

Course 1

Functional Safety & Safety Instrumented System (SIS)

- Based on SIS life cycle of IEC61511/61508.
- The course is structured in 5 modules: Introduction, Analysis of Risks, Design & Implementation, Operation & Maintenance, and Review.
- There are 5 types of online courses depending on the number of hours live with the instructor.
- Optional [FS Engineer](#) certification exam.

- FS1E-1: course for 1 participant, includes 3 hours with the instructor.
- FS1E-2: course for 2 participants, includes 4 hours with the instructor.
- FS1E-3: course for 3 to 6 participants, includes 5 hours with the instructor.
- FS1E-4: course for 4 to 7 participants, includes 12 hours with the instructor.
- FS1E-WI: course for 1 participant with support by email.

Courses in english with 60 days of free access to the virtual classroom with the contents (PDFs, videos, Excel and Word templates, evaluation test).

Live sessions with the instructor: normally at 9:30 a.m. (Central European Time CET) or at the time agreed with the participants.



Course 2

Design of Safety Instrumented Functions and SIL verification

- Based on SIS life cycle of IEC61511/61508.
- The course is structured in 7 modules with focus on the practical part with real examples from the industry.
- Includes [SILcet](#) license for SIL verification.
- There are 4 types of online courses depending on the number of hours live with the instructor.
- Optional [FS Specialist](#) certification exam if both courses have been taken.

- FS2E-1: course for 1 participant, includes 3 hours with the instructor.
- FS2E-2: course for 2 to 6 participants, includes 5 hours with the instructor.
- FS2E-3: course for 3 to 7 participants, includes 10 hours with the instructor.
- FS2E-WI: course for 1 participant with support by email.

Courses in english with 60 days of free access to the virtual classroom with the contents (PDFs, videos, Excel and Word templates, evaluation test).

Live sessions with the instructor: normally at 9:30 a.m. (Central European Time CET) or at the time agreed with the participants.

SILcet Pro Plus tool: 12-month license is included, except 6 months in the courses FS2E-1 & FS2E-WI.



Course 3: Cyber HAZOP Analysis ([read more](#))

The complete functional safety training program consists of two training courses and two certification options. Our instructors have a lot of training experience in collaboration with ISA, TÜV Rheinland and TÜV SÜD.

Course 1: Functional Safety & SIS



Functional Safety in the process industry based on the Life Cycle of IEC61511. The course is structured in 5 parts:

- ✓ Introduction
- ✓ Process Hazard Analysis
- ✓ Design & Implementation
- ✓ Operation & Maintenance
- ✓ Review

Aimed at

Students, technicians, designers, system integrators and engineers who want to learn about Safety Instrumented Systems (SIS) in the process industry.

Course Objective

The objective is to acquire the necessary knowledge to start working in Functional Safety. If you already have knowledge, the course will help you better understand the concepts and give you a real insight into the importance of the different phases of the life cycle.

You will benefit from the Lessons Learned and Best Practices acquired in large projects.

Methodology of online versions

Course in **english**.

Duration: 12 hours (depending on student experience).

There are 5 types of courses. In all of them, participants have free access to the virtual classroom (24/7) for 60 days with videos and other documents.

- FS1E-1: course for 1 participant, includes 3 hours with the instructor.
- FS1E-2: course for 2 participants, includes 4 hours with the instructor.
- FS1E-3: course for 3 to 6 participants, includes 5 hours with the instructor.
- FS1E-4: course for 4 to 7 participants, includes 12 hours with the instructor.
- FS1E-WI: course with email support.

In the live sessions the Instructor explains the main parts of the course and answers questions from the students.

Note: the schedule of the hours with the instructor is normally done at 9:30 a.m. (Central European Time CET) or as agreed with the students. Microsoft Teams or other similar programs will preferably be used.

Documentation

- Course contents in PDF format (> 350 pages).
- Excel Templates: HAZOP, Risk Graph, LOPA and SRS.
- Word template: SIL verification report.
- Videos and instructor support (only some of the course videos can be downloaded).
- Evaluation test in each module and Certificate.
- OPTIONAL: **FS Engineer** certification exam. There is a period of 6 months for taking the exam from the beginning of the course.

Contents of Course 1

Module 1: INTRODUCTION

-Basic concepts, International Standards, What does SIF, SIS, SIL mean? Control System versus Safety Instrumented System

-Types of failures and examples. The importance of diagnostics. Types and examples.

-SIS Life Cycle: Analysis Phase, Design and Implementation Phase, Operation and Maintenance Phase

Documentation: PDFs + videos

Module 2: RISK ANALYSIS

-Risk concepts and how to reduce them with layers of protection. What is an independent protection layer (IPL)? SIS principle of independence and shared elements. Examples.

-Risk Analysis Techniques.

-HAZOP Methodology and Risk Graph

- ✓ Definition of nodes and identification of deviations.
- ✓ Definition of Causes and Consequences. Evaluation of the consequences.
- ✓ Identification of safeguards (IPLs) and assigned credits. Is a SIS layer necessary?
- ✓ Determination of «SIL» with Risk Graphs.
- ✓ Examples with Excel template.

-LOPA methodology

- ✓ Identification of initiating events.
- ✓ Frequency of causes and conditioning modifiers.
- ✓ Identification of non-SIS IPLs and PFDs.
- ✓ Calculation of the scenario frequency.
- ✓ Comparison with the tolerable frequency defined by the Plant. Example of the risk matrix.
- ✓ Is a SIS layer necessary? SIL assigned to the SIF.
- ✓ Examples with Excel template.

-Exercises: HAZOP, Risk Graph and LOPA.

-Safety Requirements Specification (SRS)

Documentation: PDFs + Excel templates + SRS + videos

Module 3: DESIGN & IMPLEMENTATION

-Most used architectures and examples.

-Principles of safety system design. Safety versus Availability.

-IEC requirements and key parameters to calculate the SIL.

-Formulas to calculate PFDavg and MTTFs. Data sources of failure rates.

-Examples of real industry SIFs:

- ✓ Design assumptions (transmitter configuration, used models, architecture degradation, etc.)
- ✓ Example of tank level.
- ✓ Example of pressure vessel.
- ✓ Calculate the SIL achieved by Logic Solver.

-SIL Verification Report. Example.

-IEC 61511 requirements: FAT / SAT, Validation and FSA.

Documentation: PDFs + Verification Report + videos

Module 4: OPERATION & MAINTENANCE

-Concepts and reasons for maintaining the SIS.

-Main clauses of IEC 61511:2016 on Operation & Maintenance.

-Use of the bypass and its impact. Proof Tests and their impact. Examples. Repair of the SIF and its impact. SIS modifications.

Documentation : PDFs + videos

Module 5 : REVIEW

-General considerations to design the SIS.

-How to minimize hardware failures. How to minimize systematic failures.

Documentation: PDFs + videos

Course 2: Design of SIFs & SIL verification



Design of Safety Instrumented Functions and verification of SIL and MTTFS based on practical examples of safety functions in the process industry. Comparison of different designs and generation of reports. Most important parts of the Safety Instrumented System Life Cycle.

Aimed at

Technicians, designers, system integrators and engineers related to Functional Safety and Safety Instrumented Systems (SIS) of the process industry.

Course Objective

The objective is to acquire knowledge to understand and design Safety Instrumented Functions (SIF) from a totally practical point of view. For this, all the concepts on Functional Safety are reviewed, as well as the main parameters are explained in detail. Real examples are made with the [SILcet](#) tool that allows to calculate the SIL based on the three requirements of the IEC-61511/61508 Standard, as well as compare different design alternatives.

Methodology of online versions

Course in **english**.

Duration: 15 hours (depending on student experience).

There are 4 types of courses. In all of them, participants have free access to the virtual classroom (24/7) for 60 days with videos and other documents.

- FS2E-1: course for 1 participant, includes 3 hours with the instructor.
- FS2E-2: course for 2 to 6 participants, includes 5 hours with the instructor.
- FS2E-3: course for 3 to 7 participants, includes 10 hours with the instructor.
- FS2E-WI: course with email support.

In the live sessions the Instructor explains the main parts of the course and answers questions from the students.

Note: the schedule of the hours with the instructor is normally done at 9:30 a.m. (Central European Time CET) or as agreed with the students. Microsoft Teams or other similar programs will preferably be used.

Documentation

- Course contents in PDF format (> 300 pages).
- Excel files (SILcet) with the actual calculations of the practical examples of the course
- SILcet Pro Plus tool: 12 months license for courses FS2E-2/3, 6 months license for courses FS2E-1/WI.
- SILcet User Manual and detailed document on the formulas for calculating PFDavg and MTTFS.
- Other Excel tools: Beta factor.
- Word templates: SIL verification reports.
- Videos and instructor support (only some of the course videos can be downloaded).
- Evaluation test in each module and Certificate.
- OPTIONAL: [FS Specialist](#) certification exam. There is a period of 6 months for taking the exam from the beginning of the course (check conditions to get the FS Specialist Certification).

Requirements for SILcet tool: Windows 7/8/10, Excel 2010 or later.

Contents of Course 2

Module 1: Introduction

-Basic concepts, International Standards, What does SIF, SIS, SIL mean? Control System versus Safety Instrumented System

-Types of failures and examples. The importance of diagnostics. Types and examples.

-SIS Life Cycle: Analysis Phase, Design and Implementation Phase, Operation and Maintenance Phase

Module 2: Risk Analysis Phase

-Risk concepts and how to reduce them with layers of protection. What is an independent protection layer (IPL)? SIS principle of independence and shared elements. Examples.

-Types of Risk Analysis Techniques. Basics of HAZOP.

-Determination of «SIL» with Risk Graphs. Risk Gap concept, required SIL. Example with Risk Graph.

-Example with Safety Requirements Specification (SRS).

Module 3 : Design & Implementation Phase

-Most used architectures and examples.

-Principles of safety system design. Safety versus Availability.

-IEC requirements and key parameters to calculate the SIL.

-Formulas to calculate PFDavg and MTTFs. Data sources of failure rates.

-Simple example of SIL verification.

-Proof Tests.

Module 4: Design & SIL Verification (SILcet is used)

-Assumptions for the examples (configuration Low/High of the transmitter according to the architecture, online / offline tests, etc.).

-Practical exercises using the SILcet tool:

1. Tank Level (several cases)

2. Vessel under pressure (several cases): i) undefined sensor type, ii) transmitter vs switch, iii) diversity of elements, iv) credit by comparison, v) bypass impact.

3. Calculate the SIL achieved by the Logic Solver.

-21 general considerations to design the SIS.

-Examples of certificates and other documents from manufacturers of sensors, logic solver & final elements.

-Excel files included: "SILcet with the exercises solved" & Example of Safety Requirements Specification (SRS).

Module 5 : Design & SIL Verification (SILcet is used)

-Assumptions for the examples and SRS.

-Real practical exercises using the SILcet tool:

1. Low combustion air flow in Incinerator or Furnace.

2. Stop of high pressure pumps by partial closure of the suction.

3. Gas valve closure due to flame loss.

4. Emergency depressurization in a reactor: action on several lines when the temperature is excessive (Reactor Bed Temperature).

5. How to solve a SIF with two Logic Solvers (Safety PLCs).

6. SIF with shared elements (Control System and SIS).

7.Example with Partial Valve Stroke Test.

8.Examples with Complex Architectures.

- Excel file included: "SILcet with the exercises solved" & Example of Safety Requirements Specification (SRS).

Module 6: SIL Verification Report

-How to prepare a SIL Verification Report.

-Main document with MS-Word Template.

-Annex of parameters, graphs and results (PFDavg, PFH, MTTFs) generated by SILcet.

-Example of report with the exSILentia tool.

Module 7: Design & SIL Verification (SILcet is used)

Note: Other additional exercises that are delivered resolved to the participants at the end of the course.

-Assumptions for the exercises.

-Real practical exercises using the SILcet tool (in each case there are several possible configurations):

- Turbine Trip Valve Hydraulic System.

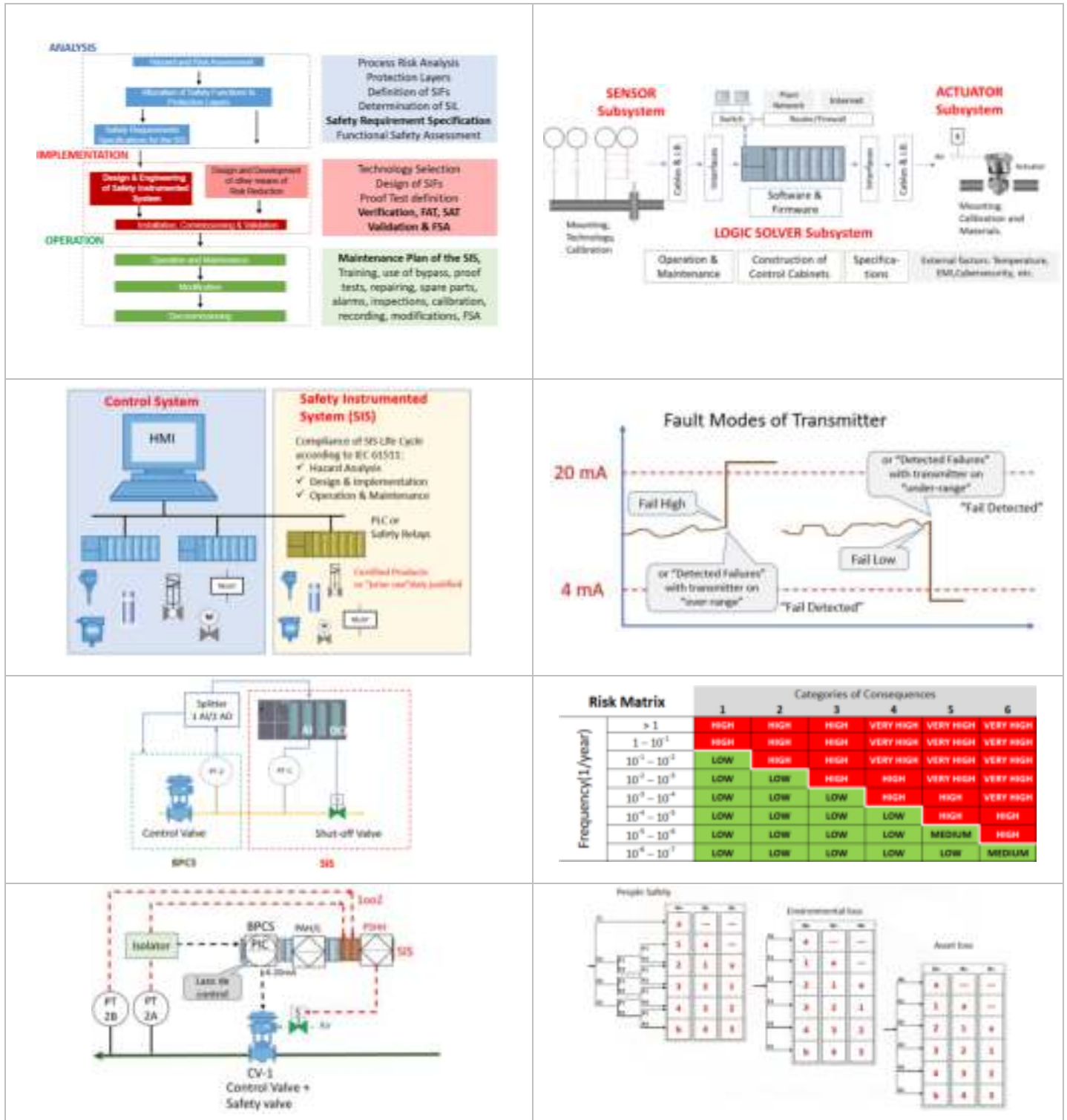
- High Integrity Pressure Protection System

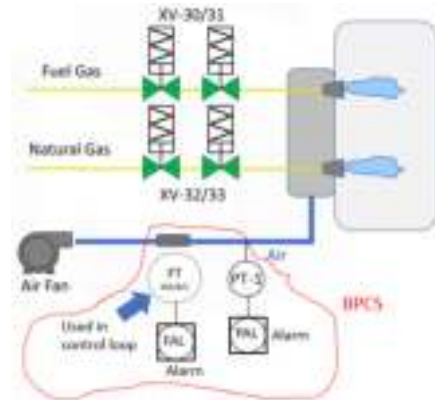
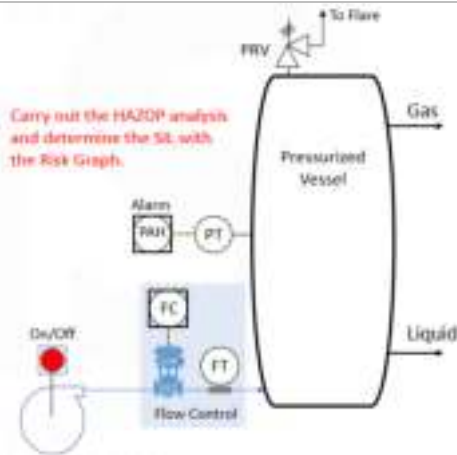
- Pressure vessels (different cases).

- Others: Solutions with high availability, Fire & Gas System, Protection of a Silo.

- Excel file included: "SILcet with the exercises solved".

Some diagrams, tables and graphs used in the courses are shown below.





Description of consequences	Initiating events	Event Frequency	System	Reduced Frequency	Redundancy	Redundancy	Frequency of undetected consequences
Frequency of initiation in the process with safety devices in service (average to process and equipment)	Failure of control system (undetected process deviation)	0.01	1.0E-5	1	1	1	0.0001
Frequency of initiation in the process with safety devices in service (average to process and equipment)	Failure of control system (undetected process deviation)	0.01	1.0E-5	1	1	1	0.0001

From LOPA
Possible failure frequency
We calculate the overall frequency of each event
Modifies (considers all possible being present, etc.)
Factor of risk reduction (overall risk reduction)

