Use of Simplified Risk Assessment Methodology in the Process Industry

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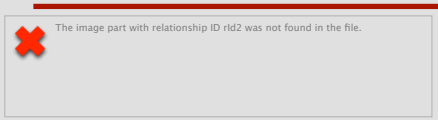
Introduction

Safety risk assessment methods employed by the process industry has evolved considerably in the last four decades.

- Qualitative method (e.g., HAZOP)
- Use of risk matrix
- Layer of protection analysis (LOPA)



HAZOP method

Hazard and Operability (HAZOP) study was developed to review systems for safety and operability related issues.

- **A systematic and qualitative approach**
- **Based on experts brain-storming meetings**
- **Deviations from the norm**
- **Focus on worst-case**
- **Recommendations**

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HAZOP method

HAZOP is based on a systematic approach.

- System divided into segments (nodes)
- Key parameters identified
- Deviations from normal conditions postulated
- Causes for deviations identified
- Assuming no safeguards, consequences identified
- Available safeguards listed

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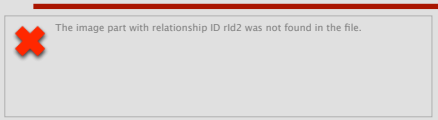
Risk ranking

A standardized risk ranking scheme provides some level of consistency.

- **Reduce experts team's bias**
- **Consistency among systems**
- **Risk matrix approach**
- **High risk scenarios must be mitigated**



Risk ranking

Consequence Severity Categories

Cat.	Safety	Environmental	Economic	Cat.	Safety	Environmental	Economic
A	Multiple fatalities	Major release requiring multiple years to remediate	>$500 million	D	Recordable Injury	Release requiring days to remediate	$10-30 million
B	Single Fatality	Major release requiring a year to remediate	$100-500 million	E	First Aid Injury	Environmental permit violation	$2-10 million
C	Permanent Partial Disability	Release requiring months to remediate	$30-100 million				

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Layer of Protection Analysis

Layer of protection analysis (LOPA) uses a simplified risk quantification approach to determine adequacy of protection layers.

- Strict methodology and data
- Standardized occurrence frequencies and failure probabilities
- Target risk level defined

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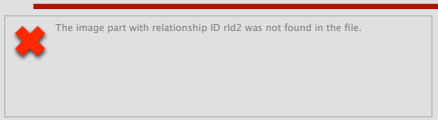
Layer of Protection Analysis

Consistent decision making process by the use of strict methodology and data.

- **Occurrence frequencies and failure probabilities defined in orders of magnitude**
- **Independence among protection layers**
- **Risk impact of enabling events and conditional modifiers**



Concluding remarks

Process industry approach to safety risk assessment meets its unique conditions.

- **Treatment of a large number of systems**
- **Consistency across all operations**
- **Easy to update when needed**
- **Potential for expensive risk reduction solutions**