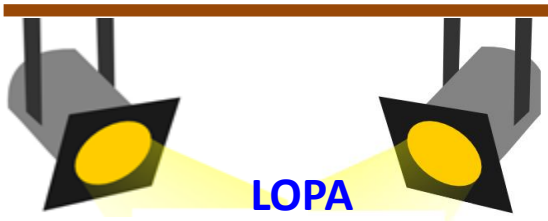


What is Layer of protection analysis (LOPA) ?

LOPA is a **simplified form of risk assessment & it is semiquantitative type.** LOPA is an analysis tool that typically builds on the information developed during qualitative hazard evaluation, such as PHA.

Primary purpose of LOPA is to determine if there are sufficient layers of protection against an accident scenario (Can the risk be tolerated by company ?). For a given scenario, only one layer must work successfully for the consequence to be prevented. LOPA does not suggest which INDEPENDENT PROTECTION LAYER (IPL) to add or which design to choose, but it assists in judging between alternatives for risk mitigation. LOPA is not a fully quantitative risk assessment approach, but is rather a simplified method for assessing the value of protection layers for **a well-defined accident scenario**.

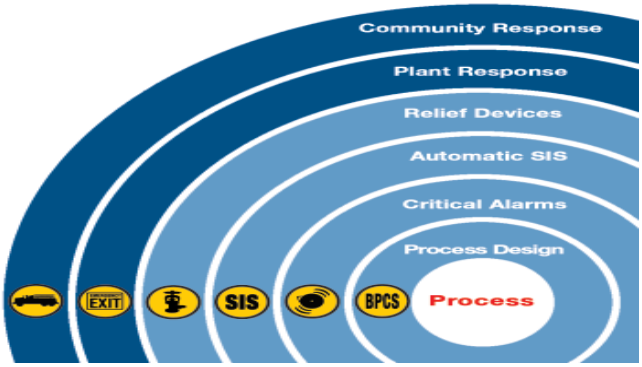
LOPA has its origins in the desire to answer questions raised during discussion of Project group, Hazard review team, Process Engineers, Safety experts, Production experts and Management using a rational, objective, risk based approach. This controls on decisions made using subjective arguments, emotional appeals, and occasionally simply by the loudness or persistence of individual. In LOPA, the individual protection layers proposed or provided are analysed for their effectiveness. The combine effects of the protection layers are then compared against risk tolerance criteria.

Key questions for protection layers are :

- **How safe is safe enough as per your company ?**
- **How many protection layers are needed as per your company guidelines ?**
- **How much risk reduction should each layer provide ?**

LOPA can be effectively used at any point in the **life cycle of a process or a facility**. It can also be used for transportation studies (road, rail, pipeline), terminal operations, toll conversion operations, auditing, loss prevention and insurance issues etc. **LOPA is typically applied after a qualitative hazard evaluation** (like PHA) using the scenarios identified by team. LOPA can also be used to analyse scenarios that originate from any source, including design option analysis and incident investigations. **LOPA should not be used as a replacement for quantitative analysis**.

HAZOP is ideally suited for brainstorming or uncovering what could go wrong and identifying potential accident scenarios.
LOPA allows the analyst to take a predefined scenarios and estimate the risk of the scenario in consistent and simplified manner.



Note that LOPA methods vary throughout the industry. LOPA methods used by various companies differ but **their common features are** :

1. Risk Tolerance criteria differs company to company which include
    - Frequency of major Fires
    - Frequency of Fatalities / LTC
    - Required number of IPLs
    - Maximum frequency for specified categories of consequence based on release size and characteristics or lost production

2. A consequence classification method as per the company or corporate standard
3. Company specific method for developing scenario.
4. Procedures for performing specific calculations & determining whether the risk associated with a scenario meets the risk tolerance criteria for an organization and, if it does not , how this is resolved by company and documented.
5. Company specific default data for initiating event frequencies and values for IPLs.

Consequences are the undesirable outcomes of accident scenarios. Decision of **consequence endpoint** is most important part in LOPA as some companies stop at loss of containment, others estimate final impact of harm or damage. **The physical effects have impact on personnel, environment and property.**

Definition and Purpose of an IPL

An IPL is a device, system, or action that is capable of preventing a scenario from proceeding to its undesired consequence independent of the initiating event or the action of any other layer of protection associated with the scenario.

The effectiveness of an IPL is quantified in terms of its probability of failure on demand (PFD) which is defined as the probability that a system (here IPL) will fail to perform a specified function on demand.

A safeguard is any device, system, or action that would likely interrupt the chain of events following an initiating event. Safeguards can be classified as

- Active or passive
- Preventive (pre-release) or mitigating (post release)

All IPLs are safeguards, but not all safeguards are IPLs.

Benefits of LOPA :

- Facilitates more precise cause-consequence pairs, and therefore improves scenario identification.
- Help organization decide if the risk is “as low as reasonably practicable” (ALARP), which may also serve to meet specific statutory / regulatory requirements.
- Provide a clear functional specification for an IPL.
- Conflicts resolution : “the risk is tolerable to me”
- Information from LOPA helps an organization decide which safeguards to focus on during operation, maintenance and training.
- Provide means of comparing risk from unit to unit or plant to plant.

Limitations of LOPA :

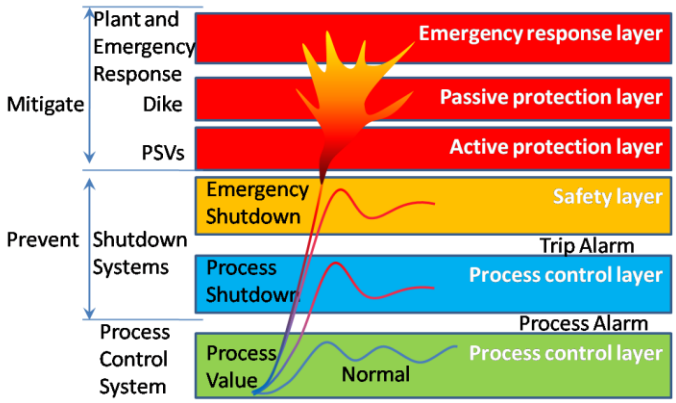
- The numbers generated by a LOPA calculations are not precise values of the risk of a scenario. This is also a limitation of quantitative risk analysis.
- LOPA requires more time to reach a risk-based decision than qualitative methods such as HAZOP & What-if.
- LOPA is not intended to be a hazard identification tool.

Each scenario consist of at least 2 elements :

1. An initiating event
2. A consequence

Scenario must be developed and documented to the level where a basic understanding of the events and safeguard is achieved. Scenario may be initially understood completely and may undergo revisions.

Any factor that could affect the numeric calculation of the consequence frequency or consequence size or type should be included and documented.



US (ISA S84.01) and international standard IEC 61508 & IEC 61511 described the architecture and design features for SIFs. The informative sections of ISA and IEC standards suggested methods to determine the required SIL (Safety Integrity Level).

We are pleased to announce that NEXA PROCESS SAFETY ENGINEERS have been approved as a training institute by Director Industrial Safety & Health(DISH) , GoG