SCIC
SINGAPORE CHEMICAL INDUSTRY COUNCIL

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PreDigest

Layer of Protection Analysis

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What is Layer of Protection Analysis?

Layer of Protection Analysis (LOPA) is a semi-quantitative method for the examination and determination of risk in a process plant. This method categorises the consequence of an event and estimates the frequency of its occurrence. It allows a company's decision makers to manage the risks in its process facilities more objectively and systematically.

Why perform Layer of Protection Analysis?

LOPA can be useful when performing Process Hazard Analysis (PHA). The primary purpose of LOPA is to determine if there are sufficient layers of protection against an incident scenario. It is an analysis tool that builds on the information from a qualitative hazard analysis, where the hazards and existing risk controls have been identified. LOPA typically evaluates scenarios that have been developed in a prior study, for example, Hazard and Operability Study (HAZOP).

When is Layer of Protection Analysis employed?

A company performing Process Hazard Analysis can decide when LOPA should be employed. The scope for LOPA application can be drawn based on the level of risk of the incident scenario.

An incident scenario with a more severe consequence would normally warrant more time and resource for its study. Generally, qualitative analysis would require less time and resource and would give less precise result. On the other hand, quantitative analysis is usually more demanding, vigorous and gives more precise result.

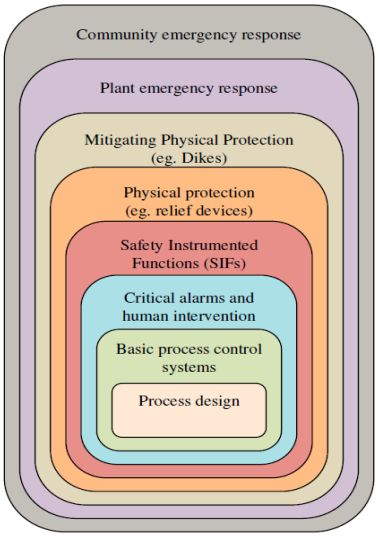
Hence, LOPA, a semi-quantitative analysis, is a method that balances both precision and practical limitations.

How is Layer of Protection Analysis performed?

In simple terms, the steps for performing LOPA can be summarised as follows:

1) Different layers of protection for an incident scenario are identified.
2) Frequency of initiating event for the incident scenario is quantified.
3) Probability of Failure on Demand (PFDs) for all Independent Protection Layers (IPLs) are quantified.
4) Likelihood of an incident scenario proceeding to its final consequence is calculated based on initiating event frequency and PFDs of IPLs.
5) Severity of the final consequence is characterised and quantified.
6) Residual risk is determined by combining the likelihood and the severity of the final consequence.
7) Residual risk is then compared with the company's risk tolerance criteria, which is often presented in the form of a risk matrix. Based on the comparison, the acceptability of the residual risk is ascertained.
8) Recommendations to lower the residual risk are proposed. Usually, recommendations would involve improvement of existing layers of protection or the addition of new layers of protection.

Various Layers of Protection



Challenge!

Sometimes, there is confusion when identifying IPLs. The following gives the criteria that an IPL needs to satisfy:

- ✓ **Independent** - *needs to be independent of the initiating event and other layers of protection*
- ✓ **Reliable** - *needs to perform its intended function upon demand at the stated reliability level*
- ✓ **Auditable** - *can be tested to proof its functionality*
- ✓ **Specific** - *can be shown to prevent the final consequence of the incident scenario*

Recommendations for further reading:

Singapore Chemical Industry Council, ***Guidebook on Process Safety***
Center for Chemical Process Safety, ***Layer of Protection Analysis: Simplified Process Risk Assessment***
Health and Safety Executive, U.K., ***Lines of Defence/Layers of Protection Analysis in the COMAH context***

Process Safety is Everybody's Responsibility!

An initiative of the Process & Engineering Committee

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