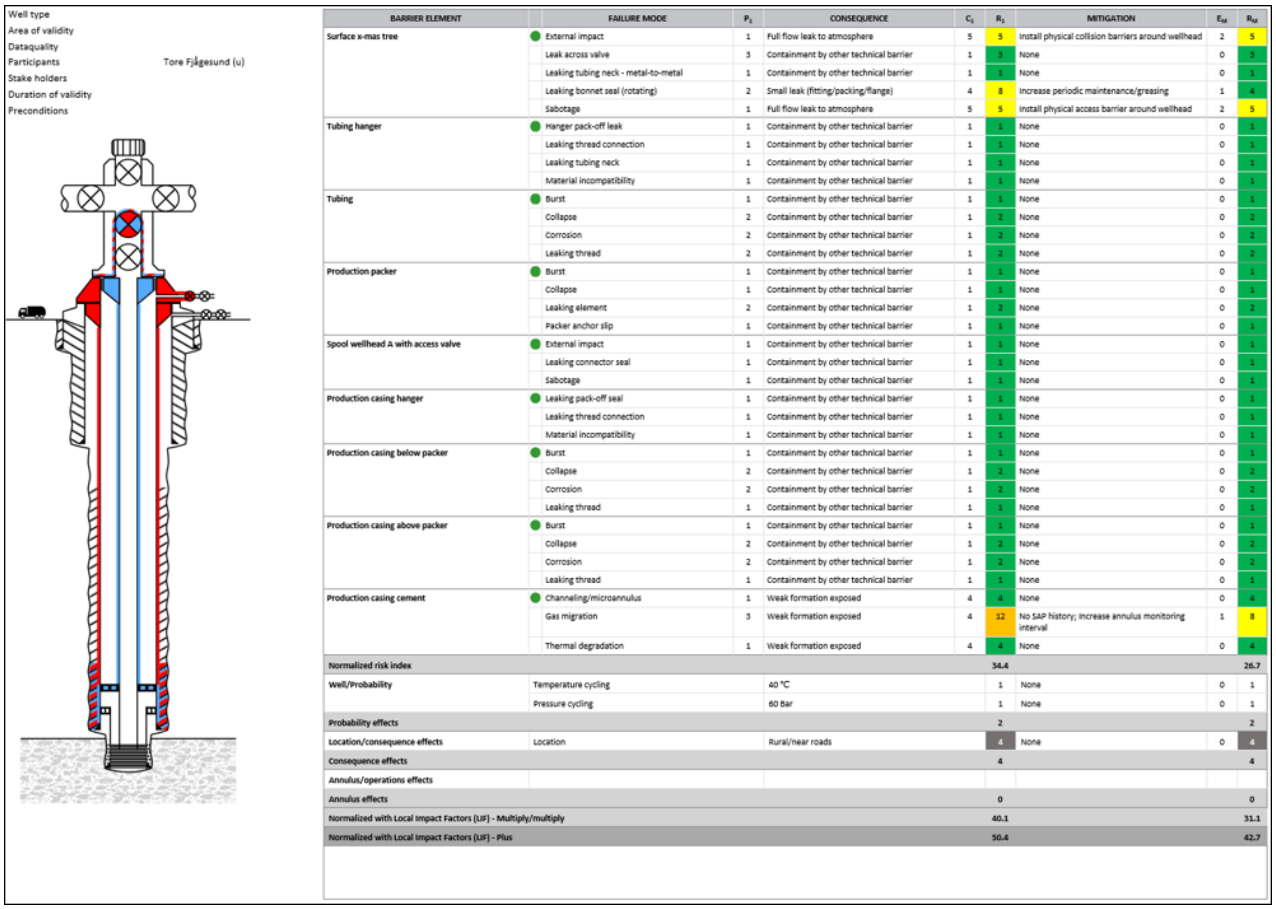
TECH SHEET

Wellbarrier Integrity Tool – Risk module

The Well Barrier Schematic prepared in the Wellbarrier Illustration Tool is used as basis to conduct a FMECA (Failure Mode, Effect and Criticality Analysis). The well barrier diagram with its definition of well barrier elements used to build the available well barrier envelopes in the well is ideally suited to serve as a basis for an element-based risk assessment.

Building on the two-barrier philosophy that will allow incidents to happen without escalating into accidents it is of vital importance to ascertain that each element is understood with respect to failure modes and consequence. If two independent barriers are not available, it is even more important to understand the risk associated with each element.



Well type
Area of validity
Dataquality
Participants Tore Fjågesund (u)
Stake holders
Duration of validity
Preconditions

BARRIER ELEMENT	FAILURE MODE	P_1	CONSEQUENCE	C_1	R_1	MITIGATION	E_M	R_M
Surface x-mas tree	External impact	1	Full flow leak to atmosphere	5	5	Install physical collision barriers around wellhead	2	5
	Leak across valve	3	Containment by other technical barrier	1	3	None	0	3
	Leaking tubing neck - metal-to-metal	1	Containment by other technical barrier	1	1	None	0	1
	Leaking bonnet seal (rotating)	2	Small leak (fitting/packing/flange)	4	8	Increase periodic maintenance/greasing	1	4
	Sabotage	1	Full flow leak to atmosphere	5	5	Install physical access barrier around wellhead	2	5
Tubing hanger	Hanger pack-off leak	1	Containment by other technical barrier	1	1	None	0	1
	Leaking thread connection	1	Containment by other technical barrier	1	1	None	0	1
	Leaking tubing neck	1	Containment by other technical barrier	1	1	None	0	1
	Material incompatibility	1	Containment by other technical barrier	1	1	None	0	1
Tubing	Burst	1	Containment by other technical barrier	1	1	None	0	1
	Collapse	2	Containment by other technical barrier	1	2	None	0	2
	Corrosion	2	Containment by other technical barrier	1	2	None	0	2
	Leaking thread	2	Containment by other technical barrier	1	2	None	0	2
Production packer	Burst	1	Containment by other technical barrier	1	1	None	0	1
	Collapse	1	Containment by other technical barrier	1	1	None	0	1
	Leaking element	2	Containment by other technical barrier	1	2	None	0	2
	Packer anchor slip	1	Containment by other technical barrier	1	1	None	0	1
Spool wellhead A with access valve	External impact	1	Containment by other technical barrier	1	1	None	0	1
	Leaking connector seal	1	Containment by other technical barrier	1	1	None	0	1
	Sabotage	1	Containment by other technical barrier	1	1	None	0	1
Production casing hanger	Leaking pack-off seal	1	Containment by other technical barrier	1	1	None	0	1
	Leaking thread connection	1	Containment by other technical barrier	1	1	None	0	1
	Material incompatibility	1	Containment by other technical barrier	1	1	None	0	1
Production casing below packer	Burst	1	Containment by other technical barrier	1	1	None	0	1
	Collapse	2	Containment by other technical barrier	1	2	None	0	2
	Corrosion	2	Containment by other technical barrier	1	2	None	0	2
	Leaking thread	1	Containment by other technical barrier	1	1	None	0	1
Production casing above packer	Burst	1	Containment by other technical barrier	1	1	None	0	1
	Collapse	2	Containment by other technical barrier	1	2	None	0	2
	Corrosion	2	Containment by other technical barrier	1	2	None	0	2
	Leaking thread	1	Containment by other technical barrier	1	1	None	0	1
Production casing cement	Channeling/microannulus	1	Weak formation exposed	4	4	None	0	4
	Gas migration	3	Weak formation exposed	4	12	No SAP history; increase annulus monitoring interval	1	8
	Thermal degradation	1	Weak formation exposed	4	4	None	0	4
Normalized risk index					34.4			26.7
Well/Probability	Temperature cycling		40 °C		1	None	0	1
	Pressure cycling		60 Bar		1	None	0	1
Probability effects					2			2
Location/consequence effects	Location		Rural/near roads		4	None	0	4
Consequence effects					4			4
Annulus/operations effects								
Annulus effects					0			0
Normalized with Local Impact Factors (LIF) - Multiply/multiply					40.1			31.1
Normalized with Local Impact Factors (LIF) - Plus					50.4			42.7

Benefits and value of our solution:

- A clear definition of well barrier elements are visualized and listed
- Each barrier element is inheriting the element status (traffic light) from the barrier form
- Failure modes and frequencies are selected from a drop-down menu
- Failure consequences are considered with respect to containment of hydrocarbons and pressure
- The risk associated with each element is calculated based on a 5x5 risk tolerance matrix
- Yellow, amber and red risk is sought mitigated to the extent desired to maintain acceptable risk
- The summarized element risk is normalized to allow different types of wells to be compared
- The normalized risk value is adjusted for local conditions
- A summary is produced allowing the Operator to work from the top of a risk ranked well listing
- The presented illustration, barrier element listing, and methodology provide an objective risk assessment reducing subjective perspectives, yet allowing the assessment to be truly well specific
- Your risk assessment is no longer driven by subjective assessment but by a robust MODEL.
- This model can then be reviewed at perioding interval to quality assure and enhance the model.