

# eFunctionalSafety®



# SIS 2 day training

## Safety Instrumented Systems

Specification, Design & Engineering  
Installation, Commissioning & Validation  
+ Operation & Maintenance overview



# SIS 2 day

## FSM

Functional Safety Management, including planning, life-cycle procedures, verification, assessment and audit

## SRS

Safety Requirements Specification key contents

## SIS DESIGN

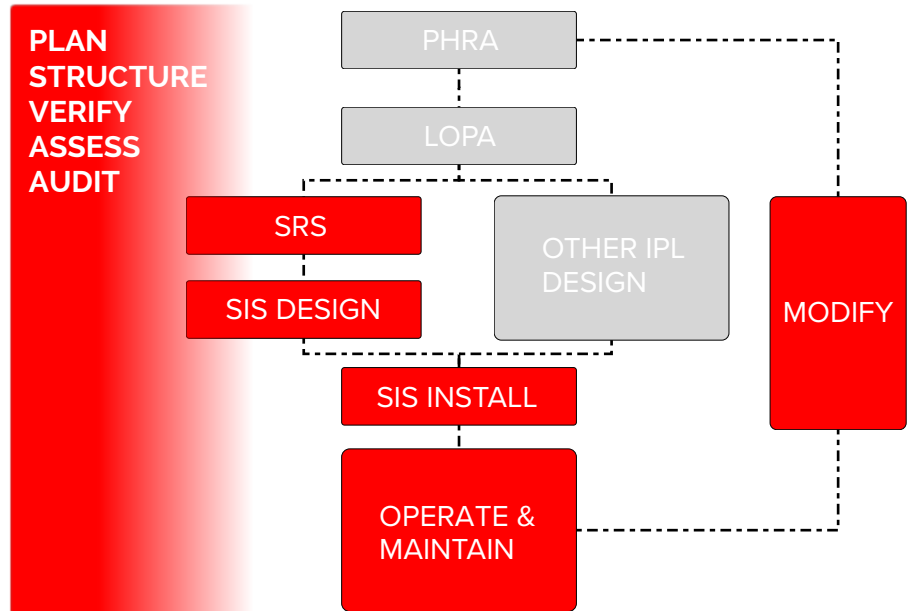
Equipment selection rules, SIS/SIF concept design including SIL verification calculations.

## INSTALLATION

I&C checklists and Validation requirements

## O&M

Operation and maintenance including proof test procedure requirements.



SIS 2 covers the lifecycle phases coloured in red

# Outline

The Safety Instrumented System (SIS) life-cycle of IEC 61511 covers all the stages shown in the above outline. This 2 day course is designed to cover the lifecycle aspects of the SIS that occur after process hazard analysis and SIL assessment has been completed, i.e. from the SRS through to the operation & maintenance requirements of a new or modified SIS.

Revised for latest  
IEC 61511 edition 2



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Aimed at End Users, OEM's, Integrators, EPC's and those in the Process Industry Supply Chain

## SUITABILITY

### Process Operators of Major Accident Hazard sites:

EHS / SHE Professionals  
Process Engineers  
Control & Instrument engineers  
Project engineers and managers  
Maintenance technicians

### Original Equipment Manufacturers of:

Instruments, Interfaces, PLC's,  
Solenoids, Actuators and Valves

### Integration and Engineering companies:

Control & Instrument engineers  
Project engineers and managers

## Learning outcomes:

Differentiate between functional safety standards IEC61508, IEC61511 and their primary usage.

Describe the IEC 61511 SIS safety lifecycle and its key inputs, procedures and outputs.

Explain the importance of Functional Safety Planning, competence management, lifecycle phase verification activities, audit and assessment requirements for SIS.

Demonstrate the key contents of safety requirements specifications, and the critical important parameters the describe safety systems and functions.

Understand the main rules around equipment selection for SIS, including "certification" and prior use options.

Develop an understanding of failure rates and hardware fault tolerance and explain how these affect probability of failure in the context of safety instrumented functions.

Explain the key contents of well designed proof test procedures for safety instrumented functions (SIF), and the importance of authorized bypass procedures and ongoing management of change.

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### Course Contents

1. Introduction
2. Key background & Terminology
3. Functional Safety Management
4. SIS Safety requirements specification
5. Design & Engineering
6. Installation, commissioning and Validation
7. Operation, maintenance and modification



### Safety Lifecycle Overview

Safety in context

Why do we need SIS?

Buncefield accident

SIS & BPCS

- SIS Safety Lifecycle Overview
- Functional Safety Management
- Hazard & Risk Assessment
- SIL Determination
- Safety Requirements Specification
- SIS Design
- Installation, commissioning and validation
- Operation and Maintenance
- Management of Change



### Key Background and Terminology

Regulation Hierarchy - EU & UK

IEC Standards

Key terminology

- Hazard, harm, risk
- ALARP & Tolerable Risk
- Risk Reduction
- SIL - Low Demand / High Demand
- SIL and Risk Reduction
- BPCS and SIS Elements
- SIS & SIF
- SIF Examples

SIS Foundation Module - W07L02  
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#### Safety Integrity Level (SIL) – \*Low Demand

	Required Risk Reduction Factor (RRF)	PFD <sub>average</sub> Requirement of SIF (1/RRF)
<b>SIL 1</b>	<b>10</b>	<b>0.1 or less</b>
<b>SIL 2</b>	<b>100</b>	<b>0.01 or less</b>
<b>SIL 3</b>	<b>1000</b>	<b>0.001 or less</b>
<b>SIL 4</b>	<b>10000</b>	<b>0.0001 or less</b>

\*Low Demand Mode – fewer demands on the safety function than one per year

## Functional Safety Management

FSM Overview  
 Functional Safety Planning  
 Organisation and resources  
 Procedures, Checklists & Tools  
 Competence - Introduction  
 Competence Management  
 V+V Planning  
 Verification plans  
 Validation plans  
 Functional Safety Assessment  
 FS Audit

SIS Foundation Module - M01L03  
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### Competence Management

## CMS Competence Management System

- Set a competence standard for lifecycle roles
- Ensure the context of each role is clear
- Set tasks, attributes and levels of required attainment
- Assign an Assessor
- Identify gaps
- Create an action plan to close gaps

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## Safety Requirements Specification

Qualities of good requirements  
 Process requirements  
 SIS Requirements  
 SIF Requirements  
 SRS Detailed Contents  
 Interfaces and other devices  
 SIS Requirements overview summary  
 SRS Challenges  
 Avoiding SRS problems in development  
 Avoiding SRS problems in operation

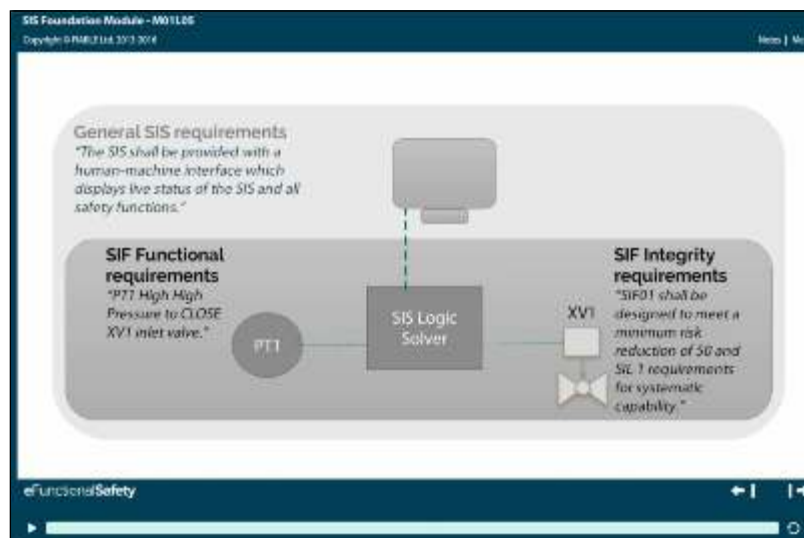


## SIS Design & Engineering

Equipment selection  
 Random & systematic failure  
 Assessing systematic capability  
 IEC61511 Prior use - FPL, LVL  
 IEC61508 Assessment  
 SIF Hardware Verification
 

- HFT and SIL - examples
- Failure Rates & Modes
- Probability of Failure—PFD/PFH

 Application Software Types  
 Software design  
 Software verification requirements



### Installation, commissioning & validation

- Validation planning
- FAT requirements
- SAT and SIT requirements
  - Installation activities
  - Pre-commissioning
  - E&I Loop Check
  - Cold commissioning
  - Hot commissioning
- Functional Safety Assessment - stage 3



### Operation & Maintenance

- Operations Planning & procedures
- Overrides and bypasses
- Overrides and bypasses
- Maintenance planning
- SIL - demand mode
  - Sensor failure modes
  - Logic solver failure modes
  - Valve assembly failure modes
- PFD and proof testing
- Example Inspection & Test Methods
- Management of change



### Background Material

- Process industry accident summaries & videos
- Glossary of terms
- Abbreviations
- Course references

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