SIS 204 - Installation & Commissioning

15 minutes

In this course:

Overview

Up to now we've been analyzing, defining, specifying, designing, planning, and developing safety requirement specifications (SRS), work procedures, and test plans with a goal of ensuring the installed SIS provides the required safety function throughout its life. Now it's time to install and commission the safety instrumented system (SIS) we've so carefully engineered.

Some might say this marks a "handoff point," a project milestone where the engineering team turns the SIS design over to a contractor to install and, perhaps, commission.

If only it were that easy.

From an installation and commissioning perspective, an SIS is much the same as a basic process control system (BPCS): good planning and careful execution are essential to avoid future problems.

And as anyone who has installed and commissioned a BPCS will tell you, there are hundreds of details to be considered and addressed. Many of these details are not defined or even implied in the engineering documentation or the installation contract, but each is important nonetheless.

This course shows how installation and commissioning planning, as required by IEC 61511, helps provide a high level of assurance that the installed SIS will operate in accordance with its SRS.

Hint

Pay special attention to:

- What an installation and commissioning plan should address
- How to minimize problems caused by improper installation and commissioning
- What full functional safety validation accomplishes.

Planning

In SIS 203 we introduced structured approaches to verification and validation. These included breaking the work into phases, decomposing the SIS solution, and developing detailed test plans that addressed the testing strategy, testing process, and people and technology requirements.

Our next step is to develop and document a detailed plan that defines at what point in the installation and commissioning phase each of those verification and validation activities will begin, how long each will take, and who is going to do it.

For example, a typical SIS might include

- Sensors, logic solvers, and final control elements
- Power and grounding
- Lightning protection
- Communication networks
- Supporting elements such as HART multiplexers and asset-management software.

For each of these, you need to develop and document plans that address

- Identification of all installation, commissioning, and safety validation activities
- What procedures, measures, practices, standards, codes, and/or techniques are to be used
- The sequence of activities
- Communication networks
- Which organizations and individuals are responsible for carrying out each activity.

Once these plans are developed, you're ready to begin installation of the SIS solution.

Installation

Many installation-related issues fall under the heading of common sense. For example, perhaps the simplest technique for avoiding problems is to follow all the installation instructions.

However, we've all seen examples of Murphy's Law that "if anything can go wrong, it will" — and its corollary, "whatever does go wrong will happen at the least opportune time." It's almost impossible to ensure a perfect installation that avoids all reliability problems.

However, there are ways to minimize potential installation problems.

Installing any control system — either BPCS or SIS — requires using contractors with proven experience in each of the subsystem areas. Additionally, people in the end user's own company (or a trusted third party) who have the knowledge and experience to head off installation mistakes should provide oversight during installation — also known as "management by walking around."

The IEC 61511 standard provides a list of installation activities. While the list isn't intended to be all-inclusive, it illustrates the diversity of activities that must be addressed, including such things as confirming that:

- Wiring for all instruments is in accordance with the manufacturers' instructions.
- Earth grounding has been properly connected to the plant grid in a way that avoids electrical noise that could jeopardize the reliability of the SIS.
- Signal wire grounding has been connected in a way that avoids "ground loops."
- Electrical power connections work properly.
- Transportation stops (shipping blocks) and packing material have been removed.
- Devices are free of physical damage, such as bent linkages or cracked cases.
- Environmental monitoring coupons are properly installed where appropriate.
- Sensor process connections are installed as designed and specified.

Everyone who's been associated with plant start-ups, maintenance, and operations could create their own list of the installation problems they've encountered over the years. But the point is that no matter how good the design specification, no matter how much planning takes place, and no matter how good the installation contractors are, there is no substitute for having knowledgeable people inspecting and managing the installation as it occurs.

The PlantWeb Advantage

Many of the same installation benefits PlantWeb offers in control applications are also available for SIS projects.

For example, diagnostics in our smart SIS devices can detect and identify many installation errors and problems — from valve air-supply problems to incorrect transmitter calibration. AMS Suite: Intelligent Device Manager makes it easy to do this troubleshooting remotely, so one person in one location can quickly detect and track down possible problems for an entire project.

Commissioning

We often think of installation and commissioning as occurring at the same time, but the reality is, these are two separate activities usually performed by different groups and disciplines.

For example, those who install conduit and wiring probably won't be the ones to perform pre-power-up checks, instrument configuration, and loop checks. Thus the commissioning team is unlikely to know exactly what the installation crew did or how they did it.

That's why it's so important to develop and document a detailed plan that defines when each commissioning activity will begin, how long it will take, and specifically who is going to do it. Like installation, commissioning activities can be diverse.

Besides activities like calibrating instruments, stroking valves, and verifying that logic solver inputs and outputs are operational, there are less obvious commissioning activities that must be completed. For example,

- A **smart SIS** (covered in SIS 401) can diagnose the state of field devices (enabling safer plant operation and predictive maintenance), and send this information to Operations or Maintenance personnel as required. Are the components that provide this capability configured correctly and working properly? Don't forget to check things like software login security and the messaging systems used to notify appropriate personnel.
- While it's common for other applications to calculate and write new values (such as setpoints, alarm limits, and tuning parameters) to a BPCS, a validated SIS is under strict change control. This means other systems may *read* SIS values, but cannot *write* new values to the SIS. If the SIS reads process-dependent values, such as trip limits specific to a given batch product, then the integrity of the communications must be defined and tested. If, for example, a shutdown in the SIS initiates loop tracking in a BPCS, commissioning activities must ensure read/write protection has been properly configured.

Other commissioning activities might include:

- Ensuring that startup bypass management procedures are correct and easily understood by operators.
- Confirming that automated partial-stroke valve testing begins after appropriate operator approval.
- Verifying that automated performance monitoring, testing, and documentation systems are properly configured and operating correctly.
- Making sure that earth-to-ground resistance is within design requirements.
- Conducting noise tests on communication links to establish a reference point if problems appear in the future.

The PlantWeb Advantage

Commissioning is also smoother and less labor-intensive with Emerson's smart SIS. It's no longer necessary to send a technician into the field with a walkie-talkie to "ring out" every device to verify its identity and communication links. Instead, as devices are connected they are auto-sensed and auto-addressed in the DeltaV system. AMS Device Manager software also reduces manual paperwork (and errors) by automatically recording as-found and as-left data for device configurations and calibrations.

Full Functional Safety Validation

Now that we know that all of the components related to the SIS are installed correctly and that they all function in isolation, it's time to test the performance of all of the safety functions defined in the safety requirements specification (SRS). This is known as a **full functional safety validation**.

This is the final step that ensures that the SIS works as it was designed to. Every safety instrumented function (SIF) defined in the SRS must be tested and the results documented. Only then can we hand the plant over to Operations and Maintenance.

The better the quality of the installation and commissioning activities up to this point, the easier the safety validation will be to perform.

Doing the Paperwork

One thing we've learned about IEC 61511 is that it requires us to document everything we do. This includes installation and commissioning activities and, by definition, safety validation.

In fact, it's safe to say that without proper documentation, including the signature of whoever did and witnessed each task, it's as though those activities never happened.

Some will argue that waiting to complete the documentation until after the SIS solution is operational helps reduce the documentation burden. That's a bad practice that can lead to incomplete or even falsified documentation.

Besides, as we learned in a previous course, the SIS solution doesn't comply with IEC 61511 until it's validated … and it can't be validated until the paperwork is finished.

What you should remember as you develop your own SIS is the importance of identifying the subsystems early and including placeholders for each in the SRS documentation. This will help facilitate development of verification test plans, as well as the planning and execution of installation and commissioning activities.

The PlantWeb Advantage

Emerson's complete range of automation services includes expert SIS and BPCS installation and commissioning. With Emerson, you not only get access to our local support teams; you also benefit from the experience of a global service organization certified as competent in accordance with IEC 61511 — and on call 24 hours every day.

Summary

In this course you have learned that…

- Planning and documentation are just as important for installation and commissioning as for earlier phases in the SIS lifecycle.
- Structured approaches such as "decomposing" the system and breaking the work into phases can help make installation and commissioning easier to plan and carry out.
- Among the things to plan are when each activity will occur, who will do it, and how it will be done.
- Although many SIS installation and commissioning best practices are the same as for a BPCS, there are differences that require attention.
- Using personnel with appropriate experience will help reduce potential problems — and so can good oversight of those workers.
- Full functional safety validation tests the ability of the completed SIS to perform each safety function as defined in the safety requirements specification (SRS).