Functional Safety Assessment Using Safety Lifecycle Manager

Safety Lifecycle Manager

Conformance to IEC61511

MANGAN Software Solutions

Functional Safety Assessments

Using Safety Lifecycle Manager

SLM® Safety Lifecycle Manager

www.Mangansoftware.com

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1 Introduction

IEC 61511-1-2016 describes the basic requirements for Functional Safety Assessments (FSA), but does not provide specifications or guidance on how to execute or document an FSA. This commonly results in FSAs that are incomplete, hard to use, or inconsistent from one application to the next. From an enterprise perspective, this challenge intensifies with multiple functional areas or sites that operate independently.
This paper discusses the requirements for Functional Safety Assessments of Safety Instrumented Systems (SIS) and the advantages of using Safety Lifecycle Manage (SLM®) as the primary tool for standardizing the conduct and documentation of FSAs and for assessing whether functional safety has been achieved or is compromised.

2 Performance Data Collection

IEC61511-1-2016 identifies the stages of the Safety Lifecycle at which an FSA should be performed. The table below summarizes the Stages and general focus areas of the FSA for that stage. **See Table 1 on next Page**

3 SLM and the FSA Module

The full suite of integrated SLM modules can generate, store, and analyze data for every stage of the Safety Lifecycle. Facility SIS personnel can leverage the SLM's workflows to generate common reports and analysis' required by US and international safety standards. If a plant has already completed portions of the safety lifecycle using third-party industry tools, data from these programs can be imported. SLM offers a standard configuration, but can be customized for specific needs of the facility.**Continued on Page 5**

Table 1: Functional Safety Assessment Stages

FSA Stage	Stage Description	Topics for FSA
Stage 1	Follows hazard and risk assessment; required protection layers have been identified and the Safety Requirement Specification (SRS) has been developed.	Review Process Hazards Analysis for compliance with organization and industry practices. Review identified safety functions including Safety Instrumented Functions (SIFs) and other Instrumented Protection Layers (IPLs). Review SRSs for completeness.
Stage 2	Following Safety Instrumented System (SIS) design.	Review SIS design relative to SRS requirements: • Have Safety Instrumented Functions (SIF) have been implemented according to the SRS? • Does selected equipment meet all requirements? • Have all Validation, Operation, Maintenance and Proof Test Procedures been identified and planned?
Stage 3	Following installation, pre-commissioning and final validation of the SIS and development of operation and maintenance procedures.	Review the inspection and testing of the SIS: • Have SIFs and SISs been inspected, tested and validated against SRS requirements? • Have all Operation, Maintenance and Proof Testing procedures been prepared and approved? • Have personnel been trained? • Is SIS ready for operation?
Stage 4	Following a period of operations and maintenance. This is a periodic FSA performed throughout the SIS Lifecycle.	Review of SIS and SIF performance: • Verify that performance has been tracked and assessed. • Compare demand rate to SRS requirements. • Compare fault and failure rates to SRS requirements. • Validate the adequacy of training and procedures.
Stage 5	After modification and prior to decommissioning of an SIS.	Review changes in SIS to verify they have been made in accordance with the Safety Life Cycle. Review of all FSA stages with respect to changes and verify that changes have not affected functional safety. Verify that decommissioning has not impacted the functional safety of the process, or related processes. Verify that all appropriate documentation has been updated to incorporate the impacts of decommissioning.

Continued from page 3:

SLM provides a standardized and easy-to-use framework for FSA completion, allowing organizations to define, populate, and validate FSAs with increased efficiency and effectiveness. The integration of all Safety Lifecycle data provided by SLM also allows for effective presentation of FSA data with other safety critical data, such as HAZOP and LOPA studies, Safety Requirements Specifications (SRSs), and SIS performance.

Module Benefits:

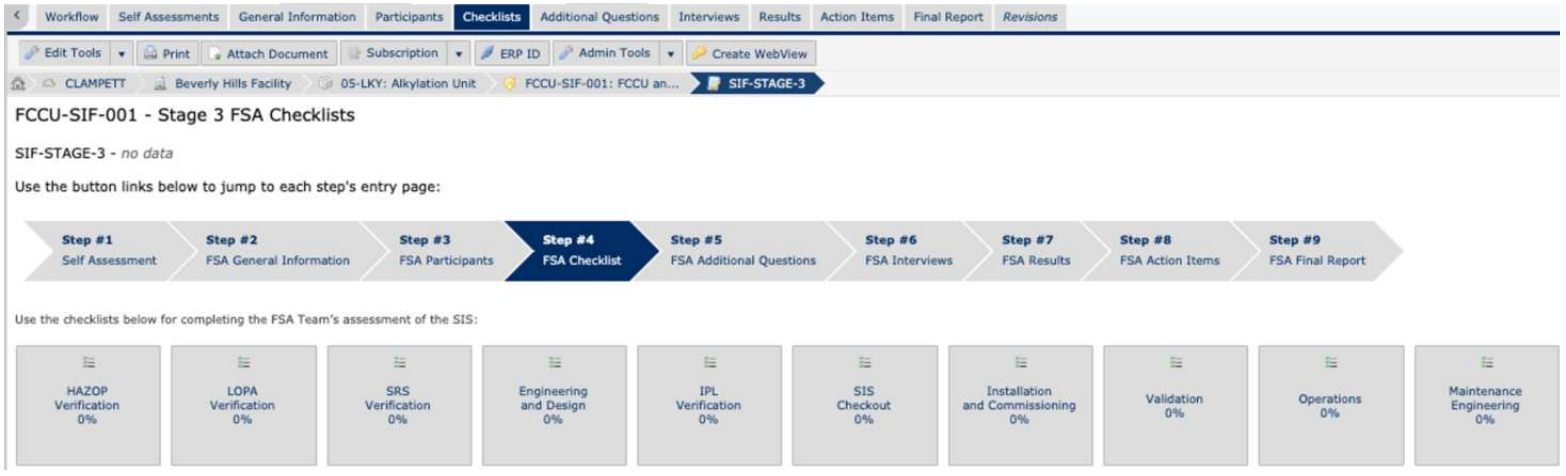
- Setting a Standard: Interpretation of best practices differs by site and FSA assessor, allowing for inconsistency from one FSA to the next. Establishing a standard that is integrated with SIS lifecycle data limits questions about documentation requirements and establishes a foundation for repeated study.
- Visibility: The FSA exists in SLM as a reference and example for future assessments across a site or enterprise. Safety and instrumentation personnel onsite can access and review all FSA information allowing for unprecedented sharing of expertise and best practices.
- Lowering the cost: Life cycle data is available in SLM with the click of a button, requiring less time locating data.
- Leverage the FSA's value: An organization must allocate resources to complete a time-consuming report, so SLM allows the user to maximize its value to the organization. Completed FSA reports in SLM are easily accessible and integrated with evergreen data, so it can be reviewed and used to inform day-to-day plant operations.

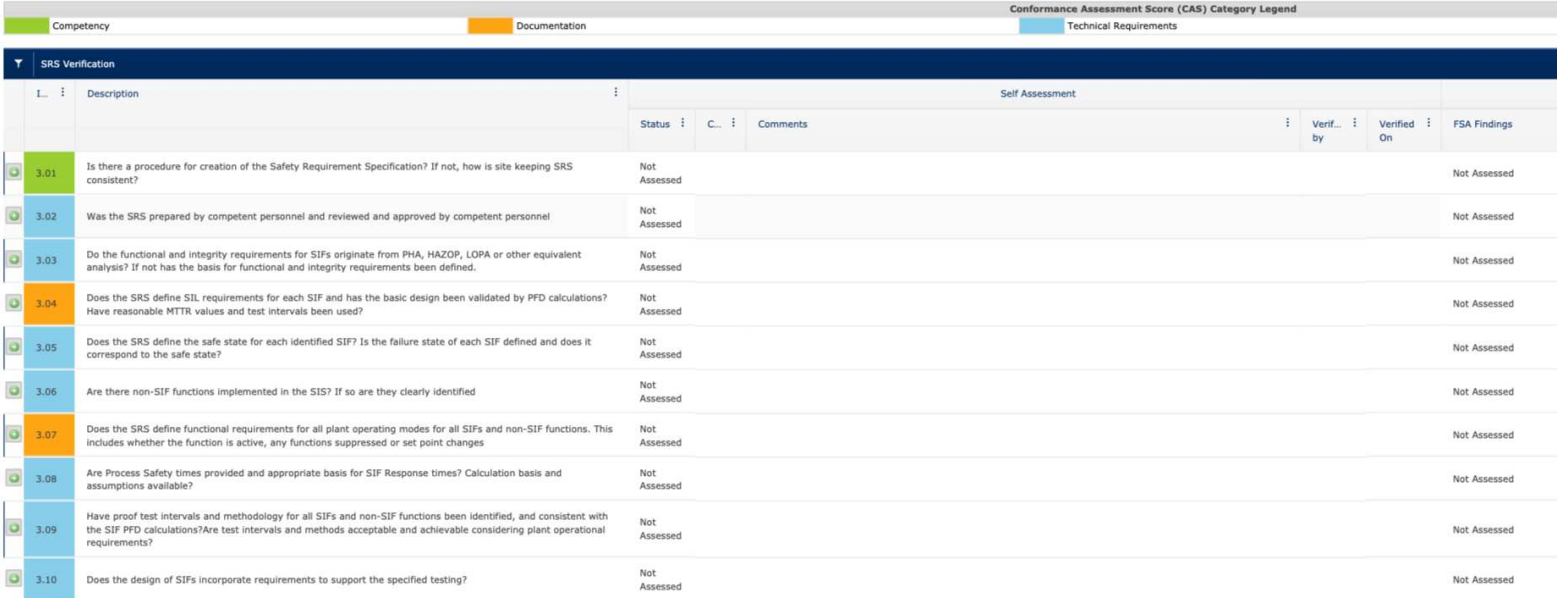
4 Conducting an FSA using SLM

The FSA process in SLM is guided through a built-in workflow. The user initiates an FSA and is presented with a view that allows the user to move through each of the FSA steps.

The user is presented with the appropriate checklists depending on what stage FSA is initiated (1-5). SLM provides an intuitive workflow for the user to complete the FSA checklists and track FSA personnel, interviews, and key findings. Participants can all access and make updates to the system simultaneously. The built-in document management system allows users to attach digital copies of supporting documentation directly to the FSA. **See Image on next page.**

Functional Safety Assessment Stages





Step 1: Self-Assessment

SLM provides a Self-Assessment Step that can be performed by a Site or a Project Team prior to conducting an FSA. This function allows the personnel responsible for the SIS design or operation to review the FSA Verification Checklists and provide their input on how they view the status of each checklist items. This checklist may be used at any time during SIS design to track completion but should be completed a few weeks prior to a FSA to allow the assessing team time to review the data.

The personnel performing the Self-Assessment employ the Verification Checklists using the interface. Fields are provided for comments and identification of who performed the Self-Assessment and when.

Step 2: FSA Participants

The FSA Participants step allows the FSA team to identify participants in the FSA and their roles. The names of participants are drawn from the Personnel Module in SLM. This allows for tracking of individual participation in Safety Lifecycle activities and captures individual competencies, qualifications and approved roles.

Step 3: Introduction

This step in the FSA allows for definition of basic information including an introduction and background to initiate the FSA, a summary of the FSA findings, and a discussion of key FSA findings for each checklist topic. Introductory material is entered at the start of the FSA with Summary and Key Finding data added as the FSA progresses. This material is also incorporated into the FSA Final Report.

Step 4: FSA Checklist:

Each FSA Checklist contains a list of the verification items for the checklist topic. These are the same items as presented for the Self-Assessment Step but with columns added for presentation of FSA comments and findings.

A base set of Checklists are provided with SLM, but these Checklists are editable at the Enterprise level by an authorized User. Prior to an Enterprise starting to use the FSA Module, the Checklists should be reviewed by personnel responsible for establishing FSA procedures and standard for the Enterprise and be customized as required to support the Enterprise's practices.

The Checklist view presents the entries by Self-Assessment and provides FSA Review columns for recording feedback, such as:

- The compliance level determined by the FSA team. A standard set of selections is provided, but the user may customize these.
- Comments by the FSA Team.
- FSA Team identification and Date.
- Action Items identified by the FSA Team.

Step 5: FSA Interviews

FSA teams conduct interviews to assess preparedness for SIS operation. Interviewees are typically operations or maintenance personnel responsible for the ongoing operation of a SIS. The FSA Interviews allow for data and identification of Action Items that may have been otherwise overlooked.

Step 6: FSA Summary

This section includes a summary and discussion of the FSA findings for each checklist topics. System users . The summary and key findings can be modified as the FSA progresses.

Step 7: Action Items

This section includes a summary and discussion of the action items added throughout the FSA. Action items are not limited to the FSA.

Any action items identified are tracked through SLM's Action Item Tracker Module and are accessible globally.

The team may classify action items according to a user-defined category set. For example, an Action Item may be identified as required pre-startup, required post-startup, a long-term item to be managed by operations personnel, or a standing guideline. Using the "Add Action" button, users can add action items to specific items on the checklist that aggregate at the final report. The action items are also available in other modules and available globally.

Step 8: FSA Final Report

SLM collects all the information entered into the database during the FSA processes and automatically prepares a standardized final report. This report captures the introduction and background, FSA Summary, FSA Key Findings, Interview details, and all FSA Action Items, and produces a viewable and printable Final Report. The user may also include a detailed report on the FSA checklists and comments and compliance level findings in the final report.

FSA Final Report Example

Step #1 Self Assessment | Step #2 FSA General Information | Step #3 FSA Participants | Step #4 FSA Checklist | Step #5 FSA Additional Questions | Step #6 FSA Interviews | Step #7 FSA Results | Step #8 FSA Action Items | **Step #9 FSA Final Report**

SLM MARKETING Business Unit	
Unit: 10-CRUDE-UNIT	Document No: *no data*

Background

This is a sample Stage 1 FSA

FSA Results

Date Started ǂ: Oct-17-2019

Date Completed ǂ: Oct-18-2019

Location ǂ: Aurora, CO

FSA Summary and Results:

This FSA was conducted to review the new SIS installation being made for the 3Q 2020 turnaround. The new SIS is a Triconex system interfaced to an existing Honeywell BPCS. The BPCS operator consoles and networks were recently upgraded to Experion operator stations and servers.

This FSA is a Stage 1 FSA, and is limited to the checklists for HAZOP, LOPA, SRS and SIS Engineering and Design. State 2 and State 3 FSA's will be conducted as the SIS project progresses.

This report is an Interim Report that captures FSA findings during the October 2019 review. A final report will be issued after completion of construction, inspection, testing and validation activities and review of the evidence of completion by the FSA team.

The FSA process is based upon review of the SIS status with respect to a set Verification Checklists that contain a number of assessment criteria that are related to IEC and ISA Safety Life Cycle requirements and plant operational requirements

Each item is assessed relative to the FSA team's opinion of the readiness for operation of the SIS and it's SIF's. The assessment categories are

- OK to Operate
- OK to Operate – Action Items to Close prior to Project Close Out
- Actions Required before Operating
- Not Applicable

FSA Key Findings

FSA HAZOP Checklist	HAZOPS on the nodes and scenarios which are affected by the new SIF's were conducted by the TCACP and FHSM projects. The contents of the HAZOPS appeared reasonable and no action items other than
	The LOPA Excel spreadsheets used by the project were reviewed. In general, the LOPA data was found to be in conformance with Clampett practices. There were several existing LOPA gaps that were identified. Plant management is aware of these gaps and they have either been approved as acceptable or there are plans to close the gaps outside the scope of the current project. Verification of the

5 FSA Lifecycle Considerations

A FSA for a SIS may be performed at multiple times in the SIS's Lifecycle. Some examples are:

- The initial FSA is conducted in Stages during the SIS specification and design steps.
- Multiple Stage 4 FSAs are required to be performed at intervals while the SIS is in service
- Multiple Stage 5 FSAs may be performed during the SIS Lifecycle as modifications are made to the SIS or any of its SIFs or non-SIF Functions.

SLM allows FSAs performed subsequent to the initial FSA to be linked to one another. When a new FSA is created for a SIS, part of that creation process is a new FSA object is created by the database. The contents of the prior FSA checklist data and Action Item data is copied to the new object. If a Stage 1 FSA has been performed and it is now time to perform a Stage 2 FSA, The Checklist Data and Action Items associated with the Checklists for the HAZOP and LOPA Verification Checklists are copied from the Stage 1 FSA to the Stage 2 FSA. The FSA team may then review the results of the Stage 1 FSA and add any additional comments and Action Items (or close those Action Items if appropriate) and then proceed with the Stage 2 Checklists.

6 Conclusions

Using SLM for execution and documentation of Functional Safety Assessments results in effective, economical, and repeatable FSAs. SLM provides a means of standardizing the inputs and results of FSAs and allows an organization to leverage FSAs for tangible improvements in SIS design and operation. When coupled with other SLM safety life cycle modules such as HAZOP, LOPA, SRS, and SIS/SIF performance, organizations can make dramatic improvements in the effectiveness of Safety Protective Functions and reduce the costs or implementing and operating these systems.

About the Author

Rick Stanley has over 40 years' experience in Process Control Systems and Process Safety Systems with 32 years spent at ARCO and BP in execution of major projects, corporate standards and plant operation and maintenance. Since retiring from BP in 2011, Rick formed his company, Tehama Control Systems Consulting Services, and has consulted with Mangan Software Solutions (MSS) on the development and use of MSS's Safety Lifecycle Management software.

Rick has a BS in Chemical Engineering from the University of California, Santa Barbara and is a registered Professional Control Systems Engineer in California and Colorado. Rick has served as a member and chairman of both the API Subcommittee for Pressure Relieving Systems and the API Subcommittee on Instrumentation and Control Systems.