Functional Safety and Safety Instrumented Systems: SIL Determination and Proof Testing

12 – 16 July 2027
Paris - Right Bank business hotel

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Introduction:

Functional safety and safety instrumented systems SIS often fail on paper before they fail in the field: SIL targets copied from old studies, sensors credited without failure data, proof tests that miss dangerous faults and bypasses left in place for weeks. This Core Concept course takes instrumentation, control and process safety engineers through the SIS safety lifecycle as IEC 61511 and IEC 61508 describe it, from LOPA output to SIL verification, proof testing and functional safety assessment. Participants build a SIF Safety Requirements Specification and SIL Verification Workbook for a trip function of their own choosing.

Course Objectives:

- Translate hazard and risk analysis results into safety instrumented functions with a documented risk reduction target
- Determine the required SIL for each function using LOPA and risk graph methods and defend the result
- Write a safety requirements specification that a SIS designer, vendor and tester can work from
- Verify achieved SIL by calculating PFDavg and checking hardware fault tolerance, architectural constraints and common cause failure
- Design proof test procedures, intervals and bypass controls that keep the achieved SIL valid in operation
- Plan functional safety management and functional safety assessment across the SIS lifecycle phases

Target Audience:

- Instrumentation and control engineers who specify and design safety instrumented functions
- Process safety and technical safety engineers who set risk reduction targets from hazard studies
- SIS designers and system integrators who select architectures, logic solvers and field devices
- Maintenance and reliability engineers who plan and perform proof testing of trip functions
- Operations engineers who authorise bypasses, overrides and demand reporting on safety systems
- Functional safety engineers who prepare lifecycle documentation and assessment evidence

Course Outline:

Day 1: Functional Safety Principles and the SIS Safety Lifecycle

- Functional Safety Concepts: Safety Function, Demand, Dangerous Failure and Safe State
- IEC 61508 and IEC 61511 Scope: Manufacturer and Process Sector End User Roles
- SIS Safety Lifecycle Phases from Analysis to Decommissioning
- Basic Process Control System Versus SIS: Independence and Separation Criteria
- SIS Current-State Review Using a Lifecycle Documentation Checklist

Day 2: From Hazard Analysis to SIL Targets

- HAZOP Scenario Handover: Initiating Cause, Consequence and Existing Safeguards
- LOPA Worksheet: Initiating Event Frequency and Independent Protection Layer Credits
- Risk Graph Calibration Against Tolerable Risk Criteria
- Allocation of Safety Functions to Protection Layers and the SIF List
- Demand Mode Selection: Low Demand, High Demand and Continuous Mode

Day 3: Safety Requirements Specification and SIS Design

- Safety Requirements Specification Template: Trip Points, Response Time and Safe State
- Sensor, Logic Solver and Final Element Selection: Certified Versus Proven-in-Use Devices
- Voting Architectures 1oo1, 1oo2, 2oo3 and Diagnostic Coverage
- Application Program Requirements and Safety Logic Cause and Effect Matrix
- Installation, Factory Acceptance Test and SIS Validation Plan

Day 4: SIL Verification, Common Cause and Operating Pitfalls

- PFDavg Calculation Using Simplified Equations and Reliability Block Diagrams
- Hardware Fault Tolerance and Architectural Constraints Check
- Common Cause Failure Assessment and Diversity Measures
- Proof Test Interval, Proof Test Coverage and Mission Time Effects on PFDavg
- Bypass, Override and Spurious Trip Management with Demand and Failure Tracking

Day 5: SIL Verification Modelling Build and Assessment Preparation

- High-Pressure Separator Case: LOPA to SIL Target Build
- Tank Overfill Protection Case: PFDavg and Architecture Verification Model
- Proof Test Procedure Drafting with Partial Stroke Testing Options
- Functional Safety Management Plan and Functional Safety Assessment Stages
- SIF Safety Requirements Specification and SIL Verification Workbook Peer Review

Skills You Will Gain:

- Safety Lifecycle Planning
- SIL Determination
- Safety Requirements Specification
- PFDavg Modelling
- SIS Architecture Selection
- Proof Test Design
- Bypass and Override Control
- Functional Safety Assessment

Why Attend This Course:

- Return with a SIF Safety Requirements Specification and SIL Verification Workbook for a trip function from your own facility
- Spot SIL targets, device credits and proof test intervals that do not hold up under calculation
- Question vendor SIL claims and certificates with the right technical questions
- Work through SIS design and testing cases with engineers from oil and gas, chemicals, power and utilities

Conclusion:

A safety instrumented function delivers its risk reduction only when the target, the design, the calculation and the testing agree. The course moves from lifecycle principles and the link between HAZOP and LOPA, through SIL determination and the safety requirements specification, to PFDavg verification, architectural constraints, common cause failure and proof testing. The final day turns this into a SIF Safety Requirements Specification and SIL Verification Workbook that engineers can use at their next SIS review or modification.