I&E Systems Pty Ltd - FS Engineer (TÜV Rheinland) Training and Certification

Why choose this course?

Failures in safety systems are primarily due to human errors in the specification, design, installation, operation and maintenance of the systems. This course puts a strong emphasis on systematic integrity: The art of deliberately preventing preventable failures. How can we be sure that we have done enough to prevent safety system failures?

The course emphasises the need for safety-centred and user-centred architectural design in safety instrumented systems and the need for effective management of the systems.

The course explains the mathematical theory to derive simple and basic principles that are essential for the design and operation of any automated safety systems. It shows that the effectiveness of risk reduction depends heavily on the architectural design and on the effectiveness of maintenance practices.

Why choose I&E Systems?

I&E Systems is an engineering consultancy specialising in systems engineering and systems integration. We bridge the gap between plant owners and the system suppliers. We work with the end-users from the initial early design concept right through design and implementation and on into long term support for operations, maintenance and modifications.

This **FS Engineer (TÜV Rheinland)** course is aimed specifically at engineers who work for:

- Engineering companies in the design, installation and commissioning of safety systems
- End-user companies who own and/or operate process plant.

It is not intended for engineers involved in the design of internal hardware for logic solver systems or for the design of field device components by OEMs. It is designed to provide candidates with a holistic view of the entire safety lifecycle, particularly from the user's perspective.

Which standards does the course cover?

The course has been designed to provide the underpinning knowledge for competence as required by IEC 61511 and IEC 61508. It also supports the units of competence defined in the Institution of Engineering and Technology '*Competence Criteria for Safety-related System Practitioners*'.

Though the course is primarily concerned with the application of safety instrumented systems in the process sector, it includes a brief introduction into the machinery safety standards IEC 62061 and ISO 13849.

The course highlights the principles that are common to process safety and machinery safety standards and explains how and why the standards are different in the details. Throughout the course comparisons are made between process sector standard IEC 61511 and the machinery sector standards IEC 62061 and ISO 13849.

Some limited guidance is included on safeguarding for minerals processing applications such as conveyors, stackers, loaders and unloaders. The main focus is on protection against hazards that can cause fatalities and on safeguarding systems that include programmable devices rather than simple hardwired interlocks.

This course does not deal with factory automation safety or safety for machines such as lathes, forges and guillotines. Those types of machines rely on relatively simple interlocks based on ISO 13849 rather than using the principles of IEC 61508, IEC 61511 or IEC 62061.

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Dealing with uncertainty in failure rates

There is a growing realisation amongst functional safety practitioners that equipment failure rates vary widely between users and between applications. Conventional mathematical analysis techniques are of limited value because the basic assumption of constant failure rate is never valid.

The course explains the wide variability in failure rates and the factors that influence system performance.

The course stresses the importance of early conceptual design of safety systems in ensuring that the performance targets can be achieved throughout the life of the system. It includes discussion of how system performance can be measured and managed in operations and maintenance.

Course Structure

The course is presented over 4 days and includes classroom exercises. The exam is held on the 5th day, after a tutorial and review session in the morning. The 5th day is optional for candidates not intending to complete the exam.

Candidates will be provided with a set of homework exercises to do in their own time. The exercises will be reviewed in tutorial sessions at the beginning of each day of the course.

	Day 1	**Day 2**	**Day 3**	**Day 4**	**Day 5**
Session 1	Introduction	SIL determination	Quantification of random failure	Exercises	Review
Session 2	Risk management	Exercises		Safety requirements	
Session 3	SIS Standards	Systematic integrity	Exercises	System detail design	Examination
Session 4	Machinery safety	FS Management	Architectural design	Operation and maintenance	
Session 5	SIL concepts	Quality management	Fault tolerance	Performance management	
Session 6	Failure modes	Verification and validation	Design patterns	Review	
Session 7	SIL determination	Audit and assessment	Review	Review	

Assessment

Underpinning knowledge will be assessed in a 3 part exam:

- Part 1: Multiple choice questions, 50 questions assessing knowledge (worth 50%) and 20 calculation questions (worth 20%)
- Part 2: Written answer questions, 10 questions on functional safety principles (30%)

To complete the exam typically takes around 3 to 4 hours. The fastest students complete it within 1.5 hours.

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Candidates wishing to apply for the FS Engineer (TÜV Rheinland) certificate need to complete an eligibility requirements form before attending the course. The following requirements need to be met to qualify for this certificate:

- A minimum of 3 to 5 years' experience in the field of functional safety
- University degree (Master's or Bachelor's degree in Engineering)
  or equivalent engineer level responsibilities status certified by employer
- A score of at least 75% in the exam.

Candidates that do not yet meet the grade may have a second attempt and will receive additional coaching.

Candidates who have not yet gained at least 3 years of experience in functional safety may still participate in the training as well as the exam.

If an inexperienced candidate successfully completes the exam, TÜV Rheinland will hold the application form and assessment results on file. Once the candidate can demonstrate the necessary 3 years of business experience in the area of functional safety TÜV Rheinland will issue the FS Engineer certificate. There is no need for the candidate to retake the exam.

10-year Recertification

TÜV Rheinland requires that FS Engineers repeat the examination to extend their certification after 10 years of practice. This is required because of the significant changes that are made to the standards over time.

Refresher training is strongly recommended but is optional. FS Engineers may attempt the exam without refresher training. Study material will be made available to FS Engineers who would prefer not to complete the refresher course.

Course Outline

- Introduction: What is 'Functional Safety'?
  - Regulatory framework
  - SIFs for risk reduction
  - Random and systematic failures
- Risk management principles, tolerable risk, ALARP
- Standards – history and structure
- Machinery safety - a comparison between IEC 62061, ISO 13849, IEC 61511 and IEC 61508
- SIS fundamentals:
  - Conceptual design,
  - SIFs and SIF allocation,
  - Continuous mode and demand mode
  - Introduction to hardware fault tolerance
  - Factors that influence failure rates
- Failure modes
  - Unrevealed and dangerous failures
  - How to distinguish random failures from systematic failures
  - Failure rate data
  - Safe failure fraction and diagnostic coverage
  - Basic principles in estimating probability of failure
- SIL determination
- Systematic integrity

  - Probability of human error
  - Systematic capability,
  - Techniques and measures
- Functional safety management
- Quality management
- Verification and validation
- Audit and assessment – closing the loop, demonstrating due diligence
- Quantification of failure rates and the main drivers influencing probability of failure
- System architectural design
  - Operability
  - Maintainability
  - Failure mode and effects analysis
  - Testability
  - Separation between protection layers
  - Separation between safety and non-safety
- Fault tolerance – achieving a balance between safety and the cost of downtime
- Design patterns – developing conceptual designs to enable performance in risk reduction
- Safety Requirements Specification
- System detailed design – documentation and traceability
- Operations and maintenance
  - Operations planning and management
  - Proof testing
  - Maintenance, inspection and testing
  - Issues and performance management
  - Modification management
  - Documentation
- Performance management – maintaining risk reduction performance targets

Presenter

Mirek Generowicz is the Principal Consultant at I&E Systems, a company that specialises in control and safeguarding systems for the process industries. He first started working with functional safety systems in 1986. Mirek worked in engineering management from 1992 through to 2018, focusing particularly on design integrity and quality management.

Mirek specialises in independent functional safety assessment and audit for end-users. Since 2004 he has carried out more than 40 functional safety audits and/or assessments for a wide variety of major SIS applications around the world. He was accredited by TÜV Rheinland as a FS Engineer in 2005 and as a FS Expert in 2012.

Course Schedule and Fees

The course schedule and course fees are listed on the registration form.

Contact training@iesystems.com.au for further details.