YOKOGAWA

Co-innovating tomorrow™

Process Safety: Functional Safety Services

Safety Excellence during Industrial Operation, safeguarding process & preventing incidents

E-BU-S251015-01EN

Index

What is Process Safety Management (PSM)?

Process Safety Management is a systematic analytical approach to prevent the release of hazardous substances or energy in industries. It encompasses a set of regulations and procedures designed to prevent accidents and injuries occurring in the (chemical) process industry.

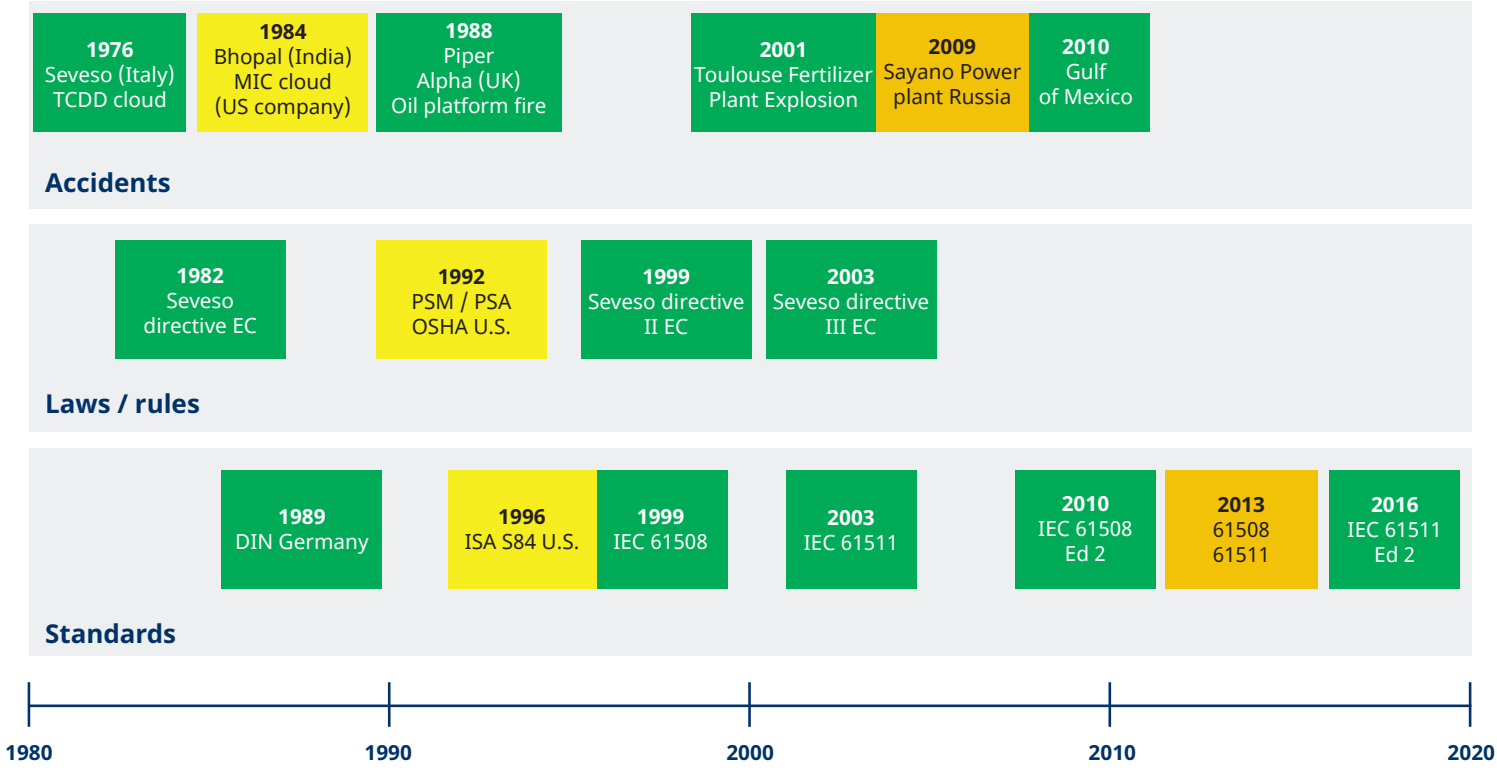
Why is PSM Important?

Although not mentioned literally as PSM in the Seveso III directive (European Law) it is covered in the "Analyze and Manage your Risk" statements of Seveso III. Therefore, indirectly the law requires you to apply PSM. In the ever-evolving industrial landscape, PSM stands as a pillar ensuring the safety of personnel, environment and assets. It helps in:

- **Preventing Accidents:** By identifying and mitigating risks in the process industries.
- **Protecting the Environment**: By preventing the release of hazardous chemicals.
- **Ensuring Compliance:** By adhering to industry standards and regulations.
- **Enhancing Productivity:** Through the optimization of processes and reducing downtime (spurious trips).

The Journey of PSM

The concept of Process Safety Management has evolved significantly over the years. Here's a brief glimpse into its journey:



1970s-1980s: Emergence of the need for a structured approach to industrial safety following several catastrophic accidents.
1980s: First edition of Seveso directive: European Law.

1990s: Introduction of OSHA's PSM standard (29 CFR 1910.119) in the USA, setting a benchmark for safety protocols globally.
2000s & Beyond: Continuous improvement and adaptation of Functional Safety Principles, incorporating technological advancements and learnings from past incidents.

Empowering Safety with Yokogawa *Training for Tomorrow's Challenges*

DID YOU KNOW? The 1970s and 1980s witnessed significant incidents in petroleum and chemical plants, leading to stringent safety legislations.

The 1970s and 1980s witnessed serious incidents in petroleum and chemical plants, leading to stringent legislations emphasizing plant owners' responsibilities. These regulations mandate a comprehensive evaluation of risks, ensuring the safety of humans, the environment and assets, throughout a plant's life-cycle. Adhering to international standards like IEC 61508 and IEC 61511, plant owners are tasked with identifying, analyzing, mitigating and managing risks.
In this evolving landscape, understanding 'Functional Safety' is paramount. It's the cornerstone of industry process plants, ensuring the correct functioning of the Safety Instrumented Systems and other protective layers. Yokogawa, with safety in its rich legacy and expertise since the 1960s, steps in as a trusted guide:

Expert-Led Training: Dive deep into the world of functional safety with courses led by Yokogawa's functional safety specialists. From real-world challenges to practical solutions, equip yourself with the knowledge to navigate the complexities of functional safety.

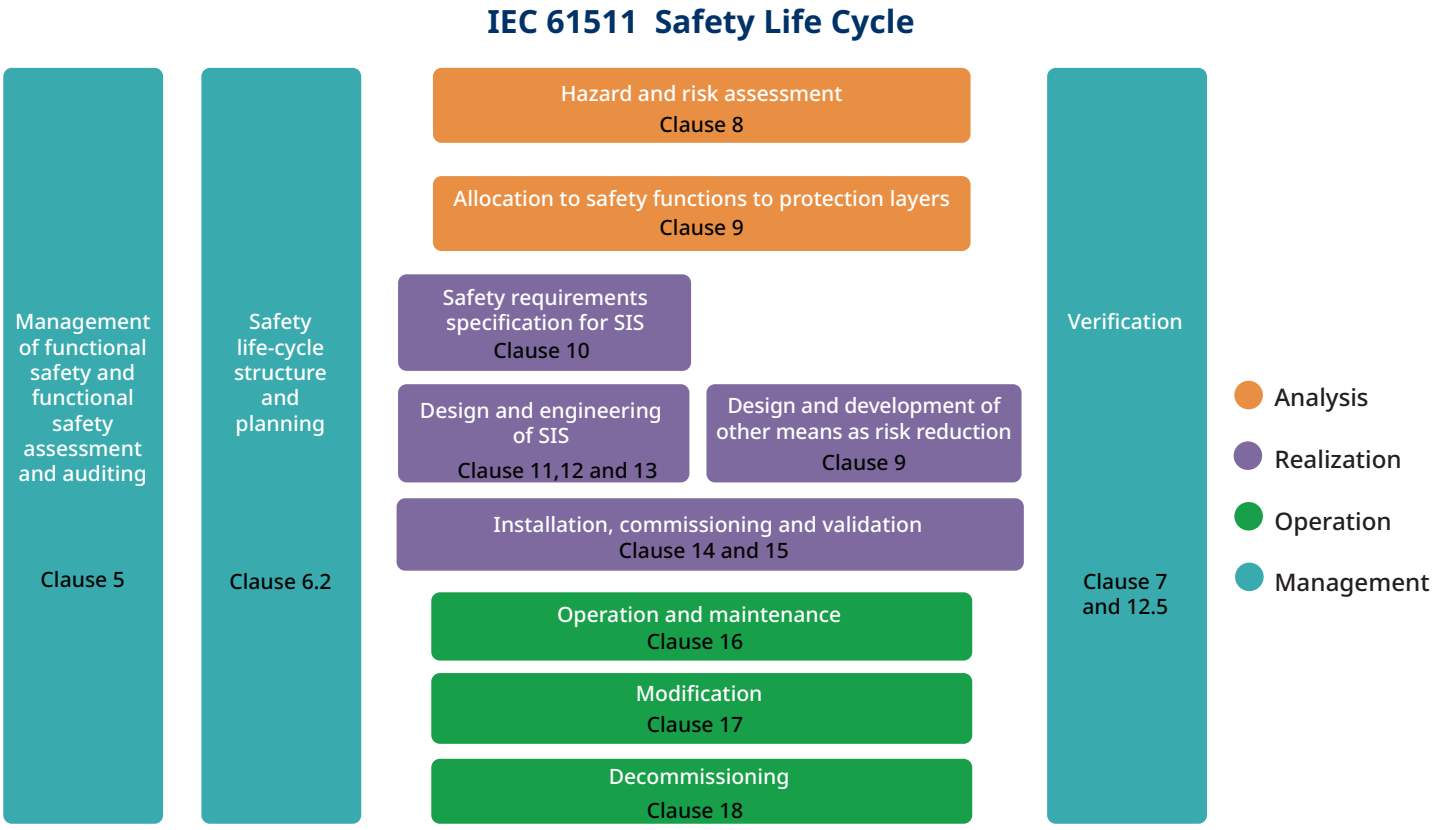
Why Choose Yokogawa?:

- **Personalized Attention:** Small group sessions ensuring individual focus.
- **Industry Expertise:** Trainers/Experts specialized in Functional Safety tailored to your industry.
- **Practical and pragmatic:** no need to learn formulas and definitions by heart, what is taught is practical and pragmatically applicable afterwards.
- **Competitive Pricing:** Quality training at a sharp price point.

Diverse Course Offerings: From the TÜV Rheinland FS Engineer SIS to 'Functional Safety for Operations' (TÜV Rheinland FS Technician) to Functional Safety for End-users to an 'Introduction to Safety Systems', Yokogawa's training program is comprehensive, catering to varied needs.
Join Yokogawa in its mission to foster a safer, smarter working environment. Equip yourself with the skills and knowledge to ensure safety at every step.

The Yokogawa "safety attitude" is applicable for the process industry in the widest sense of the meaning. As also producing water, food, beverages, pharmaceuticals, etc. requires an independent safety layer that safeguards the process.

Safety Life-cycle requirements



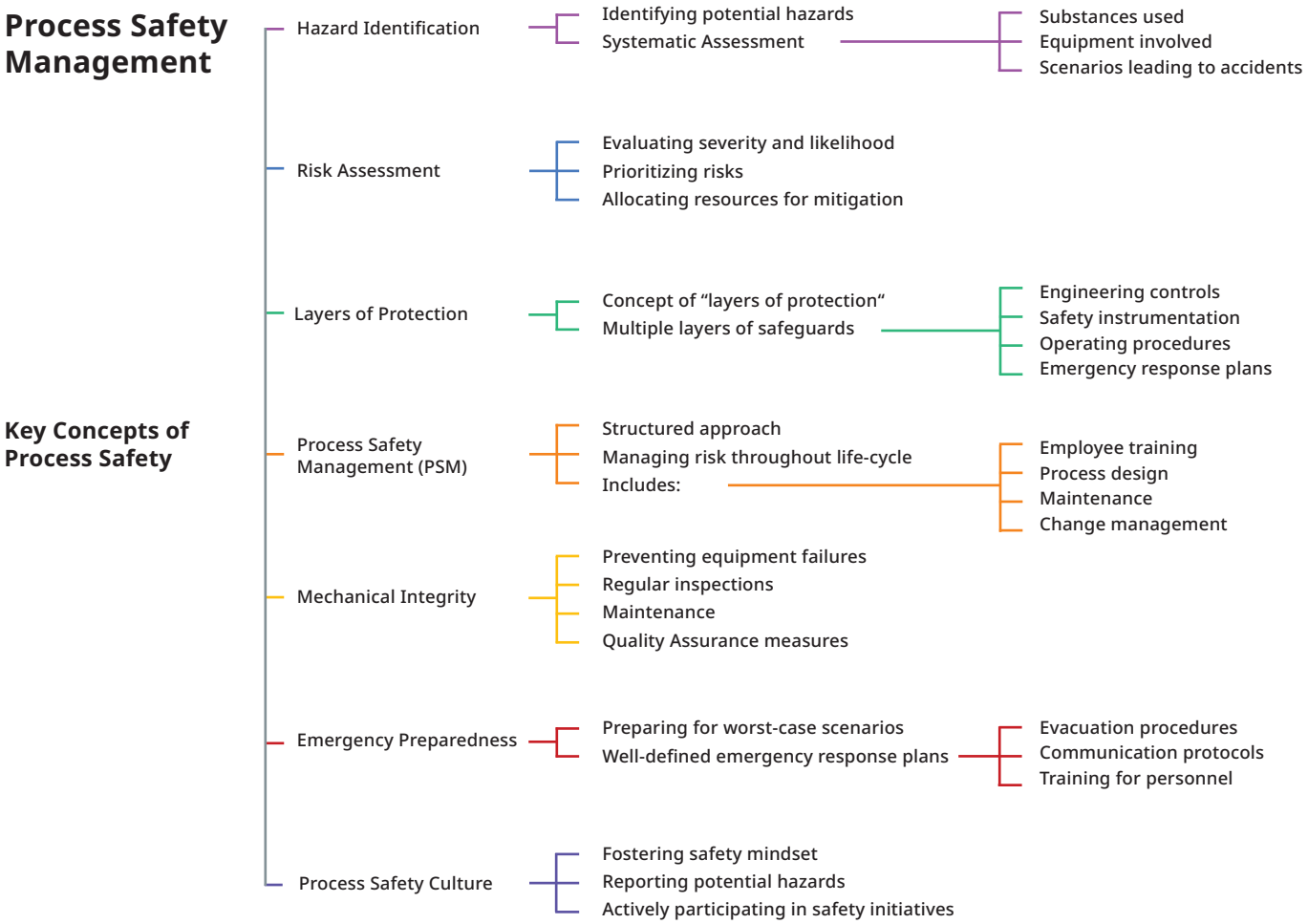
Introduction

Process safety is a critical discipline within industrial sectors that aims to prevent and mitigate the risks associated with the operation of hazardous processes and facilities. It encompasses the strategies, practices, and systems designed to ensure that industrial processes operate safely, with the goal of preventing catastrophic incidents that could result in loss of life, environmental damage, and economic disruption. Process safety is named as crucial in industries such as oil and gas, chemical manufacturing, pharmaceuticals, hydrogen and energy production,
where complex processes involve the handling of volatile substances and high-pressure systems, but can also be applied to food and beverages, water production, etc.

Key Concepts of Process Safety:

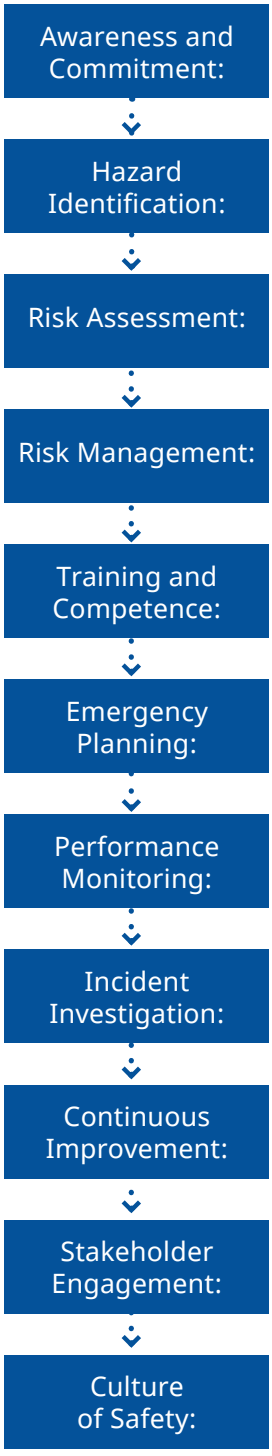
1. **Hazard Identification:** The process safety journey begins with identifying potential hazards within a given industrial process. This involves a systematic assessment of the substances used, the equipment involved, and the various scenarios that could lead to accidents.
2. **Risk Assessment:** After identifying hazards, a risk assessment is conducted to evaluate and classify the severity and likelihood of potential incidents. This helps to size and prioritize the risks and allocate resources and solutions for risk prevention and mitigation.

3. **Layers of Protection:** A fundamental concept in process safety is the concept of "layers of protection." This involves implementing multiple layers of safeguards, including engineering controls, safety instrumentation, operating procedures, and emergency response plans, to prevent, control, or mitigate the consequences of an incident.
4. **Process Safety Management (PSM):** PSM is a structured approach that includes policies, procedures, and practices for managing process safety risks throughout the entire life-cycle of a facility. It encompasses areas such as employee training, process design, maintenance, and management of change.
5. **Mechanical Integrity:** Ensuring the mechanical integrity of equipment is essential to prevent equipment failures that could lead to hazardous events. Regular inspections, maintenance, and quality assurance measures play a vital role in maintaining equipment integrity.
6. **Emergency Preparedness:** Process safety includes preparing for the worst-case scenarios. Facilities must have well-defined emergency response plans, including evacuation procedures, communication protocols, and training for personnel to effectively respond to incidents.
7. **Process Safety Culture:** Establishing a strong process safety culture is crucial. This involves fostering a mindset where all employees prioritize safety, report potential hazards, and actively participate in safety initiatives. Management commitment is crucial in creating a safety-focused company!



Process Safety = Process Safety Management

Process safety management in the industry is a systematic approach to prevent the unintentional release of hazardous materials or energy, which could lead to catastrophic incidents. The journey for process safety can be described in several key steps:



1. **Awareness and Commitment:**
   - Recognizing the importance of process safety.
   - Top management commitment to prioritize safety over production.
   - Allocation of resources (time, money, personnel) for safety initiatives.
2. **Hazard Identification:**
   - Identifying potential hazards associated with processes, equipment, and operations.
   - Using tools like Process Hazard Analysis (PHA), Hazard and Operability Study (HAZOP), and What-If Analysis.
3. **Risk Assessment:**
   - Evaluating the potential consequences and likelihood of hazardous events.
   - Determining the level of risk associated with each identified hazard.
   - Prioritizing risks for further action.
4. **Risk Management:**
   - Implementing measures to eliminate or reduce the identified risks.
   - Designing inherently safer processes.
   - Installing safety instrumented systems and protective devices.
   - Developing and implementing standard operating procedures (SOPs).
5. **Training and Competence:**
   - Ensuring that all involved in the safety life-cycle are trained and proven competent in process safety principles applicable for their job/function.
   - Regular refresher training and competency assessments.
6. **Emergency Planning:**
   - Developing emergency response plans for potential incidents.
   - Conducting regular drills and simulations to test the effectiveness of the plans.
7. **Performance Monitoring:**
   - Establishing key performance indicators (KPIs) for process safety.
   - Regularly monitoring and analyzing safety performance data.
   - Conducting functional safety audits and inspections to ensure compliance with safety standards.
   - Nowadays the above data can be easily displayed in realtime on a company safety dashboard.
8. **Incident Investigation:**
   - Investigating any process safety incidents to determine root causes.
   - Implementing corrective actions to prevent recurrence.
9. **Continuous Improvement:**
   - Regularly reviewing and updating process safety management systems.
   - Incorporating lessons learned from incidents and near misses.
   - Adopting new technologies and best practices to enhance safety.
10. **Stakeholder Engagement:**
    - Engaging with employees, contractors, regulators, and the community to promote process safety and create awareness on the safety responsibility of all involved.
    - Sharing safety performance data and seeking feedback.
11. **Culture of Safety:**
    - Promoting a culture where safety is a core value.
    - Encouraging open communication about safety concerns.
    - Recognizing and rewarding safety achievements.

Hazard and Risk Analysis

1. HAZOP Leadership
2. Risk Assessment Leadership
3. SIL Verifications

IEC 61511: Phase 1, 2 Analysis Hazard and risk assessment

HAZOP Leadership

Hazard and Risk Assessment

Although compliance with the IEC standards is not mandatory European laws (i.e. Seveso III directive) require owners of dangerous process installations to “Analyze and Manage the risk”. Starting the IEC 61511 safety life-cycle model from the top, the concept process design requires a systematic identification of potential hazards in case the process runs out of control. In 99% of the cases this is done by performing a HAZOP (HAZard and OPerability study). By performing a HAZOP the process risk is analyzed. Output of the HAZOP is a list of Safety Instrumented Functions (SIFs), every SIF refers to a dangerous process situation, also called a process demand (e.g. the Basic Process Control System (BPCS) cannot control the process anymore).

Customer Challenges

- As per IEC 61511, the initiation of the process safety life-cycle is the identification of all potential hazards associated with the process and its equipment.
- This foundational step is pivotal, as all subsequent functional safety activities are orchestrated around the prevention or mitigation of these identified hazards.

Our Solution

- At Yokogawa, we believe in a collaborative approach. Our Functional Safety Specialists will work together with the (client) nominated representatives e.g. process engineers, instrument engineers, people from operations, etc. They will meticulously examine every facet of the process plant node-by-node.
- This rigorous scrutiny is aimed at pinpointing hazards and operational concerns. Throughout this vital assessment, safeguards, including Safety Instrumented Functions (SIFs), are identified and documented for each potential hazard scenario.

Customer Benefits

- **Expertise:** Yokogawa’s commitment to safety is backed by our team of field-experienced Functional Safety Specialists. Proficient in systematic hazard identification methods they ensure that no stone is left unturned in identifying potential hazards in the process plant.
- **Comprehensive Overview:** A detailed account of all potential disturbances and their root causes.
- **Safety Instrumented Functions:** Identification of existing or new SIFs and other safeguards tailored for each hazard.
- **Documentation:** A thorough record of the HAZOP results, coupled with justifications for each Safety Function.
- **Action Plan:** A strategic roadmap for process enhancements or further clarifications required.

IEC 61511: Phase 1, 2 Analysis Hazard and risk assessment

SIL Classification Services

Safety Integrity Level (SIL) Classification

The next step for process safety, after the Hazard identification is to ensure the required risk reduction is assigned to the SIFs. This ensures the right level of protection of both people, environment as well as plant assets. Still in the first block of the IEC 61511 safety life-cycle model it mandates that every (SIF) is assigned a target risk reduction. This Safety Integrity Level (SIL) represents the target average Probability of Failure on Demand (PFDavg). The opposite (1/PFDavg) of the PFDavg is called the Risk Reduction Factor (RRF).

Customer Challenges

- Assigning a SIL level to a SIF (determining the required process safety) is depending on the expected Frequency and potential Consequences (Personal, Environment, Financial, Reputation) of the upset process.
- The team performing this SIL classification (a.k.a. Risk Assessment) has to find consensus with respect to the likelihood, consequential costs, etc.

Our Solution

- Yokogawa's Functional Safety Specialists will lead the SIL classification unbiased, allowing all participants to contribute to the debate.
- Structural methods like Risk Graph, Risk Matrix and LOPA can be facilitated.

Customer Benefits

- **Expertise at Your Service:** Yokogawa's Functional Safety Specialists ensure a comprehensive and accurate result. This helps in safeguarding people, environment, protecting plant assets and client reputation and ensuring compliance with IEC61511.
- **Cost-Effective Solutions:** With our expertise, you can be assured that your expenditure on safety equipment is budgeted realistically and effectively.
- **Proven Methods:** Utilizing industry-recognized methods, including Layers of Protection Analysis (LOPA), Risk Graphs, and Risk Matrix during the SIL classification workshops, we offer our clients:
  - A comprehensive list of all uniquely identified SIFs with their target SIL level. This SIL target for each SIF considers People, Environment and Asset protection.
  - Allocation of safety requirements to all layers of protection.

IEC 61511: Phase 1, 2 Analysis Hazard and risk assessment

SIL Verification Services

SIL Verification: Ensuring Safety & Compliance

Safety Integrity Level (SIL) verification is an important step in the process safety life-cycle. Performing the SIL verification at the early stage ensures the review is a thorough one of the Process Hazard and Risk Analysis (PH&RA) to prevent systematic failures in the first design of the SIFs with their SIL level. A SIL Verification at the analysis phase still allows a correct PH&RA but findings during the SIL verification still allow design corrections of the process installation which has not been built yet.

Customer Challenges

- Verification of the safety requirements before finalizing the plant design is a significant challenge.
- The potential repercussions of not meeting these requirements include costly redesigns and reworks of the process safety system.

Our Solution

- Yokogawa's team of Functional Safety Specialists play a crucial role in ensuring that the intended Safety Instrumented System (SIS) design aligns with the safety targets for all SIFs , as specified during the Risk Assessment.
- If any Safety Instrumented Functions (SIFs) are not meeting their respective target SIL during the verification process, our specialists will cooperate intensively with you to investigate alternative options. They then will advice you on the best course of action to resolve any issues that arise.

Customer Benefits

- **Proactive Approach:** Undertaking the SIL verification early in the design process acts as a safety net for plant designers. It will reduce or avoid systematic failures in SIS design and help in avoiding the financial and operational burdens of redesign and rework due to unmet safety requirements in the later stages of the project.
- **Expert Tools & Analysis:** Utilizing advanced tools and methodologies like Reliability Block Diagrams, Fault Tree Modelling, and Yokogawa's proprietary field-tested SIL Verification (RSV/SRC) tool, we offer our clients:
  - A comprehensive report on Verified SIFs.
  - Assurance that the proposed SIF design meets the required SIL level.

SIS Realization

1. **Safety Requirement Specification**
2. **SIS Design and Engineering**
3. **SIS Validation**

IEC 61511: Phase 3
SIS Realization Safety Requirements Specification

Safety Requirement Specification (SRS)

Safety Requirement Specification (SRS): Ensuring Comprehensive Safety
The Safety Requirements Specification (SRS) is a crucial component in the safety life-cycle. It ensures that the Safety Instrumented System (SIS) to build will comply with the specifications following the Hazard and Risk Assessment (H&RA) but is also containing all the important information for the design and engineering of the SIS.

Customer Challenges
- Ensuring that safety specifications fully consider all engineering details and aspects from the Hazard and Risk Assessment (H&RA).
- Guaranteeing that the SIS can be designed and engineered to the correct specifications at the SIS Realization.
- These specifications must be both maintainable and verifiable throughout the safety life-cycle.

Our Solution
- Yokogawa's Functional Safety Engineers produce the Safety Requirement Specification, a comprehensive document detailing the functional and safety integrity requirements for the SIFs and specifying all elements of the Safety Instrumented System (SIS).
- This document meticulously covers the SIS behavior for every mode of plant operation, ensuring comprehensive coverage in the realm of process safety.
- These specifications are determined and documented with reference to the HAZOPs, SIL Classification, Hazard and Risk Assessment (H&RA) reports generated earlier.
- Yokogawa's Functional Safety Specialists can review/verify the Safety Requirement Specification, checking if the specified SIFs will meet their assigned SIL level.

Customer Benefits
- **Comprehensive Documentation:** The outcome is a detailed document that describes the overall SIS requirements as well as the specifics of each SIF's safety and functional behavior.
- **Validation Ready:** The SIS Safety Requirements Specifications are crafted in such a way that they can be used as the main reference to validate the SIS in the subsequent phases of the IEC 61511SIS safety life-cycle.

IEC 61511: Phase 4
SIS Realization
Design and Engineering for SIS

Design and Engineering of the Safety Instrumented System

Understanding the SIS Design & Engineering

The next step in the journey of ensuring safety in industrial processes is the actual building of the SIS cabinets and the creation of the safety Application Program (AP, e.g. the logic functionality of the SIS safety controllers). All to be in accordance with the SRS. This step, outlined as IEC 61511; Phase 4, is also known as Design and Engineering of the Safety Instrumented System (SIS).
This isn't just about procuring SIL-rated equipment; it's a comprehensive process to genuinely achieve the required SILs level for the Safety Instrumented Functions (SIFs).
Note: this phase is no actual safety consultancy, it is performed by the safety engineering project team.

Key Concepts:

What to prove for every SIF during SIS Realization:

1. **PFDavg:** The average Probability of a Failure on Demand, which represents the chance that the safety function fails during a safety function shutdown request.
2. **HFT** (Hardware Fault Tolerance): The resilience of the numbers of hardware installed to tolerate hardware faults and still have enough (redundant) hardware to ensure the SIF can reach the safe state.
3. **SC (Systematic Capability):** A measure of the quality of the manufacturer's organization and Functional Safety Management (FSM) system. 2 A measure of the quality of the FSM system of all parties involved in the safety life-cycle, from EPC's to End-users, including SIS integrators, commissioning teams, etc.

Customer Challenges

- Identifying safety system integration organization capable of delivering a Safety Instrumented System that meets the Safety Requirement Specifications.
- This SIS integrator must be able to prove its SC to be compliant with the highest required SIL level. For example if the SIS contains a SIL3 rated SIF, then the SC of the SIS integrator engineering organization must be SC3. This is done by ensuring the chosen organization is backed by a robust Functional Safety Management System (IEC 61511; Phase 10) that supports the design and engineering of the SIS with the required SC.

Our Solution

Yokogawa safety project organizations are delivering SIS solutions since the 1960's, hence the Yokogawa name stands as a beacon of safety in the industry. Safety Excellence is in our DNA. Our involvement spans across all stages of safety projects:

- Front-End Engineering Design (FEED)
- SIS Realisation & Testing
- Assistance with Site Installation and Commissioning
- SIS Validation
- Overall (Site) Validation
- Modifications (if applicable)

IEC 61511: Phase 4
SIS Realization
Design and Engineering for SIS

Design and Engineering of the Safety Instrumented System

Our Global Yokogawa Competency Profile Management (CPMS) System ensures the technical competency of our Functional Safety Engineers and Safety Specialists. This system empowers us to provide the right resources, be it local or remote, for any safety project.

- Our Functional Safety Management (FSM) System ensures:
- Competent personnel deployment.
- Detailed planning and execution of required actions.
- Standardized procedures, tools, and templates.
- Thorough verification, review, and testing.
- Detailed records and documentation.
- Independent SIS validation and assessment.
- Top management support.
- TÜV Rheinland certified FSM systems in The Netherlands, Romania, United States of America, Singapore, Malaysia, India, Japan, Bahrain, United Arab Emirates, Kingdom of Saudi Arabia

Customer Benefits

- **Trusted Partnership:** Yokogawa has been a trusted name in safety solutions since the 1960s. Partnering with us ensures you're working with seasoned Specialists in the design, engineering, and delivery of Safety Instrumented Systems.
- **Operational Excellence:** With state-of-the-art technology, Corporate FSM rules, and competent resources, we guarantee operational excellence for our clients.

IEC 61511: Phase 4
SIS Realization
Design and Engineering for SIS

SIS Validation Services

SIS Validation: An extra cycle to ensure a realized SIS according the SRS.
The key philosophy (IEC61508, Ed.2 2010, route 1s) for FSM is to reduce and avoid systematic failures and, doing this, increase the systematic safety integrity of the project and/or organization. This is why Yokogawa, as company standard for safety projects, is having corporate FSM rules for following the safety standards.
Reducing and avoiding systematic failures is done within the project team by following procedures, using tools and templates, doing document reviews, extensive testing of hardware and Application Program (AP), using checksheets, etc.
At the end of SIS realization the customer is invited to do a Factory Acceptance Test (FAT) on the built system. Performing FAT, clause 13 of IEC61511 Ed. 2, is an initial validation of the SIS to see if the SIS has been realized according the SRS. This SIS validation is recommended by the IEC standards and shall not be confused with the Overall Safety Validation documented in the Phase 5 section of this brochure.

Customer Challenges
- Making sure that the Systematic Faults has been reduced as much as possible during SIS Realization.
- EPC's and other SIS integrators may not have evidence of their SC and will not apply FSM as a standard, though it is required by the IEC standards. Instead, they disclaim themselves from applying FSM (hidden) in their contracts and terms and conditions.

Our Solution
- Any Yokogawa safety solution is realized with FSM (Corporate Rules).
- Every safety solution will be independently assessed during (basic) design and after FAT. For this, the independent assessors use the Functional Safety Assessment Checksheet (FSAC) that is available for every safety project and is part of project documentation. The FSAC assessment cases refer to the applicable sections of the IEC 61508 and IEC 61511 standards.
- Every compliant assessed project will be rewarded with a Declaration of Conformance for Functional Safety (DoC(FS)) referring to the FSAC above. In simple words the DoC(FS) will state that "for the time Yokogawa realized the safety system the Yokogawa procedures were followed correctly". Knowing the Yokogawa procedures have been written according the IEC standards

Concluding on the SIS validation process:
- Making sure the SC requirements are met.
- The realized safety system has been built and tested against the SRS.
- Ensuring all deliverables, from documentation to applications, are comprehensive and current.
- Documented in an independent assessment report (FSAC).

Customer Benefits
By collaborating with Yokogawa, you can rely on an organization that knows how to build safety systems. Independent safety assessors will assess every safety project and document it. Other SIS integrators do not provide this documented evidence on a correct and compliant SIS Realization.

SIS Installation, Commissioning and Validation

1. SIS Installation Services
2. SIS Commissioning Services
3. SIS Safety Validation Services

SIS Installation Services

SIS Installation: Everything comes together and alive

Once the client has signed the FAT certificate, stating this is the safety system required with optional a list of punches still to be resolved later, the system is packed and shipped to site.
After arrival at site, the system cabinets are mounted in the equipment room, power and network connections are made, field cables to be wired up to the "open" field terminals inside the marshalling cabinets.
Note: this phase is no actual safety consultancy, it is performed by the safety engineering Project / Commissioning team.

Customer Challenges

- Ensuring that all is connected and installed as planned.
- Safeguard that the SIS will not undergo undocumented modification(s). Any modification to be done with Management of Change (MoC).
- All cabinets, networks, workstations, HMIs, etc. powered up and working as expected.

Our Solution

- Yokogawa safety project organizations are experienced in delivering and installing safety systems at site. Following their Site Acceptance Test (SAT) procedure(s) they structurally install the safety system at site location(s). Once all is installed and powered up, the system is ready for Commissioning phase, see next section.

Customer Benefits

- **Structured approach:** In most cases the original safety engineering project team will follow the safety system to site. Hence the Yokogawa representatives at site are familiar with the system and know what to install and (double) check. System faults, due to power-downs, etc. can be easily reset.
- **Commissioning Ready:** After completing and signing the SAT procedure the safety system is ready for commissioning. In some cases the Yokogawa project scope ends here. However, many customers appreciate the additional safety team support during commissioning. Yokogawa safety engineers can provide this support following client instructions and the client's FSM system. After signing the SAT certificate the client accepted the (responsibility) delivered system as "theirs".

IEC 61511: Phase 5
SIS Installation, Commissioning and Validation

SIS Commissioning Services

SIS Commissioning

After the installation is fully powered up, all networks are running, system cables are connected and HMI screens are showing the system, the SIS is ready for commissioning. Until now, field cables may have been connected to the field terminals in the marshalling cabinets, but the knives of these terminals are still open, e.g. the field is not connected to the safety system yet.
During commissioning phase the field will be connected to the safety system loop by loop. For every field loop that is connected evidence of a correct functioning of the loop is to be created by the commissioning team. Before a loop can be commissioned evidence of mechanical completion, electrical completion and if possible, also operational completion is to be available, for the commissioning team to see that the loop is ready. During commissioning procedures are followed to make sure the safety loop is 100% ready for operation. Ranges, setpoints, faults, all to be checked from the devices in the field up to the HMI screens in the control room, including alarm messages, deviation alarms, etc.
Note: this phase is no actual safety consultancy, it is performed by the client safety commissioning team if required supported by the safety engineering project team.

Customer Challenges

- Ensuring that all field loops are connected to the safety system and are working as expected in normal and abnormal situations.
- Safeguard that all the above is thoroughly documented and documentation is captured/saved to be available in later phases. In case of an incident/accident this commissioning evidence can be crucial for the client to prove the field loops have been installed, commissioned and have been operating as designed.
- Make sure the SIS will not undergo undocumented modification(s). Any modification to be done with Management of Change (MoC).
- Ultimate readiness for SIS validation before the operational phase.

Our Solution

- Yokogawa safety project organizations are experienced in supporting the client commissioning of safety systems at site. Our engineers can swiftly manipulate inputs and outputs to create process situations to be tested (i.e functional checks) to ensure commissioning has been completed, meanwhile capturing evidence of correct functioning. Once all is commissioned and tested the safety system is ready for the Overall (Site) Validation, see next section.

IEC 61511: Phase 5
SIS Installation, Commissioning and Validation

SIS Commissioning Services

Customer Benefits

- **Professional support:** nobody will know the safety system as well as the engineers that have designed and tested the SIS during realization and even in case non-involved engineers will be supporting, the application has been structurally setup in such a way they can find their way easily. Hence the Yokogawa representatives at site are familiar with the system and know what to do and capture during commissioning.
- **Overall Validation Ready:** This is the last step before “introducing the hazards”, see next section.

IEC 61511: Phase 5
SIS Installation, Commissioning and Validation

SIS Safety Validation Services

SIS Safety Validation: Last check before the hazards are introduced.
Ensuring the design, engineering, installation, and commissioning of the Safety Instrumented System (SIS) aligns with all Safety Requirement Specifications is paramount. This critical step is encapsulated in the SIS Validation (IEC61511: Phase 4) and Overall Validation (IEC61511: Phase 5), as outlined in IEC61511: Clause 15 SIS Safety Validation. The SIS Safety validation looks backwards, forwards and to the actual "now". Backwards to see if all about the SIS has been documented and to check if any safety related shortcomings/modifications from previous phases have been resolved and documented too. Forwards to see if the organization is ready for the operational phase. Check if the involved staff is proven competent (i.e. trained on the new installed system(s), basic safety knowledge, product knowledge, process knowledge, experience, etc.) Check if all procedures to be used during the operation phase are present and accessible for all. Procedures for operation, maintenance, proof testing, modifications (Management of Change), etc. And the actual "now" moment to see if all in the process is ready for startup, i.e. testfluids removed, overrides/bypasses/forcings removed, etc.

Customer Challenges
- Seeking an independent validation of the entire safety life-cycle process for delivering Safety Instrumented Systems.
- Meeting regulatory, customer, and insurance requirements.
- Identifying a top-tier safety organization capable of providing independent safety validation services.

Our Solution
- Yokogawa's team of Functional Safety Specialists ensures:
- The SIS, along with its associated Safety Instrumented Functions (SIFs), meets the Safety Requirement Specification (SRS).
- The SIS validation at the conclusion of the realization phase (IEC61511 Phase 4), see earlier in this document.
- A overall validation post the SIS installation and commissioning (IEC61511: Phase 5) as part of the pre-start up safety review (PSSR).
- Should the SIS fall short of the Safety Requirements, our Specialists document and explain these shortcomings and may be able to suggest alternative solutions. Making the SIS ready for process startup and safeguarding during the operational phase ahead

Our validation process includes:

- Leveraging independent Functional Safety Specialists.
- Testing the SIS against the SRS and other specifications.
- Ensuring all deliverables, from documentation to applications, are comprehensive and complete "as-built".
- Crafting an independent SIS validation report with a conclusion that provides a verdict on a go or no-go with respect to process startup.

IEC 61511: Phase 5
SIS Installation, Commissioning and Validation

SIS Safety Validation Services

Customer Benefits
By collaborating with Yokogawa, you're partnering with a seasoned team of Functional Safety Specialists. We offer:

- Independent overall validation of the Safety Instrumented Systems, ensuring they meet all safety prerequisites before the plant's operational phase.
- Assurance of compliance, safety, and operational excellence.

Operation and Maintenance

1. **Operation and Maintenance Services**
2. **Proof test Assistance Services**

IEC 61511: Phase 6
Operation and Maintenance

Operation and Maintenance Services

Operation and Maintenance phase: where the incidents happen...
Now the system is live and operational there is not much that can be offered for support.
Yokogawa safety specialist process knowledge is limited and cannot be compared with the knowledge of the process operators and (instrument) technicians at site. Yet, providing functional safety knowledge to these people that are exposed to the process on a daily basis is something that is not commonly done. Another way of support can be assistance in the analysis of failures, demands, spurious trips, etc.
The reason why this analysis must take place is that initially the SIL levels of the SIFs are determined based on assumptions of the people in the Hazard and Risk Analysis, now the system is in operation the actual number of demands, trips becomes tangible and may lead to a change in the initial assumptions.

Customer Challenges

- **Knowledge Gap:** The actual (functional) safety knowledge about safety systems, SIFs, SIL, etc. with the people in the operational phase.
- **Operational Challenges: Registering SIS behavior:** Demands, Trips, Spurious trips, etc. Without these process facts a proper comparison with the HAZOP and Risk Assessment assumptions can not be performed.
- **Documentation:** Efficiently recording SIS operational and maintenance results and tracking genuine and spurious plant trips.

Our Solution
Yokogawa's suite of services ensures comprehensive proof testing:

- **Training:** A Functional Safety for End Users training or Functional Safety for Operations training (this training is within the certification program of TÜV Rheinland known as FS Technician).
- **Structured Approach:** Studying SIS behavior data from the operational process and independently compare against the HAZARD and Risk Assessment assumption data.

Customer Benefits

- **Safety Awareness:** For all working with safety systems in the operational phase. Operators, (Instrument) Technicians, Plant Management, etc.
- **Safety Assurance:** Independent Safety Specialist that study the operational data impartially.
- **Risk Identification:** Detect anomalies in actual process safety behaviour that may lead to dangerous process situations, safeguarding people, the environment and assets.
- **Regulatory Compliance:** Ensure adherence to international safety standards IEC 61508 and IEC 61511

IEC 61511: Phase 6
Operation and Maintenance

Proof Test Services

Understanding Proof Testing

Proof Testing is a crucial aspect of maintaining Safety Instrumented Systems (SIS) and Safety Instrumented Functions (SIF). It's not just a routine check but a vital process to uncover any dangerous, undetected failures in the SIS. Proper proof testing ensures that the SIS and SIF will function correctly during an actual process demand. Inadequate or poorly designed proof test procedures can compromise the system's safety integrity. But many end users are not aware that not performing proof tests is categorized as: negligent maintenance. And negligent maintenance is a good argument for Insurance Companies not to pay for damage and consequences. It may also lead to liability issues and legal prosecution for negligent maintenance.

Customer Challenges

- **Knowledge Gap:** Lack of specialized knowledge about SIS element technologies, making it challenging to draft detailed proof test procedures.
- **Resource Constraints:** Limited resources to conduct proof tests for various Safety Instrumented Functions (SIFs) within the stipulated time intervals.
- **Operational Challenges:** Balancing production schedules with proof test frequency requirements.
- **Documentation:** Efficiently recording proof test results and tracking genuine and spurious plant trips.
- **Adaptability:** Re-evaluating testing frequency based on historical data, plant experiences, and hardware degradation.

Our Solution

Yokogawa's suite of services ensures proof testing assistance:

- **Structured Approach:** Provision of proof test procedures and templates.
- **On-Site Testing:** Assisting with proof testing on site and providing detailed reports documenting the proof test has been successful (or not).
- **Optimization:** Re-evaluating and proposals to optimize proof test intervals. Also making use of data of actual demands or spurious trips it may not be needed to do a proof test, partial or for the total SIF.
- **Re-assessment:** Re-calculating the SIF PFDavg based on changed proof test intervals following proof test outcomes.
- **Automation:** Although not implemented by safety specialists, Yokogawa has automated tools for: automated sensor testing, SIF monitoring regardless the SIS hardware installed.

IEC 61511: Phase 6
Operation and Maintenance

Proof Test Services

Customer Benefits

- **Safety Assurance:** Uphold the Safety Integrity Levels of plant Safety Instrumented Functions and, where possible, optimize production uptime.
- **Risk Mitigation:** Detect and identify dangerous undetected failures which will cause that a SIF cannot perform its safety action once the process goes out of control, safeguarding people, the environment, and assets.
- **Operational Efficiency:** Once automated, enhanced productivity through the use of demand/trip evidence as well as spurious trip evidence may lead to optimized scheduling.
- **Cost-Effective:** Achieve time and cost savings when using automated registration and analysis of SIS behavior leading to streamlined proof testing.
- **Regulatory Compliance:** Ensure adherence to international safety standards IEC 61508 and IEC 61511.

1. Safety Modifications

IEC 61511: Phase 7
Safety Modifications

Safety Modifications

Management of Change

It is inevitable that during the operational phase changes are required to the safety system. These can be simple setpoint changes, additional I/O, changes in logic, etc. Statistics have proven that human failures are the largest common cause of making mistakes during the operational phase. Production pressure, time pressure and not having the possibility to fully test the modification without a (partial) process shutdown can introduce systematic failures which may lead to failures on demand of the SIS. It is therefore that rigid and comprehensive procedures must be applied for doing modifications of the safety system. As FSM must be applied during all life-cycle phases, Management of Change and the Safety Impact Analysis is crucial when implementing modifications in the SIS.
Note: this phase is no actual safety consultancy, it is performed by the safety engineering project team.

Customer Challenges

- **Awareness Gap:** Lack of understanding of the negative effects safety modifications can cause. The importance of doing a rigid safety impact analysis, if applicable: feedback from the people involved in the Hazard and Risk analysis, approval from management or technical authorities.
- **Resource Constraints:** If one person does the engineering, another person must do the testing to prevent blind spots in the design of the modification. All this to reduce and avoid systematic faults. In many cases the same person will do the engineering but also the testing.
- **Operational Challenges:** In many cases modifications cannot be tested on the target SIS due to operational constraints. I.e. tripping safety outputs during tests may cause a (partial) shutdown which is conflicting with the operational targets.
- **Documentation:** Efficiently recording of the modification test results and new as-built documentation of the documents affected by the modification.

Our Solution

- **Implementation Assistance:** Yokogawa safety service organizations are experienced in implementing and delivering safety modifications at site. If they cannot follow the client's Management of Change (MoC) procedure they will use the Yokogawa Procedure for Site Modification and Test (PSMT) for the Yokogawa scope of the modification.
- **Organizational Assistance:** Yokogawa Safety specialists can assist in setting up a proper Management of Change system to be used in the client's FSM system. Structured Approach: Crucial to prevent Systematic Failures.
- **Re-assessment and Revalidation:** The safety impact analysis comprises the decision to what phase of the safety life-cycle one have to go back to implement the modification. Before returning to the operational phase all intermediate steps must be (partially) repeated and documented. This also includes a re-assessment and re-validation of the modification.

IEC 61511: Phase 7
Safety Modifications

Safety Modifications

Customer Benefits

- **Safety Competence:** Yokogawa engineers can assist in programming safety systems following MoC and/or PSMT procedures. Yokogawa safety specialist can assist in setting up MoC systems.
- **Risk Mitigation:** All incidents happen during the operational phase. To mitigate the risk it is important that any modification to a SIS is done with a full safety impact analysis and management of change.
- **Regulatory Compliance:** Adherence to the international safety standards IEC 61508 and IEC 61511 is applicable for all life-cycle phases, including the modification phase.

Functional Safety Management

1. FSM in general
2. Functional Safety Assessments
3. FSM Audits

IEC 61511: All phases
Functional Safety Management

FSM in general

Understanding Functional Safety Management

A Functional Safety Management System/Framework is an organized systematic approach to manage and ensure safety throughout the life-cycle of industrial systems. As introduced in the introduction of this brochure: “Analyze and Manage your risk”. Where the Analysis is described in the Management is explained in this section. It is explained in the IEC61511, clause 5, 6.2, 7 and 12.5, but actually all IEC standards emphasize a structural and systematic approach. The FSM in the IEC 61511 standard encompasses policies, procedures and practices required to handle safety-related systems. In different words FSM intends to reduce or avoid systematic failures. By reduction or avoiding systematic faults the systematic safety integrity is increased. For the SIFs this means to ensure they function correctly to maintain or achieve the safe state.

The level of matureness of company’s FSM is expressed as Systematic Capability (SC) followed by a number (e.g. 1, 2, 3 or 4). Depending on the highest to be achieved SIL level, the SC number must correspond.

I.e. for a SIL3 SIF, the organizations (life-cycle: EPC’s, SIS Integrators, SIS hardware manufacturers, End Users, etc.) must have a systematic safety integrity of SC3.

Customer Challenges

- **Unawareness:** Having SIL rated SIFs in your plant also requires an FSM system in place to manage and maintain the SIL levels of the SIFs throughout the operational phase. Hence also end-users must have some evidence of their Systematic Capability (SC). In practice many end-users, but also all other parties involved in the life-cycle are not aware of this.
- **Complexity:** Having FSM in place is as complex as having an ISO9001 quality management system. For the majority of the end-users FSM requires some additional procedures for handling the SIFs during the Operational and Modification phases, if the end-user is also involved in other phases of the life-cycle also these phases must be covered in the FSM system.
- **Competency:** Just attending a training does not make people fulfil the requirement of the IEC standards: Proven Competence which have to be managed.
- **Documentation:** Maintaining comprehensive and up-to-date safety documentation that meets regulatory requirements.
- **Continuous Improvement:** Making mistakes is human as we all are. FSM is about striving for continuous improvement. If a mistake is made, what is done to prevent it happening next time and document this.

IEC 61511: All phases
Functional Safety Management

FSM in general

Our Solution

Yokogawa's Functional Safety Management System Services offer:

- **Structured Approach:** A gap analysis, if needed followed by more detailed investigations. What is already present, what is missing to be compliant to the IEC 61511 standard.
- **Example documents:** Depending on the life-cycle phase we can assist customers by offering them example documents that can be embedded in the customer QA/FSM system.
- **Competency management:** Competency is not only about training, it is also about evidence the training is understood, assessed and refreshed. Next to this it is about experience and responsibilities. Yokogawa Safety Specialist can advise in setting up a competency management system that documents which person is allowed to do what on the safety system(s).
- **Continuous Training:** Regular safety training modules and workshops to keep the workforce sharp and up to date at the latest in safety practices.

Customer Benefits

- **Safety Assurance:** Uphold the Safety Integrity Levels of plant Safety Instrumented Functions.
- **Risk Mitigation:** By having a "live" FSM system in place, all involved in the safety life-cycle know what is expected from them, which procedures to follow, which training to (re)attend and their corresponding responsibilities.
- **Life-cycle documentation:** At any moment incidents or accidents can happen, at that moment governmental or insurance company's investigations will start looking at the documented evidence that all is done to reduce or avoid (systematic) errors. They use a very simple criteria: "If it is not written down, it is not true". Hence the importance for a well documented up-to-date system.
- **Regular FSM audits:** A knowledgeable independent auditor will assess the FSM system and if the organization is living after the compliance to this system. In the audit report a statement can be made on the achieved systematic safety integrity (SC) of the company.
- **Regulatory Compliance:** Ensure adherence to all regulatory requirements, maintaining the highest safety standards.

Functional Safety Assessments

Understanding Functional Safety Assessments

The IEC standards require the necessity of Functional Safety Assessments (FS Assessment) throughout the SIS Safety Life-cycle. Within the SIS life-cycle stages, a minimum FS Assessment is mandatory at stage 3 (i.e. plant operations commence). This ensures that all safety measures are in place "before the hazards are introduced." The FS Assessment is a mandatory part of the Overall Safety Validation. Next to the assessment before plant startup, the IEC standards advise to do another assessment at the basic design step of the realization phase. Doing an assessment also at this moment can detect errors with still some time to correct.

The level of independence required for an assessor varies based on the highest required Safety Integrity Level (SIL) of the SIFs in the system. The IEC61508 defines the following independence criteria.

Minimum level of independence	Safety integrity level / Systematic capability			
	1	2	3	4
Independent person	X	X1	Y	Y
Independent department		X2	X1	Y
Independent organization			X2	X
NOTE: See 8.2.15, 8.2.16, and 8.2.18 for details on interpreting this table.				

Legend:
Y = insufficient
X = minimum required
X1, X2 = X2 is more appropriate; depends on organization and factors

Based on the table above, the minimum independence criteria for a Functional Safety assessor criteria are as follows:

- **Highest SIL = 1:** The assessment can be conducted by a qualified independent individual.
- **Highest SIL = 2:** While an independent individual perform the assessment at this level, it is more appropriate to use an independent department to undertake this task.
- **Highest SIL = 3:** An independent department can be suitable for the assessment. However, it is more desirable to have an independent organization to conduct the assessment.
- **Highest SIL = 4:** Safety Instrumented Systems with SIFs at this integrity level must exclusively be assessed by an independent organization.

Customer Challenges

- **Responsibility Awareness:** End users, while able to delegate or subcontract tasks, retain ultimate responsibility for all SIS safety life-cycle phases. Recognizing this responsibility and corresponding tasks is the first challenge.

Functional Safety Assessments

- **Locating Independence:** Once aware of the independence requirements, the next challenge is to find assessors with the required independence. In most cases persons from subcontracted organizations have an interest in an assessment that will not reveal any mistakes or shortcomings. Ultimately during the operational phase incidents can happen because the assessor did not have the correct independence. So where to find real independent assessors?
- **Assessment Needs:** Ensuring that an independent Functional Safety Assessment is conducted, at the very least, after Commissioning before plant start-up.

Our Solution

- **Independent Organization:** Yokogawa's Functional Safety Specialists from the European Safety Assurance department are recognized as an Independent Organization. Hence, assessments on safety systems up to SIL 4 can be performed.
- **Structured Approach:** Performing FS Assessments is part of the daily activities where structurally procedures and work instructions are followed. Regardless the customer SIS hardware.
- **On-Site Assessments:** Although the assessments is mainly a paper-based exercise collecting evidence and doing interviews with the involved customer staff can be part of the assessment, this is best to be done face-to-face.
- **Documentation:** All assessment activities with clear references to the corresponding documentation will be documented in a FS Assessment report. Assessment cases will carry the references to the applicable sections of the IEC 61508 and/or IEC 61511 standards.

Customer Benefits

- **Safety Assurance:** Once the FS assessment has been completed and all assessment findings have been resolved/corrected the final document will document that all is in place and ready for plant start-up.

Functional Safety Management Audits

Understanding FS Audits

In order to check and maintain the Systematic Safety Integrity (i.e. Systematic Capability, SC) of organizations, the IEC standards enforce the implementation of a Functional Safety Management (FSM) system for all parties involved in the Safety Life-cycle. This FSM system is like a "super ISO9001 QA system" and contains the "company's" procedures, tools, templates and detailed information of all the products used in the Safety Instrumented Functions (SIFs). With respect to the SIL-rated SIFs the FSM system also holds the procedures tools and templates to prove the SIL level of each SIF. This SIL level needs to be proven in 3 ways:

1. Calculation of the PFDavg of the "pipe-to-pipe" SIF.
2. The assessment on the Hardware Fault Tolerance (HFT) of the SIF, depending on the hardware used.
3. The assessment on the SC (Systematic Capability, i.e. FSM system) of the manufacturers of the components within the pipe-to-pipe SIF. But, also the Systematic Capability of all parties involved in the engineering and realization of the SIFs. E.g. MAC, Contractors, EPC's, System Integrators, Maintenance Companies and ultimately the End-user.

The fundamental goal of FSM is to identify and mitigate (reduce or avoid) systematic failures and by doing this enhance the systematic safety integrity. This is achieved through a structured, disciplined approach involving competent personnel, structured (project) management and continuous thorough verification and testing processes. All of this is to be well documented and to be kept up-to-date.

Customer Challenges

- **(Un)awareness of Responsibilities:** Many customers are under the misconception that compliance with the required SIL level with respect to PFDavg and HFT (see 1. and 2. above) suffices. However, without an FSM system with an aligned SC corresponding with the highest SIL level in their installation, actually no SIL can be claimed whatsoever.
- **Systematic Capability Responsibility:** Customers must recognize and fulfill their role in setting up and maintaining an FSM system compliant with the IEC standards.

IEC 61511: All phases
Functional Safety Management

Functional Safety Management Audits

Our Solution

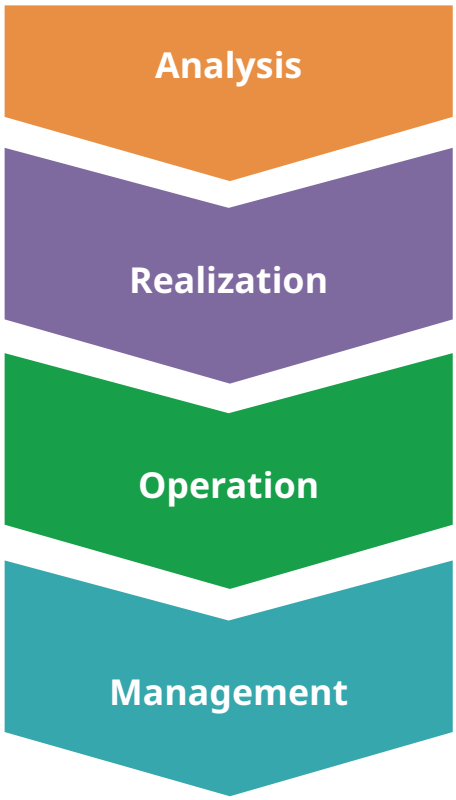
Yokogawa stands as a global leader with multiple TÜV Rheinland certified offices worldwide, offering extensive experience in establishing and maintaining FSM systems. Our services encompass:

- **FSM Readiness Checks and Audits:** From preliminary checks to gap analyses and comprehensive audits, we assess the readiness of your FSM system.
- **Preparation for Certification:** If your goal is certification by a notified body, we facilitate the preparation process through detailed audits assessing your company's readiness.
- **Expert Auditors:** Our Functional Safety Specialists conduct annual audits on the implementation and execution of FSM across all offices/departments handling safety projects. These audits can be extended to companies and end-users irrespective of their association with Yokogawa hardware.

Customer Benefits

- **Expert Analysis:** Yokogawa's Functional Safety Specialists offer independent audits on your organization, evaluating the implementation of FSM through a detailed analysis of processes, tools, and templates.
- **Gap Identification and Improvement Suggestions:** Our audits pinpoint gaps and propose actionable improvements to enhance functional safety.
- **Self-Declaration Support:** Following the audit-report, customers can confidently issue a self-declaration on their Systematic Capability, backed by the insights and recommendations detailed in the FSM Audit report. A self-declaration is allowed by the IEC standards provided it is backed-up with an independent audit report proving the SC of the customer. Certification is nowhere required by the IEC standards, yet, End-Users may require external certification by a notified body.

Functional Safety Trainings and Workshops



1. Yokogawa Safety Training
2. Training Introduction into Functional Safety
3. Training Functional Safety for End Users
4. Training TÜV Rheinland Functional Safety Engineer
5. Training TÜV Rheinland Functional Safety Technician (for Operations)
6. Customized Functional Safety Training
7. Workshop: Functional Safety for QHSE-teams
8. Workshop: Making Safety calculations without sophisticated tooling
9. Workshop: Functional Safety for Dummies
10. Customized workshops

Yokogawa Safety Training

Enhance Your Knowledge and Awareness in Functional Safety

Overview

Equip yourself with the necessary knowledge to perform your function in your respective roles properly as a plant manager, operator, (instrument)engineer, or (instrument)technician involved in daily safety life cycle activities.
Yokogawa offers specialized instructor-led courses and introductions next to TÜV Rheinland certified trainings to make you “proven competent” and help you to navigate through the complexities of functional safety in accordance with IEC61508 and IEC61511 standards.

Why Choose Yokogawa Safety Courses?

1. Small groups with individual attention
2. Experienced trainers specialized in your industry
3. Competitive Pricing

Training Programs

- Introduction into Safety Systems
- Functional Safety for End-users
- Functional Safety Engineer (TÜV Rheinland FS Engineer SIS)
- Functional Safety for Operations (TÜV Rheinland FS Technician SIS)
- Optional: Customized Functional Safety Training Programs

Note: Training programs and presentations can be conducted at your site premises, off-site facilities, or online.

For more details, visit: Yokogawa Safety Training

Introduction into Functional Safety

A High Level Basic Insight into Process Safety and Safety Systems

Objective

This introduction presentation aims to impart a deeper understanding of the role played by safety systems in industrial production processes. It focuses on preventing personal injuries/fatalities, environmental damages, asset damages (incl. production loss), reputational damages. The training encompasses a the highlights of the terminology associated with safety systems, the international safety standards IEC 61508 and IEC 61511, and the solutions provided by the various safety systems. Timewise-tailored to meet your company's specific needs, this course is the entrance gateway to a safer and industrial process environment. Next to peace of mind, it may also bring possibilities to a higher plant efficiency.

Target Audience

- Managers and Management Teams
- Operators, Instrument- and Maintenance Engineers
  ... and anyone keen on exploring the multiple aspects of safety systems in industrial production processes. No prerequisite knowledge is required.

Customized Program

The presentation time schedule is flexible and can be customized based on the time allocated for the presentation. A typical one-day 4 to 6 hours introduction includes:

- Welcome and Presentation Agenda
- Basic understanding of Safety and Risk
- Introduction into the Usage of Safety Systems
- Understanding Safety Instrumented Systems Terminology
- Intention of International Standards: IEC 61508 & IEC 61511
- Optional: Discussion on Customer's situation
- Optional: Short Functional Safety Knowledge Assessment (the certificate handed out at the end of the training will show participated instead of attended)

Introduction into Functional Safety

Expert Trainer

Our trainers are seasoned professionals with extensive experience in Functional Safety within the industry. They hold formal qualifications, complemented by a rich background in training and assessment standards, ensuring a fruitful and interactive learning experience.

Duration

The ultimate introduction spans one day. However, depending on the time made available by the customer the duration can be adjusted as per agreement.

Embark on a Journey of Learning with Yokogawa - Your Partner in Safety Excellence!

For more details, visit: [Introduction into Functional Safety]

Training Functional Safety for End Users

Step up from unconsciously incompetent to consciously incompetent to proven competent

Objective

Equip participants with the vital knowledge on functional safety, grounded on the international standards IEC 61508 and IEC 61511. This training is designed to foster a deep understanding and proficiency in safety protocols, ensuring a safer and more efficient workplace.

Target Audience

- Architectural and Basic Designers
- Lead Engineers
- Project Engineers
- System Engineers
- Application Engineers
- Instrument Engineers
- Site Engineers
- Project Managers
- Operators
- QHSE representatives
- QA representatives
- Shift supervisors/managers
- Other management

...who are actively involved in safety projects.

Prerequisite Knowledge

A keen interest and understanding of industrial safety is expected from all participants.

Program Outline

Day 1

- General Introduction
- Module 1: Introduction to Functional Safety
- Module 2: International Safety Standards (IEC 61508 & IEC 61511)
- Module 3: HAZOP – SIF – SIL
- Module 4: Safety Engineering

Training Functional Safety for End Users

Day 2

- Module 5: Functional Safety Management
- Module 6: Understanding Failures and Hardware Fault Tolerance
- Module 7: Safety Calculations
- Module 8: Installation and Commissioning
- Module 9: Operations, Maintenance, and Proof Testing
- Module 10: Modifications and Decommissioning
- Assessment

Training Methodology

Interactive lectures coupled with engaging exercises, fostering both group collaboration, group discussions and individual learning experiences.

Expert Trainers

Our trainers are highly qualified, boasting extensive Functional Safety experience across various industries. They hold formal qualifications in addition to training and assessment standards, ensuring a rich and comprehensive learning experience.

Duration

A compact yet comprehensive 2-day training program.

Participant Capacity

The training is designed for a group of 6 to 20 participants, promoting interactive and focused learning.

Join Us for an Enlightening Journey into the World of Functional Safety!

For more details, visit: [Functional Safety for End-users]

Certificate: FS Engineer (TÜV Rheinland)
Safety Instrumented Systems

Objective

Empower engineers engaged in the engineering and implementation (Realization) of Safety Instrumented Systems (SIS) need fundamental and essential knowledge on functional safety, in line with the international standards IEC 61508 and IEC 61511. This Yokogawa facilitated course, on behalf of TÜV Rheinland, ensures your functional safety engineering competency is set to an internationally recognized FS Engineer level. Where non-TÜV Rheinland courses are not maintained, TÜV Rheinland requires re-examination (and optional refresher courses) every 10 years to keep up-to-date with the latest IEC standards.

Upon completion, participants will be proficient in:

- Engage in Hazard and Risk Analyses or other SIL determination studies.
- Solid basic understanding of Functional Safety and the IEC 61508 and IEC 61511
- Understanding of the design and engineering of a Safety Instrumented Function (SIF) to meet the required SIL level from PFDavg[1], HFT[2] and SC[3] point of view.

Participants will also understand:

- The comprehensive requirements of the IEC61508 and IEC61511 life-cycle and its management.
- The legal necessity for compliance with IEC61511 or IEC61508.
- The appropriate functional safety standard to apply (IEC61508, IEC61511, or machinery safety standard).
- Functional safety terminology such as SIS, SIF, and SIL.
- The role of hazard and risk analysis in establishing SIL targets.
- The significance and contents of the Safety Requirement Specification (SRS).
- The critical role of functional safety management systems in maintaining the SIL level of the SIS.
- The necessity for an audit trail and best practices to minimize different types of failures.
- The criteria for developing safety-related application (logic) programs.
- The responsibilities of operations and maintenance to ensure sustained SIL compliance of a SIF.
- The importance of procedures for Operations, Maintenance, Proof Testing, Modifications, Decommissioning.

[1] **PFDavg:** Average Probability of a Failure on Demand
[2] **HFT:** Hardware Fault Tolerance
[3] **SC:** Systematic Capability a.k.a. Systematic Safety Integrity

Training TÜV Rheinland Functional Safety Engineer

Target Audience

Instrument Engineers, Application Engineers, Site Engineers, and Modification Engineers involved in the design and implementation of safety-related systems.

Prerequisite Knowledge

As per the TÜV Rheinland International Safety Program:

- Minimum 3 years of experience in functional safety.
- Bachelor's degree (or higher) or equivalent engineer-level responsibilities, or a letter as acknowledged by the employer.

Program

Day 1

- General Introduction
- Module 1: Introduction to Functional Safety
- Module 2: International Safety Standards IEC 61508 and IEC 61511
- Module 3: HAZOP – SIF – SIL

Day 2

- Module 4: Safety Engineering
- Module 5: Functional Safety Management
- Module 6: Failures and Hardware Fault Tolerance

Day 3

- Module 7: Common Cause Influences and Other Failure Types
- Module 8: Safety Calculations
- Session for Revision and Questions

Day 4 (Morning)

- Examination

Examination

Participants will undertake a comprehensive 4 hours exam at the end of the course, consisting of 60 multiple-choice questions and 7 case studies, with a minimum required passing score of 75%. Successful candidates will be awarded the TÜV Rheinland FS Engineer SIS certificate.

Training TÜV Rheinland Functional Safety Engineer

Methods of Delivery

Interactive lectures and exercises, encompassing both group and individual activities.

Trainers

- TÜV Rheinland accredited FS Experts or FS Trainers.
- Local trainers can facilitate in local language (if available), but course training material and exam will be in English.
- For China Training Materials and Exam can be in Chinese language (future).
- Yokogawa FS Engineer trainers are specialists, boasting extensive industry experience and formal qualifications.

Duration

3.5 days

Number of Participants

6 to 12 participants

Dates & Locations

Click here (Functional Safety Engineer (certificate TÜV Rheinland FS Engineer SIS) to view all upcoming dates and locations or scan the QR code

Embark on a Journey of Continuous Learning with Us!

For more details, visit: Functional Safety for Engineering

Training TÜV Rheinland Functional Safety Technician (for Operations)

Certificate: FS Technician (TÜV Rheinland) Safety Instrumented Systems

Objective

Equip the people involved in daily operations with fundamental knowledge on functional safety, grounded in the international standards IEC 61508 and IEC 61511. Intended participants are operators, maintenance technicians, instrument technicians, shift supervisors, shift manager and all others involved in the daily operation and maintenance of Safety Instrumented Systems (SIS).
This Yokogawa facilitated course, on behalf of TÜV Rheinland, ensures the functional safety competency of the people in the most dangerous phase of the safety life-cycle. They learn to understand why safety systems and the functional safety environment around it are of major importance day-in, day-out.
Where non-TÜV Rheinland courses are not maintained, TÜV Rheinland requires re-examination (and optional refresher courses) every 10 years to keep up-to-date with the latest IEC standards.

Participants will gain insights into:

- Functional safety terminology such as SIS, SIF, and SIL.
- The significance of implementing a safety system.
- Key concepts within the IEC61508 and IEC61511 safety standards.
- The application of the IEC61511 standard in their plant.
- The necessity of functional safety management systems in maintaining the SIL level of the SIS throughout the full safety life-cycle.
- The importance of the participant's contribution during the various safety life-cycle phases (e.g. operations, maintenance, proof testing, modifications, decommissioning).

Target Audience

Maintenance and instrument engineers/technicians, operators, and even supervisors and/or (line) management involved in the life-cycle (from installation to decommissioning) of Safety Instrumented Systems.

Prerequisite Knowledge

As per the TÜV Rheinland International Safety Program:

- Minimum 2 years of experience in functional safety.
- Technical diploma/certificate or equivalent engineer-level responsibilities, as certified by the employer.

Training TÜV Rheinland Functional Safety Technician (for Operations)

Program

Day 1

- Module 1: General Introduction
- Module 2: Standards IEC 61508 and IEC 61511
- Module 3: Installation & Commissioning
- Module 4: General Aspects for All Phases

Day 2

- Module 5: Overall Safety Validation
- Module 6: Operational Phase
- Module 7: Maintenance and Repair
- Module 8: Proof Testing
- Module 9: Modifications
- Module 10: Decommissioning and Disposal

Day 3

- Examination

Examination

Participants will undertake an exam at the course conclusion, comprising 30 multiple-choice and 5 open questions, with a minimum required passing score of 75%. Successful candidates will be awarded the TÜV Rheinland FS Technician SIS certificate.

Methods of Delivery

Interactive lectures and exercises, encompassing both group and individual activities.

Training TÜV Rheinland Functional Safety Technician (for Operations)

Trainers

- TÜV Rheinland accredited FS Experts or FS Trainers.
- Local trainers can facilitate in local language (if available), but course training material and exam will be in English in principle.
- If the IEC 61508 and IEC 61511standards are available in local language and Yokogawa has a local trainer training and exam may be translated into the local language.
- Yokogawa FS Technician trainers are specialists, boasting extensive industry experience and formal qualifications.

Duration

2.5 days

Number of Participants

6 to 12 participants

Dates & Locations

Click here to view all upcoming dates and locations or scan the QR code
(Functional Safety for Operations (certificate TÜV Rheinland FS Technician SIS)

Join Us for a Comprehensive Learning Experience!

For more details, visit: Functional Safety for Operations

Customized Functional Safety Training

Tailored Functional Safety Programs to Meet Your Unique Needs

Objective

In the dynamic field of industrial and process safety, one size does not fit all. Yokogawa can facilitate a customer-specific a functional safety training program, designed to equip your team with the required knowledge and skills essential for maintaining a safe and efficient working environment. Our customized training modules can be crafted to align with your specific safety protocols, ensuring a seamless integration of safety practices and IEC standard requirements in your operational competency framework.

Why Choose Our Customized Training?

Personalized Curriculum: Tailored to meet your specific industry needs and safety standards.
Expert Guidance: Learn from the seasoned professionals in the field of functional safety.
Hands-On Experience: Our training programs can offer real-time scenarios for a practical understanding of safety protocols.
Flexible Scheduling: Choose a training schedule that aligns with your team's availability.

Get Started with Us

Embarking on your journey to dedicated functional safety expertise is just a call away. Contact us so we can better understand your training needs. Our dedicated team is here to guide you through the enrollment process, ensuring a smooth transition into a safer working paradigm.

Contact Us

Reach out to us to initiate the journey towards a safer working environment. Our team is ready to assist you in crafting a training program that is as unique as your safety needs.

Yokogawa - Your Partner in Cultivating a Culture of Safety Excellence!

Workshop: Functional Safety for QHSE-teams

Understand why Safety Systems have a big contribution to your Quality, Health, Safety, and Environment Management System!

Objective

One of the focus areas of QHSE teams is for personal safety. Employees are wearing PPE, holding handrails, etc. but do QHSE representatives have any idea how much danger there is in the industrial process of the company they work for? Do they know the role of the Safety Instrumented System?
By following this workshop QHSE teams become aware about this danger coming from the process and learn that human behavior of staff (e.g. operators) can lead to more severe consequences than someone "not holding the handrail".

Key Takeaways:

- Introduction into IEC 61508 and IEC 61511 standards.
- Familiarization with the Safety System abbreviations and definitions
- Understand the significance of the Process Hazard and Risk Assessment.
- Basic understanding about Functional Safety Management.
- Learn which questions to ask to get an idea how the process is doing.

Duration

1 Day of Intensive Learning

Our Trainers:

Learn from Functional Safety Specialists with years of industry experience.

Workshop: Functional Safety for QHSE-teams

Interactive Session:

- Case Studies
- Group Discussions
- Q&A with Specialists
- Practical exercises

Who Should Attend?

- QHSE Representatives
- Safety Officers
- Compliance teams
- Management teams
- Anyone keen on enhancing their functional safety knowledge in the QHSE domain.

Date & Venue:

To be scheduled, based on your request

Join us for an informative workshop and elevate your QHSE practices with the power of Functional Safety knowledge!

Workshop: Making Safety calculations without sophisticated tooling

Understand that safety calculations are only as accurate as the data you calculate with. Learn that not every safety certificate you see can be trusted.

Objective

It is a misconception that the required SIL level of a Safety Instrumented Function is to be proven by making a safety calculation only. Fed by slick marketing campaigns of well-known companies you are tempted to buy expensive calculation tools to prove the required SIL levels with calculations only. But there is more to prove a SIL level and in some cases you are misled by these companies and/or by manufacturers.
By participating in this workshop you will be taken by the hand in the understanding of safety manuals and safety certificates, doing the assessment on Hardware Fault Tolerance, doing the assessment on Systematic Capability and see that making safety calculations does not require a higher investment than buying a scientific calculator...

Key Takeaways:

- Introduction into IEC 61508 and IEC 61511 standards.
- What to prove per Safety Instrumented Function (SIF)
- How to interpret Safety Manuals and Safety Certificates
- How you are misled by manufacturers and certification companies
- Do the assessment on Hardware Fault Tolerance (HFT) and Systematic Capability (SC)
- Make a safety calculation by using simplified formulas.
- Optional: A scientific calculator as take-away

Duration

6 hours of interaction with real examples from practice.

Our Trainers:

Learn from Functional Safety Specialists with years of industry experience.

Workshop: Making Safety calculations without sophisticated tooling

Interactive Session:

- Theoretical background
- Group Discussions
- Practical exercises

Who Should Attend?

- Anyone involved in SIL verifications, SIL calculations, SIF engineering keen on enhancing their functional safety skills.

Date & Venue:

To be scheduled, based on your request

Join us for an eye-opening workshop and elevate gut feeling to a healthy suspiciousness in Functional Safety!

Workshop: Functional Safety for Dummies

Heard about Functional Safety and interested to learn a bit more without going into the nitty gritty details?

Objective

To convince people that have the perception that (Functional) Safety is expensive, but incidents are much more expensive in a light and funny way. Safety Systems and Functional Safety Management systems can provide you “peace of mind”. Knowing more about it will make you realize you have been lucky until now but this can be totally different tomorrow.

Key Takeaways:

- Introduction into safety systems.
- Buying cheaper is only a short-term effect, you’ll pay for it later.
- Serious safety companies versus “serious” safety companies.
- Why Yokogawa for Safety Excellence, even with hardware from other brands.

Duration

2 hours of light entertainment but with a serious catch.

Our Trainers:

Learn from Functional Safety Specialists with years of industry experience.

Interactive Session:

- Safety basics
- Group Discussions
- Eye openers
- Practical examples

Workshop: Functional Safety for Dummies

Who Should Attend?

- Anyone who has heard about functional safety and want to know a little bit more about it. Anyone involved in the decisions to buy a safety systems but does not have the ability to judge what they are buying.

Date & Venue:

To be scheduled, based on your request.

Join us for a possible “confronting” workshop and see the added value of Functional Safety and Safety Systems!

Customized workshops

In case you have the need for a customized workshop about functional safety and safety systems, or you want to integrate this in your company safety campaign. We can most likely support you in this.

Objective

The fundamental drive for Yokogawa Safety Specialists is: “to make the world a little safer!” If this is also the intention of your event or company maybe we can cooperate and add a dedicated or integrated workshop. As a toolbox meeting, as a presentation for your company, as a parallel session in your safety event.

Subjects available:

- Introduction into functional safety and safety systems
- Introduction into IEC 61508 and IEC 61511 standards.
- Think safety is expensive? Try an incident!
- How to prove a SIL level for a SIF
- Any related subject for your company specific needs.

Duration

Depending on the time allowed

Our Trainers:

Learn from Functional Safety Specialists with years of industry experience.

Session options:

- Theoretical
- Interactive
- Group Discussions
- Practical exercises

Customized workshops

Who Should Attend?

- Anyone.

Date & Venue:

To be scheduled, based on your request.

Let us help you to elevate the safety awareness in your company.

Yokogawa's Commitment to Safety: Protecting People, Environment and Assets

Challenges and Benefits of Process Safety:

Implementing effective process safety measures comes with its challenges, such as the complexity of managing hazardous processes, coordinating between multiple stakeholders, and the potential tension between safety and production goals. However, the benefits of a robust process safety program are substantial:

1. **Safety:** The primary benefit is the prevention of accidents, injuries, and loss of life, both for employees and neighboring communities.
2. **Environmental Protection:** Process safety measures prevent releases of hazardous substances into the environment, minimizing ecological damage.
3. **Reputation and Trust:** Companies that prioritize process safety build a positive reputation and foster trust among employees, investors, regulators, and the public.
4. **Legal and Regulatory Compliance:** Process safety measures help organizations adhere to industry-specific regulations and legal standards, avoiding fines and legal actions.
5. **Operational Continuity:** Effective process safety practices lead to fewer unplanned shutdowns and disruptions, ensuring consistent production.
6. **Innovation:** Process safety drives innovation in engineering and technology, leading to the development of safer processes and advanced safety systems.

In conclusion, process safety is a vital discipline that ensures the safe operation of industrial processes involving hazardous materials. By following key concepts such as hazard identification, risk assessment, layers of protection, and process safety management, industries can safeguard their operations, protect their workforce, and prevent catastrophic incidents that could have far-reaching consequences. Process safety is not just a compliance requirement; it's a commitment to ethical responsibility and the well-being of society as a whole.

https://www.yokogawa.com/eu/FunctionalSafetyConsultancyServices

OpreX™ Through the comprehensive OpreX portfolio of products, services, and solutions, Yokogawa enables operational excellence across the enterprise.

YOKOGAWA EUROPE B. V.
Euroweg 2, 3825 HD Amersfoort
The Netherlands
https://www.yokogawa.com/eu/

YOKOGAWA ELECTRIC CORPORATION
World Headquarters
https://www.yokogawa.com

YOKOGAWA ELECTRIC KOREA CO., LTD.
https://www.yokogawa.com/kr

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https://www.yokogawa.com/br

Printed in The Netherlands, 511(D) [Ed: 01/d]

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