

# SIS Project Execution Services

## Safety Instrumented Systems

*Conceptual Design, Front End Engineering, Detailed Design, Implementation, Integration, Factory Acceptance Testing (FAT), Installation, Site Acceptance Testing (SAT), Commissioning, and Validation*



*Emerson can help get your Safety Instrumented System off to a good start through the application of best safety engineering practices as defined in the IEC 61511 Safety Life Cycle, to achieve the Safety Integrity Levels specified by your Safety Requirement Specification.*

- Project efficiency for IEC61511 compliance.
- Ensure regulatory compliance.
- Managing risk with global standards.
- Total solution – sensors, logic solvers, final elements, and SIS project expertise.
- World class installation and commissioning.

### Introduction

International standards, IEC 61511 and ISA S84, are aimed directly at total process plant operations and cover the whole lifecycle of the system from concept to operation, maintenance, function testing, through to decommissioning.

A study by the Health and Safety Executive in the United Kingdom found that 44% of accidents involving control systems resulted from specification issues, 15% from design and implementation issues, 6% for installation and commissioning, 15% for operation and maintenance issues, and 20% for changes after commissioning.

### Challenge

The SIS design challenge is a two-fold one: reduction in random hardware failures through selection of appropriate equipment, and reduction in systematic faults caused by poor specifications or poor engineering. This is critical because approximately 60% of failures are built into SIS before commissioning, and 85% of those are engineering related. Omissions in the design of a Safety Instrumented Function (SIF) could remain undiscovered until an incident occurs.

## Benefits

Reducing random hardware failures and reducing systemic failures are what the IEC 61511 standard is all about. Having certified Functional Safety Experts (CFSEs) involved early in the process helps with both issues, by helping ensure appropriate equipment is chosen, specifications are written correctly, and SIF designs will achieve the desired performance requirements.

**Managing Risk with Global Standards.** Companies that correctly plan for and manage the operational risks inherent to industrial processes avoid exposure to production outages, equipment damage, environmental incidents, injury to personnel and loss of life.

Emerson Process Management provides certified hardware, software, field devices, and engineering services needed to meet the requirements of the safety system lifecycle. Emerson can support clients in developing their Safety Requirement Specification (SRS), can create SIF designs, as well as perform the SIL verification calculations. Emerson can also help in selecting the right architecture and technologies to achieve their SIL requirements.

Also, the best safety engineering practices can help you achieve the Safety Integrity Level (SIL) of each loop in your plant's Safety Instrumented System (SIS) and maintain these levels throughout the life-cycle of your plant. A sound installation, which is professionally commissioned and rigorously validated in accordance with internationally agreed standards, will help achieve the objectives set forth in your plant Safety Requirements Specification (SRS).

**Certified Safety Process.** Emerson utilizes a Functional Safety Management System as defined by the IEC 61511 standard. This TÜV-certified system covers:

- Management of functional safety
- Safety lifecycle structure/planning
- Verification
- Design & engineering of SIS to decommissioning

Emerson personnel utilize this process and their expertise with the latest safety technologies and practices to help clients define and implement safety systems that are consistent with the most stringent demands for protection, risk reduction and reliability.

**Certified Safety Personnel.** What qualifies a person or a company to call themselves certified in this field? IEC61511 clearly states that, "Persons, departments, organizations involved in safety life cycle activities shall be competent to carry out the activities for which they are accountable."

Emerson has committed the resources to ensure that we can provide high quality TÜV- certified procedures in alignment with IEC 61511. In addition, all employees involved with safety systems engineering and development are required to complete extensive safety training and Emerson certification.

Many of our engineers and technologists have also completed a rigorous competency qualification known as the Certified Functional Safety Expert (CFSE) or Certified Functional Safety Professional (CFSP). These certifications require a minimum amount of experience in the Safety Instrumented System (SIS) field, as well as successful completion of a comprehensive examination.

Also, Emerson SIS service specialists help ensure that your SIS installation achieves the SILs specified in your SRS, in accordance with the industry Best Practice IEC 61511 standard by working with you to plan all of your site activities and applying industry best practices.

Our SIS service specialists can verify the initial SIS delivery and installation, perform site acceptance testing (SAT), verify the Integration of the control and the safety system, provide commissioning support, and perform SIS functional validation. All work is performed in accordance with our site-work procedures, which TÜV has certified to comply with the requirements of the IEC 61511 Standard.

Extensive industry experience, together with PlantWeb™ architecture knowledge, SIS technology expertise, and in-depth understanding of your site SIS instrumentation project, makes Emerson SIS service specialists uniquely qualified to deliver your SIS installation services.



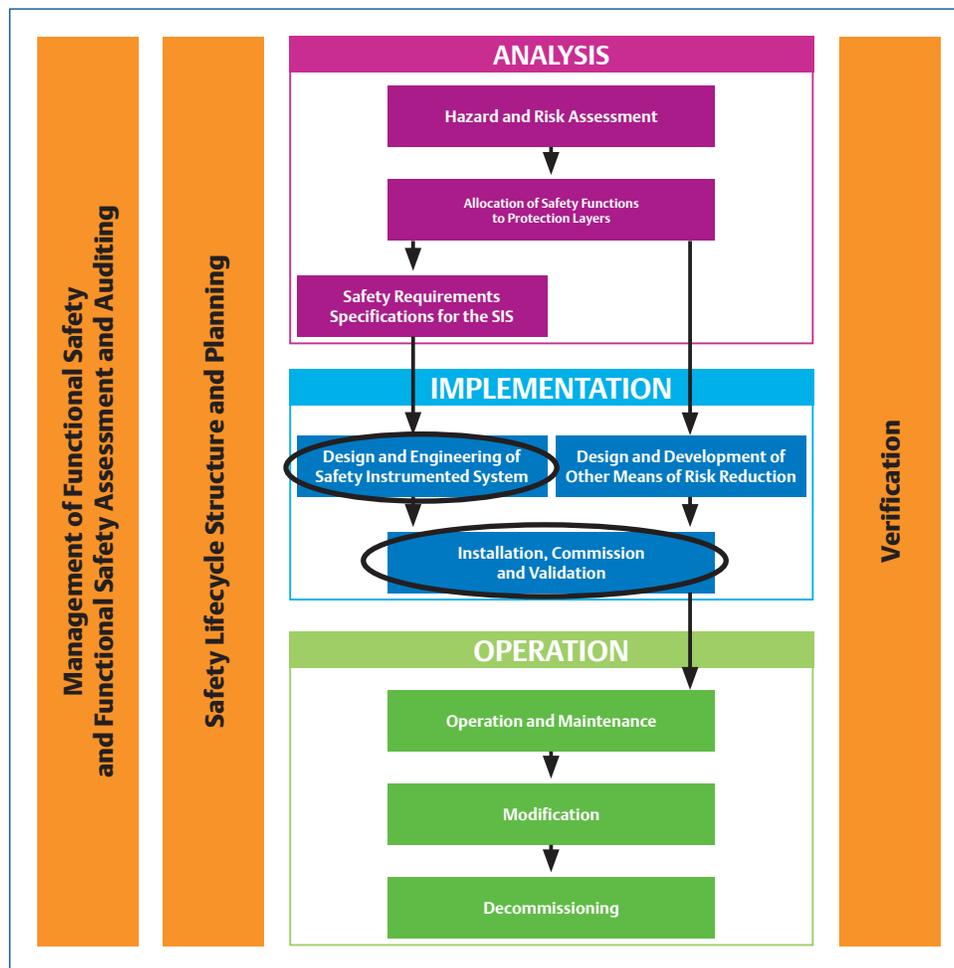
# SMART SIS

**Global Automation Contracting.** Emerson provides solutions with certified hardware, software, and engineering services needed to meet the requirements of the safety system lifecycle. Emerson’s SIS services are IEC 61511 and ISA84 compliant and certified by an independent third party, TÜV.

Emerson has extensive global coverage for Main Automation Contractor (MAC) services, providing a single source for all of your SIS project needs. These services include all aspects of your automation project from front end engineering and design (FEED) onward. Emerson can provide a turnkey solution for your project that includes equipment selection, commissioning services, and implementation and operational capabilities.

### IEC 61511 Safety Life Cycle

*Meeting regulatory requirements such as the IEC61511 Safety Life Cycle requires a partner with experience, and with the best available technology and services.*



*SIS Project Services address IEC61511 during the Design and Engineering of Safety Instrumented System and Installation, Commissioning, and Validation phases of the Safety Lifecycle.*

## Service Description

Different projects and different customers require different levels of support. From Front End Engineering Design (FEED) onward, Emerson can support you in the different phases of a project. This extends beyond implementation services, to include installation and startup, operations and maintenance, modification, verification and documentation support throughout the SIS's entire safety lifecycle.

### Conceptual Process Design & Front End Engineering

These are the critical considerations that are typically taken into account during this early process:

- **Applicable Standards.** These are the standards
- **Process Requirements.** A critical step in the discovery of vital process info and the assignment of work.
- **SIL Selection.** The safety performance requirements for the various hazards must be defined by the customer or an independent third party.
- **Architecture.** Once the standards are defined and have been completed, architecture requirements are considered.
- **Safety Requirements Specification (SRS) document.** The philosophy, operation, and functionality of your SIS are recorded in the SRS. The SRS also specifies the safety requirements standards to help you follow IEC 61511 best practices and should contain information that will form the basis of the design. This includes things like desired proof test intervals, acceptable mean time to failure, process safety time, hardware fault tolerance, and diagnostics. It should also include process requirements, like maintenance bypass, startup bypass, resets, and HMI interactions.
- **SIF Design and SIL Calculations.** based on the process requirements, SIL requirements, and the safety requirements, designs for SIFs are created and verified using specialized tools
- **Safety Verification Plan.** Early in the project, this plan will be developed for Emerson's scope with respect to safety verification activities.

### Conceptual Design of the SIS

This is the first step of implementation, and is the cornerstone of the detailed software and hardware phases that follow. It is also the verification basis for Factory Acceptance Testing in the same way that the SRS is the basis for the SIS Validation.

I/O, wiring practices and loop templates, and cabinet designs are designed at a high level. Software design aspects, including methodology for bypasses, resets, testing, and others are also designed at a high level. All of these activities are done with respect to the SRS, which is analyzed in detail at the start of the phase.

### Detailed Design

Emerson's breadth of PlantWeb technology and expertise means that you have a single source for all of your safety project needs, integrated to ensure compatibility. Delivering the expertise and consistent work processes required to offer this level of success comes from decades of global process experience. With our processes, we can turn a conceptual design into a detailed design that can be efficiently coded, and is unambiguous, traceable, and provides all the documentation a customer would need for IEC compliance.

- **SIS Software Detailed Design.** Our design and engineering services turn the conceptual design into a well defined, well specified software design. Utilization of tested and proven configurations are the norm, however we can also create custom solutions for the particular nuances of a customer's system/process.
- **SIS Hardware Detailed Design.** Our hardware engineers take the conceptual design, and turn out a set of detailed drawings and specifications for cabinets, loops, wiring, power, and grounding, that use proven designs and utilize all of our expertise with our product line. We can also create customized solutions if that is required.

### Implementation/Build, Integration, and FAT

- **SIS Hardware Detailed Design.** Our hardware engineers take the conceptual design, and turn out a set of detailed drawings and specifications for cabinets, loops, wiring, power, and grounding, that use proven designs and utilize all of our expertise with our product line. We can also create customized solutions if that is required.
- **Hardware Build.** Using both Emerson and approved 3rd party panel shops, Emerson demands the highest quality in the cabinets that are delivered for the project. If necessary, Emerson can also assist with the build for associated electrical/mechanical rooms and similar buildings/cabinets/panels.

- **Integration.** Depending on the customer’s wishes, we can integrate the HW and SW for FAT, or we can integrate at site. We are not limited by any particular factors; we have excellent simulation capability, but we also have a great deal of experience testing large, integrated systems. We can even bring in 3rd party equipment if required.
- **Factory Acceptance Testing (FAT).** Our FATs are tailored to the customer’s needs. Our internal testing is very rigorous, so our FATs are typical very effective. If the customer does not know exactly what they want for FAT, we can help them define it, or we also can use standard FAT plans and procedures that are proven and cover the various IEC testing requirements.

**SIS Post-Factory Acceptance Test Life-Cycle Phases and Activities**

Phases and Activities	Objectives	Inputs	Outputs
<p><b>IEC 61511 Clauses 7, 12.3, 14, and 15</b></p> <p><i>SIS installation, commissioning, and validation</i></p>	<ul style="list-style-type: none"> <li>■ To install the SIS in accordance with the specifications and drawings</li> <li>■ To integrate and test the SIS</li> <li>■ To commission the SIS so that it is ready for final system validation</li> <li>■ To validate, through inspection and testing, that the installed and commissioned SIS and its associated safety instrumented functions (SIFs) achieve the requirements stated in the SRS. Note: This is sometimes referred to as a SAT.</li> </ul>	<ul style="list-style-type: none"> <li>■ Plan the installation and commissioning activities, procedures, measures, and techniques to be used for installation and commissioning activities</li> <li>■ Validate all relevant modes of operation of the process and its associated equipment and reasonably foreseeable abnormal conditions (e.g., those identified through the risk analysis phase) Note: Examples of validation activities include loop testing, calibration procedures, and simulation of application software.</li> </ul>	<ul style="list-style-type: none"> <li>■ Provide fully functioning SIS, in accordance with the SIS design results of the integration tests</li> <li>■ Document the installation, commissioning, and validation activities</li> <li>■ Document the validation activities of the SIS SIFs</li> <li>■ Provide appropriate recommendations</li> </ul>

**Installation**

DeltaV SIS Installation (per IEC 61511-1 Clause 14) is to ensure that the SIS has been delivered, in accordance with specifications and drawings, and that it is ready for SAT requires good planning and execution.

- **Installation plan.** Reviews the SIS installation procedures, methods, and techniques to be used for the initial installation of the system and to meet the project schedule

- **SIS installation verification.** Ensures that the SIS is installed, in compliance with the SIS design and installation plan, including the DeltaV SIS hardware, power sources, grounding, and communications network
- **SIS installation report.** Identifies any noncompliant items and provides appropriate recommendations

## Site Acceptance Testing

Site Acceptance Testing (per IEC 61511-1 Clause 12) ensures that the SIS has been installed, in accordance with the specifications and drawings and the previously tested hardware and software, in preparation for commissioning (i.e., excluding testing or verification of field equipment and third-party devices that are not part of the Emerson scope of supply). Deliverables:

- **Detailed site audit of the DeltaV SIS installation.** Includes power, grounding, and signal wiring and communication cable connections; verifies that grounding and energy sources have been properly connected and are operational
- **Initialization of system power supplies and DeltaV SIS equipment.** Ensures this is done in a safe and controlled manner.
- **SAT report.** Identifies any non-compliant items

## Site Integration Testing

Site Integration Testing (per IEC 61511-1 Clause 14) is to verify that the DeltaV and DeltaV SIS communicate with each other, in accordance with the design specification (i.e., may not be required if the DeltaV SIS and DeltaV basic process control system (BPCS) have been integrated and tested prior to delivery). Deliverables are:

- **DeltaV and DeltaV SIS commissioning.** Ensures proper communications and functionality
- **Quality check.** Verifies the quality of the communications between the system components to ensure robust operations, in compliance with the design requirements
- **Site integration test (SIT) report.** Identifies any non-compliant items

## SIS Commissioning

SIS Commissioning (per IEC 61511-1 Clause 14) is to verify that the SIS has been commissioned in accordance with the specifications and drawings, and that it is ready for functional validation and a pre-start up safety review (excluding testing or verification of third-party devices that are not part of the Emerson scope of supply).

Deliverables:

- **SIS commissioning plan.** Verifies instrument and calibration records to ensure that all instruments have been properly calibrated and all field devices are operational, in accordance with the criteria established by the SIS design specification.
- **Verification of logic solver I/O operations.** Verifies operations of logic solver I/O; initializes and commissions all devices, including the devices to the DeltaV SIS, to ensure proper communications and functionality, including SIS loop checks.
- **Reviews and records of all device statistics.** Includes AMS alerts and verifies that all interfaces to other systems and peripherals are operational; performs valve signature scanning and document system performance baseline statistics.

**Commissioning report** –Includes test results and comments about whether the design criteria have been met.

## SIS Validation

SIS Safety Validation (per IEC 61511-1 Clause 15) is to validate, through inspection and testing, that the installed and commissioned SIS and its associated SIFs achieve the requirements, as stated in the SRS. Deliverables:

- **Validation planning.** Defines all activities required for validation, including:
  - Validation activities, including the validation of the SIS(s) with respect to the SRS, including the implementation and resolution of resulting recommendations
  - Procedures, measures, and techniques to be used for validation and associated schedules
  - Identification of the persons, departments, and organizations responsible for these activities and levels of independence for validation activities
  - References to information against which validation shall be performed (e.g., cause-and-effect chart)

*Note: Typical validation activities include loop testing, calibration procedures, and simulation of application software.*

- **Validation of hardware and associated SIFs.**

Validates all items, in accordance with the SIS validation plan, including, but not be limited to:

- Verification that the SIS performs under normal and abnormal operating modes (e.g., startup and shutdown) as identified in the SRS
- Confirmation that adverse interaction of the BPCS and other connected systems do not affect the proper operation of the SIS
- Verification that the SIS properly communicates (i.e., where required) with the BPCS or any other system or network
- Verification that the logic solver, sensors, and final elements perform, in accordance with the SRS, including all redundant channels
- Verification that the SIS documentation is consistent with the installed system

- **Validation of the software.** Shows that all of the specified software safety requirements are correctly performed

- **Validation of the written report.** Details the results of the SIS validation, including discrepancies between expected and actual results, the analysis made, and any decisions made regarding whether to continue the validation or to issue a change request and return to an earlier part of the development lifecycle

## Ordering Information

Description	Model Number
SIS Project Execution Services	Please consult your local Emerson Process Management office for availability

## Pricing

SIS installation, commissioning, and validation activities can be provided on a fixed priced or variable basis, depending on the SIS size and complexity.

**PRE-SALE QUALIFICATION:** SIS installation, commissioning, and validation are customized to each customer's unique situation and therefore require project qualification prior

to order acceptance. A written summary of the customer's requirements and expected project timing must be submitted to and reviewed by Emerson Process Management prior to generation of a quotation for services.

*To learn how comprehensive service solutions address your process management needs, contact your local Emerson sales office or representative today or visit our web page at [www.emersonprocess.com](http://www.emersonprocess.com)*

©2015, Emerson Process Management. All rights reserved.

The Emerson logo is a trademark and service mark of Emerson Electric Co. DeltaV SIS is a mark of one of the Emerson Process Management family of companies. All other marks are the property of their respective owners.

The contents of this publication are presented for informational purposes only, and while every effort has been made to ensure their accuracy, they are not to be construed as warranties or guarantees, express or implied, regarding the products or services described herein or their use or applicability. All sales are governed by our terms and conditions, which are available on request. We reserve the right to modify or improve the designs or specifications of our products at any time without notice.

### Emerson Process Management

Asia Pacific: 65.777.8211  
 Europe, Middle East: 41.41.768.6111  
 North America, Latin America:  
 +1 800.833.8314 or  
 +1 512.832.3774  
[www.emersonprocess.com](http://www.emersonprocess.com)