

Course No. 1518

Quantitative Risk Assessment (QRA) Training Course

**PROCESS SAFETY & LOSS PREVENTION
INDUSTRIAL ENGINEERING, MAINTENANCE & OPERATIONS**

DURATION

5 Days

DELIVERY

Classroom



Course Overview

The Quantitative Risk Assessment (QRA) Training Course provides a comprehensive and practical framework for understanding, developing, applying, and reviewing quantitative methods for assessing industrial and operational risks. The course focuses on converting identified hazards and potential accident scenarios into measurable estimates of risk, enabling organizations to support engineering decisions, prioritize risk reduction measures, strengthen process safety, and improve the overall management of major accident hazards.

Quantitative Risk Assessment is particularly important in high-hazard industries where decisions concerning facility design, process modifications, protection systems, emergency planning, and operational controls require a structured understanding of risk. The course examines how accident scenarios are developed, how initiating events and consequences are quantified, and how individual and societal risk measures can be used to support risk-based decision-making.

The program covers the principal elements of QRA, including hazard identification, initiating event analysis, frequency estimation, consequence modelling, escalation analysis, risk calculation, uncertainty assessment, and risk presentation. Participants will examine scenarios involving fire, explosion, toxic releases, loss of containment, equipment failure, and other major accident hazards relevant to industrial facilities.

A strong practical emphasis is placed on building and reviewing QRA models, selecting appropriate data and assumptions, interpreting frequency and consequence results, and communicating findings to technical and management stakeholders. Through industrial case studies and structured exercises, participants will develop the ability to evaluate risk models, identify important assumptions and limitations, compare risk reduction alternatives, and prepare clear recommendations for effective risk management.

Objectives

- Analyze the fundamental principles, scope, and applications of Quantitative Risk Assessment during the course.
- Evaluate hazardous scenarios and identify initiating events, failure mechanisms, and potential consequences.

- Apply structured methodologies for estimating event frequencies and developing credible accident scenarios.
- Assess fire, explosion, toxic release, and loss-of-containment scenarios using appropriate consequence assessment principles.
- Develop quantitative risk models that connect initiating events, escalation pathways, consequences, and risk outcomes.
- Evaluate individual and societal risk concepts and interpret their relevance to industrial decision-making.
- Apply sensitivity and uncertainty analysis to identify the influence of assumptions, data quality, and modelling parameters.
- Assess risk reduction options and compare alternative safety measures using quantitative evidence.
- Evaluate QRA documentation, assumptions, results, and limitations to identify potential weaknesses or inconsistencies.
- Develop a professional QRA reporting and communication approach that translates technical results into actionable risk management recommendations.

Who Should Attend

The Quantitative Risk Assessment (QRA) Training Course is designed for engineers and professionals working in process safety, functional safety, risk management, engineering, operations, maintenance, reliability, asset management, and industrial project management. It is particularly relevant to process safety engineers, risk engineers, safety engineers, chemical engineers, mechanical engineers, petroleum engineers, reliability engineers, loss prevention specialists, emergency planning professionals, and technical specialists involved in industrial risk assessment.

The course is also suitable for process safety managers, engineering managers, operations managers, asset managers, project managers, risk managers, HSE professionals, technical authorities, consultants, auditors, and senior decision makers responsible for evaluating major accident hazards and approving risk reduction strategies. It is especially relevant to government entities, ministries, oil and gas organizations, refineries, petrochemical facilities, chemical plants, energy companies, utilities, transportation facilities, manufacturing organizations, and other high-hazard industrial operations.

Learning Outcomes

- Explain the purpose, structure, and practical applications of Quantitative Risk Assessment.
- Identify hazardous events, initiating events, failure mechanisms, and credible accident scenarios.
- Develop event sequences and escalation pathways for major accident scenarios.
- Estimate event frequencies using appropriate historical, analytical, and reliability-based information.
- Evaluate consequences associated with fires, explosions, toxic releases, and loss-of-containment events.
- Interpret individual risk and societal risk results within an industrial risk management context.
- Assess the influence of uncertainty, assumptions, data quality, and model parameters on QRA results.
- Review QRA models and identify critical dependencies, inconsistencies, and areas requiring further investigation.
- Compare risk reduction measures and determine their potential influence on overall risk.
- Prepare and communicate QRA findings in a clear technical and management-oriented format.

Course Outline

DAY 01

Fundamentals of Quantitative Risk Assessment and Hazard Identification

- Introduction to Quantitative Risk Assessment and its role in industrial risk management
- Relationship between QRA, process safety, risk management, and major accident prevention
- QRA scope, objectives, boundaries, and study methodology
- Hazard identification and major accident hazard screening
- Initiating events and failure mechanisms
- Loss of containment scenarios
- Equipment, process, human, and external event contributors
- Accident scenario development and event sequence construction
- Data requirements and quality considerations

DAY 01 — CONTINUED

PRACTICAL APPLICATION

Develop a QRA study structure for a representative industrial facility and identify key hazardous scenarios and initiating events

DAY 02

Frequency Analysis and Accident Scenario Development

- Fundamentals of frequency estimation
- Historical failure data and reliability information
- Equipment failure frequencies
- Human and organizational contributors
- Initiating event frequency assessment
- Event trees and fault trees
- Escalation mechanisms and conditional probabilities
- Common cause and dependent failures
- Uncertainty in frequency estimation

PRACTICAL APPLICATION

Develop event sequences and estimate frequencies for selected fire, explosion, toxic release, and loss-of-containment scenarios

DAY 03

Consequence Assessment and Risk Modelling

- Principles of consequence assessment
- Release and dispersion scenarios
- Flammable material releases
- Fire and thermal radiation assessment
- Explosion mechanisms and overpressure
- Toxic release and exposure assessment
- Vulnerability and consequence modelling

DAY 03 — CONTINUED

- Escalation and domino effects
- Combining frequency and consequence information

PRACTICAL APPLICATION

Analyze representative release scenarios and develop a structured consequence and risk model

DAY 04**Risk Calculation, Uncertainty, and Risk Reduction**

- Individual risk and societal risk concepts
- Risk profiles and risk contours
- Risk matrices and quantitative risk presentation
- Combining multiple accident scenarios
- Uncertainty and sensitivity analysis
- Model assumptions and data limitations
- Evaluating the influence of critical parameters
- Risk reduction measures and protection layers
- Comparing engineering and operational risk reduction options

PRACTICAL APPLICATION

Review a QRA model, perform sensitivity analysis, identify dominant risk contributors, and evaluate alternative risk reduction measures

DAY 05**QRA Review, Reporting, and Decision-Making**

- QRA quality assurance and technical review
- Reviewing assumptions, data sources, and calculation methodologies
- Validation and verification considerations
- Interpretation of QRA results
- Communicating technical risk to management and decision makers

DAY 05 — CONTINUED

- Risk-informed engineering and operational decision-making
- Integration of QRA findings into emergency planning and process safety management
- QRA documentation and reporting
- Recommendations, action tracking, and continuous improvement

FINAL WORKSHOP

Develop a complete QRA assessment framework covering hazard identification, frequency analysis, consequence assessment, risk calculation, uncertainty, risk reduction, reporting, and management recommendations

Register or Request More Information

Course page: <https://quest-training.com/courses/quantitative-risk-assessment-qra-training-course>

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