

Course No. 1521

Layer of Protection Analysis (LOPA) Training Course

PROCESS SAFETY & LOSS PREVENTION
INDUSTRIAL ENGINEERING, MAINTENANCE & OPERATIONS

DURATION

5 Days

DELIVERY

Classroom



Course Overview

The Layer of Protection Analysis (LOPA) Training Course provides a structured and practical methodology for evaluating process risks and determining the adequacy of independent protection layers within high-hazard industrial environments. The course focuses on using Layer of Protection Analysis as a systematic risk assessment technique to support process safety decisions, reduce the likelihood of major incidents, and strengthen operational risk management.

Participants will explore the fundamental principles of Layer of Protection Analysis, beginning with the identification of hazardous scenarios and progressing through cause-and-consequence analysis, identification of protection layers, evaluation of their independence and effectiveness, and assessment of risk reduction. The course emphasizes the distinction between independent protection layers and operational controls that may not meet the necessary independence or reliability requirements.

The Layer of Protection Analysis Training Course is particularly relevant to oil and gas, petrochemical, chemical processing, energy, utilities, manufacturing, and other industrial environments where effective risk control is essential. Through practical exercises and industry-oriented case studies, participants will learn how to evaluate protection strategies, identify risk gaps, and support technically sound safety decisions.

The course also focuses on translating LOPA findings into practical actions, including identifying the need for additional safeguards, reviewing existing controls, supporting safety system decisions, and improving risk reduction strategies. Participants will develop a structured approach that can be applied within process safety management programs, risk assessment activities, new project development, plant modifications, and existing facility operations.

Objectives

- Analyze hazardous process scenarios and identify their initiating causes and potential consequences using a structured LOPA methodology during the course.
- Identify existing preventive and mitigative protection layers and evaluate their relevance to selected hazardous scenarios.
- Apply Layer of Protection Analysis principles to realistic industrial scenarios and document the analysis process and findings.

- Evaluate the level of risk before and after applying independent protection layers using structured risk assessment techniques.
- Develop clear cause-and-consequence relationships for selected scenarios and connect them with appropriate protection measures.
- Distinguish independent protection layers from basic process controls and operational safeguards that may not meet independence requirements.
- Evaluate the need for additional protection layers when existing safeguards do not achieve the required level of risk reduction.
- Improve the quality and consistency of LOPA documentation to support technical review, management decisions, and safety assurance.
- Relate LOPA findings to hazard identification, risk assessment, process safety management, and functional safety activities.
- Assess the quality of assumptions, initiating-event data, and protection-layer information used during LOPA studies.
- Develop practical recommendations for strengthening protection strategies and improving risk management across industrial operations.
- Complete an integrated LOPA case study that demonstrates the application of the methodology to a realistic process safety scenario.

Who Should Attend

The Layer of Protection Analysis Training Course is designed for professionals involved in process safety, risk management, process engineering, chemical engineering, instrumentation and control, reliability engineering, and industrial safety. It is particularly relevant for process safety engineers, process engineers, safety engineers, risk assessment specialists, functional safety professionals, and members of hazard identification and risk assessment teams.

The course is also suitable for operations and maintenance managers, safety and environmental managers, risk managers, engineering project managers, technical authorities, process control specialists, and professionals responsible for reviewing safety studies and making decisions regarding risk reduction measures. It can also benefit consultants, technical auditors, and specialists responsible for process safety management systems and major accident prevention.

The program is highly relevant to professionals working in oil and gas, petrochemical, chemical processing, power generation, utilities, manufacturing, refining, and other high-hazard industries.

Managers and decision makers involved in capital projects, plant modifications, operational risk, safety assurance, and engineering design can also benefit from understanding how LOPA findings support effective risk-based decisions.

Learning Outcomes

- Identify hazardous scenarios that are suitable for Layer of Protection Analysis and prioritize them according to their risk significance.
- Construct clear cause-and-consequence relationships for hazardous events and loss-of-control scenarios.
- Identify preventive and mitigative independent protection layers associated with specific hazardous scenarios.
- Evaluate the independence of protection layers and identify common dependencies that could undermine their effectiveness.
- Estimate initiating-event frequencies and assess the assumptions used in quantitative LOPA studies.
- Evaluate the contribution of individual protection layers to overall risk reduction.
- Determine gaps between existing risk levels and defined or acceptable risk targets.
- Recommend additional engineering, instrumentation, operational, or protective measures to address identified risk gaps.
- Review the quality and consistency of assumptions, data, and protection-layer information used in LOPA studies.
- Document LOPA results in a clear format that supports technical review and management decision-making.
- Integrate LOPA findings with hazard identification, process safety management, functional safety, and risk reduction activities.
- Conduct a practical LOPA assessment for an industrial scenario and develop actionable recommendations for strengthening protection layers.

Course Outline

DAY 01

Fundamentals of Process Risk and Layer of Protection Analysis

- Principles of process safety and industrial risk management.
- Relationship between hazard identification, risk assessment, and Layer of Protection Analysis.
- Purpose, scope, methodology, and applications of LOPA.
- Identification of hazardous events and relevant process scenarios.

PRACTICAL APPLICATION

Select an industrial scenario and define its initial causes and consequences.

DAY 02

Scenario Development and Cause-and-Consequence Analysis

- Development of hazardous scenarios resulting from loss of process control.
- Identification of initiating events and contributing causes.
- Analysis of potential consequences to people, assets, environment, and business continuity.
- Development of logical relationships between initiating events, hazardous events, and consequences.

PRACTICAL APPLICATION

Develop a detailed hazardous scenario and analyze its event sequence.

DAY 03

Independent Protection Layers and Risk Reduction

- Definition and characteristics of independent protection layers.
- Preventive versus mitigative protection measures.
- Assessment of independence, reliability, and effectiveness of protection layers.
- Factors affecting protection-layer performance and probability of failure.

DAY 03 — CONTINUED

PRACTICAL APPLICATION

Evaluate protection layers for selected industrial scenarios and determine their adequacy.

DAY 04

Quantitative Risk Evaluation and Protection Decisions

- Estimation of initiating-event frequencies and scenario probabilities.
- Evaluation of risk before and after the application of protection layers.
- Identification of risk gaps and determination of the need for additional safeguards.
- Relationship between LOPA, safety instrumented systems, emergency shutdown systems, and other protective functions.

PRACTICAL APPLICATION

Perform an integrated LOPA assessment and evaluate the resulting risk reduction.

DAY 05

Advanced Applications and Management of LOPA Findings

- Review, verification, and documentation of LOPA studies.
- Evaluation of assumptions, data quality, and analytical consistency.
- Converting LOPA findings into practical engineering and operational recommendations.
- Integration of LOPA results into process safety management and enterprise risk management.

FINAL WORKSHOP

Complete an integrated LOPA assessment for an industrial scenario and develop an action plan for strengthening protection layers.



Register or Request More Information

Course page: <https://quest-training.com/courses/layer-of-protection-analysis-lopa-training-course>

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