Functional Safety for SIS & LOPA

Functional Safety Management of Safety Instrumented Systems

Duration: 4 Days
Standards Referenced: IEC 61508, IEC 61511

Course Description

This course provides a comprehensive understanding of **functional safety principles**, **Safety Instrumented Systems (SIS)**, and **Layer of Protection Analysis (LOPA)** used in the process industries. It focuses on the **functional safety lifecycle**, hazard and risk assessment, SIL determination, SIS design concepts, and functional safety management practices aligned with internationally accepted standards and industry best practices.

Target Audience

- Process Safety Engineers
- Instrumentation & Control Engineers
- Automation Engineers
- HSE and Risk Professionals
- Operations and Maintenance Engineers
- Engineering Managers involved in safety systems

Course Objectives

By the end of this course, participants will be able to:

1. Understand functional safety concepts and terminology
2. Explain the functional safety lifecycle for SIS

3. Perform hazard and risk assessment using LOPA
4. Determine SIL targets for Safety Instrumented Functions (SIFs)
5. Understand SIS architecture and reliability concepts
6. Apply functional safety management principles
7. Interpret roles and responsibilities across the SIS lifecycle

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Detailed Table of Contents

- Safety Instrumented Functions (SIFs)
- Typical SIS architecture

Day 2 – Hazard Identification & LOPA

5. Process Hazard Analysis (PHA)

- Hazard identification techniques (HAZOP, What-If, FMEA)
- Risk concepts: likelihood, consequence, and risk tolerance
- Documentation and outputs of PHA

6. Introduction to Layer of Protection Analysis (LOPA)

- Purpose and principles of LOPA
- Independent Protection Layers (IPLs)
- Risk reduction concepts

7. LOPA Methodology

- Consequence severity assessment
- Initiating event frequency
- IPL effectiveness and crediting
- Risk tolerance criteria

8. LOPA Outputs

- SIL target determination
- Documentation requirements
- Common LOPA mistakes and limitations

Day 3 – SIL Determination & SIS Design Concepts

9. Safety Integrity Level (SIL)

- SIL definition and risk reduction factors
- SIL 1, SIL 2, SIL 3 overview
- Relationship between LOPA and SIL

10. Safety Requirements Specification (SRS)

- Purpose and importance of SRS
- Mandatory SRS content
- Performance and integrity requirements

11. SIS Architecture and Reliability Concepts

- Hardware fault tolerance
- Redundancy (1oo1, 1oo2, 2oo3)
- Common cause failures
- Proof testing concepts

12. SIL Verification (Conceptual Overview)

- Probability of Failure on Demand (PFD)
- Qualitative vs quantitative verification
- Verification lifecycle placement

Day 4 – Functional Safety Management & Lifecycle Operation

13. Functional Safety Management (FSM)

- Functional safety policy and planning
- Competence management
- Configuration and change management
- Documentation control

14. SIS Installation, Operation & Maintenance

- Installation and commissioning requirements
- Proof testing and maintenance strategies
- Managing bypasses and overrides

15. Management of Change (MoC)

- Impact of changes on SIS performance
- Change authorization and validation
- Maintaining SIL throughout lifecycle

16. Audits, Assessments & Continuous Improvement

- Functional safety assessments and audits
- Performance monitoring and KPIs
- Continuous improvement in functional safety

17. Case Studies & Practical Discussion

- LOPA example walkthrough
- SIL determination example
- Common industry failures and prevention strategies

Learning Outcomes

After completing this course, participants will be able to:

- Explain functional safety and SIS concepts confidently
- Apply LOPA for risk assessment and SIL targeting
- Understand SIS lifecycle requirements
- Support functional safety activities within their organization
- Communicate effectively with safety, operations, and engineering teams