Shell Global Solutions

Risk Assessment, Limbo Dancing, and ALARP

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Safety and Risk

Safety = Freedom from intolerable risk

Risk = Consequence of an undesirable event
x Likelihood of the event happening

Risk without benefit is unacceptable.

Tolerable v Acceptable

Tolerability does not mean acceptability!

Tolerability refers to a willingness to live with a risk to secure certain benefits **and with the confidence that it is being properly controlled**.

To tolerate a risk means the we do not regard it as negligible or something we can ignore, **but rather something we keep under review and reduce further if and when we can**.

Managing Hydrogen Safety

Managing hydrogen hazards and risks is a challenge!

Not because hydrogen is inherently more hazardous than conventional fuels – although the hazards and consequences may be different,

but a challenge because this is an emerging technology and thus we don’t have historical data on which to base our assessments of the risks.

Risk Management

- Identify the hazards
- Where possible eliminate the hazards
- Assess the residual risks
- Manage the residual risks

The risk assessment may be qualitative (RAM) or quantitative (QRA) as appropriate.

RAM (Risk Assessment Matrix)

Severity	Consequences				Increasing likelihood				
	People	Assets	Environment	Reputation	A	B	C	D	E
					Never heard of in the Industry	Heard of in the Industry	Has happened in the Organisation or more than once per year in the Industry	Has happened at the Location or more than once per year in the Organisation	Has happened more than once per year at the Location
0	No injury or health effect	No damage	No effect	No impact					
1	Slight injury or health effect	Slight damage	Slight effect	Slight impact					
2	Minor injury or health effect	Minor damage	Minor effect	Minor impact					
3	Major injury or health effect	Moderate damage	Moderate effect	Moderate impact					
4	PTD or up to 3 fatalities	Major damage	Major effect	Major impact					
5	More than 3 fatalities	Massive damage	Massive effect	Massive impact					

QRA (Quantitative Risk Assessment)

Risk = Consequence of an undesirable event x
Likelihood of the event happening

Consequence of an event – usually from modelling

Likelihood of the event – failure/leak frequencies, ignition probabilities ...

Lack of failure data specific to hydrogen means reliance on generic data derived from the oil and gas industries. Hydrogen systems typically have small-bore piping, connected by mechanical fittings; whereas industry data is dominated by larger pipes, flanged fittings, and often in corrosive service.

Limbo Dancing

Limbo Dancing

Set the bar (tolerance criteria) **first** and then quantify the risks (QRA).

If the quantified risks don't get you below the bar, **don't** bend over backwards (fiddle the inputs to the QRA) to get beneath the bar! **That's Limbo Dancing!**

ALARP (As low as reasonably practicable)

ALARP assumes that there is a balance between risk and benefit – Risk without benefit is unacceptable.

ALARP is taking measures to progressively reduce risk until the cost of any further risk reduction is grossly disproportionate to the risk reduction thereby obtained.

ALARP

On the 14th June 2007 the European Court of Justice held in *Commission v UK C-127/05* that the UK's use of the expression "so far as is reasonably practicable", where it appears in UK Health and Safety Law, was not inconsistent with the UK's obligations under the Framework Directive 89/331.