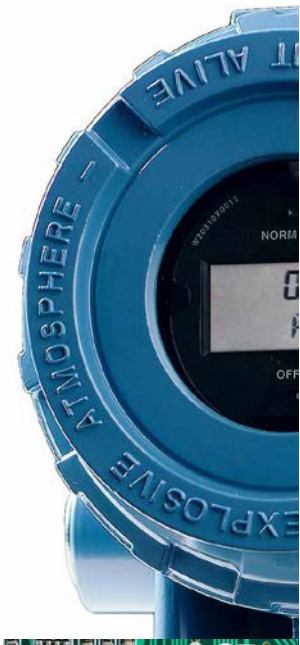
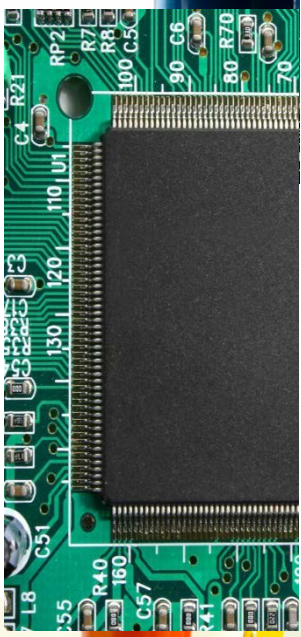
TÜV Rheinland Functional Safety Engineer and Technician Programs



Safety Instrumented Systems:
FS Engineer (TÜV Rheinland) SIS
and
FS Technician (TÜV Rheinland) SIS
or
Process Hazard and Risk Analysis:
FS Engineer (TÜV Rheinland) PH&RA

The **TÜV Rheinland Functional Safety Training Program** is the only worldwide extended vocational training program in the area of Functional Safety where knowledge and competencies are approved by the world renowned certification institute TÜV Rheinland Industrie Service GmbH, Automation and Functional Safety.



TÜV RHEINLAND FS ENGINEER AND TECHNICAN TRAINING COURSES

These 4 (SIS/Tech) and 5 (PH&RA) day courses are run in accordance with the TÜV Rheinland Functional Safety Training Program and comprise three or 4 days of classroom tuition and practical guidance, for understanding and mastering the application, principles and requirements of Edition 2 IEC 61508 & IEC 61511. There is a competency assessment on day 4 (SIS) and day 5 (PH&RA).

Successful participants, who must also demonstrate that they have a minimum of 3 years relevant functional safety experience, will achieve the prestigious FS Engineer or FS Technician (TÜV Rheinland) certificate.

For further information, including other locations and dates:
E: info@silsupport.com
T: +44 (0) 13398 86618
W: www.silsupport.com

C&C technical support services

TÜVRheinland®
Precisely Right.

to obtain your
FS Engineer or FS Technician (TÜV Rheinland) Certificate

C & C Technical Support Services is an accepted course provider of the TÜV Rheinland Functional Safety Training Program.

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TÜV Rheinland Functional Safety Engineer Safety Instrumented Systems Training (4 days)

This 4 day FS Engineer (TÜV Rheinland) SIS course is run in accordance with the TÜV Rheinland Functional Safety Training Program and comprises three days of classroom tuition and practical guidance, for understanding and mastering the application, principles and requirements of IEC 61508 / IEC 61511. There is a five hour competency assessment on the fourth day. Practical exercises will performed throughout the course which will be based on real life examples.

The assessment on the last day is in two parts with:

70 multiple choice questions (1 mark each question)
10 multiple part questions (3 available marks per question)
Pass score requirement is 75%

Successful participants, who must also have a minimum of 3 years functional safety experience, will achieve the prestigious FS Engineer (TÜV Rheinland) SIS certificate. All FS Engineers of the TÜV Rheinland Functional Safety Training Program are also listed on the TÜV Rheinland website for Functional Safety at www.tuvasi.com

Course Objectives

Led by a TÜV Rheinland Functional Safety Expert, this FS Engineer (TÜV Rheinland) certificate course will equip participants with the knowledge for understanding and mastering the application, principles and requirements of IEC 61508 – Functional safety of electrical/electronic/programmable electronic safety systems and IEC 61511 – Functional Safety: Safety Instrumented Systems for the Process Sector.

Who Should Attend?

Instrument Engineers, Process Engineers and Process Safety Engineers as well as Senior Operating and Maintenance personnel who are involved in any of the lifecycle phases for safety instrumented systems from hazard and risk assessment, shut down system/fire and gas systems design to testing and maintenance.

Day 1 Agenda

Will cover process hazard analysis and associated risk management using the most popular and internationally adopted methods and tools. Such hazards can lead to loss of life, damage to their asset, loss of production and profitability, damage to the environment and company reputation. Participants will be introduced to the concepts of the main international standards that cover this area of risk assessment and risk reduction.

Content:

- EC 61508 and IEC 61511 background
- Hazards, Risk and ALARP principles
- Risk Reduction and mitigation
- Safety Instrumented System (SIS) and Safety Instrumented Functions (SIF)
- Types of SIF
- Integrity specification of a SIF
- SIL Determination by risk graphs
- SIL Determination Exercises

- Layer Of Protection Analysis (LOPA)
- SIL determination using LOPA
- LOPA Exercise
- Fault Tree Analysis (FTA)
- SIL Determination by (FTA)
- Case Studies with typical findings and issues

Day 2 Agenda

During the second day delegates will be taken through the requirements for a Safety Requirements Specification (SRS) and shown how to undertake appropriate cost effective designs for Safety Instrumented Systems (SIS) and Safety Instrumented Functions (SIF) and how optimal test and maintenance strategies for them can be achieved. Participants will be instructed in methods for calculating the probability of failure on demand (PFD), safe failure fraction and hardware fault tolerance. The concepts of failure modes, reliability and the influence of common cause failures will also be covered.

Content:

- SIS Safety Requirements Specification
- Selection of Components and Subsystems
- Proven in use (Prior Use)
- Field Devices used in SIS
- Systematic Failures
- Random Failures
- Failure and Reliability
- Demand Modes
- Probability of Failure on Demand (PFD)
- PFD Exercises
- SIF Implementation (Low demand mode)
- Importance of Testing and Maintenance
- Fractional Dead Times
- Partial Closure Testing of Valves
- The Impact of Common Cause and Common Mode Failures
- Safe Failure Fraction and Hardware Fault Tolerance
- SFF Exercises
- Calculating PFD for Low Demand Systems with Diagnostics
- Calculating PFH for High and Continuous Demand Systems with Diagnostics
- Reliability Data

Day 3 Agenda

Day 3 will look at the application software requirements for safety instrumented systems (SIS) and the relationships between hardware and software architecture. This will include the development of application software specification, module testing requirements and integration with other SIS subsystems. This final day of tuition will also include techniques for undertaking more advanced SIL determination and methods for solving more complex safety instrumented functions.

Content:

- Software requirements
- Relationships between Hardware and Software Architecture
- Application Software Requirements Specification
- Application Software Validation Planning
- Requirements for Application Software Architecture
- Requirements for Support Tools, User Manuals and Application Language

- Requirements for Application Software Development
- Requirements for Application Module Testing
- Integration of Application Software with SIS Subsystems
- Requirements for Application Module Testing
- Integration of Application Software with SIS Subsystems
- FPL and LVL Software Modification procedures
- Application Software Verification
- Factory acceptance Testing
- Installation and Commissioning
- Site Acceptance Testing and SIS Validation
- SIF Interaction with Other Technologies
- Primary & Secondary Functions
- Intermediate Trips
- Risk Graph Calibration
- Fire and Gas Systems
- SIS Overrides
- Maintenance
- Modifications and Change Control
- Document Control
- Course summary

Day 4 Agenda

A five (5) hour two part proficiency assessment comprising:

- Part 1 = 70 multiple choice questions (1 mark each question);
- Part 2 = 10 multiple part questions (3 marks each question).

The pass score criterion is 75%.

Participant eligibility requirements

In accordance with the TÜV Rheinland Functional Safety Training Program:

- A minimum of 3 to 5 years of experience in the field of functional safety and safety instrumented systems.
- University degree or equivalent engineering experience and responsibilities as certified by employer or engineering institution.

TÜV Rheinland Functional Safety Engineer Process Hazard and Risk Analysis Training (5 days)

This 5 day FS Engineer (TÜV Rheinland) PH&RA course is run in accordance with the TÜV Rheinland Functional Safety Training Program and comprises four days of classroom tuition and practical guidance. This aim of the course is to understand and master the application of process hazard analysis and associated risk assessment, as required for the early lifecycle phases of IEC 61508 / IEC 61511. There is a five hour competency assessment on the fifth day. Practical exercises will performed throughout the course which will be based on real life examples.

The assessment on the last day is in two parts with:

- 70 multiple choice questions (1 mark each question)
- 3 multiple part questions (30 marks spread over 3 questions)
- Pass score requirement is 75%

Successful participants, who must also have a minimum of 3 years of experience in the field of process hazard analysis and risk assessment, will achieve the prestigious FS Engineer (TÜV Rheinland) PH&RA certificate. All FS Engineers of the TÜV Rheinland Functional Safety Training Program are also listed on the TÜV Rheinland website for Functional Safety at www.tuvasi.com

Course Objectives

The topics cover the concepts of identifying hazards using tools such as What-If, Failure Mode and Effect Analysis (FMEA) and HAZard and OPerability (HAZOP). This will be further developed into the analysis of risk and methods of risk reduction to consider the effectiveness of preventative and mitigating layers of protection. The use of preventative safeguarding efficiencies will be introduced for use with the PHA Matrix, along with the advantages/disadvantages of using the PHA Matrix with different Hazard Analysis methods.

The different questioning techniques used by a Hazard study leader to guarantee a systematic study methodology are investigated, as is the HAZOP flowsheet design, by considering the use of the HAZOP for specific needs such as LOPA. A LOPA exercise will actually be carried out from the output of the course HAZOP exercise. Consideration of constructing effective nodes will be examined and better definition will be given to claims of double jeopardy.

In order to compare similar designs which are ‘proven in use’, the course looks at the considerations required when building effective checklists, along with the advantages of combining this method with brainstorming approaches. Constant comparison of the different Hazard Analysis methods is made through highly practical exercises to allow the delegate to appreciate the benefits of the different methods used.

Some process related activities can only be carried out procedurally. When this is the case, Hazard identification methods for procedural activities must be considered. The course will look at the techniques available, and give consideration to which technique should be used with the associated good practice of implementing those techniques.

The course will introduce participants to the use of Safety Integrity Levels (SIL) and SIL determination using internationally agreed methods for assessing and quantifying process

risk and risk reduction requirements. Delegates will be equipped with the knowledge and methods for undertaking various types of qualitative, semi quantified and quantitative risk assessments.

Practical exercises will be carried out for Semi Quantitative methods such as risk graph and LOPA. The shortfalls of the quicker methods will be investigated to allow the analyst to appreciate the limitations of screening tools. The most popular semi quantified method, Layer of Protection Analysis (LOPA), will be explored in depth. Practitioners often lose sight of the potential for high demand systems in the process industries, so a special section has been added to allow the delegates to consider when a system might be high demand. An exercise to demonstrate SIL determination for high demand will be carried out.

Delegates will gain an appreciation for the need for Fault Tree Analysis (FTA) given the potential for common cause failure when the consequences of a single top event require the analysis of a highly complex redundant system. Simplified FTA exercises will also be carried out to introduce the engineer to the method in both qualitative and quantitative terms.

The effective use of Event Tree Analysis will be looked at in two different forms (Mitigation ETA and Traditional ETA). HAZOP studies can often generate pages of hazard analysis for a complicated, high hazard process system that can fail in a number of ways generating many different consequences. The course will focus on how ETA can be used to qualitatively support the analyst in mapping out the various consequences given various events with safeguard success or failure. Analysts can then select those events which generate consequences of interest for which FTA may be required.

Delegates will also be taken through the requirements for safety management and the framework of a Safety Management System (SMS) for achieving effective process risk management. Best practice for SMS will be investigated with the use of Bow-ties linking the Hazard and its safeguards to the SMS. An insight into how process safety KPIs can be used to better align engineering and management in the prevention of major accident hazards will be covered. The order in which we consider protecting against hazards will be strongly emphasised throughout the course and a section on Inherent Design will be covered. Various videos will support the course material and the three main aspects of how managers should understand Process Risk will be constantly emphasised. Degraded organisational structure examples will be investigated to demonstrate how this can impair, and then normalise the good judgement of engineers, in such a way that this can potentially increase the probability of a hazardous events occurring. The course will examine real life examples of how organisational structure contributed towards Texas City and Macondo disasters.

Realistic practical exercises and case studies will be used to compliment the instruction.

Who Should Attend?

Process Engineers, Safety Engineers, Instrument Engineers and Operations personnel who are who are involved in maintaining the integrity of their processes, and are more involved the early lifecycle phases of functional safety management.

Section 1 Agenda

Content:

- Process Safety and Management Systems
- Safety Legislation and Compliance
- IEC 61511 for the Process Industries
- Management of Functional Safety
- Prescriptive and Risk Based Standards
- Inherent Safety
- Process Lifecycle & Introduction to PH&RA Methods
- Safety Instrumented Functions (SIF)
- Process Risk and Risk Judgement
- How organisational Structure can degrade and normalise engineers judgement
- The effect of Group-Think on engineering judgement

Day 2 Agenda

Content:

- Hazard Identification Methods
- HAZard and OPerability (HAZOP) Studies
- What-If Analysis
- Checklist Analysis
- What-If/Checklist Analysis
- HAZOP or What-if of Non-Routine Operating Modes
- Failure Modes and Effect Analysis

Day 3 Agenda

Content:

- Risk Graphs
- Risk Graph Calibration
- LOPA
- Probability of Failure on Demand (PFD)
- Demand Rate
- Event Tree Analysis
- Fault Tree analysis
- Safety Requirement Specifications
- Recording and reporting risk assessment findings.

Day 5 Agenda

A five (5) hour two part proficiency assessment comprising:

Part 1 – 70 multiple choice questions (1 mark each question)
Part 2.1 – 15 marks HAZID/SIL Determination question
Part 2.2 – 15 marks HAZOP question
Pass score requirement is 75%

Participant eligibility requirements

In accordance with the TÜV Rheinland Functional Safety Program:

- A minimum of 3 to 5 years of experience in the field of process hazard analysis and risk assessment.
- University degree or equivalent engineering experience and responsibilities as certified by employer or engineering institution.

TÜV Rheinland Functional Safety Technician Certificate Training (4 days)

This 4 day course for the FS Technician (TÜV Rheinland) certificate is run in accordance with the TÜV Rheinland Functional Safety Training Program and comprises three days of classroom tuition and practical guidance, for understanding and mastering lifecycle phases for testing, maintenance and change control of safety instrumented systems in accordance with the requirements of IEC 61508 / IEC 61511. There is a 2 part competency examination on the fourth day. Practical exercises will performed throughout the course which will be based on real life examples.

The examination on the last day comprises:

1. Multiple choice questions (60 marks available)
2. Open written questions (40 marks available)

The pass score requirement is 75 %.

Successful participants, who must also have a minimum of 3 years of experience in the installation, development and/or maintenance support of electrical, electronic and programmable electronic Safety Instrumented Systems (E/E/PES) for process plant applications, will achieve the prestigious FS Technician (TÜV Rheinland) certificate. All FS Technicians of the TÜV Rheinland Functional Safety Training Program are also listed on the TÜV Rheinland website for Functional Safety at www.tuvasi.com

Course Objectives

The objectives of this course are to provide participants with the principles, techniques and guidance for achieving good practice testing of the most common types of SIS subsystems. They will learn how testing and maintenance should be recorded to enable better reliability analysis of hardware components used in SIS subsystems, and how an optimised testing and maintenance regime improves plant safety and availability.

Throughout the course, emphasis will be placed on experience and realistic practical exercises, and case studies will be used to compliment the instruction.
Successful participants, who also have sufficient experience as a Technician working in the area of Functional Safety and SIS, will be awarded the prestigious FS Technician (TÜV Rheinland) certificate.

The course will provide 3 days of classroom tuition and practical guidance, mixed with exercises based on real life examples. This will be followed by a two part 3 hour proficiency examination on day 4.

Who should attend?

Technicians involved in the installation, development and/or maintenance support of electrical, electronic and programmable electronic Safety Instrumented Systems (E/E/PES) for process plant applications.

Day 1 and the Morning of Day 2

Objectives:
This section is intended to give participants an understanding of Functional Safety in line with the international IEC 61508 and IEC 61511 standards, and the role of Safety Instrumented Systems (SIS) in reducing process related risk. They will be given a basic introduction to risk assessment so that they understand how Safety Integrity Levels (SIL) are established for SIS and how the SIL relates to risk reduction. The basic concepts of SIS subsystem design will be discussed to give an appreciation of how this is related to the SIL.

Content:

- An Introduction to Functional Safety and the Safety Lifecycle.
- A brief overview of the IEC 61508 and IEC 61511 standards.
- The concept of process related hazards and associated risks.
- An overview of the approaches and objectives of risk assessment.
- Achieving risk reduction in line with ALARP principles.
- The role of Safety Instrumented Systems in risk reduction.
- The importance of testing and maintenance in Functional Safety Management.
- The basic concepts of SIS subsystem design.
- The relationships between SIS designs and testing requirements.
- Human factors and common cause failure issues.

The workshop will use numerous practical examples and team exercises drawn from real life experience to support understanding.

The Afternoon of Day 2 and Day 3

Objectives:
To give participants a firm understanding of the good practice principles of testing techniques and procedures for the most common types of SIS subsystems in line with the international IEC 61508 and IEC 61511 standards. To demonstrate how appropriate testing and maintenance is important to sustaining reliability. To learn how testing and maintenance should be recorded to enable better reliability analysis of hardware components used in SIS subsystems and how an optimised testing and maintenance regime improves plant safety and availability.

Content:

- SIS installation and commissioning.
- Overall SIS Validation.
- The Relationship between SIS testing, failures and reliability.
- Safe failure modes and dangerous failure modes.
- To understand and evaluate the effects of testing and maintenance on SIFs.
- Proof testing techniques for SIS, and associated operational constraints:
    - Proof testing practices for measurement subsystems;
    - Proof testing practices for final elements;
    - Content of proof testing procedures;
    - Format of proof testing procedures;
    - Planning and scheduling;
    - Proof test records.
- Partial closure testing of valves.
- Overrides.
- Authorisation.

- Alarms and Diagnostics.
- Modifications and management of change.

Day 4

A two part proficiency examination comprising:

- Part 1 - multiple choice questions
- Part 2 - written questions

The pass score criterion is 75% in both parts.

Benefits of this course

Participants will be taken through the good practice principles of testing for the most common types of SIS subsystems and shown how appropriate testing and maintenance is important to sustaining reliability.

They will learn how testing and maintenance should be recorded to enable better reliability analysis of hardware components used in SIS subsystems and how an optimised testing and maintenance regime improves plant safety and availability.

Duty holders will be able to demonstrate compliance with the relevant competence requirements of IEC 61508.

Participant eligibility requirements

In accordance with the TÜV Rheinland Functional Safety Training Program:

- Technicians working with Safety Instrumented Systems for a minimum of 2 years;
- Completed TÜV Rheinland Eligibility form;
- Qualification with a National Certificate, or equivalent, in a relevant technician discipline, or reference letter from employer.

TÜV Rheinland Functional Safety Experts and Approved Trainers
All training will be undertaken by a TÜV Rheinland Functional Safety Experts who have been approved by TÜV Rheinland to provide their training programs.

Training Fees
These are based on a per delegate basis and will vary by location and participant numbers. Large training groups will enjoy significant discounts, and C&C will be pleased to provide a quotation to meet your training requirements on request.

Location and Facilities
The training location and facilities, including power beam projection, flipcharts and stationary can be provided by the client or arranged by C&C at additional cost.

Training Attendance
We recommend group training sessions as these will facilitate stimulating discussion for exercise purposes. C&C can provide training on a one-to-one basis but our daily rate consultancy fees will apply.

Training Manuals
Training manuals containing all the presented material and exercise examples will be provided for each student.

Contact Details

C&C Technical Support Services

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