to NORSOK/company EAC tables

The Wellbarrier Illustration Tool incorporates the barrier definitions that embrace the two-barrier principle as a core component of establishing well barriers.


Managing wells consists of several elements

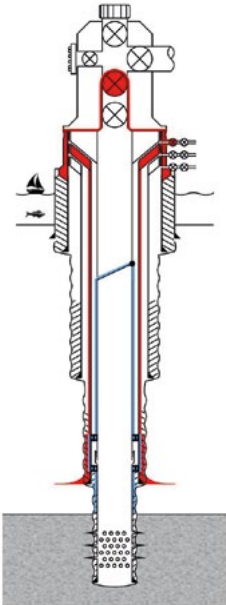
The well barrier illustration is used as a core for several outputs in different contexts.



Well Barrier Schematics

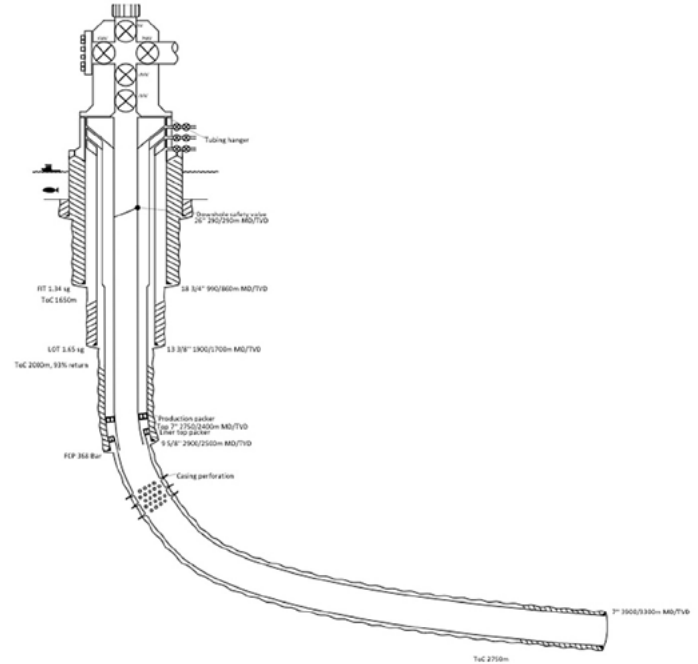
Well barrier illustration and listing of barrier elements in the well with qualification and monitoring requirements.

	Field : Project	Well design pressure xxx bar
	Well : Brochure	Reservoir pressure xxx bar
Schematic: WB 4.2.d-a rev.0		Prepared By :
Date :		Verified By :
Platform production well primary - secondary example		
Well handed over to owner		
Primary well barrier		
Element	As built	Monitoring
SCSSV	Inflow tested to xxx bar	Frequent inflow test to xx bar
Tubing	Pressure tested to xxx bar	A-annulus pressure
Production packer	Pressure tested to xxx bar	A-annulus pressure
Production casing	Pressure tested to xxx bar with x.xx sg fluid	B-annulus pressure
Liner top packer	Pressure tested to xxx bar	Not applicable
Liner	Pressure tested to xxx bar with x.xx sg fluid	Not accessible
Liner cement	Formation test, job performance or bond log	Not accessible
Secondary well barrier		
Element	As built	Monitoring
Surface production tree with PMV	Pressure tested to xxx bar	Pressure anomaly
Wellhead annulus access valve	Pressure tested to xxx bar	Pressure anomaly
Wellhead	Pressure tested to xxx bar	External observation
Production casing hanger	Pressure tested to xxx bar	B-annulus pressure
Production casing	Pressure tested to xxx bar with x.xx sg fluid	B-annulus pressure
Production casing cement	Formation test, job performance or bond log	B-annulus pressure
Formation (in-situ)	Quote tested or prognosis strength	Not accessible
Healthy well, no or minor issue		
<p>Note: Tubing PBR to be equipped with relief valve or have documented ability to withstand thermal expansion of trapped fluid. Production casing to have qualified cement at production packer setting depth. Otherwise compensating measures for production casing common barrier element shall be implemented.</p>		



Well Schematic

The Well Schematic is based on the barrier illustration. Reservoir and barrier coloring are removed and the illustration is shaped to the desired curvature in a quick and effective manner together with appropriate automatic annotation.

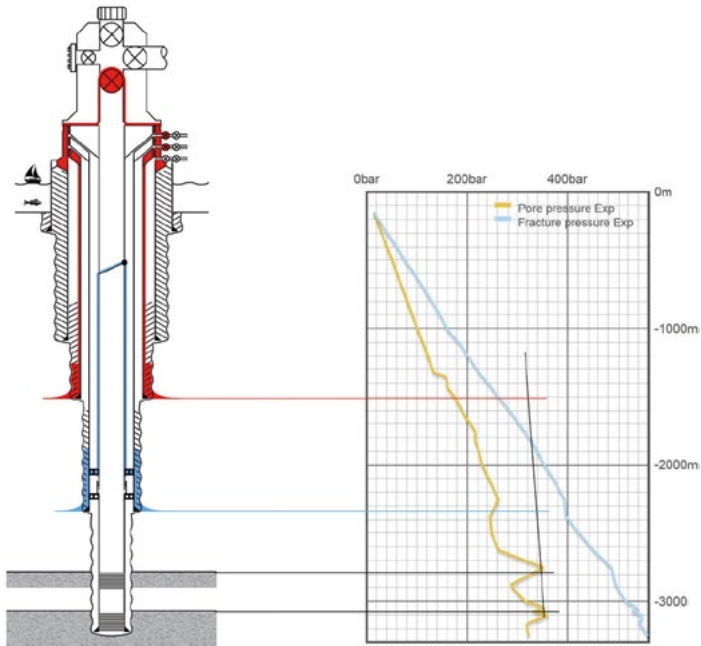


Depth reference: RKB Platform A, None

A center line is added to the well barrier schematic, together with completion component details. The curvature is simply shaped by a drag function.

Well barrier vs. pressure plot

The well barrier illustration can be aligned with a pore and fracture pressure plot to confirm formation strength at critical points in the well.



By using horizontal cross reference lines and drawing gradient lines on the pressure plot we are able to verify robustness or identify weaknesses in the well barrier definitions. This offers a clear highlight to a number of activity scenarios throughout the life cycle of the well; casing setting depth, dual gradient drilling, managed pressure drilling, plug and packer setting depth, gas-lift and injection scenarios, plug and abandonment.

Completion Diagram

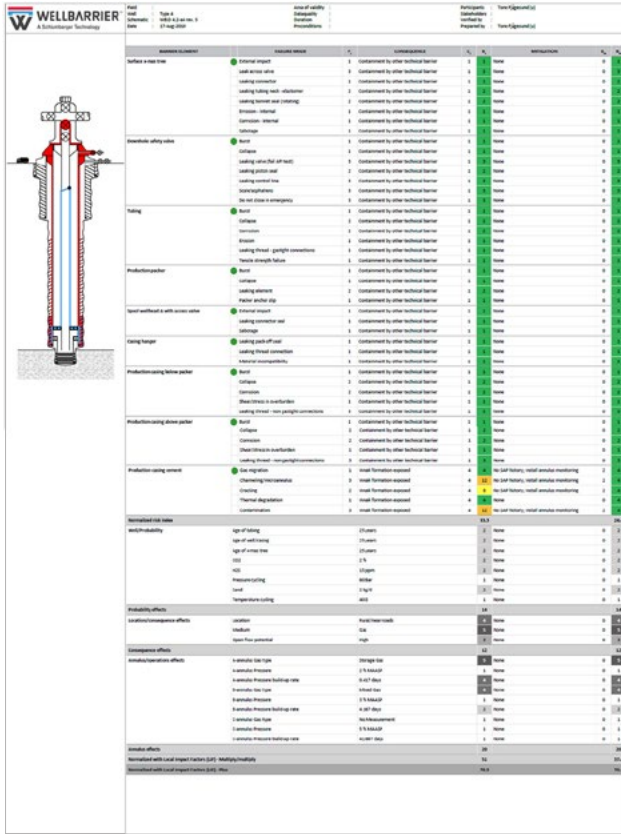
A completion diagram can be created to have a consistent representation of the installed completion.

	DESCRIPTION	TOP MD (m)	LENGTH MD (m)	TOP TVD (m)	ID (inch)	OD (inch)	DRIFT ID (inch)	BURST (Psi)	COLLAPSE (Psi)	SUPPLIER
12	Tubing hanger dual bore 8.625"	0.00	6.00		4.000	5.500	4.000	5000.00	5000.00	
	Tubing 5.500" 20R L80 BTC BoxUp- PinDown	6.00	144.00		4.778	5.500	4.653	9000.00	8830.00	
11	Downhole safety valve 7.000"	150.00	6.00		5000.000	5000.000	5000.000	5000.00	5000.00	
	Tubing 5.500" 20R L80 BTC BoxUp- PinDown	156.00	1752.00		4.778	5.500	4.653	9000.00	8830.00	
10	Crossover up 5.500" x 6.625"	1908.00								
	Tubing 6.625" 20R L80 BTC BoxUp- PinDown		1800.00		4.778	6.625	4.653	9000.00	8830.00	
09	Crossover down 6.625" x 5.500"									
	Tubing 5.500" 20R L80 BTC BoxUp- PinDown		96.00		4.778	5.500	4.653	9000.00	8830.00	
08	Downhole gauge 5.500"									
	Tubing 5.500" 20R L80 BTC BoxUp- PinDown		24.00		4.778	5.500	4.653	9000.00	8830.00	
07	Chemical injection valve 5.500"									
	Tubing 5.500" 20R L80 BTC BoxUp- PinDown		12.00		4.778	5.500	4.653	9000.00	8830.00	

The completion module uses the elements found in the 'Completion' table in 'Well overview' to populate a completion string and a description table, which has a layout where the component as seen in the string has detailed explanation directly to the right of it. All components have clear and consistent graphics.

Risk Assessment

Using the well barrier definition to risk rank wells in a portfolio, a robust model allows users to assess risk objectively and consistently.



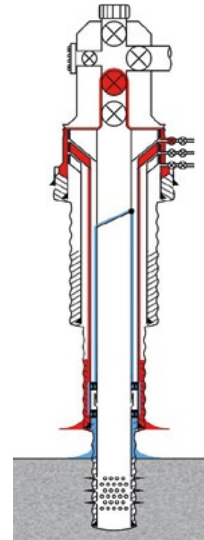
Component	Description	Status	Risk Rating
Surface area	Internal aspect	Compared to other technical barrier	High
Wellhead	Wellhead cover	Compared to other technical barrier	High
	Wellhead seal	Compared to other technical barrier	High
	Wellhead seal	Compared to other technical barrier	High
	Wellhead seal	Compared to other technical barrier	High
Casing	Casing	Compared to other technical barrier	High
	Casing	Compared to other technical barrier	High
	Casing	Compared to other technical barrier	High
	Casing	Compared to other technical barrier	High
Production	Production	Compared to other technical barrier	High
	Production	Compared to other technical barrier	High
	Production	Compared to other technical barrier	High
	Production	Compared to other technical barrier	High

The module is based on a standardized 5x5 risk tolerance matrix with the primary objective of containment. When focusing on containment, other risks, such as the environment and assets and financial losses, are also taken care of. It uses the failure mode, effects and criticality analysis (FMECA) to assess the risk associated with pressure containment and the possible consequences.

Establishing well barriers

When the well is penetrating the natural barrier – the caprock, this must be replaced by man-made barriers.

Well barrier definitions



Primary barrier is starting at the point where the well penetrates the natural barrier. The primary barrier is the one that is in direct contact with the pressure source and prevents flow of formation fluid.

When you penetrate the reservoir and set a casing/liner, you will need to establish barriers both internally and externally to the installed casing/liner.

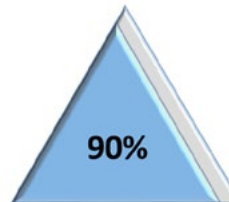
Secondary barrier is an independent redundancy. The defined secondary barrier is not necessarily barrier number two in a sequence, but is always shown in its last stage, typically with closure of a blind seal ram or master valve.

There also needs to be a secondary barrier external to the casing/liner in the well.

How the individual barrier elements are verified and monitored must be clearly communicated.

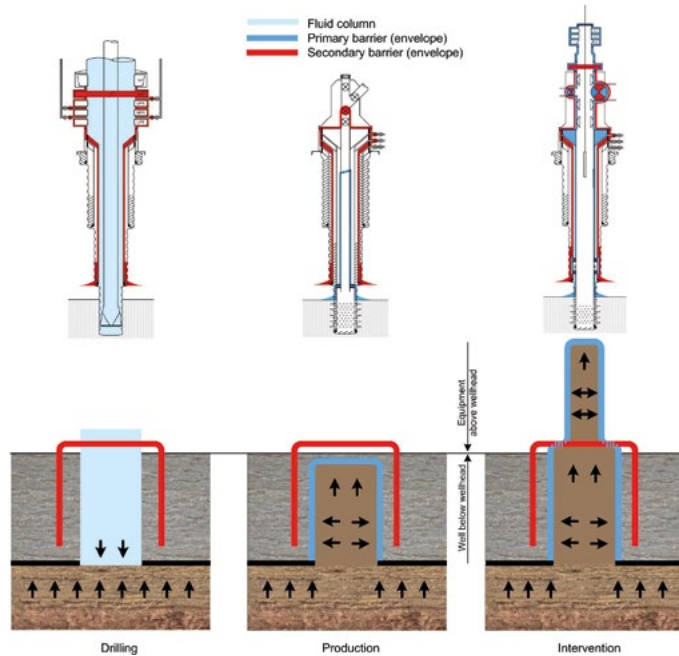
It should be noted that in order to activate the secondary well barrier envelope, a deliberate activation of an element must be completed.

Figuratively speaking, 90% of well integrity is about the technical well barriers, which have the capability and strength to contain pressure and hydrocarbons. Any organizational, operational, and functional barrier merely serves to support the process of making available technical well barriers.



Two barrier philosophy

In addition to the primary barrier, it is desired to have a secondary barrier in place, to provide redundancy should a primary barrier element fail.



The secondary barrier consists of connected barrier elements outside the primary barrier, forming a “hat-over-hat” arrangement that is strong enough to contain the well pressure.

This is possible for most well operations, with the exception of intervention in live wells with pressure at surface. Some elements will then be a part of both the primary and secondary barrier and as such become common barrier elements. When this occurs, risk mitigation measures must be implemented.

Application

Applying the Wellbarrier® Illustration Tool in your work

From a well integrity management perspective, it is paramount to have a firm reference to elements that are included in the well barrier envelope. The identification of the well barrier elements is an obvious starting point including critical items such as cement and formation strength.

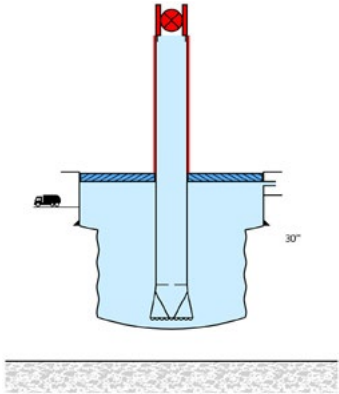
The **Well Barrier Schematic (WBS)** is the backbone of the Wellbarrier Illustration Tool. It clearly shows the well barrier definitions. It can be used in all phases of a well's life cycle, illustrating wells in operation. All illustration can be presented as a sequential diagram that shows work progress.

The following pages feature a **sequence of illustrations** to show how you can build and apply well barrier illustrations to help you manage and safeguard your wells throughout their entire life cycles.

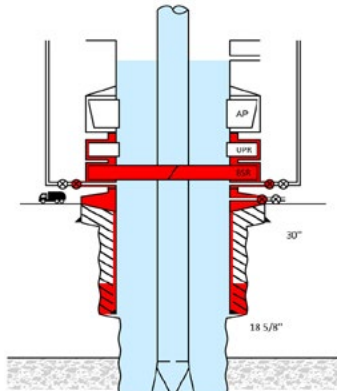
Try our Demo for Free

www.wellbarrier.com/request-demo

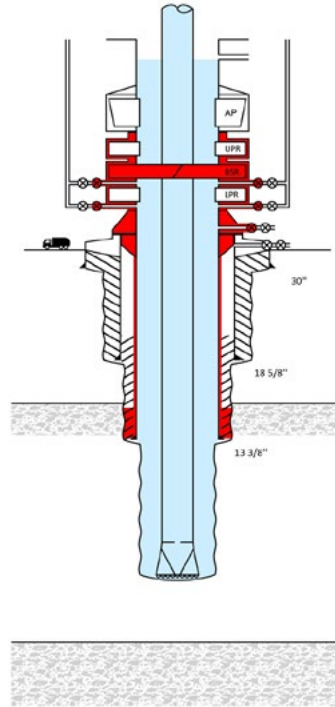
Drilling top hole without BOP



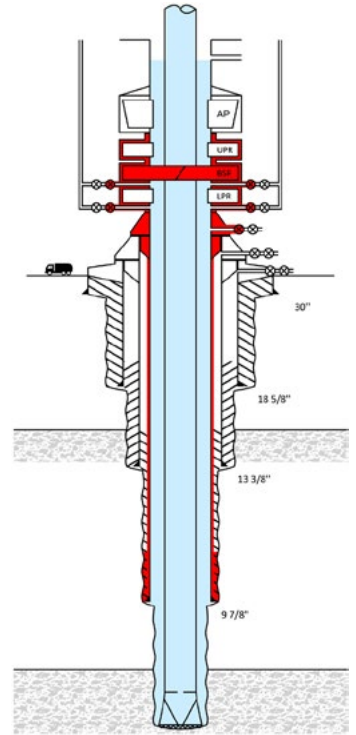
Drilling intermediate casing section



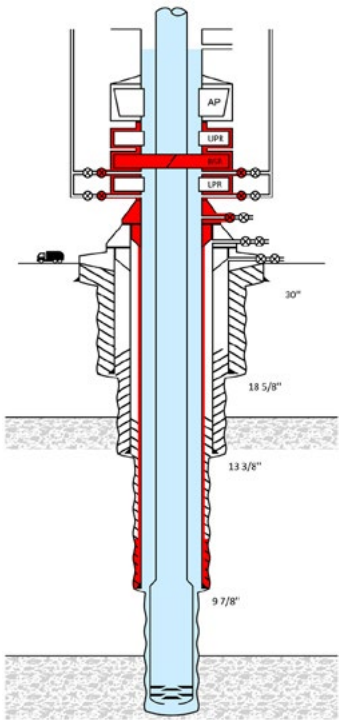
Drilling production casing section



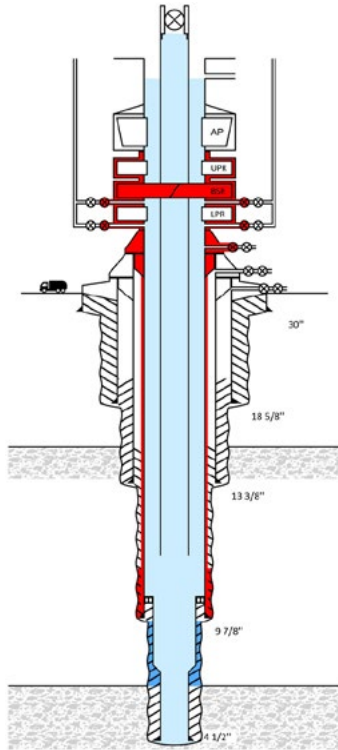
Drilling reservoir section



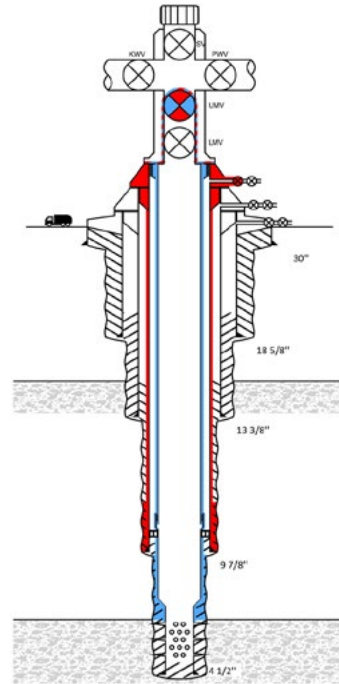
Running production liner



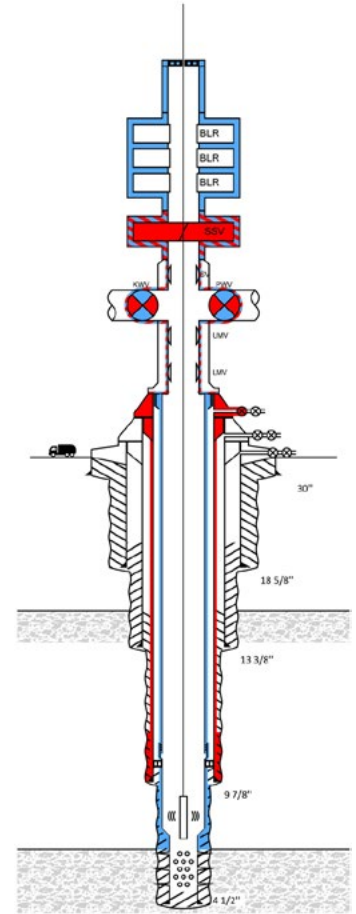
Running completion string



Well perforated ready for operation



Running wireline



About us

Wellbarrier was established in 2007 to provide customized well barrier illustrations to the oil and gas industry. Wellbarrier's strong association with the development of NORSOK D-010 and Well Barrier Schematic forms are well recognized in the tool.



Contact

Telephone: +47 51 63 08 00

email: post@wellbarrier.com

Office address

Risabergveien 3

4056 Tananger

Norway

Mail address

P.O. Box 8013

4068 Stavanger

Norway

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www.wellbarrier.com

