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GO SAFE

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QUANTITATIVE RISK ASSESMENT

What is QRA?

Quantitative Risk Assessment (QRA) is a structured approach to identify to estimate the likelihood and consequences of hazardous events, and expressing the results quantitatively as risk to people, environment and organisation. It also assesses the robustness and validity of quantitative results, by identifying critical assumptions and risk driving elements.

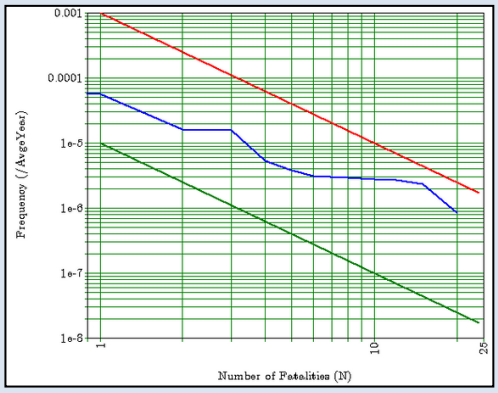
Why QRA is needed?

Satisfactory demonstration of acceptable risk levels is often a requirement in, for example, the approval of major hazard plant construction plans, or significant changes to operations which may include areas such as plant modification and changes in operational manning levels

Who need QRA?

Facilities requiring Quantitative Risk Assessment (QRA) studies may include production and processing facilities, high pressure pipelines or storage and importation sites including liquefied natural gas (LNG). QRA may be a requirement of applicable legislation and/or internal company governance to show that risks are identified and controlled to an acceptable level. The criteria for risk acceptability may be defined by local regulations or company / investor policy.

Objective of the Study



The objective of the QRA study is to assess major accident risks. Specifically, the study will cover the following:

- Quantify risks identified with major accident hazards (primarily for gas dispersion, explosion overpressure, fire and toxic gas).
- Assess associated risks to workers.
- Evaluate acceptability of the risks.
- To suggest and recommend risk reduction measures as required.
- Carry out cost-benefit analysis for identified improvement measures in case of ALARP to determine which recommendations are practicable to implement.
- Provide conclusions and demonstrate that risks are ALARP when recommendations are implemented.

The main objective of the QRA study is to estimate the potential risk levels for personnel due to the accidental release of hazardous materials. The study includes an assessment / evaluation of the acceptance of risk levels. Risk reduction measures are proposed, wherever the risks are found to be high.

Methodology

The method may include some or all of the following:

- Identification of Hazards
- Selection of scenarios to be modelled
- Estimation of Frequency of Failure(By Fault Tree Analysis OR Event Tree Analysis)
- Consequence Analysis: An analysis of the severity / consequence of accident scenarios
- Predicted number of fatalities / casualties for each scenario
- Estimation of Individual risk
- Group / Societal risk

- Potential loss of life
- Location specific risk
- Preventive / mitigation measures.

Quantification of Risk

After determination of potential sources of accidents and their zone of effect, the risk is quantified in terms of likelihood of fatalities due to these accidents by combining the frequency and severity (consequences). The commonly used risk indicators for onshore facilities are:

- Individual Risk per Annum (IRPA),
- Potential Loss of Life (PLL) and
- Societal Risk for the facilities

The risk at any particular location is expressed as Location Specific Individual Risk (LSIR). The LSIR is then combined with personnel occupancy levels to obtain the fatality risk expressed as individual risk. The estimated risk levels are assessed against Company Individual risk tolerable criteria for existing facilities to establish whether the project facilities can be regarded as in compliance with them.

Individual Risk & Criteria:

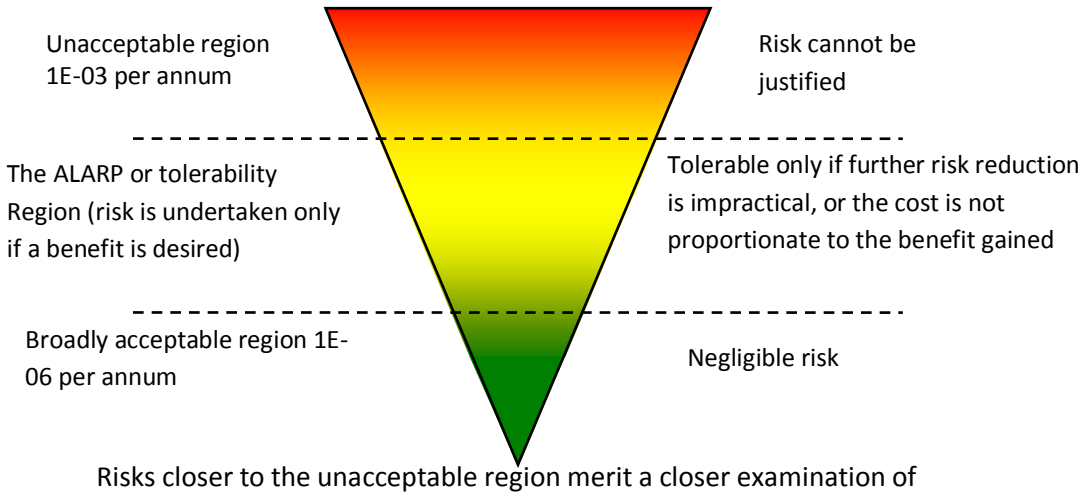
Individual risk is defined as the frequency at which a named individual would be killed as a result of exposure to a hazard.
Individual Risk = LSIR X Occupancy
Where, 'Occupancy' is the proportion of time the individual is exposed to the hazard.

Societal Risk

Assessment of societal risks is even more important than assessment of individual risk because they involve the likelihood of multiple fatalities. Societal risk is the risk to any person or group of persons who are not connected to project facilities and are outside the facility fence line.

F-N Curve

It is helpful to consider group risk in the demonstration that risks are ALARP. This allows consideration to be given to events, which, although low in frequency, may cause multiple injuries or fatalities. Group risk can be presented in the form of a plot of cumulative frequency versus number of fatalities (F-N curve).
F = frequency (experienced or predicted) and N = no. of multiple fatalities.
'N' includes indirect deaths caused as a result of the main event occurring and can therefore be difficult to predict e.g. many people may die years after exposure to a toxic chemical.



Risks closer to the unacceptable region merit a closer examination of potential risk reduction measures

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