Hazard Identification Techniques

Following Hazard identification, we need to look at RISK or the probability and consequence. The Risk Assessment process should focus on challenges to integrity of containment.

Loss of containment is loss of control and key is looking at how this loss may occur including overfill of vessels, corrosion, physical damage, Hi or Lo temperature or pressure.

Next is evaluating the potential impact consequences of this loss, this covers a range of areas and is directly relevant to the substance, for instance flammability; so what ignition sources are available, what is the explosive impact, what about environmental effects. We also need to consider damage to other equipment or buildings as well as the human impact, fatalities and injuries.

Following this consider the probability, how likely is it that the event will occur! This measure can be achieved through qualitative or quantitative methods.

Qualitative assessment is a very straightforward process based on judgement requiring no specialist skills or complicated techniques. Whereas Quantitative Risk Assessment or QRA is made of the probability that a defined harm will result from the occurrence of a particular event.

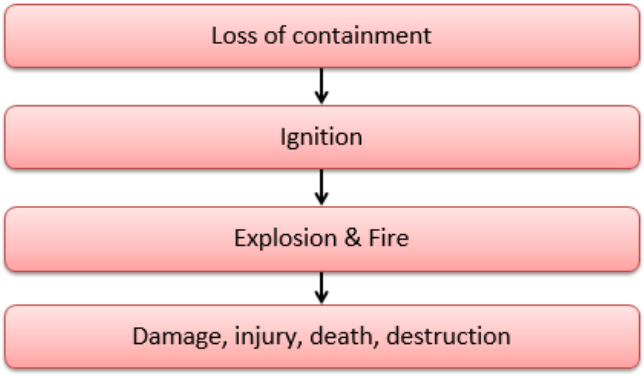
The type of technique will depend on the potential and consequences that can arise, this forms a key part in the risk profiling so that you can control your risks to ALARP, As Low As Reasonably Practicable.

ALARP involves weighing a risk against the trouble, time and money needed to control it. Thus, ALARP describes the level to which dutyholders are expected to control workplace risks.

Remember there is not a 'one-size-fits-all' solution to determining the appropriate control measures. As dutyholders you should be able to show that you have properly profiled your major hazard risks, this should include consideration on the potential deterioration and failure of the barrier.

Hazard Realisation

Within the analysis process we need to understand how the hazard will be realised, this is the realisation of an event that leads or may lead to other uncontrolled events occurring; for example:



Risk Assessment Some Definitions

What is it!

The risk assessment process is a structured examination of what, in the workplace, could cause harm to people, providing the information to determine whether the current precautions are suitable or if further controls need to be implemented

Note

Should include personnel with knowledge of the task being undertaken, and the likely hazards that will arise from this work

Note

Should not be undertaken as a desk top exercise ……
To be effective it needs to be carried out at the work location

A good risk assessment will help avoid accidents and ill health, which can not only ruin lives, but can also increase costs to business through lost output, compensation claims and higher insurance premiums

Hazard

A hazard is something (e.g. an object, a property of a substance, a phenomenon or an activity) that can cause adverse effects. For example:

- Oil on a staircase is a hazard, because you could slip or fall and hurt yourself;
- Loud noise is a hazard because it can cause hearing loss;
- Breathing in asbestos dust is a hazard because it can cause cancer.

Risk

The likelihood that a hazard will actually cause its adverse effects, together with a measure of the effect. It is a two-part concept and you have to have both parts to make sense of it!

Note

Hazard & Risk can be confused – activities within the oil & gas sector are sometimes referred to as ***High Risk*** when they are ***High Hazard.*** It is key that good risk control is adopted to reduce the potential for hazard realisation!

Assessing Risk

The HSE adopt a five step model for risk assessment these steps are:

1. *Identify the likely **hazards** arising from the work*

2. *Decide who might be harmed and how includes **risk** of injury to a person and/or to adjacent structures arising from the work*

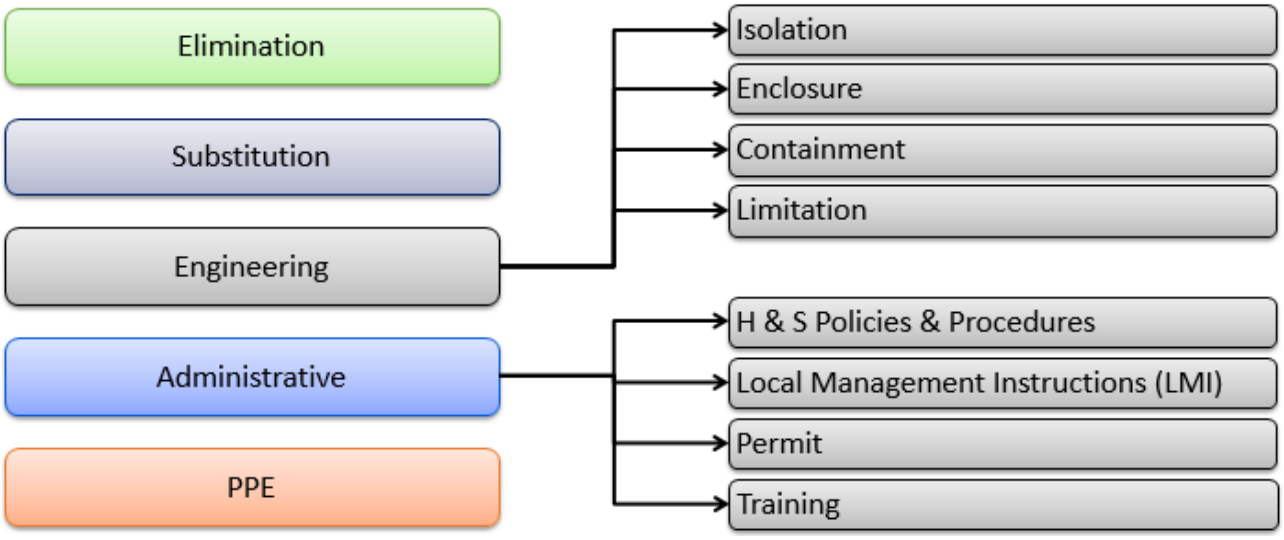
3. ***Evaluate** the risks and decide on precautions*

4. ***Record** the results and **implement** them*

5. ***Monitor & Review** controls for effectiveness, update if necessary*

Hierarchy of Control

This process is underpinned by the control measures employed, remember consider inherent safety into the process. The hierarchy of control is based on the following structure:



ALARP – As Low As Reasonably Practicable

When hazards have been identified they need to be evaluated and controls implemented to:

'Reduce the risk to as low as is reasonably practicable (ALARP)'

This is a position where it can be demonstrated that the costs of further reduction in the level of risk are disproportionate to any improvement that may be achieved.

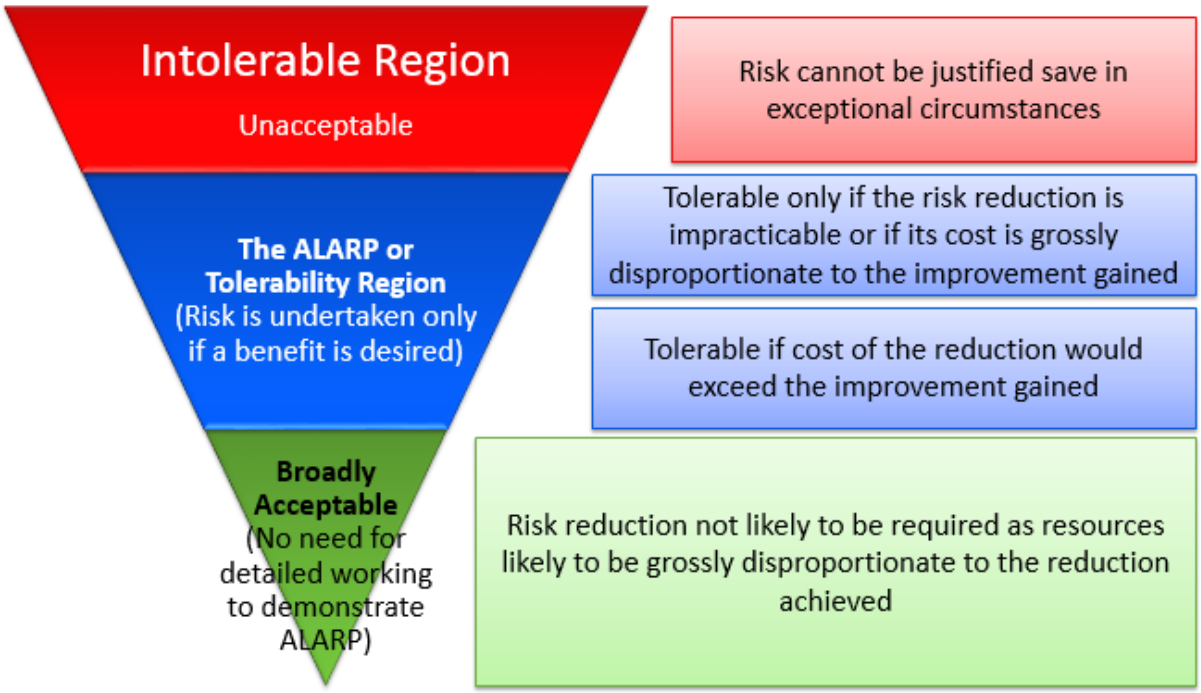
Reasonably Practicable implies that a computation of the risk has been made by the employer based on the level of risk versus the sacrifices made!

- **Sacrifice** as a cost; and
- **Risk** in so far as it is being reduced, as a benefit.

There is no absolute value of what is acceptable, the judgment is made by the employer or their advisor (Approved by the employer).

For a risk to be ALARP it must be possible to demonstrate that the cost involved in reducing the risk further would be grossly disproportionate to the benefit gained. The ALARP principle arises from the fact that infinite time, effort and money could be spent on the attempt of reducing a risk to zero. It should not be understood as simply a quantitative measure of benefit against detriment. It is more a best common practice of judgement of the balance of risk and societal benefit.

Risk Acceptability Framework



Intolerable Risk

Clearly, if the risk is in this region then ALARP cannot be demonstrated and action must be taken to reduce the risk almost irrespective of cost.

Tolerable Risk

If the risks fall in this region then a case specific ALARP demonstration is required. The extent of the demonstration should be proportionate to the level of risk.

Broadly Acceptable Risk

If the risk has been shown to be in this region, then the ALARP demonstration may be based on adherence to codes, standards and established good practice. However, these must be shown to be up-to-date and relevant to the operations in question.

Extreme examples may be:

To spend £1m to prevent five staff suffering bruised knees is obviously grossly disproportionate.

BUT

To spend £1m to prevent a major explosion capable of killing 150 people is obviously proportionate

Risk Evaluation Techniques

Failure Modes and Effects Analysis (FMEA)

A systematic, tabular method for evaluating and documenting the effects of known types of component failures. Applies to electrical/mechanical systems. Can also be applied to flow systems where very high reliability factors are needed (such as fire-fighting water supply systems).

Source: http://www.piii.com/

Layers of Protection Analysis

The term 'LOPA' is applied to a family of techniques used for carrying out a simplified- (often referred to as a semi-) quantified risk assessment of a defined hazardous scenario. As originally conceived, the LOPA methodology applied simple and conservative assumptions to make the risk assessment. In this approach, factors are typically approximated to an order of magnitude. Over time, some operating companies have applied greater rigour to the analysis so that the LOPA may now incorporate and summarise several more detailed analyses such as fault trees and human reliability assessments.

Source: http://www.hse.gov.uk/comah/buncefield/fuel-storage-sites.pdf (Page 82 onwards)

Fault Tree Analysis

A logic model that graphically portrays the combinations of failures that can lead to a specific main failure or incident of interest (Top event). This method using Boolean Logic (And & Or logic gates). Assigning statistical values to each end point on a branch allows the calculation of risk.

Source: http://www.piii.com/

What-If/Checklist Analysis

A brainstorming approach in which a group of experienced people familiar with the subject process ask questions or voice concerns about possible undesired events. The method is similar to What-if alone, with the difference being that broad categories of types of concerns are used to structure the analysis.

Source: http://www.piii.com/

Hazard and Operability (HAZOP) Analysis

A systematic method in which potential operating problems are identified using a series of guide words to investigate process deviations. Can be applied to any mode of operation of a flow process and can also be applied to any procedure or flowchart.

Source: http://www.piii.com/

Dow Fire and Explosion Index (F&EI)

A method, developed by Dow Chemical Company, for ranking the relative potential fire and explosion risk effect radius and property damage/business interruption impacts associated with a process. Analysts calculate various hazard and exposure indexes using material characteristics and process data.

Source: http://www.piii.com/

Dow Chemical Exposure Index (CEI)

Address five types of factors that can influence the effects of release of the material: (1) acute toxicity, (2) volatile portion of material which could be released, (3) distance to areas of concern, (4) molecular weight of the substance, and (5) various process parameters such as temperature, pressure, reactivity, and so forth. The CEI is the product of values assigned for each of the factors of concern using arbitrarily defined numerical scales.

Source: http://www.piii.com/

Fault Tree Analysis (FTA)

A logic model that graphically portrays the combinations of failures that can lead to a specific main failure or incident of interest (Top event). This method using Boolean Logic (And & Or logic gates). Assigning statistical values to each end point on a branch allows the calculation of risk.

Source: http://www.piii.com/

Event Tree Analysis (ETA):

A logic model that graphically portrays the combinations of events and circumstances in an incident sequence. Assigning statistical values to each branch point (failure or condition) allows the calculation of composite risk starting from a defined initiating event.

Source: http://www.piii.com/

Human Reliability Analysis (HRA) event tree

A graphical model of sequential events in which the tree limbs designate human actions and other events as well as different conditions or influences upon these events. Assigning statistical values to each branch point (correct or incorrect performance of a step) allows the calculation of composite risk starting from a defined first step.

Source: http://www.piii.com/

Bow Tie Analysis

A BowTie is a diagram that visualises the risk you are dealing with in just one, easy to understand picture. The diagram is shaped like a bow-tie, creating a clear differentiation between proactive and reactive risk management. It gives you an overview of multiple plausible scenarios, in a single picture. In short, it provides a simple, visual explanation of a risk that would be much more difficult to explain otherwise.

Source: http://www.cgerisk.com/knowledge-base/risk-assessment/thebowtiemethod