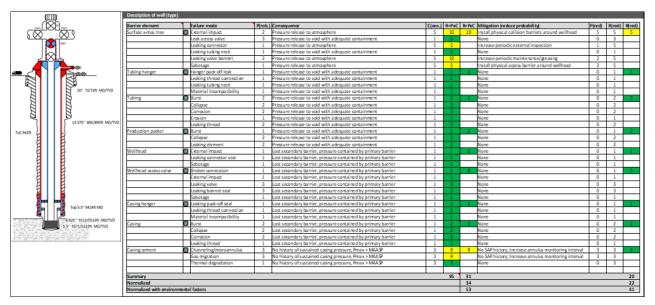Tech Sheet

Wellbarrier Integrity Tool – Risk assessment 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.

Barrier element	Failure mode	P(rob.)	Consequence	C(ons.)	R=PxC	R=PxC	Mitigation (reduce probability)	P(red)	R(red)	R(red)
Surface x-mas tree	External impact	2	Pressure release to atmosphere	5	10	10	Install physical collision barriers around wellhead	5	5	5
	Leak across valve	3	Pressure release to void with adequate containment	1	3		None	0	3	
	Leaking connector	1	Pressure release to atmosphere	5	5		Increase periodic external inspection	1	5	
	Leaking tubing neck	1	Pressure release to void with adequate containment	1	1		None	0	1	
	Leaking valve bonnet	2	Pressure release to atmosphere	5	10		Increase periodic maintenance/greasing	2	5	
	Sabotage	1	Pressure release to atmosphere	5	5		Install physical access barrier around wellhead	2	5	
Tubing hanger	Hanger pack-off leak	1	Pressure release to void with adequate containment	1	1		None	0	1	1
	Leaking thread connection	1	Pressure release to void with adequate containment	1	1		None	0	1	
	Leaking tubing neck	1	Pressure release to void with adequate containment	1	1		None	0	1	
	Material incompatibility	1	Pressure release to void with adequate containment	1	1		None	0	1	
Tubing	Burst	2	Pressure release to void with adequate containment	1	2	2	None	0	2	2
	Collapse	2	Pressure release to void with adequate containment	1	2		None	0	2	
	Corrosion	2	Pressure release to void with adequate containment	1	2		None	0	2	
	Erosion	1	Pressure release to void with adequate containment	1	1		None	0	1	
	Leaking thread	2	Pressure release to void with adequate containment	1	2		None	0	2	
Production packer	Burst	1	Pressure release to void with adequate containment	1	1	2	None	0	1	2
	Collapse	2	Pressure release to void with adequate containment	1	2		None	0	2	
	Leaking element	2	Pressure release to void with adequate containment	1	2		None	0	2	
Wellhead	External impact	1	Lost secondary barrier, pressure contained by primary barrier	1	1	1	None	0	1	1
	Leaking connector seal	1	Lost secondary barrier, pressure contained by primary barrier	1	1		None	0	1	
	Sabotage	1	Lost secondary barrier, pressure contained by primary barrier	1	1		None	0	1	
Wellhead access valve	Broken connection	1	Lost secondary barrier, pressure contained by primary barrier	1	1	3	None	0	1	3
	External impact	1	Lost secondary barrier, pressure contained by primary barrier	1	1		None	0	1	
	Leaking valve	3	Lost secondary barrier, pressure contained by primary barrier	1	3		None	0	3	
	Leaking bonnet seal	3	Lost secondary barrier, pressure contained by primary barrier	1	3		None	0	3	
	Sabotage	1	Lost secondary barrier, pressure contained by primary barrier	1	1		None	0	1	
Casing hanger	Leaking pack-off seal	1	Lost secondary barrier, pressure contained by primary barrier	1	1	1	None	0	1	1
	Leaking thread connection	1	Lost secondary barrier, pressure contained by primary barrier	1	1		None	0	1	
	Material incompatibility	1	Lost secondary barrier, pressure contained by primary barrier	1	1		None	0	1	
Casing	Burst	2	Lost secondary barrier, pressure contained by primary barrier	1	2	2	None	0	2	2
	Collapse	2	Lost secondary barrier, pressure contained by primary barrier	1	2		None	0	2	
	Corrosion	2	Lost secondary barrier, pressure contained by primary barrier	1	2		None	0	2	
	Leaking thread	1	Lost secondary barrier, pressure contained by primary barrier	1	1		None	0	1	
Casing cement	Channeling/microannulus	3	No history of sustained casing pressure, Pmax > MAASP	3	9	9	No SAP history; Increase annulus monitoring interval	3	3	3
	Gas migration	3	No history of sustained casing pressure, Pmax > MAASP	3	9		No SAP history; Increase annulus monitoring interval	3	3	
	Thermal degradation	1	No history of sustained casing pressure, Pmax > MAASP	3	3		None	0	3	
Summary				95	31					20
Normalized					34					22
Normalized with environmental factors					53					41

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 for

- 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 relative risk ranking is produced for the wells portfolio allowing the Operator to work from the top of a risk ranked listing

- The presented illustration, barrier element listing, and methodology is providing an objective approach to the risk assessment reducing subjective perspectives, yet allowing the assessment to be truly well specific

- Your risk assessment is no longer driven by subjective assessment by a robust MODEL. This model can then be reviewed at perioding interval to quality assure and enhance the model.