SLM ® FAQ Booklet

Safety Lifecycle Manager

Conformance to IEC61511

SLM | SLM Demo

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Open Action Types

Generate

Open Action Types within CLAMPETT
This report provides a visual representation of overdue action items

Open Action Types

Overdue: 0
Due: 16

FSP Action Item   FSP Action Item   LOPA Action Item

Action Item Type

■ Due   16   ■ Overdue   0

Open Action Types   📄 Export to PDF   📊 Export to Excel

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MacBook

SLM®
Safety Lifecycle Manager

SAFETY
LIFECYCLE
MANAGER® (SLM®)

MANGAN
Software Solutions

Table Of
Contents

SLM®
Safety Lifecycle Manager

Continuous Safety
for All Lifecycle Phases

Safety is not a one-off initiative or a quick and permanent fix – it is a continuous, dynamic process. Ensuring the safety of your industrial plants requires you to examine the whole picture. You need to consider the entire lifecycle of your safety system: from planning and installation to operation and modification. Even the eventual decommissioning of the system needs to be taken into account.

Why SLM® System?

Putting continuous safety strategy into practice requires significant effort and extensive knowledge. You need to have a technology partner that can support you in all phases of this critical process, giving you peace of mind and a sense of trust and satisfaction, so that you can focus on your core business.

Mangan Software Solutions (MSS) Safety Lifecycle Manager (SLM®) systam is a comprehensive set of interconnected application modules that cover the entire Process Safety and Functional Safety Lifecycle. From HAZOP and LOPA Studies to SIS Design, Operations, and Maintenance, the MSS SLM® system is on hand to support you from the very start through entire lifecycle.

Trusted by The Leaders

The MSS SLM® system has been adopted by the industry's top names including, but not limited to, Chevron, Marathon, Motiva, BP, TotalEnergies, and Shell, etc. The MSS SLM® system has all the tools you need to successfully manage the complete Safety Lifecycle and is engineered to solve your toughest Process Safety and SIS Lifecycle Management challenges. It's the ONLY software platform having IEC - 61508 and 61511 ed. 2 TÜV and Rhineland certifications.

HAZOP
MODULE

Designed to be the successor to legacy PHA/HAZOP software tools, the HAZOP module not only offers an intuitive HMI to accelerate HAZOP studies and quickly view HAZOP data, but gives organizations the ability to standardize their processes. Instant reports reduce the cost of third-party experts, and the underlying data allows SMEs the ability to study how the organization executes risk management.

01

HAZOP

1 Can you provide an overview of the HAZOP Module?

- The SLM® system PHA functionality has been designed to replace the legacy PHA/HAZOP software tools of the past. This dynamic software tool offers an all new HAZOP Quick Workflow™ to accelerate HAZOP studies and quickly view and enter HAZOP data, as well as simultaneously and automatically populating other modules for efficient data entry and quality assurance, giving organizations the ability to standardize their PHA processes and methodologies. Facilitation is straightforward and follows a linear workflow, making it easy for scribes and facilitators to perform the HAZOP and for management to review the HAZOP data. The workflow starts with identifying Parameter-Guideword-Deviation either from manually entering them, or bringing them in from the Standard Deviations templates described below.

2 Does the SLM® System support multiple PHA methodologies?

- The SLM® system supports multiple Process Hazard Analysis methodologies out of the box, some of which includes HAZID, HAZOP, CHAZOP, WHAT-IF, LOPA, etc.

3 Does the SLM® System support different HAZOP Types (HAZOP of Record, Project HAZOP, etc.)?

- The SLM® system supports several different types of HAZOPs providing the user the ability to properly document and organize the studies as per the organization's requirements. Below is a view of the user interface for choosing the HAZOP type.


4 Is the HAZOP Module configurable, including for different Risk Matrices and Targeted Mitigated Event Likelihoods?

- The SLM® system's highly configurable Dynamic Risk Matrix (DRM) can be set up at the enterprise level (organizational DRM template) and be synchronized for any Site within the SLM® system. This provides the user the ability to employ the Risk Matrix setup standardized by the organization or, in a case where a Site uses a different setup, modify it to match the accepted standard at the current location. The setup of the DRM includes selecting the Targeted Mitigated Event Likelihood to various Severity Classes. Below is an image of a DRM within the SLM® system:

5 Does the SLM® System offer template creation for efficiency during PHA process?

The "Standard Process Deviation" functionality within the SLM® Global Module allows organizations to create their own custom Parameter, Deviation, Guideword to simplify and accelerate the process of performing a HAZOP. At the start of a HAZOP or the creation of a new node in the HAZOP, these previously created Deviations can be opted for inclusion in the node. In addition to setting up Deviations, equipment types can be modeled prior to the HAZOP being performed that bring in Deviations upon the selection of a specific equipment type, for example: Boilers, Compressors, Drivers, etc.
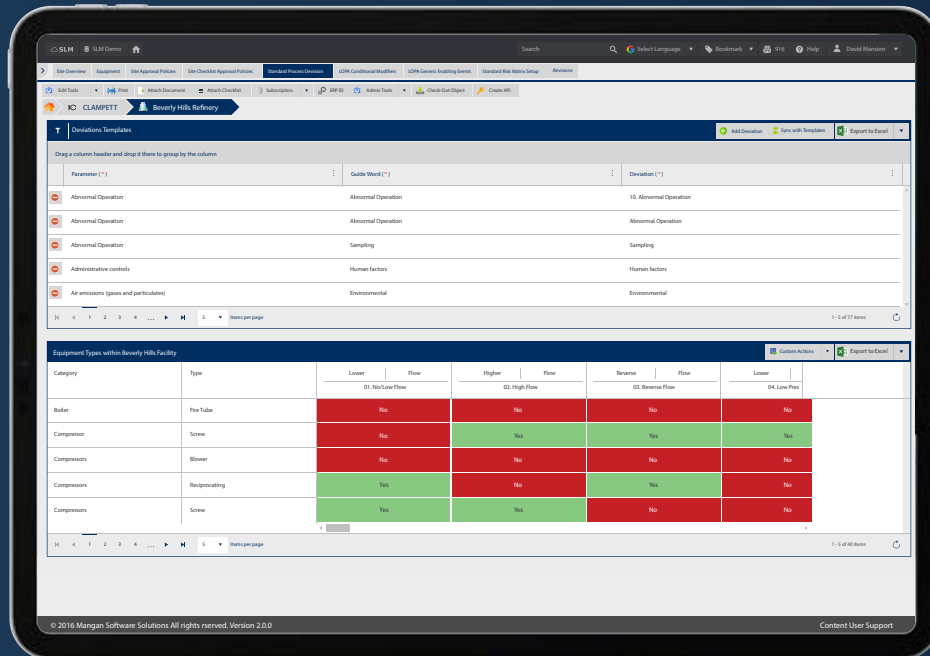
6 Does the SLM® System track/document Personnel competencies for PHA participants?

The SLM® system provides several methods to record personnel data. The personnel module allows the user to keep track of competencies, certifications, and statuses on personnel. It also provides the opportunity to determine what clearance level (approvals, etc.) the individual will have access to. When facilitating HAZOP and LOPA, the facilitation team and their competencies are recorded and tracked within the module. The image below is an example from the facilitation personnel setup within a HAZOP.
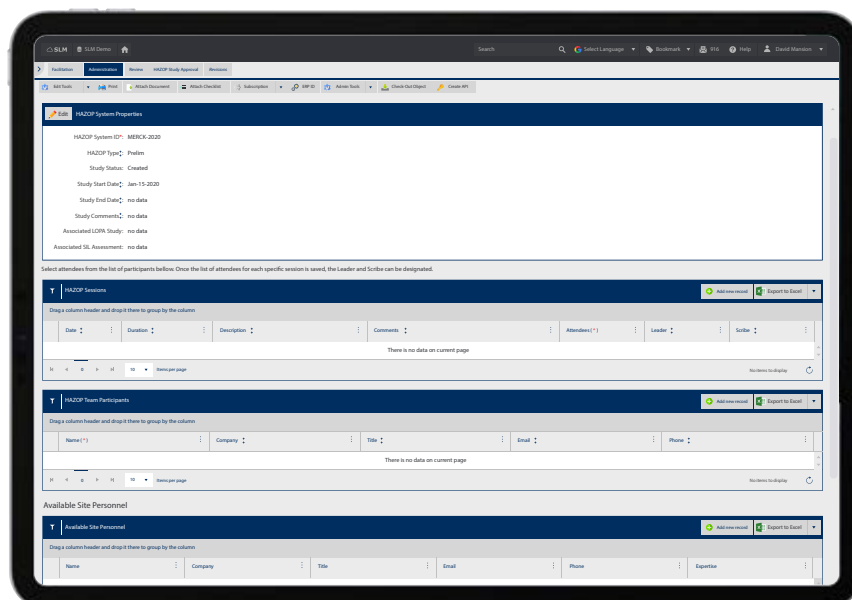
7 Does the SLM® system offer PHA version control/tracking?

— The SLM® system provides several methods of version control. For every object in the SLM® there is a Revisions tab that tracks all changes that have been made to the object, including who made the change, what the change was, when the change was made, and the original content of that field. Every LOPA has a version number that is updated upon usage, in addition to the Revision tab. The HAZOP approval workflow implements a built-in version control and provides instant updates in case of any status change. Below is an example of the Revisions tab of the HAZOP.
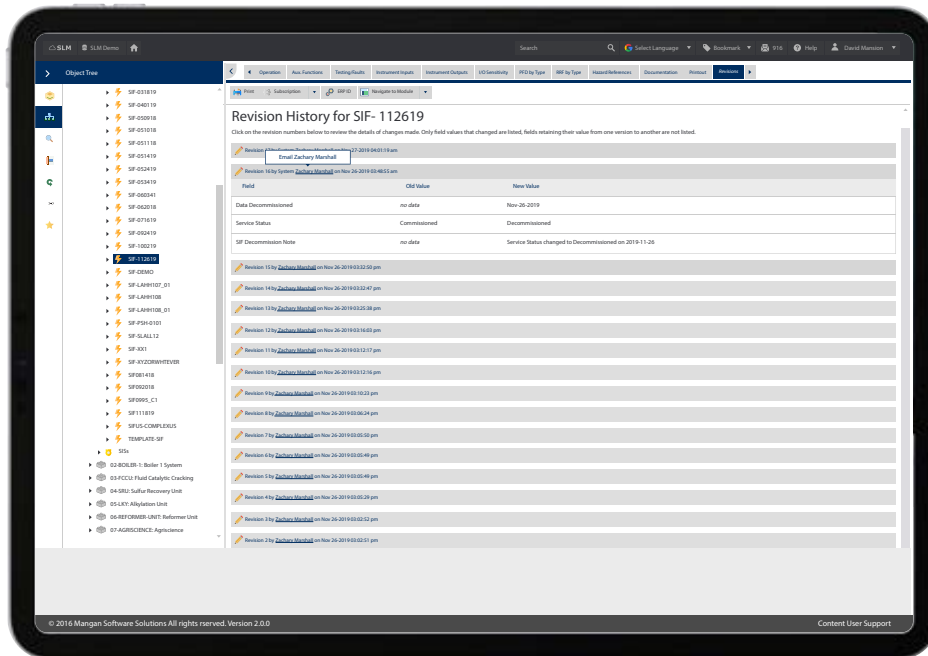
8 How are HAZOP Approvals workflows handled?

— Secure and accurate approval workflows can be setup for most HAZOP/data types. HAZOPs need to be approved as a HOR (HAZOP of Record) by an assigned approval authority for the SLM® system to validate as a completed, of record HAZOP. Security roles and approval authorities are assigned by a System Administrator. Below is an example of HAZOP Study Approval Workflows:
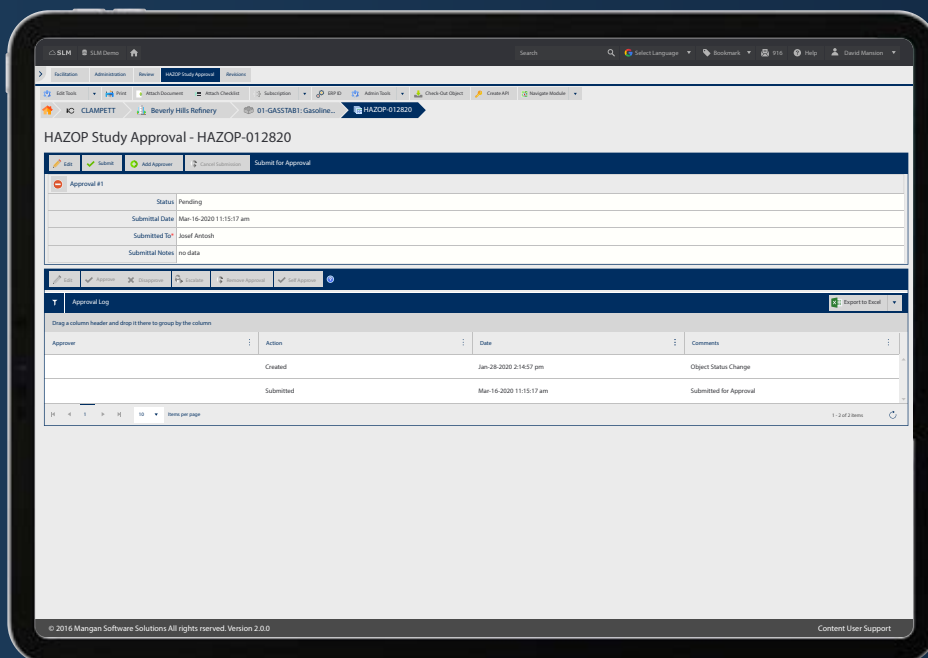
9 How are HAZOP Recommendations/Action Items managed in the SLM® system?

- For any required actions, the SLM® system Action Item Tracker provides the tools needed to turn any item identified as requiring action, whether it be a Gap result from a LOPA or a Partial Stroke Test to be performed, into clearly communicated tasks. With the push of a button, recommendations from HAZOP/LOPA can be made into Action Items where the recommendation description becomes the Requested Action. Below is a view of the SLM® Recommendation List, and a view of the HAZOP Summary, with recommendations/Action Items.

10 Does data created during Process Hazard Analyses (PHA) cascade information to other modules/templates?

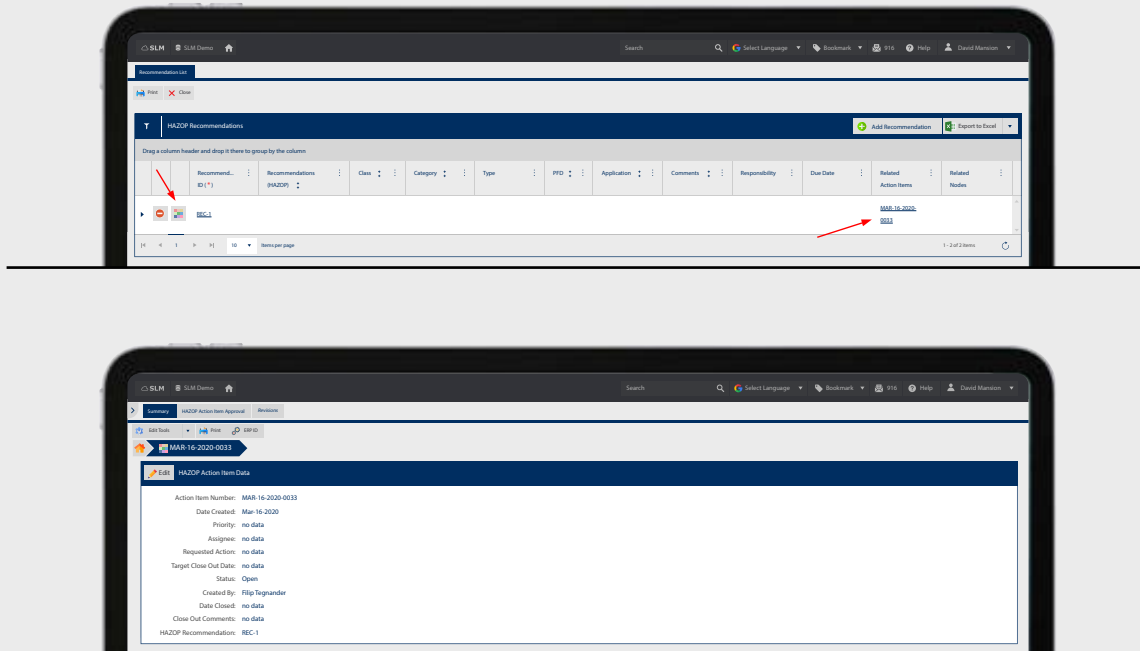- The SLM® system instance uses a single SQL Object Oriented Relational Database to manage data across modules and functionality. The system models the real world by using objects that mirror real world hardware. For example, output XV-101 is an object that can be used by multiple SIFs or interlocks as is common in the material world. If the test frequency for XV-101 is changed, it affects all of the SIFs it is associated with the same as if it was tested in the material world.

- Different but related data can also be linked in the SLM® system. For example; a LOPA study may identify a SIF IPL but not have the tag number and only a description. The LOPA IPL can be linked to a fully defined SRS IPL even though the identifiers are different.

- The SLM® system uses this database functionality to greatly increase efficiency. For example; Nodes can be established for each piece of process equipment. When a PHA is initiated and process equipment is selected, the nodes will automatically populate.

11 Does the SLM® System include "View only" access of PHA data?

- A WebView link is a feature incorporated in the SLM® system that allows the user to capture a view within the SLM® system and share it with others using a hyperlink. The link directs the individual to the captured view with read-only capabilities. Navigation to other areas and objects within the SLM® system is also restricted from a WebView link to maintain data security and integrity.

12 Can PHA data from other software tools be imported into SLM® System?

- Yes, the SLM® system's import adapters allow users to easily drag-and-drop files (google-like) to import data files. SLM import adapters allow mapping and importing HAZOP and LOPA data from PHA Pro, PHA Works, Excel Spreadsheets, and Various other PHA tools.

13 How can SLM® System's HAZOP module benefit my business/plant?

EFFICIENCY

For PHA execution, the SLM® system's intuitive workflows and modern software functionality make the PHA process much more efficient - copy/paste, cloning, templates, etc. Extensive reporting can be generated with the click of a button, reducing time-consuming reporting activities significantly.

ACCESS TO ACCURATE DATA

Legacy PHA tools offer limited visibility into PHA Data/Process Safety Information as the data is often handed over by contractors or PSM teams and contained in pdf files or desktop software. The SLM® system's HAZOP Module allows web-based access that ensures unlimited access and confidence the data is evergreen.

STANDARDIZATION

Most organizations require standardization efforts due to mergers/acquisitions or from years of decentralized management of these activities.

ACCURACY / ELIMINATE RE-WORK

A good example is when different Project Teams rename nodes and the HAZOP of Record becomes convoluted or difficult to reconcile with multiple Project HAZOPs. The SLM® system facilitates a more standardized approach and clearly, quickly, and accurately documents activities versus siloed Project Teams making changes with little visibility into the impact these changes will have on teams later having to pore over documents and time spent reconciling data.

COMPLIANCE

As a TÜV Certified Lifecycle Management Platform, the SLM® system offers compliance for several engineering activities, including implementation and execution of HAZOP/LOPA methodologies.

SUPPORT DURING INCIDENT INVESTIGATION AND AGENCY/INTERNAL AUDITS

The SLM® system's data structure and one-click reporting makes incident investigation and audits much more efficient. Quickly react to audit findings.

14 Who owns the data in the HAZOP Module?

- Typically, HAZOP data is owned by Administrators/PHA Execution Teams. There are several Quality Control features in the SLM® system to support proper change/version control efforts.

15 Who at my company would use the HAZOP Module and what would they use it for?

- PHA Teams – In support of PHA Study Planning, Execution, Reporting, and Sharing data.
- PSM Directors – For visibility into PHA Cycles and PHA Progress, enforcing standardization, and analysis
- PSM Manager – For planning PHA cycles, visibility and analysis of Process Safety Design and performance gaps, for Gap Closure planning/scheduling
- PSM Engineers – To support data management such as IPL Identification and analysis, failure analysis, KPI Tracking
- Engineering Teams – Quick access to Process Safety Information

16 What are the main reports that are available in the HAZOP Module?

- The SLM® system Includes the following reports in the HAZOP Module:

- Approved HAZOP Study List
- Dynamic Risk Matrix
- HAZOP Barrier List
- HAZOP Critical Equipment List

- HAZOP Inherent Risk Chart
- HAZOP Recommendations
- HAZOP Reevaluation Timeline
- HAZOP Scenarios Requiring LOPA vs. LOPAs performed.

LOPA
MODULE
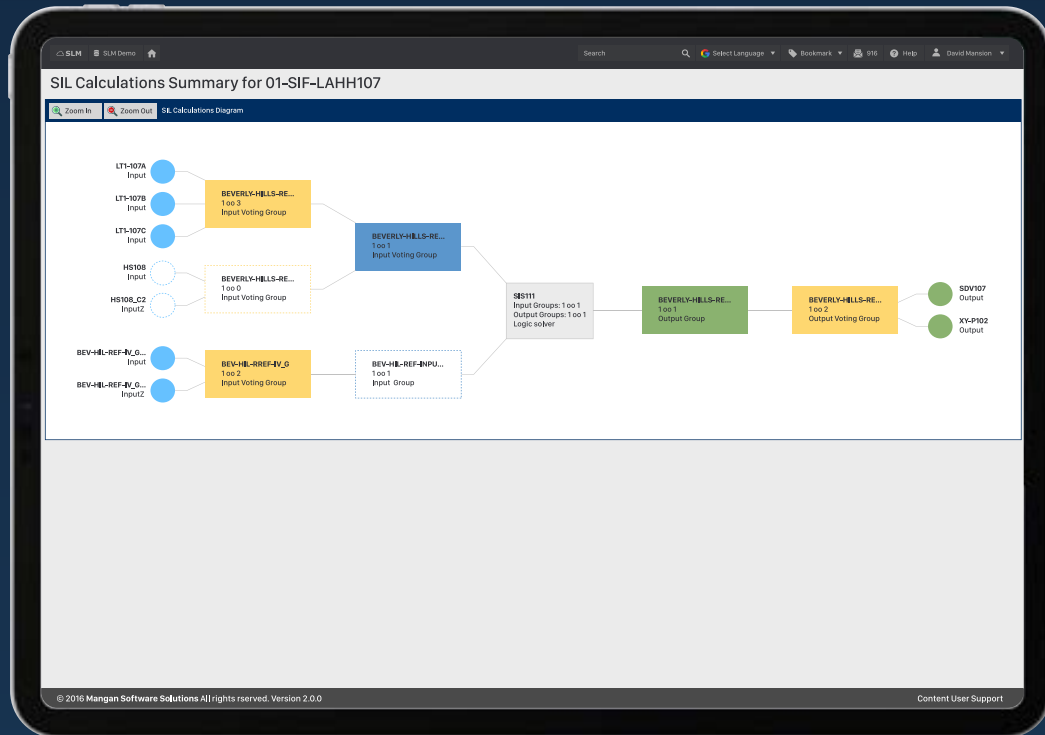
Designed to be the successor to legacy PHA/HAZOP software tools, the LOPA module not only offers an intuitive Human- Machine Interface (HMI) to accelerate LOPA studies and quickly view LOPA data, but gives organizations the ability to standardize their processes. Instant reports reduce the cost of third-party experts, and the underlying data allows SMEs the ability to study how the organization executes risk management.

02

LOPA

1 Can you provide an overview of the LOPA Module?

— The LOPA Module provides intuitive workflows to standardize your LOPA process and conduct IPL Assessments. The Dynamic Risk Matrix is configurable and may offer real-time risk monitoring and identification. Instant reports and KPIs reveal unmitigated risks to allow IPL gap closure scheduling and progress. These reports offer unprecedented review of risk mitigation strategies.
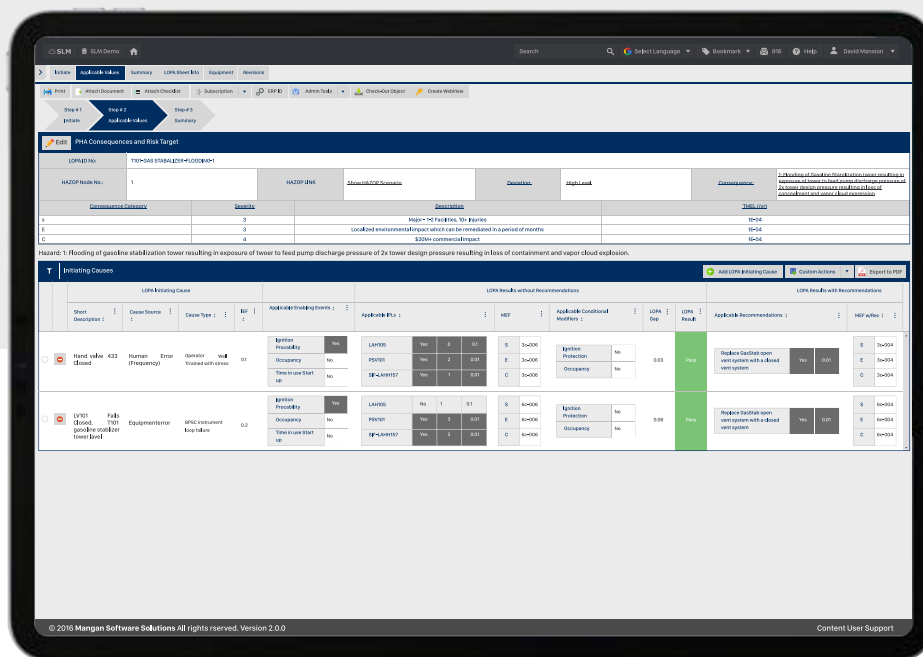The SLM® system LOPA worksheets offer familiar workflows and graphics with added modern software navigation and access to relevant data. See below example of a LOPA worksheet in the SLM® system:

2 Are the HAZOP & LOPA Modules Integrated?

— The SLM® system's HAZOP and LOPA modules are integrated. This integration allows users to complete HAZOP and generate LOPAs on specific scenarios or generate a LOPA during the HAZOP. All information identified during the HAZOP automatically populates LOPA with links between scenarios.

3 Does SLM generate diagrams, User Friendly Graphics, and other representations of Layers of Protection?
Yes, the SLM® system automatically generates IPL diagrams showing each LOPA scenario that a selected
— IPL is credited for. The IPL diagrams are easy for a non-expert to understand as they show the initiating events, protection layers, and consequence in an intuitive way.

— For example, these graphics aid in evaluating (among others):
     i. Failures and associated Function issues/information.
     ii. Consequences of bypassing safety functions.
     iii. Mitigating actions to take prior to bypass of safety functions.

See below example of a LOPA scenario in the SLM® system:
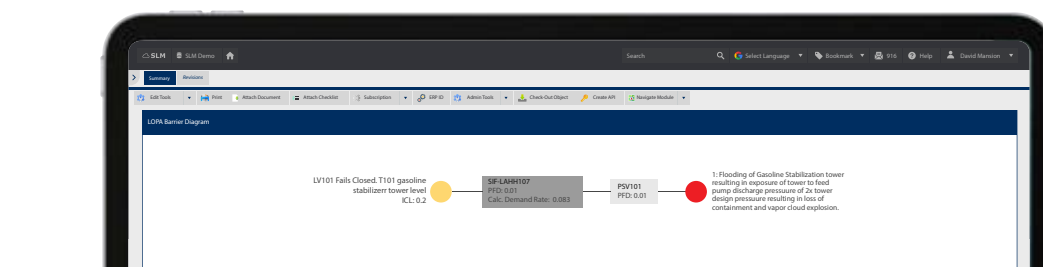
4 How does the SLM® System handle Initiating Causes Types?

— Each LOPA worksheet allows users to select from a dynamic dropdown that will identify typical Cause Types based on the selected Cause Source (Equipment Error, Human Error (Frequency), and Human Error (Probability). The SLM® system is configurable to allow administrators to add new cause types as needed.

5 Which Safeguard Types can be managed in the SLM® System?

— HAZOP Safeguards can be linked to IPLs. Safeguard types match IPL Types tracked in the LOPA module. They include:
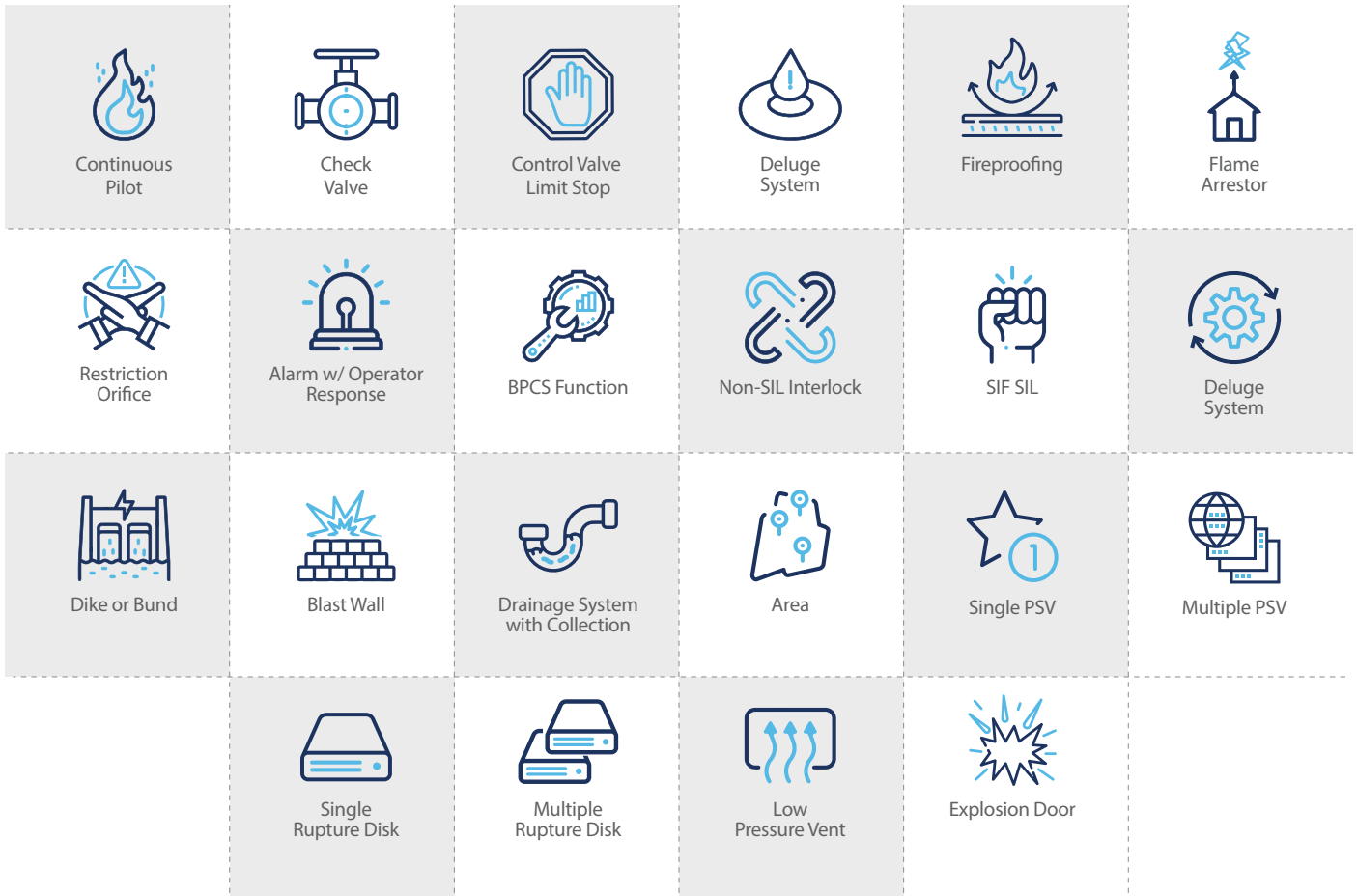
Continuous Pilot	Check Valve	Control Valve Limit Stop	Deluge System	Fireproofing	Flame Arrestor
Restriction Orifice	Alarm w/ Operator Response	BPCS Function	Non-SIL Interlock	SIF SIL	Deluge System
Dike or Bund	Blast Wall	Drainage System with Collection	Area	Single PSV	Multiple PSV
	Single Rupture Disk	Multiple Rupture Disk	Low Pressure Vent	Explosion Door	

6 Does the SLM® System include Checklists for assessments to be completed?

— Yes, the SLM® system includes over 70 standard checklists. The SLM system administrators can add a new checklist to any object or object type in the System Module. The SLM® system also has reporting capabilities to track completion progress of any checklists.

7 What reporting is available in the LOPA Module?

- The SLM® system has built in LOPA Recommendation reports. These reports can be filtered based on site and unit. See below examples of LOPA Views/Reports in the SLM® system:

8 How can the SLM® LOPA module benefit my business/plant?

- Besides similar benefits to the HAZOP Module (Efficiency, Standardization, Access to data, and Compliance). The SLM® LOPA Module offers the following added benefits:

ANALYSIS & PLANNING

PSM resources can do in-depth analysis of current design architectures and proposed modifications with unparalleled ease.

SUPPORT DURING REVALIDATIONS

With performance data available in the same platform, PSM resources can dramatically enhance revalidation efforts.
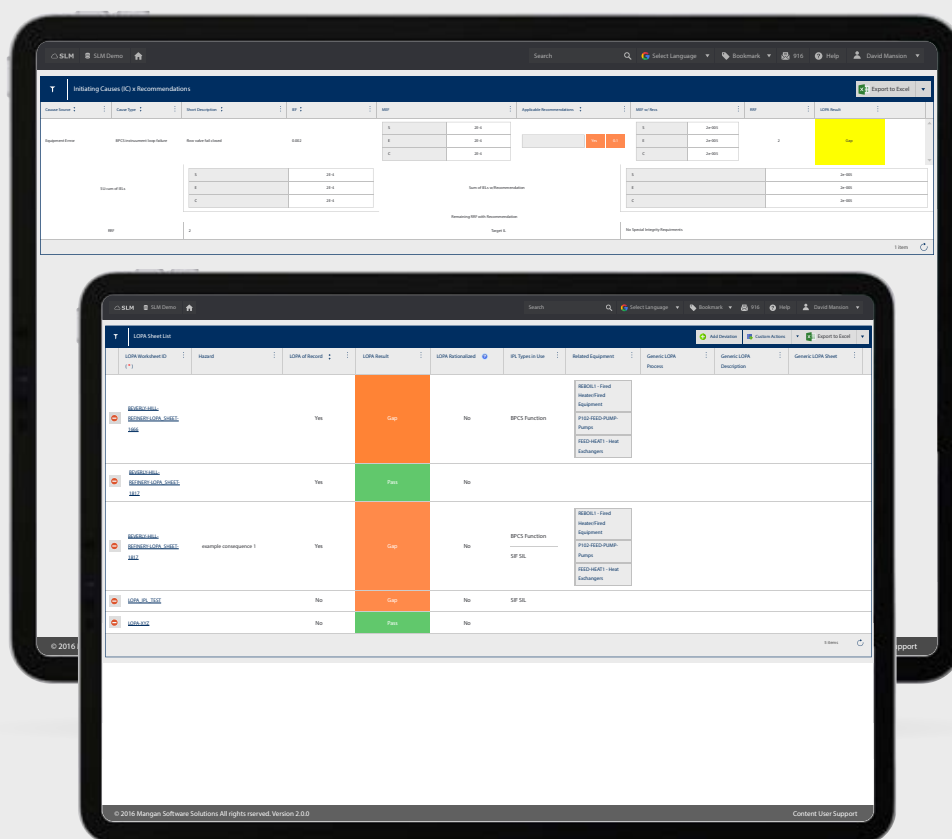
CONFIDENCE

The SLM® system allows organizations to be confident in the decisions they are making with data to justify those decisions.

ALIGNMENT

The SLM® system closes the gaps between Corporate and Site Engineering risk mitigation strategies and activities.

TRANSPARENCY

The SLM® system provides relevant and accurate data to those who are responsible, offering unpresented visibility into Site level Risk Mitigation activities.

CULTURE CHANGE

The SLM® system promotes collaboration, ownership, and accountability – users know the work they are doing will not be lost in the shuffle, and that their work will be more closely monitored.

9 Who owns the data in the LOPA Module?
- Typically, LOPA Study data is owned by PHA Execution Teams. Non "LOPA of record" data can be owned by Technical Authorities/SMEs.

10 Who at my company would use the LOPA Module and what would they use it for?

PHA TEAMS

Supporting Detailed analysis and design during PHA activities.

- -

PSM ENGINEERS

The SLM® system closes the gaps between Corporate and Site Engineering risk mitigation strategies and activities.

- -

PSM DIRECTORS

Unparalleled access to IPL data across all facilities.

- -

PSM MANAGERS

The SLM® system allows organizations to be confident in the decisions they are making with data to justify those decisions.

11 What are the main reports that are available in the LOPA Module?
- The SLM® system Includes the following reports in the LOPA Module:

  - Credited IPLs vs Recommended IPLs
  - Dynamic Risk Matrix
  - Dynamic Risk Matrix with Recommendations
  - IPL Assessment Overview
  - IPL Credit Breakdown
  - IPL Credit by Unit Type
  - LOPA Barrier Register
  - LOPA Critical Equipment List
  - LOPA Recommendations
  - LOPA Sheet Report
  - LOPA Sheets with Open Recommendations
  - LOPA Study Report
  - LOPA Worksheet List

BOWTIE
MODULE
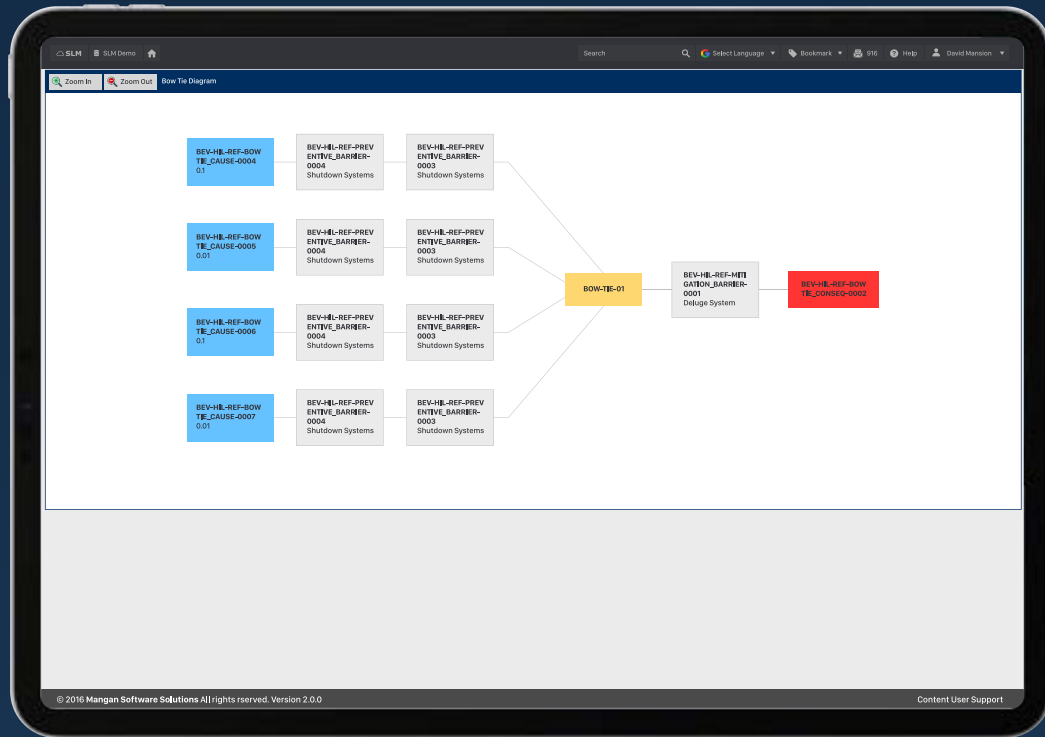
The SLM® system's BowTie module not only allows users to create a BowTie with one click of the button using existing LOPA data, but also allows users to execute barrier assessments to ensure the systems will be effective. The SLM® system will then print out a fully populated report on the Barrier Assessment, streamlining the Barrier Assessment process.

03

BOWTIE

Can you provide an overview of the Bowtie Module?

- The BowTie Module incorporates your existing hazard analysis data to facilitate Risk Analysis and Risk Assessments on your mitigation and prevention barriers. BowTie analysis communicates important risk mitigation measures for a wide range of facilities. Integration with the evergreen data in the LOPA Module ensures analysis is using the most up-to-date information at your organization's fingertips. BowTies provide a visual and interactive experience; allowing users to identify preventive and mitigating barriers. With the barrier assurance workflow, users have a complete picture of all barrier levels to determine the total risk of a hazardous event within the plant.
  See below example of BowTie in the SLM® system:
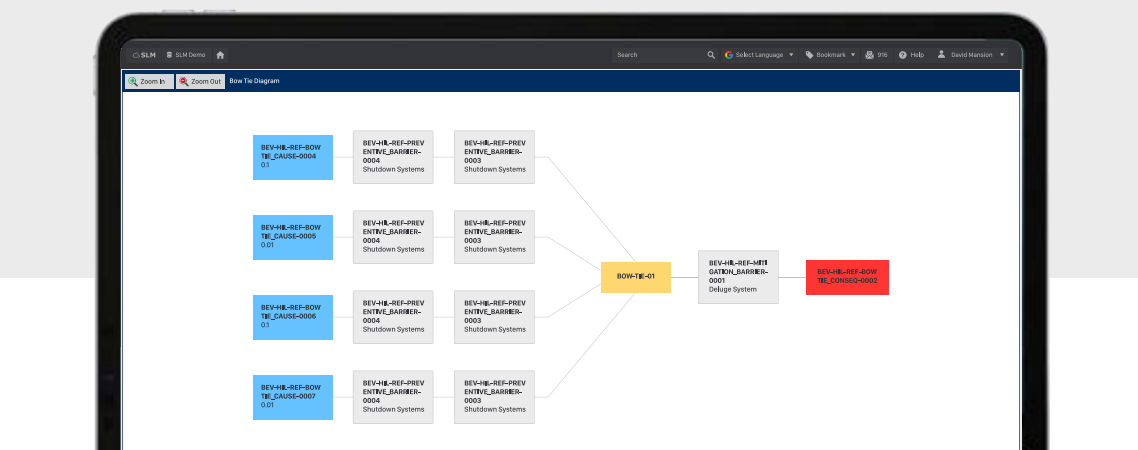
2 How can the SLM® BowTie Module benefit my business/plant?

- **Analysis and Visibility -** Comprehensive analysis via user-friendly visual representation of preventative barriers such as shutdown functions and mitigative barriers such as blast walls, containment systems or fire and gas systems for a complete picture of all available means to achieve risk reduction goals/targets.

- **Access to relevant data -** Automated and consistent access to information across the plant reduces overhead on data-searching and communication costs that drain time and resources.

3 Who owns the data in the BowTie Module?

- Typically, evergreen BowTie Study data is owned by PSM Resources. Additional BowTie studies can be done by any number of users across several Engineering Disciplines.

4 Who at my company would use the BowTie Module and what would they use it for?

PHA TEAMS

In support of IPL Analysis during PHA Study Planning, Execution, Reporting, and Sharing data.

PSM ENGINEERS

Support during Bypass Risk Assessments, Failure Analysis, and Project Planning and Execution.

5 What are the main reports that are available in the BowTie Module?

- The SLM® system Includes the following reports in the BowTie Module:

  - BowTie Studies
  - BowTies Fit for Service Results

INSTRUMENTED SYSTEMS
MODULE
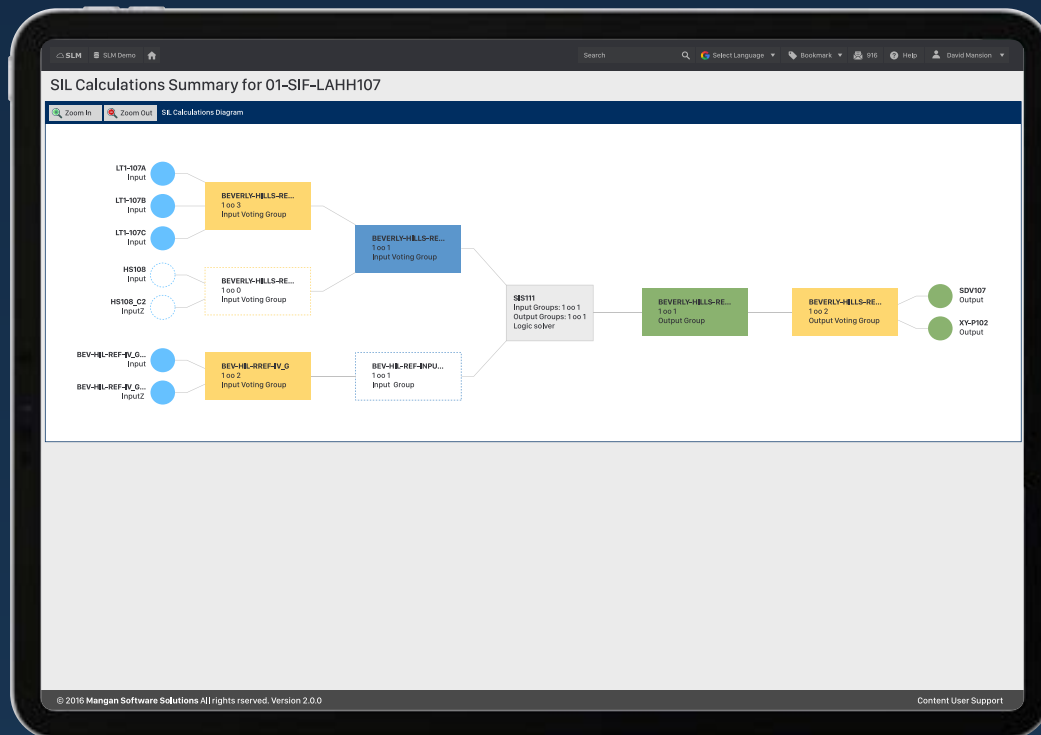
Identify, document and manage instrumented IPLs and their assets and equipment. A Safety Requirements Specification (SRS) can be a complex document. The SRS defines requirements for many topics and requires a significant number of supporting documents. Our SLM® software's SIL Calculation functionality is fully implemented and is now linked to the SRS for fast access to related safety specifications. The module comes standard with SIS and SIF SRS templates that incorporate ISA/ANSI 84.00.01 requirements and industry best practices. Users can define voting logic, and input/output structure of instrumented systems. Users can automatically create cause and effect matrices for all safety related functions. Systems are available automatically and immediately in the Operate/Maintain/Integrity Module to begin logging events.

04

INSTRUMENTED SYSTEMS

1 Can you provide an overview of the Instrumented Systems Module?

— The Instrumented Systems Module documents safety critical instruments and associated voting structures for evergreen Safety Requirement Specifications (SRS) with updated SIL calculations and Cause & Effect (C&E) Matrices available on-demand. It includes Safety Instrumented Function (SIF) diagrams that aid in visualization of the sensor/final-element layout and Safety Integrity Level (SIL) verification achieved using the SLM® system's powerful fault tree based SIL calculation engine. Accurately calculate complex voting structures with the click of a button. Any IPL (SIF, alarm, BPCS, etc.) in Instrumented Systems Module can be synchronized with Barriers or IPLs from HAZOP/LOPA modules.

See below equipment lists example in the SLM® system:

2 Does the SLM® system include Checklists for assessments to be completed?

— Yes, the SLM system includes over 70 standard checklists. The SLM® system Administrators can add new checklist to any object or object type in the System Module. The SLM® system also has reporting capabilities to track completion progress of any checklists.

See below example of a Audit Workflows and Checklist in the SLM system:

3 Does the SLM® system include Safety Integrity Level (SIL) Calculations

- Yes, the SLM® system uses TÜV certified IEC61511 compliant fault tree calculation methodology which allows for very complex calculations and SIF modeling with a few clicks of a button.

  See below example of SIL Calculations in the SLM® system:

4 Does the SLM® system allow tracking of elements not used in the SIL Calculation?

- Yes, the SRS allow modeling of inputs and outputs that are not part of the SIL calculation to allow for a complete architecture and automatic generation of complete C&E matrices.

- See below example of SIF Architecture including final elements not included in SIL Calculation:
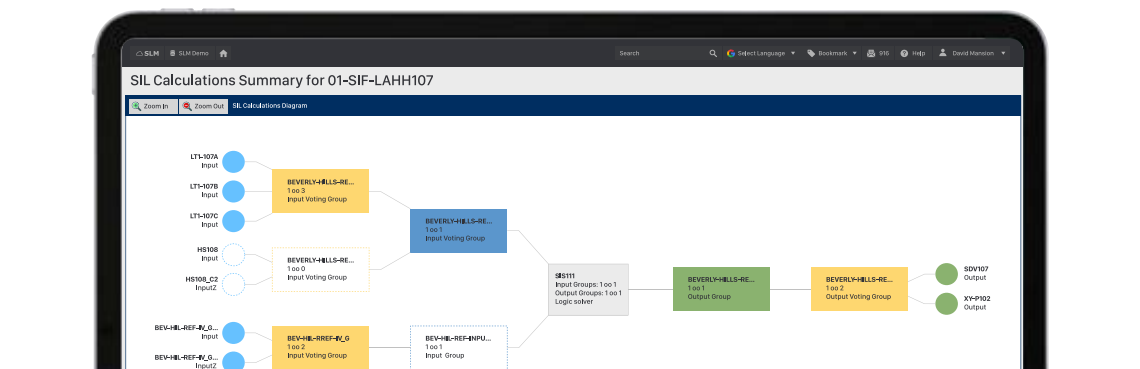
5 Does the SLM® system allow creation of Cause & Effect Matrices?

- Yes, users can quickly create C&E matrices. the SLM® system offers the below functionality for C&E:

    - SIFs, Alarms, Interlocks, and BPCSs can be easily added to the C&E matrix using a simple interface.
    - Users select Input and Output Devices to be included on the C&E.
    - Toggle between modes of operation: Startup, Shutdown, or Normal Operation.
    - Add Notes and Output Actions to each applicable C&E Input/Output intersection.
    - Export directly into Excel for quick and easy sharing and markup.
    - All tags listed in the C&E are hyperlinked putting access to relevant data sheets at user's fingertips.

- Can be configured to incorporate data that has already been added in the SRS phase. For example, the SIF SRS field "Output Action" is entered in the SRS, and then appears automatically in the C&E. This
- gives project teams a head-start on their C&E matrices while validating assumptions and design parameters in the SRS.

See below example of one-click C&E in the SLM® system:
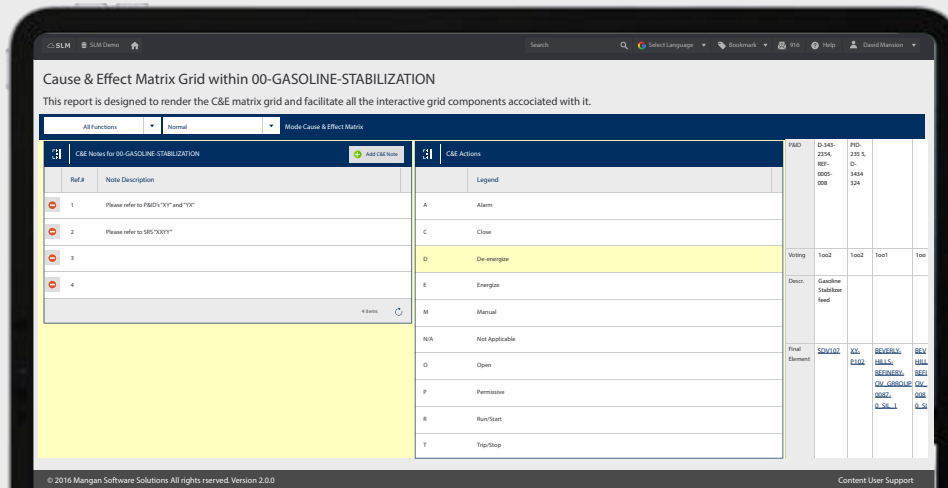
6 How does the SLM® manage Safety Requirements Specifications (SRS)?

- The SLM® system Instrumented Systems module is designed to be the complete SRS development and tracking package fulfilling all requirements of the IEC61511 and ISA84. Within Instrumented Systems the user can build all the safety functions employed within the Business Unit and provides the user with the ability to record and review a tremendous amount of data pertaining to these functions. Instrumented Systems also contains the SLM® system's Fault Tree based, Boolean Algebra SIL calculation engine to provide accurate and current failure rates. The SRS Report can either be viewed electronically within the module or printed out (exported) in a format configured by the user to meet the organization's practices.

7 Can a process Safety Requirement Specification (SRS) and detailed design SRS be managed separately?

- Yes, we have clients that have this specific capability in the SLM® system to maintain an "SRS of record" and conversely one for live process SRS. Some clients have set up the capability to maintain various version to maintain SRS of record through multiple phases of design.

- The SLM® system also tracks all data changes including who made the change, when it was made with before and after data images.

8 Does the Safety Requirement Specification part (SRS/ASRS) in the software support revision management and ability to handle several revisions of the SRS/ASRS?

- Yes, the SLM® system can be used to manage several versions of the SRS. The SLM® system is designed with true digitization in mind with full revision management, change tracking and auditing. MSS recommends using the SLM® system's Verification Checklist and configurable workflow functionality to track completion status and specific workflows for issuing for design, construction and record. Any number of customizable Verification Checklists can be attached to SRS objects and used to verify quality and completeness via lists of questions. Reports track how complete each SRS is through this process from both a data and a quality perspective.

- Users can use the cloning function to create a new version of an SRS. Users can also generate a .pdf SRS report at any time to capture a snapshot of data. The .pdf reports can be attached or linked to the SRS object

— The SLM® system's SIL calculation engine, as well as other components of the platform are TÜV Certified.

See below TÜV Certification:

Certificate

Functional Safety
TÜVRheinland
CERTIFIED
www.tuv.com
ID 0600000000
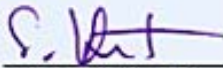
No.: 968/FSP 1719.00/18

Product tested	T2 Supporting Tool according to IEC 61508-3	**Certificate holder**	Mangan Software Solutions 12621 Featherwood Drive Houston, TX 77034 USA

Type designation Safety Lifecycle Manager SLM 2.4.1 (Operate Maintain Module, Instrumented Systems Module, Functional Safety Assessment Module)

Codes and standards IEC 61508-3:2010 (in extracts)   ANSI/ISA -84.00.01-1:2004 (in extracts)
IEC 61511 Parts 1-3:2016 (in extracts)

Intended application The Safety Lifecycle Manager SLM modules are used as supporting tools for engineering documentation and handling of life cycle documentation, Functional Safety Management (FSM), Operation and Maintenance related aspects of IEC 61511 / ISA 84. The assessed modules meet the requirements for T2 SW-Tools.

Specific requirements The instructions of the associated User Manuals shall be considered.

Valid until 2023-09-17

The issue of this certificate is based upon an examination, whose results are documented in Report No. 968/FSP 1719.00/18 dated 2018-09-17.
This certificate is valid only for products which are identical with the product tested.

TÜV Rheinland Industrie Service GmbH
Bereich Automation
Funktionale Sicherheit
Am Grauen Stein, 51105 Köln
Certification Body Safety & Security for Automation & Grid

Köln, 2018-09-17   Dipl.-Ing. Stephan Häb

www.fs-products.com
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TÜVRheinland®
Precisely Right.

10 How can the SLM® Instrumented Systems Module benefit my business/plant?

- Peace of Mind - The SLM® system TÜV Certified Workflows and Reports give you peace of mind that the plant is safe and that decisions are being made with accurate/evergreen data.

EVERGREEN DATA

The SLM® system offers an evergreen IPL register for better management and tracking of active IPLs.

IMPROVE OWNER/ CONTRACTOR RELATIONSHIP

The SLM® system improves communication and accountability between Owners and EPC/Contractors/ Consultants. Consultants can easily leverage previous Project works using standardized data.

UPDATED SIL CALCULATIONS

Update SIL Calculations with a few clicks

IPL RATIONALIZATION

Figuring out and documenting relationships between SIS/SIF and plant assets can be time consuming. The SLM® system eliminates the need for numerous excel files, custom access database, and endless communications/meetings to unravel years of complicated and non-integrated documentation.

CULTURE/ COLLABORATION

The SLM® system empowers Engineering teams to be confident they are systematically creating and managing data that will be preserved for additional use across the lifecycle and across the organization.

CONTRACTOR ACCOUNTABILITY

The SLM® system removes the guesswork around deliverables from Contractors through templates and one-click progress reports that allows unprecedented oversight and management of EPC/Contractors/Consultants.

DESIGN VERIFICATION

Using the the SLM® system checklists, users can systematically identify if designs meet LOPA requirements and easily communicated gaps to stakeholders who can easily access all relevant data and prioritize gap closures.

HANDOVER

The SLM® system facilitates handover to Operations with an accurate database of all instruments providing Critical Equipment protection.
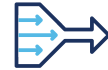
SIMPLIFY DATA

The SLM® system makes complex data relationships manageable/digestible

PREVENT OVER-ENGINEERED IPLS/ SOLUTIONS

The SLM® system provides clear concise data that may help identify or prevent over engineered SIS designs as design activities often initiate before SRS completion/resolution due to lack of integrated data management.

STANDARDIZED SRS

Using the SLM® system as a system of record for SRS ensures completeness and consistency without unnecessary information

DOCUMENT REPOSITORY

The SLM® system Document Management System (DMS) allows large amounts of documents to be attached to any object in the database. The DMS also allows users to include links to other Document Managements systems for seamless access to additional documents.

11 Who owns the data in the Instrumented Systems Module?

- Typically, data in the Instrumented Systems module is owned by Administrators or Technical Authorities/SMEs.

12 Who at my company would use the Instrumented Systems Module and what would they use it for?

SIS TECHNICAL/ DISCIPLINE AUTHORITIES

To enforce risk strategies, policies and compliance to industry (IEC 61511) and/or client-specific standards using templates and standardized workflows.

SAFETY INSTRUMENTED SYSTEMS SME

Quick access to create, analyze, and share design data.

INSTRUMENT CONTROLS & ENGINEERING TEAMS

To execute Risk Assessments and all SIL Calculations (SIL Verification, SIL Validation, etc.) and to generate reports easily. To establish Safety Requirements Specifications (SRS). To execute FSAs. To complete Gap Analysis.
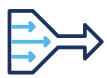
ENGINEERING MANAGERS

Access to Risk Assessments, SIL Validations, and reports.

CAPITAL PROJECTS TEAMS

The SLM® system offers a framework for planning, developing, and executing Analysis & Design activities including enforcing standardization from contractors using SLM's template functionality. Store and share large amounts of data versus physical files.

13 What are the main reports that are available in the Instrumented Systems Module?
The SLM® system includes the following reports in the Instrumented Systems Module:

- SIF List
- SRS Completion Report
- Generic SIF Templates
- Function Type Summary
- Input/output Asset Type
- SLM HIPS SRS Printout
- SLM SIF SRS Printout
- SLM SIS SRS Printout
- SIF Asset Protection Category Report
- Interlock Asset Protection Category Report
- Alarm Group Asset Protection Category Report
- Alarm Asset Protection Category Report
- BPCS Asset Protection Category Report
- F&GF Asset Protection Category List
- F&GF SSRS Report
- Document List

OPERATE
AND MAINTAIN
MODULE
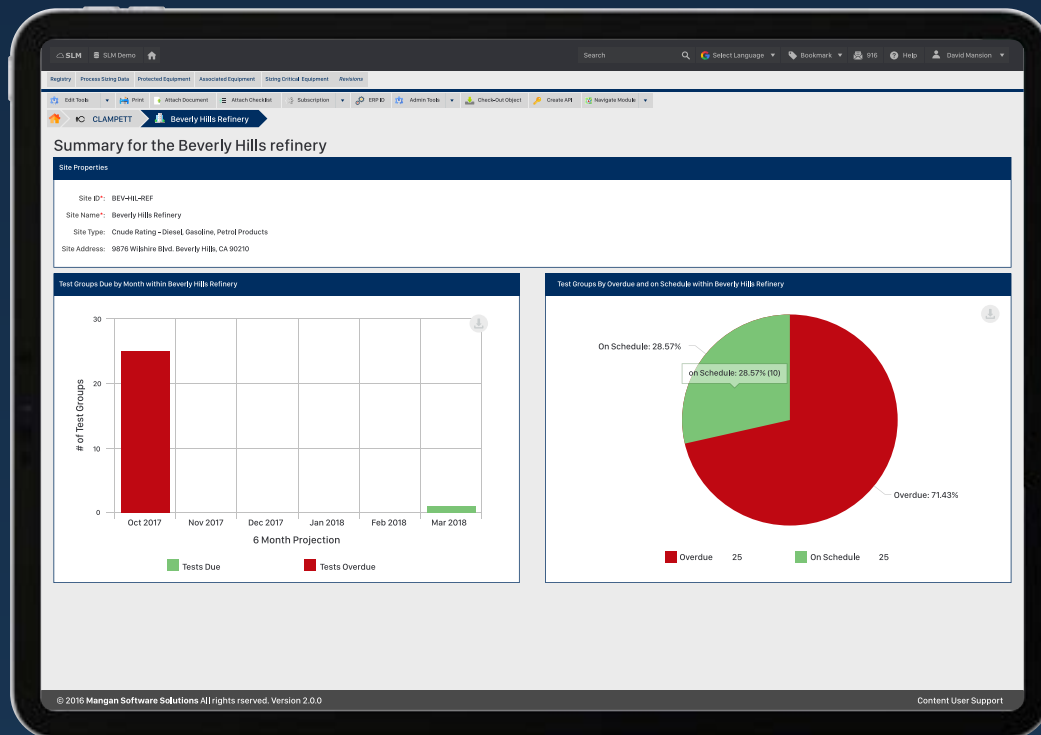
CMMS tools were not meant to manage the operations and maintenance of your safety instrumented systems. Neither was Excel.

The SLM® system gives maintenance and functional safety teams the ability to manage their asset integrity and reliability programs in full compliance with the ISA-84 Operate and Maintain requirements.

05

OPERATE AND MAINTAIN MODULE

1 Can you provide an overview of the Operate and Maintain Module?

- The Operate and Maintain Module is designed to capture the in-service performance of Safety Related IPLS and Safety Related Devices within a processing facility, and report on the history and status of these entities. Data captured over time allows managers to identify performance trends and address problems and performance. System users can easily define Test Procedures at the unit level and begin recording test data immediately. The Operate and Maintain module uses device event data to generate proven-in-use data and reliability statics.

2 What aspects of Operate and Maintain can be managed in the SLM® system?

- The SLM® system Operate and Maintain module has the following functionality:

- Using data analytics to generate KPIs and to determine the performance effect of individual devices upwards in the hierarchy to functions, process equipment units, facilities and the enterprise.

- Bypass/override management. The SLM® system allows users to apply for and approve bypass authorizations with actual bypass tracking from historian data. The system displays KPIs informing the user of availability and effects of bypassing from the function level and process equipment levels.

- Test planning. Users can set up test plans and the system will track overdue and due tests and has a test deferral authorization system.

- Fault failure analysis.

- Efficient semi-automatic data entry where tests with no failure results are automatically propagated to all of the associated devices (transmitters, valves, etc.).

- Automatic failure rate statistics generation for device types based on individual device performance. Failure rates are fed back into the SIL verification calculations.

- Demand/activation tracking and classification with KPIs.

- Bad actor identification.

- Event collection. Each Operate and Maintain event is saved in SLM® system and can be accessed through search engines or filterable tables.

- Approvals processes where events can be required to be approved by a selected approver before affecting the system data.

- Tier 3 leading indicator metrics.

See below example of analysis available in the SLM® system. Below is an Optimal Test Interval analysis being done on a SIF:
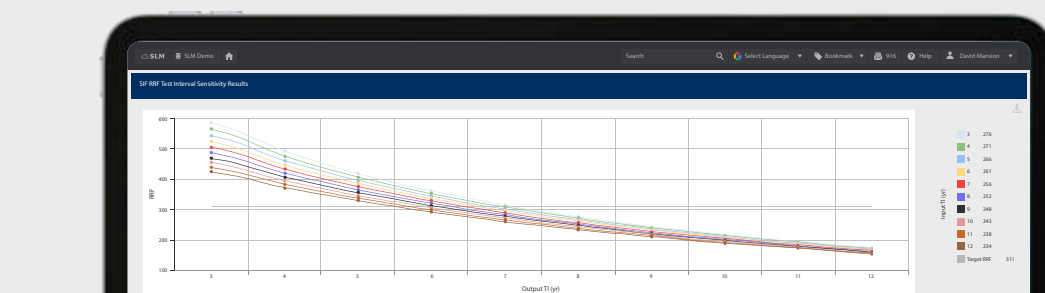
3 Does the SLM® system record Risk and Event categorization data.

‐ The SLM® system provides functions to record Risk and Event categorization data. It contains every field required to accurately and efficiently fulfill all aspects of the Safety Lifecycle. Bypasses and other Service Status Events are recorded and maintained in the Operate and Maintain module.

‐ A more recent development within the software is the LOPA Risk Matrix which brings in live data from bypasses in Operate and Maintain module. This allows the user to feed live data from operations into their risk analysis creating a true evergreen Risk Matrix. A function identified as a barrier which is placed in bypass, will display the effect of the (temporary) loss of this barrier on the Risk Matrix by the appropriate amount (depending on the reliability of that function).

4 How does the SLM® system manage Functional Proof Tests?

‐ Following completion of the Design and Safety Requirements Specification, IPLs can then be associated to Test Procedures in the Operate and Maintain module. The Test Procedure is assigned a First Test Date and a Test Interval facilitating a framework for test planning and scheduling. When system users log a Test Event on a particular Test Procedure, the IPL and the devices are given credit for proven in time. The SLM® system adds proven time on Input and Output devices for Passed test events, and logs failures for any failed test events. Through reporting, proven hours and failed events accumulate on device generic models allowing an Enterprise to track In-Service failure rates for commonly used equipment. As stated earlier, these failure rates can then be fed back into the SIL Calculation when the time comes to revalidate SIL.

‐ The following is a list of Events that can be logged in the SLM® Operate and Maintain module per IPL:

Demands	Tests	Maintenance Events	Faults/Failures	Bypasses	Service Status Changes
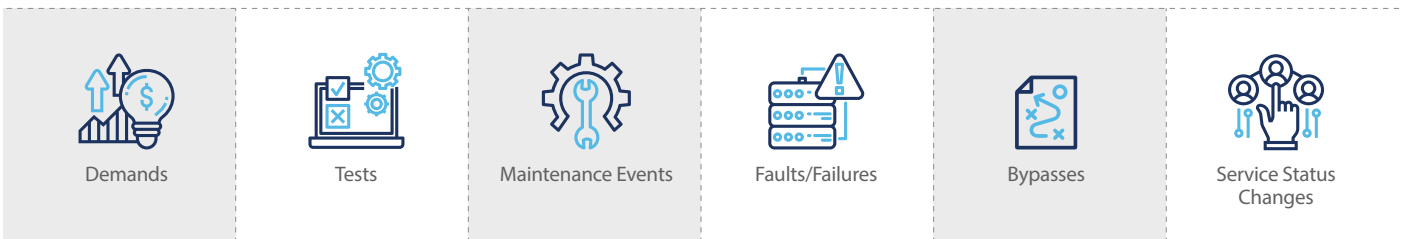
‐ Each event type follows the same basic workflow in which a user can add performance detail for the IPL as well as each individual device. Using just the data collected in Test Events, Bypasses, and Demands, site management can track the following Tier 3 metrics per IPL:

- ‐ **Availability:** 1 / (Time Bypassed/Time in service)
- ‐ **Demand rate:** Process Demands/Time in Service
- ‐ **Failed Test Rate:** Failed Test Events/Time in Service
- ‐ **Fail to Operate Rate:** Failed Process Demands/Time in Service

‐ Tier 3 metrics are reportable at the Site, Unit, and Equipment level allowing site management to identify performance trends and possibly faulty equipment and IPLs.

See below examples of reports in the SLM® system:

5 Does the SLM® system offer Bypass Management functionality?

- Bypass events can be viewed from the Site, Unit or Function level. Different views include; Active Bypasses, Approved Bypasses – Pending Bypass, Bypass Authorizations - Not Approved, Bypass Authorizations – Pending approval, and Closed Bypasses.

- Bypass, Demand and Test Event results impact IPL KPIs and roll up to the Unit/Site level.

See below screenshot of Bypass workflows in the SLM® system:
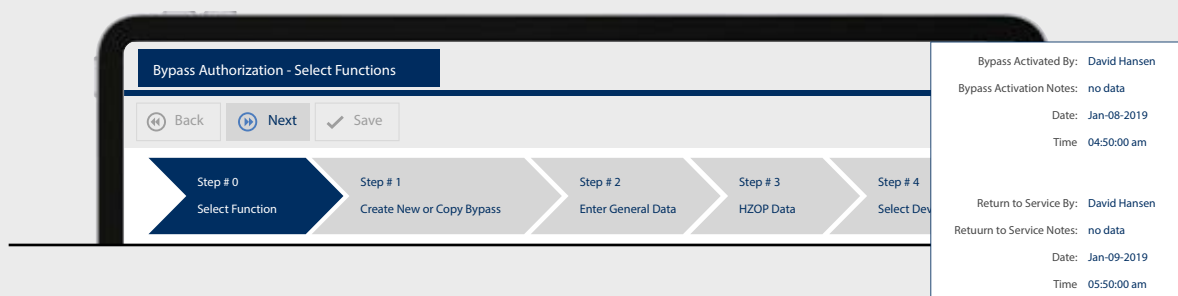
6 Does the SLM® system offer ability to document Fault Codes / Failure Rate Analysis?

- Results from Tests, Demand, and Bypasses affect the generic model failure rates. In turn, this can affect the In-Service calculation of achieved SIL for a SIF. Standard failure codes in accordance with ISO 14224.

- Demands and Tests that are logged on Functions are also logged on the components. The example below shows the Test Event workflow and the ability to log individual device results that drive generic model failure rates and In-Service SIL Calculations:

7 Does the software provide any tools to aid with the creation of SAT and FAT procedures? Can test results be logged within the tool?

- The SLM® system can be used to support much of the SAT or FAT activities:

- The SLM® system allows the users to track/log the results of the tests and to use the Test Group functionality to plan and document SAT and FAT tests and select functions directly from the SLM database. Users can attach detailed test procedure documents to the applicable Test Groups.

- The SLM® system does have the capability of easily generating C&E documents which are generated directly from the Information of Record SRS data. Since SAT and FAT tests are usually performed against C&E documents, this feature ensures the tests are validating installed SIF and interlock functionality against accurate SRS data.

- The Functional Safety Assessment module can be used to document internal and external functional safety assessments in detail and create and track actions if deficiencies are discovered. The functional safety assessment questions include assessing the results of the SAT or FAT tests. The SLM® system comes with a comprehensive library of functional safety assessment question lists.

- Tasklist questions can be attached to each FAT or SAT test group to ensure that all the required steps are executed.

- The Personnel module can be used to develop a FAT or SAT plan, including evaluating the competency requirements, actual competencies and documenting competency gap closure requirements.

8 Does the SLM® system offer a failure rate database? If yes which ones? If so, how is data gathered and assured? Is there a possibility to use user defined databases?

- SLM® system is designed to capture our clients Prior Use data in the Operate and Maintain module in order to generate failure rates for the devices that are used in their various processes. The system includes best practices that determine if a device model's failure rate data is enough to use in SIL calculations. Examples of some of the requirements include:

  - At Least 100 Units Installed Enterprise-Wide

  - At least 1000 Units installed Industry-Wide

  - At least 100 Years cumulative Service - Enterprise-Wide

  - Have at least 100 Events been recorded for this Device Type?

  - In-Service Failure Rate meets minimum requirements?

  - Manufacturer ISO 9000 Compliant?

  - Does this Device Type have clear and complete documentation?

  - Are Failure Modes of the Device well understood?

  - Does this Device have adequate adjustment controls?

  - Are Site Maintenance Personnel trained and qualified on the Device Type?

- The system is also able to compare the the SLM® system -generated failure rate with other commonly used failure rate sources. These failure rates can be bulk imported into the SLM® system and used in the SIL calculations. These failure rate sources include:
  - NAMUR
  - OREDA
  - PERD
  - Exida
  - SIS-Tech
  - Kenexis

- The failure rates can also be broken down by the service the device is being used in. The system provides failure rates for General Clean Service, Moderate Service, Severe Service, as well as total failure rate.

- Gathering failure rate data can be entered into the system in multiple ways. Test results exported from existing computerized maintenance management systems, spreadsheets and incident logs are how some clients manually enter failure rate and test result data.

- Some clients choose the integration path connecting to existing maintenance systems, data historians and internal applications to collect past and current failure events to populate their SLM® system Prior Use database. Sensors and final elements that pass the functional and systematic criteria can be issued a Prior Use certificate.

9 Does the software have the ability to create proof test procedures? Are there any templates available in the software?

- The SLM® system does not "create" proof test procedures but does have the ability to attach externally generated proof test procedures to Test Groups (maintenance plans) in the Operate and Maintain Module and track the "As Found" and "As Left" results of the test. The results tracking workflows allow assigning of failure codes to each function and device, and users can also document the results in detail using text fields. Each test result is stored in the system as a test event. Test Groups are used to plan testing activities. Functions and devices are added to test groups and the SLM® system automatically tracks and notifies users when the tests are due or are overdue and can be used to document, justify and approve or reject test deferrals. The results of the tests feed back into the system and are used to calculate prior use SIL verification calculations, to monitor the performance of device types, and to generate KPI information and identify poor performing functions.

10 How can the the SLM® system Operate and Maintain Module benefit my business/plant?

ACCURATE DATA

Validated event data is crucial. Keeping it organized and available for anyone, anywhere is what the the SLM® system Operate and Maintain Module offers.

VISIBILITY

Have real-time data for analysis on IPL performance (Active bypass, demands, failed tests).

SINGLE SOURCE OF TRUTH

Eliminate the need for multiple sources of critical safety data.

IMPROVED WORKFLOWS

the SLM® system provides user friendly workflows to plan, schedule, execute, and document test results in a standardized way, making data usable not only across your plant, but across the organization.

REPORTING

One click reporting dispersed to those who need the data most.

STANDARDIZATION

Create and enforce repeatable processes to ensure quality data.

SUPPORT DURING FAILURE ANALYSIS

the SLM® system workflows, checklists, graphics and hyperlinks to Process Safety Information make Failure Analysis efficient and thorough.

11 Who owns the data in the Operate / Maintain Module?
- There can be many owners of data in the Operate / Maintain module as it supports dynamic management of event activities. Test results, bypass authorizations, and entering failure analysis data can all be managed by a range of users.

12 Who at my company would use the Operate / Maintain Module and what would they use it for?

GLOBAL DIRECTORS

PSM/ICE/Reliability – KPIs / Dashboard Reporting of Critical Equipment.

OPERATIONS

Improved work processes for Bypass Authorizations & Execution, Test Scheduling and Documentation, one-click reporting, and more.

REGIONAL/ BU DIRECTORS

PSM/ICE/Reliability – KPIs / Dashboard Reporting of Critical Equipment.

PLANT MANAGERS

Real-time Dashboard view of plant Safety Profile. Trend Analysis via access to accurate/relevant IPL performance data.

RELIABILITY / MAINTENANCE MANAGERS

One click reports versus weeks of data management activities each week/month/quarter, support during Failure Analysis, Test Interval Optimization Analysis, responding to Deferral requests, and more. To help identify bad actors.

MANGAN
SoftwareSolutions

13 What are the main reports that are available in the Operate / Maintain Module?

- The SLM® system Includes over 70 reports in the Operate /Module. A few examples are:

- Bypass Events
- Active Device Bypasses
- Availability Bad Actors
- Bypass Override Procedure Worksheets
- Current Bypasses
- Demand Events Recorded
- Demand Rate Bad Actors
- Demand Rates
- Demand Status
- Demand Summary
- Device Event Summary: INPUTS
- Device Event Summary: OUTPUTS
- Device List
- Device Summary: INPUTS
- Device Summary: OUTPUTS
- Devices Last Event Failed
- Devices with Events Prior to Install Date
- Devices with No Events
- Equipment Scorecard
- Event Type Summary
- Failure Distribution By Generic Model
- Failure Distribution By Generic Model Graph
- Failure Distribution by Site
- Failure Rates
- Failure Summary
- Generic Models/Prior Use Statistics
- INPUTS Failure Rates
- Install Count and Hours in Service by Gen. Mode
- IPL List

- List F&GFs and TGs
- List Interlocks and MPs
- List Interlocks/Inputs/Outputs and MPs
- List SIFs and TGs
- Lists Alarms and TGs
- Lists BPCS and TGs
- Operate Fail to Test Actors
- Outputs Failure Rates
- Prior Use Dataset Change Report
- Prior Use Statistics
- SIF/SIS/Logic Solver with no Test Groups
- SIFs with TGs Test Intervals
- SIL 3 SIFs Overdue vs Completed Test
- Specific Input Devices By Unit
- Specific Output Devices By Unit
- Spurious Trip
- Spurious Trip Rate Actors
- Test Group IPLs and Devices
- Test Groups by Functions
- Test Groups by Overdue and On Schedule
- Test Groups with no I/O
- Test Groups with no Last Test date
- Tests Groups Due
- Tier 3 Scorecard
- Tier 3 Summary
- Tier 3 Scorecard for SIFs
- Upcoming Tests
- Upcoming Tests Look Ahead

FUNCTIONAL SAFETY ASSESSMENT (FSA)
MODULE
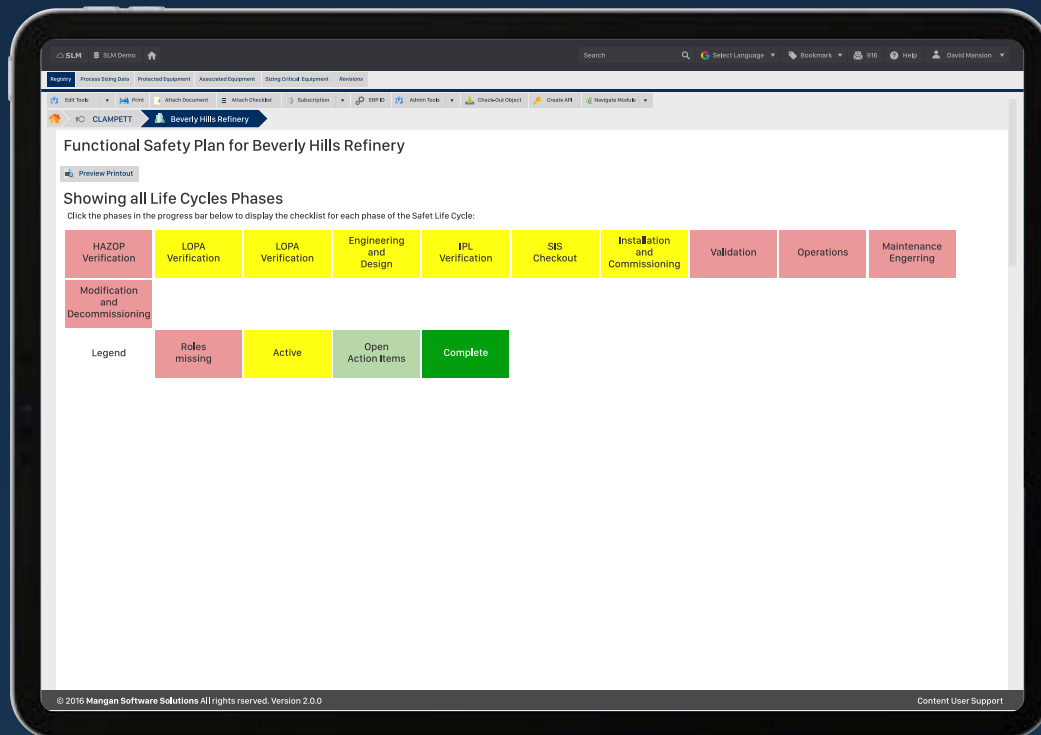
The SLM® system's Functional Safety Assessment module allows you to readily complete a stage 1 through stage 5 FSA in a standardized format -- ensuring consistency throughout your organization. This tool allows you to define requirements for an FSA then use the application to improve the effectiveness and efficiency of execution. The integration of all Safety Lifecycle data provided by the SLM® system also allows for effective integration of FSA data with other critical data such as HAZOP and LOPA studies, Safety Requirements Specifications and SIS Performance

06

FUNCTIONAL SAFETY ASSESSMENT (FSA)

1 Can you provide an overview of the FSA Module?

The SLM® system's Functional Safety Assessment module allows you to readily complete a Stage 1 through Stage 5 FSA in a standardized format – ensuring consistency throughout your organization. This tool allows you to define requirements for an FSA and then use the application to improve the effectiveness and efficiency of execution. The integration of all Safety Lifecycle data provided by the SLM® system also allows for effective integration of FSA data with other critical data such as HAZOP and LOPA studies, Safety Requirements Specifications and SIS performance.

See below example of FSA workflows:
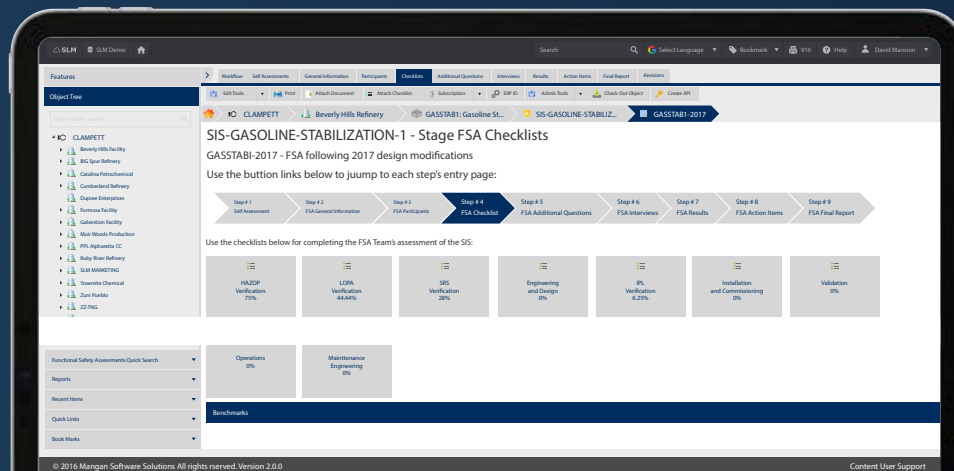
2 Can the software support audit mechanisms and provide/generate checklists for use in assessments and audits; EX: Functional Safety Assessments?

‒ The SLM® system includes a fully developed Functional Safety Assessment (FSA) module that utilizes a workflow process and developed but modifiable checklists to allow users unfamiliar with assessment processes to easily manage assessment workflows and reporting. The user can select different types of assessments or audits, and checklist and interview requirements are populated as required.

‒ The FSA can be used to document and assign FSA actions which are tracked by the SLM® system Action Item Tracker module.

‒ The FSA module generates KPIs and automatically generates assessment reports.

3 How would the tool be used for functional safety assessments? Has it been used by customers in an area where FSAs are becoming more important to regulators (e.g., the UK)?   If so, what was the result?

‒ The SLM® system Functional Safety Assessment (FSA) module allows users to perform a stage 1-5 FSA through workflows and tasklists that guide an independent chairperson and FSA team through the process of executing an FSA. The checklists that are included in the system were created through best practices from industry SMEs with years of experience conducting and facilitating FSAs. The Standard FSA tasklists are tied to ISA and IEC standards to assess conformance with those requirements. The checklist within the system can also be modified to conform to our clients own FSA standard checklists. In addition, our FSA module allows sites to perform "self-verification" (internal) FSAs, and SIS audits.

‒ Enterprises large and small use the FSA module to facilitate and document their FSA results. The FSA module is used extensively as part of their ongoing process safety management plans. At BP, FSAs

are required to ensure the hazards arising from a process and its associated equipment are properly controlled, per SIS. BP outsourced FSAs to SIS SME Engineering Service Providers at an average cost of $75K per SIS. Each FSA had long durations, impacted local resources, and follow-up on findings and action items were challenging. With some locations forecasting over 30 FSAs in 2014, execution became a cost concern. The FSA module features a workflow standardized FSA process, automating final reports and eliminating costly 3rd party consultant deliverables.

- Conformance Scoring and help features within the solution offered them a virtual SIS SME for the sites executing FSAs, improving the safety culture of the sites, ensuring standardization across the enterprise and offering BP the chance to internally source these projects. As a result, BP saw FSA projects cost reduce 66% to ~$25k each using automated reporting. There was an increase of SIS/FSA competency, and BP transitioned to internal FSA chairpersons. Engineers were able to track action items and justify conformance gap closure to leadership, leading to a safer facility. Process Safety Information available from SIS/LOPA data within the software shortened the duration of the FSA sessions by 44%.

- MSS' strategic partner, AIM, has decades of experience with UK/EU regulations, and execute FSAs as part of their service offering.

4 How can the FSA Module benefit my plant/business?
- The FSA module truly highlights the power of the SLM® system. Stage 1-5 Functional Safety Assessments become extremely efficient once Process Safety Information, Design, and other relevant data are entered. This can offer greater visibility into potential issues before they become costly to remediate.

5 Who owns the data in the FSA Module?
- Typically, data in the FSA Module is owned by FSA Execution Teams as well as Engineering Managers.

6 Who at my company (titles/positions) would use (Module) and what would they use it for?
- FSA Execution Teams would be the primary users to take advantage of the FSAs user friendly workflows. Additionally Engineering Teams would want access to this information after they have been completed.

7 What are the main reports that are in the FSA Module?
- The SLM® system Includes the following reports in the FSA Module:

  - FSA Checklists Completion
  - FSA SSRS Final Report

MANAGEMENT OF CHANGE (MOC) MODULE
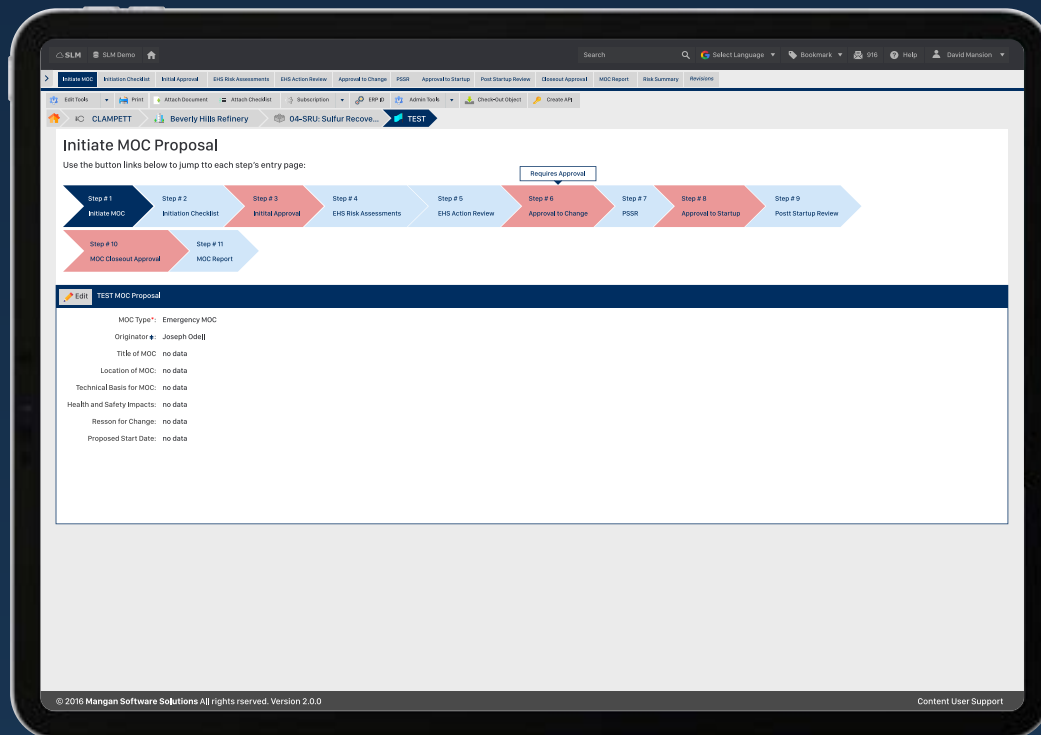
The SLM® system's MOC module creates a standardized 10-step approach for your Change Management process. The software workflows provide tools which facilitate the evaluation and control of design modification, operation, technology, facilities, equipment or procedures. Progress through your MOC with the required checklists, assessments, reviews and approval processes -- all generated within the SLM® system MOC. Quick Links to Process Safety Information within the other modules accelerates the MOC process and ensures accurate analysis of potential hazards. As with all of the modules, the flexible SLM® platform makes configuration fast and inexpensive.

07

MANAGEMENT OF CHANGE (MOC)

1 Can you provide an overview of the MOC Module?

- MOC creates a standardized 10-step approach for your Change Management process. The software workflows provide tools which facilitate the evaluation and control of design modification, operation, technology, facilities, equipment or procedures. Progress through your MOC with the required checklists, assessments, reviews and approval processes – all generated within MOC. Quick links to Process Safety Information within the other modules accelerates the MOC process and ensures accurate analysis of potential hazards. As with all of the modules, the flexible SLM platform makes customization fast and inexpensive.

  See below example of MOC Workflows in the SLM® system:
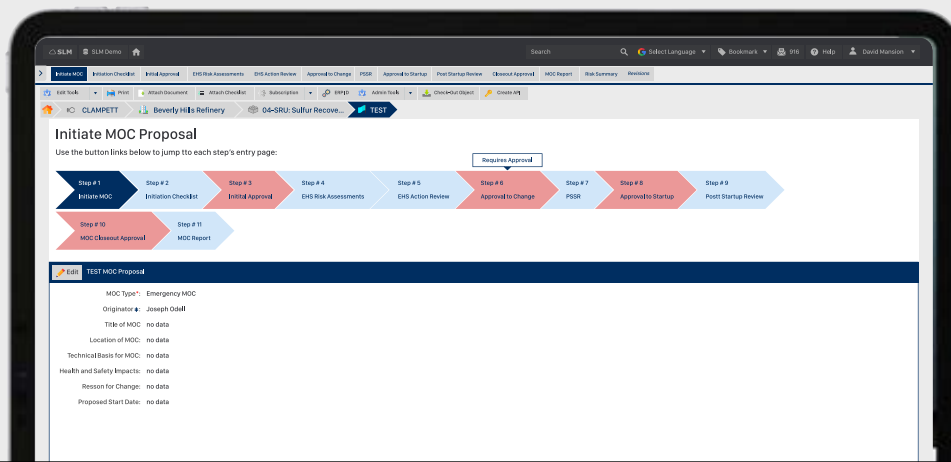
- The SLM® system MOC Module uses a Stage Gate workflow methodology. The workflow was developed in conjunction with industry veterans and improved over the years by our User Groups, client feedback, and Road Map Planning Committee. Additionally, workflows can be configured to meet IPL specification for methodologies, standards, and practices.

- The SLM® system allows MOC reviewers to view all steps of the approval process. Each unique MOC populates with a basic 10-step flow diagram showing users where they are in the MOC process. Approval gates that have been passed or validated show as green. MOC users can review completed steps but can only change subsequent (un-approved) steps.

01 STEP
INITIATE MOC
Enter basic MOC info to include MOC reason. Associate Process Equipment to MOC.

02 STEP
INITIATION CHECKLIST
Answer Scoping Questions that will populate the MOC with predetermined checklist items and automatically categorize the Level of Change and Degree of Hazard.

03 STEP
INITIAL APPROVAL
Approver(s) review the scoping questions and approve the Initiation of the MOC

04 STEP
EHS RISK ASSESSMENTS
MOC team participants respond to standard MOC checklist items and add action items where necessary.

08 STEP
APPROVAL TO STARTUP
Approver reviews the PSSR and can submit for approval

07 STEP
PSSR
Provide responses to the Pre-Startup Safety Review questions.

06 STEP
APPROVAL TO CHANGE
Approver reviews Risk Assessment responses and ensure action items are closed. Following the approval, the MOC project work is completed.

05 STEP
EHS ACTION REVIEW
Close any action items before the Change is approved.

09 STEP
POST STARTUP REVIEW
Closeout open Post Startup actions.

10 STEP
MOC CLOSEOUT APPROVAL
Approver reviews the MOC Final Report and approves

11 STEP
MOC FINAL REPORT
Print Final MOC Report to PDF. This step compiles all steps into one read-only view.

2 How are communications managed? (Organization, managing and dissemination of communication within the MOC workflow)

The SLM® system has workflows for notifying MOC participants within the SLM® system as well as integrating with your current emails systems. The platform is configured to send email notifications. The SLM® system has a subscription capability allowing for notifications when the MOC has been changed by any other system users.

3 Describe customizations/workflow management (Ability to customize and manage a defined sequence of tasks)

The SLM® system was specifically designed to be able to be configured to each of our client's unique standards and practices, including workflows, templates, tasklists, reference tables, etc. the SLM® system current workflow can be modified to add or remove MOC steps. With Admin privileges, checklist items can be modified based on site needs.

4 Does the SLM® system include the ability to select alternatives, substitutes, and overriding approvers for each step in the MOC process.

The SLM® software workflows are configurable to meet the needs of our customers. Kraton can assign pre-defined criteria for multiple, alternate, substitute, or overriding approvers for each step in the MOC process. Pre-defined criteria can be equipment based, process type based, or any number of predefined criteria, or designated at any point throughout the MOC process. This capability can also be defined on a per MOC at any step in the MOC process.

5 Does the SLM® system include the ability to send out email and text message alerts and notifications.

The SLM® software has workflows for notifying MOC participants within the SLM® system as well as integrating with your current email systems as well as mobile multi-factor authentication for approvals of MOC. In addition, the SLM® system has a subscription feature which enables subscribers to a particular MOC to receive automatic notifications when the MOC has been modified or updated by a user.

- Approvals
  IPL can assign pre-defined criteria for multiple, alternate, substitute, or overriding approvers for each step in the MOC process. Pre-defined criteria can be equipment based, process type based, or any number of predefined criteria, or designated at any point throughout the MOC process. This capability can also be defined on a per MOC basis at initiation. Users can also rescind approvals in cases where specific MOC steps must be repeated and re-approved.

- The SLM® system provides the ability to approve MOCs electronically, including requiring token security keys sent electronically.

- MOC Action Item Management
  The SLM® system Action Items Tracker Module functionality is incorporated into the MOC workflow:

  - The SLM® system has robust Action Item Tracking functionality.
  - Action Items can be initiated and updated through the eMOC interface, or through the Action Item Tracker module.
  - The SLM® system is configured to allow positive responses to eMOC checklists to generate default action items.
  - Users can predefine which MOC step the Action Item will become active and assign to site/unit MOC roles.
  - Action Items can be cloned to reduce data entry requirements.
  - The SLM® system Action Item Tracker Module also includes commonly used reports and allows for custom reporting if needed.

- **Notifications and Alerts**

    The SLM® system has workflows for notifying MOC participants within the SLM® system as well as integrating with your current emails systems. The platform is currently configured to send email notifications. The SLM® system allows subscription to MOCs that pushes automatic notifications when the MOC has been changed by any other system users. Phone numbers and service providers can be added to specific user accounts to allow text notification.

- **MOC Reporting**

    Enterprise, Site, and Unit-level reporting is built into the views for the SLM® system data hierarchy. At each level or scope, system users have quick report access to:

    - My Action Items
    - My Approval Queue
    - My MOCs

- On each report, the user can toggle to "View All" which will expand records to include all users.

- This generic reporting capability allows even enterprise-level managers to access and report on all MOCs with just a few clicks.

- The SLM® system facilitates statistical and comparative analysis and "out of the box" reporting for each Site and Unit Depending on the level of complexity, reports can be configured by either MSS or IPL. Every data object, report, or list in the system can be printed or exported into Excel or PDF. The SLM® system has many built-in KPIs to ensure alignment with corporate risk mitigation strategies.

- Administrators can establish dashboard views based on security roles. Administrators can also allow the SLM® system users to configure their dashboards to include recently viewed items, quick links, and bookmarks to quickly access data or go to frequently visited areas.

- **Configurability**

    The SLM® system was specifically designed to be able to be configured to each of our client's unique standards and practices, including workflows, templates, task lists, reference tables, etc. Workflows can be modified to add, remove or change MOC steps that come "out of the box". The SLM® system uses the latest and most user-friendly interface for ease of use. Admin-level privileges allow configuration for MOC generic roles that can be added, changed, or removed based on evolving site needs. Roles are then applied to system user accounts. On an Enterprise system, roles can specify down to the site level allowing for varying approvals and action item management across sites.

6 Does the SLM® system allow users to conduct Pre-Start Up Safety Review.

- The SLM® system includes a robust intuitive PSSR Workflow in addition to a selection of checklists out of the box or configurable to existing checklists.

- Also, as PSSR is a part of the SLM® system MOC Workflow, please refer to Section 3 of the "MSS Functional Requirements Supplement" document Requirement No. PSM004-011

7 How can the MOC benefit my business/plant?

- The SLM® system MOC Module can greatly enhance the entire MOC process with intuitive workflows and comprehensive Action Items Management and Reporting. MOCs can easily be tracked and viewed by anyone, anywhere. the SLM® system allows remote workgroups to collaborate seamlessly.

8 Who owns the data in the MOC Module?

- Typically, evergreen MOC data is owned by MOC Teams/Workgroups.

9 Who at my company would use the MOC Module and what would they use it for?

- MOC Teams/Workgroups would be the primary users of the SLM® system MOC Module. View only access allows a wide range of users to access needed MOC data.

10 What are the main reports that are in the MOC Module?

- The SLM® system Includes the following reports in the MOC Module:

  - Action Items Assigned
  - MOC List
  - NOC Report
  - Open MOCs by Type
  - Overdue MOCs

ACTION ITEM TRACKER (AIT)
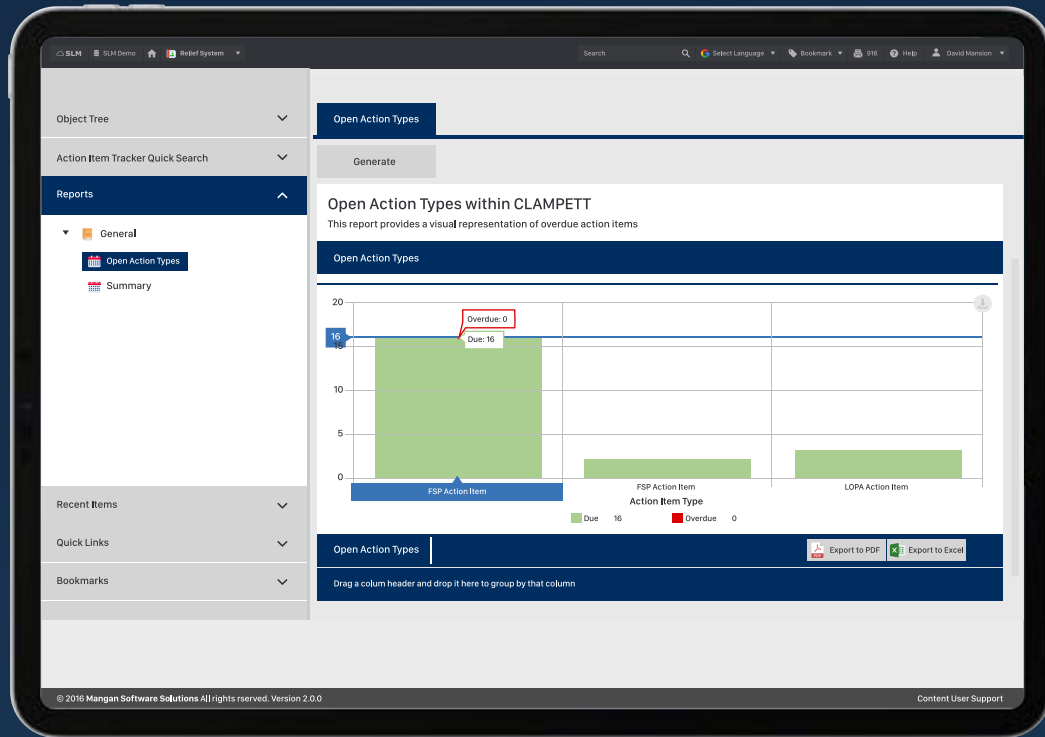
The Action Item Tracker Module is a centralized location where users can create and access action item information from all modules for follow-up & reporting. Data relating to the action item is linked across modules and readily available for reference purposes. Custom reports and KPIs are available with a click of the mouse.

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ACTION ITEM TRACKER (AIT)

1 Can you provide an overview of the Action Item Tracker Module?

- The Action Item Tracker Module is a centralized location where users can create and access assigned action item information from all modules for follow-up and reporting. Data relating to the action item is linked across modules and readily available for reference purposes. Custom reports and KPIs are available with a click of the mouse.

2 Does SLM® system have ability to assign and monitor tasks/actions within MOC workflow?

- Yes, the SLM® system has robust Action Item Tracking functionality. Action items can be updated through the MOC interface and workflow, or they can be completed through the Action Item Tracker module. The SLM® system is currently configured for Default MOC Action items where positive responses to MOC checklists generate action items. Action Items can be cloned to reduce data entry requirements.

INFORMATION TECHNOLOGY (IT)

MSS employs a multi-tier Deployment Model. This includes Development, QA/Staging and Production Deployments. Prior to a release or upgrade to customer data, an update is applied to a development/QA instance on MSS Systems to ensure successful functional deployment

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INFORMATION TECHNOLOGY (IT)

1 Can you describe scheduled maintenance times and upgrade schedule?

- MSS works with our licensed customers to ensure timely and successful updates of their SLM® system software. This includes data validation for new releases as well as timely security updates for any vulnerability identified through our continuous application security testing.

- Cloud Deployed Instances: For Cloud Deployed Instances hosted and managed by MSS. MSS employs a multi-tier Deployment Model. This includes Development, QA/Staging and Production Deployments. Prior to a release or upgrade to customer data, an update is applied to a development/QA instance to ensure successful functional deployment. A data snapshot is taken from Production and applied to a staging instance which mirrors the production environment and additional testing and validation of data is performed. Once complete and signed off MSS schedules a system update window with the customer and completes the system update to production.

- On-Premise Deployed Instances: For On-Premise instances managed by our customers or third-party IT organizations. MSS employs a multi-tier Deployment Model. This includes Development, QA/Staging and Production Deployments. Prior to a release or upgrade to customer data, an update is applied to a development/QA instance on MSS Systems to ensure successful functional deployment. A data snapshot is taken from Production and applied to a staging instance deployed On-Premise which mirrors the production environment and additional testing and validation of data and update or patch is performed. Once complete and signed off, MSS schedules a system update window with the customer and provides assistance as needed to complete the system update to production.

2 Does your solution provide any validation techniques to ensure integrity when processing/storing data into the system?
Please describe if applicable

- Yes: All Data Form Fields are Checked against Injection attacks, Malicious Code Injection, and on client validation of Field Type integrity.

3 What kinds of data are stored in the system logs

- IP level connections, date and time of access, W3C Standard Logs, Application Events, Background Task Events.

- No sensitive data is stored in the logs

4 Can the SLM® system ensure users cannot escalate privileges, under any circumstances, without logging into a higher-privileged role first.

- The SLM® system Atlas Platform™ Authentication leverages a Role based Security System. All users are applied to Roles within the system. This provides granular permissions over Application module access for View, Edit and Modify of Objects, Data, Reports and all Application Features. Roles are cascaded down and no user can promote either themselves or another user to a role above their current access level.

5 Can the SLM® system ensure Authentication and Authorization must be used.

- The SLM® system Atlas Platform™ Authentication leverages a Role based Security System. All users are applied to Roles within in the system. This provides granular permissions over Application module access for View, Edit and Modify of Objects, Data, Reports and all Application Features. Roles are cascaded down and no user can promote either themselves or another user to a role above their current access level.

6 Are Passwords masked when being entered.

- the SLM® system Application Authentication uses standard Web Browser password Field obfuscation and masking.

7 Can you describe password management system control? (the use of a combination of lower and upper case alphabetic and/or numeric or special characters in every password shall be used.)

- "Password Controls are configurable within the System Administration Module > Global Configuration > Authentication.

- Password Complexity: Letters   Any password in the system must contain at least one English alphabet letter (a-z).

- Password Complexity: Mixed   Any password in the system must contain at least one English alphabet letter in both UPPERCASE and lowercase (A-Z and a-z).

- Password Complexity: Numbers   Any password in the system must contain at least one numeric digit (0-9).

- Password Complexity: Symbols   Any password in the system must contain at least one symbol or punctuation mark (avoid spaces at the beginning and end of passwords)."

8 How is data security ensured when data is in the Cloud provided by Vendor

- Mangan Software Solutions leverages Microsoft Azure Enterprise Cloud Security and Application Firewalls, as well as a layered approach to information and data security using our ISO27001 ISMS Access Control Policies, DAST and SAST and Penetration Testing. All data is encrypted at rest on Cloud. Each customer has their own private cloud provisioned CPU/Storage/Memory for SLM software runtime. Access to systems and backend services are limited per user function and audited for use. All communications to our SLM software are encrypted using a minimum of 256-bit TLS Encryption. Access to backend systems is only available via a secure encrypted tunnel from Mangan Software Solutions Premises by Approved Mangan Software Solutions Employees. No external or outside individuals have access to our Cloud data servers.

9 Can you provide a general description of Backup and Disaster Recovery procedures.

- Mangan Software Solutions maintains the following Disaster Recovery Management Objectives.

- Recovery Point Objective (RPO) - Full Data and Application Backups for Daily for previous 30 Days, 1 Full Restore Point Per Month for 3 years. (Up to minute of failure transaction log retention of dataset can be realized with Global Geo-Sync Data Redundancy*).

- Recovery Time Objective (RTO):

- 24-hour to full System Recovery from catastrophic loss to New Geo Region.

- 12-hour full System Recovery from singleton system loss in same Geo Region.

- All Mangan Software Solutions Cloud Deployments by default use Geo Redundant Disk storage. Typical data loss period for a catastrophic failure loss of primary data source is 5 minutes of transactions.

10 Can you describe System Integration and Interoperability? (Interoperable with other required/related software; bringing data or a function from one application program together with that of another application program. Ability to interact with other systems; Outlook email, SAP, Synergi, EDMS, Risk Management, Single-Sign on)

- The SLM® system has an open architecture allowing for real time integration with 3rd Party systems. As part of that integration process, the MSS Business Intelligence Group will work with corporate and site-level personnel to develop integration requirements.

11 What is the maximum number of concurrent users the system may comfortably support?
- There is no maximum number of concurrent user limitation, the performance of the system will not be affected. The SLM® system is a robust enterprise software platform, designed to support multi-site and user requirements. It is currently in use by global organizations with operations in many countries with extensive userbase.

12 What type of queries are supported by your helpdesk, user assistance or issue resolution only?
- Mangan Software Solutions Support Desk is available for user application support queries as well as technical application support, and software system feature requests and application configuration support and assistance. All Support Queries are issued a Support Ticket and are tracked to resolution in our software support tracking system.

13 Is the software accessible via VPN? Are there any unique considerations we should be aware of?
- Mangan Software Solutions Software is a Cloud Based (HTML5) Web Application which can be deployed on Premise or licensed as a fully hosted and managed Software as a Service. In either case the software can be accessed over VPN connections as long as the VPN network supports SSL/TLS encrypted connections to a webserver over the VPN.

14 Can you describe, for internally hosted Applications and Databases, minimum system requirements? Server Requirements
- The server requirements below are specified for an average load enterprise deployment in a single geographic region. Advanced configurations for multi-site geographic data synchronization and traffic routing can be provided and supported as part of the the SLM® system-Cloud Services or Software-as-a-Service (SaaS) deployment models.

- Application Server (Base)*
  4-8 vCPU or cores
  16 GB RAM
  120 Gb SSD disk drive space
  Windows Server Current Release

- Database Server (Base)**
  4-8 vCPU or cores
  24 GB RAM
  120 Gb SSD disk drive space
  Windows Server Current Release
  Microsoft SQL Server Standard or Enterprise Current Release
  SSRS configured in native mode

- Additional Infrastructure Requirements
  Minimum 1Gbps interconnect between the servers
  Each instance requires a dedicated access URL, access to DNS may be required
  SSL/TLS Certificate for Secure Data Transmission
  SMTP server and authentication access to SMTP Delivery or Relay
  (Optional) shared file storage. This is required in load balanced application server scenarios.

15 With which Web Browsers is the software compatible (if required?)
- IE11*, Edge (Current Release), Chrome (Current Release), Firefox (Current Release), Safari (Current Release) - * Microsoft will cease support for IE11 on Jan 14, 2020.

16 What up time is guaranteed?
- 99.9% Uptime SLA.

17 Does your organization have any type of security certification or attestation (i.e. SOC Type 1 or ISO 27001)? If you have some type of documentation, please attach it for review.
- We are currently Covered by Azure SOC 1,2 and SSAE16 and are in process to receive additional SOC 2 Attestation for MSS Specific SLM-Cloud App Services in Q1 2019.

18 Do you use application security testing techniques to discover source code and interface errors (among others) with a view to enhancing overall security of an application?
- Yes, MSS leverages OWASP TOP 10 and advanced Query and dictionary attack test systems as well as SAST source testing toolsets to identify and detect possible exploits.

19 Are you capable of supporting open standards for federation such as SAML, OAuth and OpenID?
- SAML2 Federated SSO can be configured. We have successfully integrated with Okta, PingFederate, PingOne, Azure AD Federated SAML2, Google SAML2.

20 Are application programming interfaces (APIs) used to manage and interact with cloud services appropriately secured?
- API's require encryption secure token / key as well as auth and will only respond to TLS1.2 requests.

21 If your system stores Personal Data do you have a link to your Privacy Policy on the website used to access the application?
- SLM® system does not store personal Privacy data, however, we do provide a privacy policy and work without vendors to ensure the privacy policy is provided to each user as part of initial login acceptance and can be downloaded from the user's profile configuration.

22 Does the SLM® system include ability to configure for Single Sign On.
- The SLM® system Supports SSO configuration.

23 Can master data be easily configurable (e.g. workflow, PHA templates, fields, guidewords, questionnaires and drop-down lists).
- The SLM® system is designed to be easily configurable and provides a comprehensive set of configuration tools for workflows, checklists and questionnaires, PHA templates, data fields, dropdown lists, and guidewords.

24 Is the SLM® system mobile friendly / responsive and be accessible on all devices i.e. Tablets, smart phones.
- As a browser-based software, the SLM® system system is easily accessible on mobile devices such as smart phones and tablets. Additionally, MSS is conducting R&D into mobile Application options for further accessibility for clients.

SOFTWARE DEPLOYMENT/ INTEGRATION

The SLM® system-Cloud is a comprehensive service offering that provides data center infrastructure, hosting, and managed services. This offering allows clients to utilize Mangan Software products in a secure, hosted environment over the internet or tunneled to an internal network. Under this software delivery model, Mangan Software Solutions provides the data center, hardware, network, software, and IT services to maintain the infrastructure and Mangan Software applications on behalf of Mangan's clients. This software delivery model offers an alternative option to the traditional on-premises software delivery model.

10

SOFTWARE DEPLOYMENT/INTEGRATION

1 What ports are required by the software?

‒ HTTPS (TLS 1.2) Port 443 - Access to the Application Web Interface.

2 If the software is compatible with Windows 2016 Server and Windows 10; and If the software is compatible with McAfee anti-virus software.

‒ The SLM® system is fully Windows Server 2016 and Windows 10 Compliant. The SLM® system is compatible with McAfee Anti-Virus. Application is 100% browser based and does not use any 3rd-Party Browser Plugins.

3 Could you please advise on the implementation and engineering services that you offer?

‒ Services include:

 ‒ Data loading and modeling.
 ‒ Solutions consulting - how the SLM® system can be used to solve specific client problems.
 ‒ Configuration modifications for solving specific client problems.
 ‒ Functional Safety Assessments.
 ‒ Data verification using MSS subject matter experts.
 ‒ Training.
 ‒ Integration with third party systems including historians and maintenance systems.
 ‒ Engineering services through the parent company Mangan, Inc.

4 Can you import existing SIF PFD calculations into Company's software database for each site, with timing of the imports to vary by site. DuPont's existing SIF PFD calculations are in individual CSV format text files (i.e., one file per calculation record.)

‒ The SLM® system contains CSV mapping functionality called Import Adapters that can map data fields provided by the client to the SLM® system data fields and import. The SLM® system contains a comprehensive IEC61511 fault tree TÜV compliant SIL calculation engine with a graphical interface which can perform very complex SIF PFD calculations along with proof test interval optimization capabilities.

5 Please advise the timeframe, after an agreement is fully executed, for your company to start implementation. How long does a typical implementation take?

‒ Upon receipt of purchase order Mangan Software Solutions will develop a full project and implementation schedule for Kickoff, System Deployment, Data Collection, Data Analysis, Import, Validation and Verification, Training, and more.

‒ A typical basic implementation usually takes two months.

‒ Items that may impact implementation timeline:

 ‒ The data is not very structured and has to be read by a person and organized into objects such as inputs and outputs.

 ‒ Data quality needs to be verified by a Corteva/DuPont SME.SLM configuration changes are required to meet customer specific needs.

 ‒ Integration with external systems is required. Integration varies between customers and it can take a while to gain access to customer IT resources.

 ‒ It is an onsite installation behind the user's firewall. Onsite installations take longer than SaaS installations because of MSS access restrictions.

- Single facility implementations, with all of the above challenges are likely to take about 4 months. Users can start benefiting from the SLM® system after the instance is setup, core data is loaded such as process units, process equipment, personnel lists, failure rate data and risk matrices and after users are trained.

6 What is the process to provide/distribute releases and patches to the SLM® system?
- MSS works with our licensed customers to ensure timely and successful updates of their the SLM® system software. This includes data validation for new releases as well as timely security updates for any vulnerability identified through our continuous application security testing.

- Cloud Deployed Instances: For Cloud Deployed Instances hosted and managed by MSS. MSS employs a multi-tier Deployment Model. This includes Development, QA/Staging and Production Deployments. Prior to a release or upgrade to customer data, an update is applied to a development/QA instance to ensure successful functional deployment. A data snapshot is taken from Production and applied to a staging instance which mirrors the production environment and additional testing and validation of data is performed. Once complete and signed off MSS schedules a system update window with the customer and completes the system update to production.

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7 Can the SLM® system be implemented in the Cloud?
- The SLM® system is a Cloud-First technology stack and as such is typically deployed using our the SLM® system-Cloud hosting services.

8 Can SLM® system be implemented on Client Servers/Networks?
- MSS can provide our the SLM® system system software product as an On-Premise Installation or as a hybrid Cloud solution with On-Premise and Cloud Synchronized systems.

9 Can multiple users access data from the same project simultaneously?
- Yes, one of the key features of the SLM® system is collaboration. The platform allows for simultaneous access for users and project teams to access real-time data and efficiently conduct work.

10 Does the software have the ability for users to work offline, when corporate network not available and sync to the cloud later?
- The SLM® system is not a desktop software product or singular tool but rather an Enterprise Safety Management Platform. We can provide limited offline functionality with a localized Virtual Machine Instances which data can be exported from a localized version to be imported to the cloud/enterprise. For network disconnected sites such as offshore instances or remote sites, it is much simpler to provide a virtualized on premise instance of the software which leverages data sync to a centralized cloud rather than localized single laptop instances of the software like the legacy desktop software models of the past.

11 Does the SLM® system allow importing from other PHA/LOPA software
- The SLM® system import adapters allow users to easily drag-and-drop files (google-like) to import data files. The SLM® system import adapters allow mapping and importing HAZOP and LOPA data from PHA Pro, PHA Works, Excel Spreadsheets, and Various other PHA tools.

12 Do you have preferred work processes and perhaps tools/templates for implementing the complete tool?

➖ MSS follows best-in-class software implementation processes when deploying the SLM® system. Adhering to these practices ensures user adoption, reduces cost overruns and ensures a successful and quick implementation. MSS and AIM are uniquely positioned with implementation teams that are technically proficient in both SIS/PSM requirements and our software tool, which reduces the burden on our client base when they are looking to align their engineering practices with the software.

13 Does the tool have an import feature to get the information it needs? If so, does the input need to have a fixed format or is it flexible?

➖ Our experience has been that from the PHA process to a decommissioning checklist, each client has different protocol and taxonomies for each engineering practice in the lifecycle. Some corporate/enterprise clients have sites that use different PHA methods, SRS requirements, FSA and much more. Even at the plant level, HAZOP methodologies shift from facilitator to facilitator.
Our vision is to allow our clients to keep their processes and practices. To ensure this, our software design allows for multiple PHA/LOPA methodologies, SIS standards and within one system. Our Atlas Platform™ import/export adapter technologies allow our clients the ability to import data quickly, with mapping tools in the system available to account for deviations to internal protocol or spreadsheets. The tools are simple enough for a user to modify and allows the user to save the "mappings" for future imports.

14 Do you have experience with converting legacy customer systems into the tool? How would that process work and how much effort would be involved?

➖ Data transition is performed using our standard ETL (Export, Transform, Load) tools which can significantly reduce the effort involved with getting the initial data into the system. This can either be using the SLM Import / Export Adapter Engine for simple comma separated datasets or using the Back-End SSIS (SQL Server Integration Services) ETL translation tools to integrate directly with existing business server infrastructure.

➖ Our experienced data management teams and automated importing adapters greatly reduce the costs of data ETL services. For one client, our teams were able to gather, collect and load all of their SIS/SIF related data from each plant in just two weeks per site.

➖ In addition, the SLM® system can integrate and feed data to/from third-party systems, legacy customer systems and historians using our PGA (Process Gateway Adapter) tool. This allows our clients to maintain their previous investments in software applications or slowly transition from legacy software systems at their own schedule.

15 Is the tool suitable to use web based and using business-level server?

➖ TThe SLM® system is a web-based tool that can be hosted in the the SLM® system-Cloud provided by MSS or hosted on Premises on a Business level server.
➖ The SLM® system-Cloud security includes:

  ➖ 256Bit SSL End-to-End Encryption of all data
  ➖ Session Keyed Application Request Load Balancer
  ➖ State-full packet inspection firewalls for Edge Servers
  ➖ Dedicated IP Restrictions and ACL's
  ➖ Secure Federated SSO Authentication
  ➖ Site-to-site VPN for Private Cloud Interconnect
  ➖ Geo-Replication of all data including Disaster Recovery Backups
  ➖ Fully Encrypted Codebase to Prevent Malicious Code Injection

- Bi-Annual HP Fortify Dynamic Application Security Test (DAST)
- Annual 3rd Party Application Penetration Test
- 99.9% Uptime Service Level Agreement

- The SLM® system can also be installed On-Premises in a Central or Distributed model. The On-Premise Centralized model has the application server with a data cache, MSSQL database server, and a disaster recovery in a centralized location that all sites have access to. An On-Premise Distributed model includes a MSSQL Database server, File Server, and Disaster recovery in a central location, but also includes an Application Server with data cache at each site the system is being used.

16 Adopt a solution that is compatible and certified with SAP

- The SLM® system includes a robust ReSTFul API which allows 3rd Party integration and dissemination of data within the SLM® system Software Platform. The the SLM® system-API has simplified orchestration to allow for the sending of Asset Synchronization, Asset Test Events and Work Order Assignments to ERP Systems like SAP PM. Mangan Software Solutions and our SAP Integration Partners Leverage Certified SAP interfaces such as Unvired, Talend, MuleSoft, and SAP PI to facilitate direct SAP Integration and Orchestration.

17 Guidance on best practices to ensure we implement the most robust solution possible.

- Organizations that purchase the the SLM® system system product can leverage MSS' entire portfolio of professional services to ensure a successful implementation of our software product at each facility, ensure user adoption and reduce deployment costs. Around the world, at some of the world's largest organizations, MSS executes our proven methodology for software implementation.

18 Data Importing.

- SLM® system comes standard with two powerful Excel-based importing capabilities:

  - Importing by Data Type:
    With just a few clicks, users can import IDs and fields of single data type.

    - Ex. Site-level import of all device tags stored in a database such as SAP)

  - Generic Import Mapping:
    Using the Generic Import interface, users can map an Excel file template to data type and fields in SLM® system, and then re-use the mapping for subsequent imports.

    - Ex. Unit-level import of an SIS, all implemented SIFs, and Input/Output devices)

  - As a third method, MSS can develop Specialized Import Adapters to facilitate one-click importing. For example, LOPA data originating from a third-party software can be exported in a standard database template and imported directly in the SLM® system.

    - Although the SLM® system comes standard with intuitive importing capabilities, it important upon implementation of the SLM® system platform to develop an initial data loading strategy that leverages MSS's vast experience implementing for other clients. The MSS Project Team will work with IPL technical leads to assess sites/facilities and recommend an approach that maximizes user adoption.

SOFTWARE SCOPE/ CAPABILITIES/ COMPLIANCE

The SLM® system has software modules for risk assessment and management methodologies like HAZOP, LOPA, and BowTie. As well as Instrumented, Non-Instrumented, and Relief Systems for IPL management and SIS design and SIL verification. To ensure that the designed systems are managed and performance is measured, SLM® system has an Operate and Maintain, Functional Safety Assessment, MOC, Action Item Tracker, And Personnel Modules to manage the operation and validation of your safety systems and personnel.

11

SOFTWARE SCOPE/CAPABILITIES/COMPLIANCE

1 Which primary functions in the design phase of the Safety Lifecycle is supported by the software; HAZOP? LOPA? SIL calculation? If some of these functions are not supported; what features are available to import/export data?

- Safety Lifecycle Manager (the SLM® system) encompasses the entire Safety Lifecycle and supports all process safety and functional safety related design and operations phase activities using TÜV Rheinland certified, comprehensive functionality. Design phase functionality includes:

  - PHA including PHA template functionality
  - LOPA with LOPA templates which can be linked to SRS data and operations and maintenance data
  - IPL registers
  - Process equipment specifications linked to IPLs and PHA/LOPA scenarios and Operations and Maintenance results
  - P&ID objects linked to equipment, SIFS and other objects
  - Personnel lists and competency management. Personnel lists can be attached to objects such as PHA studies
  - Approval processes
  - Functional Safety Planning
  - Risk Graph
  - LOPA rationalization
  - Action tracking
  - Verification - Verification checklists attachable to most objects
  - Safety Requirements Specification (SRS)
  - SIL verification calculations
  - Proof test frequency analysis
  - Cause and Effect generation from SRS data and interlock data
  - Detailed specifications for BPCS IPLs, Alarm IPLS and non-SIF interlocks
  - Specifications for mechanical IPLs
  - Relief valve specifications
  - Instrument data sheets
  - Ability to clone/copy SIFs, devices and entire units. Cloning process ensures no duplicate tag numbers.
  - KPIs and reports
  - Management of Change
  - BowTie diagrams
  - Functional Safety Assessments
  - Document management. Documents can be attached or linked to most objects.
  - Adapter module for importing or exporting data. This module has pre-built export and import functionality for common types of imports/exports. It also has mapping functionality for performing custom imports.

2 Safety consists of more than Safety Instrumented Systems. Is the software able to register, manage and follow-up on passive barriers like release valves, physical barriers (walls, screens) and similar?

- Yes, any type of safeguard or IPL barrier can be document and managed in the PHA and LOPA modules. Non-instrumented Systems/ Relief Valve modules and others can be used to further define and manage non-instrumented barriers. The BowTie module can be used to assess and visualize both preventative barriers such as shutdown functions and consequence reduction (mitigative) barriers such as blast walls, containment systems or fire and gas systems.

3 Does the software contain or include access to a typical fail-rate database for process equipment like measurement devices, relays, solenoids, valves and similar?

- MSS has found that customers now use varied failure rate sources, increasingly including those developed internally. MSS adds failure rates to the SLM® system library based on what the customer prefers. The SLM® system also generates failure rates over time based on performance statistics generated from the Operations and Maintain module. The SIL verification calculation engine can generate a table of results for different failure rate data sources.

4 Does the software contain a semi-automatic (fill-in-the-blanks) safety requirement specification?

- The SLM® system uses data fields throughout the platform including the SRS. Some of the fields have selectable data from pulldowns, others select and link to other objects in the system such as P&IDs or instruments and others are text fields. Data fields support spell check, other automatic validation and language conversions. The SLM® system can track completeness of SRS fields for project progress reporting purposes.

- The SLM® system has cloning functionality where objects including an SRS, groups of SRS or entire process units can be cloned. The system adds cloning identifiers to ensure tag numbers remain unique. The functionality can be used to create SRS templates and to reduce engineering hours. Cloning functionality can also clone children of objects. So, an SRS may be cloned along with all of its device (instrument and valve) children.

- The SLM® system is fully object oriented so the system recognizes when the same object is used in more than one place and takes advantage of that knowledge. For example, a valve XV-101 can be used in multiple safety functions and the system recognizes it as the same physical object wherever it is used to mirror real life.

5 Is the Safety Requirement Specifications in the software aligned with the requirements in IEC61511 Ed 2.0 2016?

- Yes, the SLM® system was recently TÜV certified to IEC61511 2016 and IEC61508. As part of that evaluation, TÜV verified that all of the IEC61511 data fields were available.

6 Is the Safety Requirement Specifications in the software aligned with the requirements for Application Safety Requirement Specification (ASRS), defined in IEC61511 Ed 2.0 2016

- Yes, the SLM® system also contains all of the Application Safety Requirements data fields. The ASRS fields are located within the SIF and SIS SRS structures as they apply to other functionality and data.

7 Does the software work with a common database allowing for functionality such as:
a. Data is only entered data once.
b. Cascading updates - data is updated at one source?

- Yes, An the SLM® system instance uses a single SQL Object Oriented Relational Database to manage data across modules and functionality. The system models the real world by using objects that mirror real world hardware. For example, output XV-101 is an object that can be used by multiple SIFs or interlocks as is common in the material world. If the test frequency for XV-101 is changed, it affects all of the SIFs it is associated with the same as if it was tested in the material world.

- Different but related data can also be linked in the SLM® system. For example; a LOPA study may identify a SIF IPL but not have the tag number and only a description. The LOPA IPL can be linked to a fully defined SRS IPL even though the identifiers are different.

- The SLM® system uses this database functionality to greatly increase efficiency. For example; Nodes can be established for each piece of process equipment. When a PHA is initiated and process equipment is selected, the nodes will automatically populate.

8 Can the software handle all of the SLC or possibly be integrated with/communicate with other SLC management software? In case of integration; can the import/export of data be automated be setup as a fixed & testable import/export filter?

- The SLM® system is designed to handle and centralize the entire SLC. The platform has the ability to easily import and export data using the Adapter module. Users can also one click export from data tables to excel or .pdf format.

- MSS also has Application Programmable Interfaces (APIs) for full integration with OSI PI (and other historians) for control system data collection and with SAP (and other ERP's) for test result data collection. APIs automate data exchange without requiring manual data import or export.

9 Does the software support a register for certified resources, enabling keeping track of safety certifications?

- Yes, the SLM® system manages both personnel competency and certifications and device type certifications.

- The Personnel module can be used to document competencies including certifications and certifications can be attached to each person's profile.

10 Software functions for LOPA execution or documentation, test procedure generation, demand tracking of activations of the safety functions, and generation of dashboards for comparing operating data vs. design criteria.

- HAZOP and LOPA modules can be used to import data and link to the SRS and Operate and Maintain.

- The HAZOP/LOPA or just LOPA can also be used to facilitate studies.

- The LOPA module can calculate demand rates for each function based off the initiating event frequencies and associated IPL probability of failures for all scenarios that the SIF is used in. The Operate and Maintain module can be used to track actual demand rates and compare to the calculated demand rates.

- There are many dashboards available for comparing operating data vs design data, most of which give the use the ability to navigate and sort data to create their own dashboard.

- Users can currently attach test procedures to any function, device or test group/maintenance plan. the SLM® system workflows can be used to document test results in an intuitive way. MSS is developing the ability to create test procedure templates for each device type linking to SRS data then generating procedures at the device level. The SLM® system will determine the failure effect on SIFs and interlocks utilizing the function architecture structure.

11 Ideally, Company's software will be able to dynamically (i.e., on-demand) convert from English to an alternate language or vice versa

- The SLM® system is capable of switching between English, Spanish, French and most other languages through a language selection pull down menu. Control buttons, identifiers and field data all translate. Users can enter data in non-English languages and non-Latin-based alphabets by setting their operating system to whatever language they wish to use.

12 Compliance to calculations according to international standards? Can you elaborate on that? Also, how are changes to the standards managed? How are these changes pushed out to the customers?

- The SLM® system functional safety modules were designed to meet ANSI/ISA.84.00.01 and IEC 61511 standards, however, is intended to be flexible enough to meet any "Recognized and Generally Accepted Good Engineering Practices" as defined by OSHA. When any change to the standard is published or industry guidance is issued, the SLM® system advisory board reviews the impact of the changes to the

system and develop a roadmap to adjust any changes needed to meet new requirements released within the updated standards and/or best practices. Changes and system modifications are released to the client via an update and technical bulletin identifying these new alignments to standards.

- Specifically, in regard to SIL calculations, MSS has developed our SIL calculations based on ISA-TR84.00.02-2002-Part 3. Our SIL Calculations use Fault Tree logic (Boolean algebra) to derive the resulting calculations. In order to handle multi-dimensional voting configurations, we employ the use of a triangular array of the binomial coefficients (Pascal's Triangle) this is an array of MooN to solve for the Minimum Cut Sets (MCS) to determine the PFDavg of a SIF.

  - $MCS=N-M+1N!/(MCS!\times(N-MCS)!)$

- All changes that are made to the system go through our internal quality management process that includes design and independent verification, build and configuration, QA and testing, and deployment. This includes updating client's instances of the software as part of their annual maintenance contracts.'

13 Is there a full list of functional requirements that the product was designed to meet?
- The SLM® system is the only software platform on the market that fully encompasses functional safety, process safety and asset integrity management good engineering practices. These tools are managed, configured, and deployed around the energy industry.

14 How can you best show the value of this tool?
- For every customer, the value the SLM® system brings to them is different both tangible and non-tangible. Collaboration, streamlining engineering processes, automating reporting and key performance indicators are all value propositions that are attractive to potential clients.

- One of the biggest impacts the SLM® system has on an organization are the links in our system that integrates process safety, functional safety and reliability into one system. Changes made in the HAZOP or LOPA data are automatically updated across the entire system. Users can automatically access valuable and evergreen PSI instantly, streamlining MOC and FSA processes, SRS documentation and risk assessments. The system reduces the burden on the PSM team to constantly keep issuing out updated PSI and PHA data and eliminates the need to update data on internal documentation or systems.

- MSS has been working with some of the largest integrated energy companies to help understand how our software can make their plants and processes safer and manage the overwhelming data and risk profiles needed to properly follow the industry and their internal safety standards and to make critical technical and commercial decisions based on the most current and accurate data & information. To that end we have developed a number of business justification tools that help Management groups see the financial benefits which are always secondary to the health, safety, environmental, and compliance benefits of our software. We would welcome the opportunity to leverage our business justification tools to help you understand the unique benefits that can be gained by Shell.

- Our business justification tools offer demonstrated, tangible cost savings in the following segments from the implementation of our SLM software:

      Proliferation of PHA/PSM/Process Safety Information data across the plant/enterprise
  - Implementation of Safety Functions-SRS, SIS upgrade/installs, IPL assessments
  - Functional Safety Assessments-streamlining FSA studies and reports
  - Operational Events and Monitoring-Failure analysis and demand tracking documentation,
  - reporting

- Testing Status, Scheduling and Execution-Test tracking and scheduling, reporting
- Performance Evaluation and Reporting-SIS/PSM KPI tracking, Prior Use reporting
- Ongoing Avoided Costs of Consequences and Spurious Trips-Increased savings from the reduction of spurious trips through reliability analytics

15 Different access for user's- Read Only, Action Items, Create & Edit, etc.
- User accounts may be restricted to specific viewing and editing permissions of data. Access can be defined/restricted per user by an Administrator (client).

16 Ability to export to standard software systems (SharePoint, Reliability Software, Tableau, etc.)
- The SLM® system operates in an open architecture, allowing for integration with several 3rd party software platforms. MSS' Business Intelligence Group consults on Integration Requests.

17 For Cloud based systems - Describe how you provide visibility to monitoring and operational management.
- The SLM® system-Cloud services provides 2 monitoring endpoints for application status metrics, usage and user details
    - In Application User Metrics
    - Cloud Layer Monitoring (Microsoft Azure Monitoring)

    - 1. In-Application User Metrics: Mangan Software Solutions In-Application User metrics include User Activity Monitoring, System Usage, User Activity Tracking, User Runtime Metrics, User Usage Time, User Application Usage, User Browser Metrics, System Metrics Per User.

    - 2. Cloud Layer Monitoring (Microsoft Azure Monitoring): Mangan Software solutions leverages Microsoft Cloud Monitoring Metrics and Analytics to Monitor and Proactively Alert our cloud deployed infrastructure

18 What is the number of years vendor has provided this software tools and services in North America?
- Mangan Software Solutions has been developing and providing innovative safety management software since 1999, celebrating 22+ years of successful global partnerships.

19 Configurability (Ability to customize software to meet local needs or requirements; regulatory, lists, tags, labels, etc.)
- The SLM® system was specifically designed to be able to be configured to each of our client's unique standards and practices, including workflows, templates, tasklists, reference tables, etc. The level of complexity of the configuration request will determine if an Admin super-user can make the change or if the request must be developed. For instance, changes to specific checklist items can be performed by an Admin while adding a step to the overall MOC process would require development.

20 Compatibility with IPL based Software
- Mangan Software Solutions (MSS) the SLM® system is built leveraging industry standard technology libraries with an Open Data Architecture and Interfaces to allow integration across our entire platform of software technology. This includes open interfaces used to integrate data with SAP, Maximo, Meridium, and any open ReST API interface.

- The SLM® system Application Interfaces.

- The SLM® system Platform supports Industry Standard Application Interfaces to Produce and consume data from various Enterprise Data Sources, as well as integrate with 3rd Party Data Integration Platforms.

- Open SSL-ODBC Interface for Common Reporting and Data ETL
- Object Data Tables
- Object Data Views
- Object Reporting Material Views
- Import/Export Adapter Interface (CSV, XML, Data Processing via WebUI)
- Native SQL Server Reporting Interface
- SLM-API Interface for Data Interchange
- SLM-CGI OSI-PI and OPC-HDA Interface to Process Historian and external On-Premise Data Sources
- LDAP Authentication Interface
- SAML/Federated SSO Authentication Interface
- SMTP/TLS for Mail Authentication and Secure Transmission
- Memory Resident Object Data Cache (Memcache/CouchBase™)
- 3rd Party ESB/iPaaS Interfaces via SLM-API for CMMS/ERP (MuleSoft™, Talend™, Boomi™, UnVired™)
- SAP, Maximo, JD Edwards, Oracle ERP Interface via SLM-API and ESB/iPaaS

21 Ability to record GPS location data.
- The SLM® system offers a large number of standard data fields but can easily be configured to provide customer-specific data fields, such as GIS and GPS data.

22 Must support clients organizational and location hierarchy.
- The SLM® system allows any number of hierarchy types. Standard ones include: Enterprise, Business Unit, Site, Area, Unit, and Field Location. These can be configured per the customer's requirements to add, delete, and/or identify with specific names. Section 6 of the "SLM® Functional Requirements Supplement" document provides detailed information regarding the functions to support organizational and location hierarchy data.

23 System should have version control for all PHA, Risk Assessments and Questionnaires.
- The SLM® system provides several methods of version control for PHA, Risk Assessments, and Questionnaires. For every object in SLM® system there is a Revisions tab that tracks all changes that have been made to the object, including who made the change, what the change was, when the change was made, and the original content of that field. Every LOPA has a version number that is updated upon usage, in addition to the Revision tab. The HAZOP approval workflow provides built in version control, with specific updates as the status and status changes of the HAZOP. Below is an example of the Revisions tab on a SIF.

24 Ability to represent question and answer functionality within each workflow.
- All workflows within the MSS the SLM® system are fashioned in a Q&A format. Open field general descriptions are allowed for on many objects, but all objects and workflows have a direct field title (question) that awaits a corresponding entry (answer). The questions in the SLM® system are even ranked by assumed importance based on international and industry standards (mandatory field, required for IEC61511 compliance, recommended field, etc.). Below is an attached image of a small section of SIF information within the SLM® system's Instrumented Systems module showing standard Question and Answer workflow provided in the software.

25 Unique numbering convention for each transaction & unique naming convention for each transaction type.

- Object IDs within the SLM® system are unique within a scope that varies depending on the type of object. For example, SIF IDs are unique across a unit, unit IDs are unique across a Site, etc. Each object has its own unique hash (a hidden numeric-alphabetic identification number representing the objects uniqueness within the database) which allows the SLM® system to be a proven success for managing large sets of data across various areas. Any changes made to an object within the SLM® system is tracked within the Revisions tab found on every object within the software.

26 Provide automated notifications when receiving actions and for nominated time-based scenarios.

- The SLM® system comes equipped with an extensive notification system. Admin or managers of a project, along with personnel assigned to a project receive notification upon certain changes, i.e., approvals, status changes, submittals, etc. Each user has the option to configure the software to send emails upon receiving a system notification to ensure users are kept up to date on developments within their projects or scope of work.

- Reports can also be scheduled to be generated on a set time/date at which the SLM® system will notify the appropriate party that the report has been generated.

27 Provide compliance reporting for overdue/open actions across all modules.

- The MSS SLM® system's reporting capabilities are unparalleled within the PSM industry. Our software comes pre-packaged with a vast selection of reports that can be generated based on Sites, Areas, Units, People, and much more. As certain types of reports can vary greatly and be very specific depending on the organization, we at MSS are also experts and designing new reports that caters to the exact needs and desires of our clients. Any reports configured for our clients are added in addition the large selection of reports already available in the SLM® system and do not create any deviance from our core software structure.

28 The solution must contain a future state product roadmap. Vendor to provide details of any innovative technologies / solutions being planned.

- MSS has a roadmap team which plans and prioritizes new functionality for the SLM Software.

29 Vendor to describe dashboard and reporting capability.

- The SLM® system features a dashboard for every module, and a dashboard on every parent object within the system. This can be seen on some of the examples provided in the Functional Requirements Supplement, for example, the Action Item Tracker overview.

SUPPORT/
MAINTENANCE
PRICING

Mangan Software Solutions provides robust customer support for our software products. This centers around our customer support center operations. All support requests are managed in our support tracking system. Customer support representatives and technical experts are assigned to each support ticket based on the type of request. Support tickets are updated with customer responses and requests to document and manage the support lifecycle.

12

SUPPORT/MAINTENANCE PRICING

1 To what extent is services and technical support complementary and part of a yearly fee?

- For annual cloud-based Software as a Services (SaaS) subscriptions, the annual subscription fee includes Support & Maintenance. For perpetual license purchases, Support & Maintenance are based on a fixed percentage (20%) of the license fee and renewable annually.

- Software updates are included under both software license and subscription models.
  MSS provides robust customer support for our software products for our global user base. This centers on our customer support center operations.

  - SLM® system allows users to take a screenshot of the SLM view and create a support request directly within SLM® system.
  - All support requests are managed in our support tracking system.
  - Technical experts are assigned to support tickets based on the type of request.
  - Responses and requests are captured to document the support lifecycle.

2 Individually for licensing and for acquiring access as software-as-a-service, also provide cost estimates for maintenance/support

- Support and Maintenance Services are available for License Purchases and Software as a Service Options.

- For License Purchases - The SMS is 20% of the License Fee, paid annually

- For SaaS - Hosting and Maintenance are included in the subscription fee.

- Details regarding the annual SMS would be defined in the Software Maintenance Service Agreement (SMSA) or Software as a Service (SaaS) Agreement, but at a minimum, will include the following:

  Software system updates, including defect patching, maintenance releases, security releases, major and minor software and technology releases

  - Telephone and email technical assistance
  - Defect remediation support
  - Documentation updates
  - Technical newsletters

3 What is the vendor's support model for the system? (e.g. phone support 24x7, local office support, remote support dial-in, remote office support)

- Mangan Software Solutions provides robust customer support for our software products for our global user base. This centers around our customer support center operations.

  - All support requests are managed in our support tracking system.
  - Customer support representatives and technical experts are assigned to each support ticket based on the type of request.
  - Support tickets are updated with customer responses and requests to document and manage the support lifecycle.

- The latest version of the SLM® system to allows users easily take a snapshot view of whatever the
- SLM® system view they have a concern with and create a support request from directly within the SLM® system

4 What is the problem notification and resolution process?

- the SLM® system provides robust customer support for our software products for our global user base. This centers around our customer support center operations.

  - All support requests are managed in our support tracking system.
  - Customer support representatives and technical experts are assigned to each support ticket based on the type of request.
  - Support tickets are updated with customer responses and requests to document and manage the support lifecycle.

5 What is the license pricing scheme? (Describe scalability, additional standalone license requirements, enterprise license models)

- The SLM® system licensing is designed to allow ease of scalability.

- Named User License / SaaS Subscription - A named user license provides one account for each user. The system will not allow separate user profiles for one named user. A two or greater named user license would provide two or greater user accounts/profiles. Each named user will have a specific username and password.

- Concurrent User License / SaaS Subscription - A concurrent user license allows unlimited user accounts/profiles to be created. Each user accesses their account using their own username and password. The number of users allowed in the system at one time is limited only by the number of concurrent licenses purchased. For example, if you have purchased 3 concurrent user licenses, you could have, for example, 40 users (or more), but would be limited to three individual users allowed in the systems at one time.

- Licenses and subscriptions are offered on a unit basis (named or concurrent), volume/enterprise discounts are available.

TRAINING
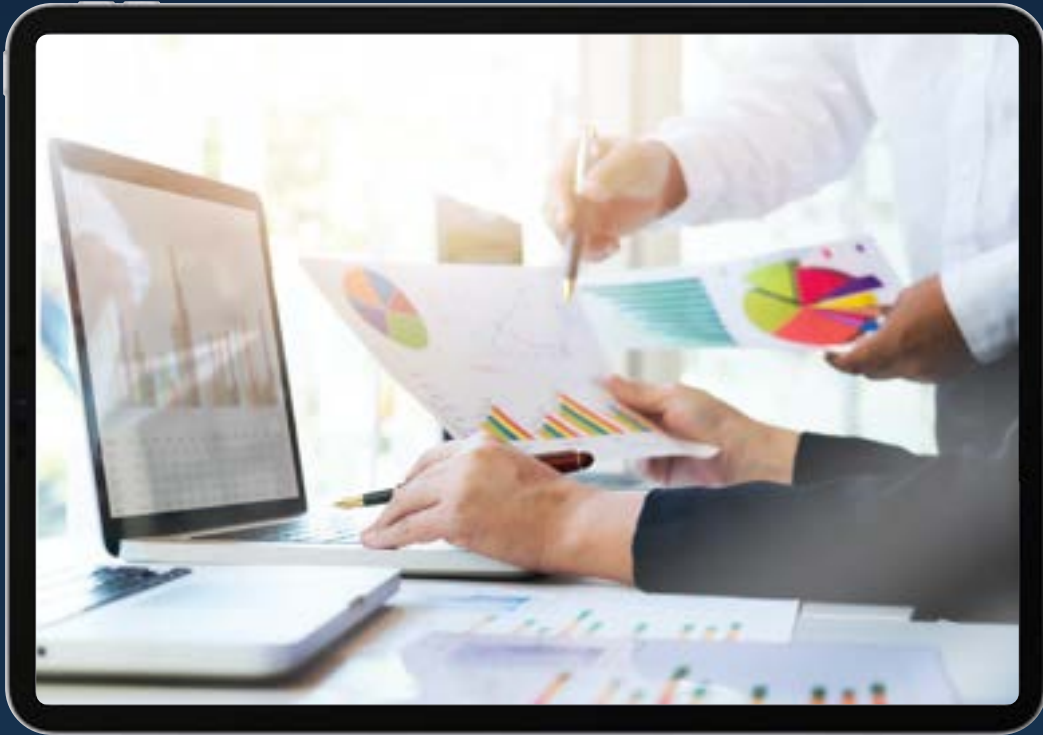
The Mangan training courses are designed for personnel involved in Functional Safety, including Operations and Maintenance, provide trainees with an understanding of how SLM integrates information throughout the safety lifecycle, creating a seamless transition from process safety to functional safety. It focuses on designing IPLs, gathering performance tracking data to produce reports and analytics, and auditing the process. In this interactive course, trainees will use instructor-guided examples on how to use the SLM® system to design safety systems and functions, perform Safety Integrity Level (SIL) Calculations, record test, demand, bypass, and other event results to track their performance, and audit their lifecycle.

13

TRAINING

- There are four levels of training for certified the SLM® system users: Basic, Professional, Professional Import Export Adapters, and Expert.

- The Basic the SLM® system Course is 1 to 3 days, depending on number of modules, showing the client the basics of SLM. It's designed for read-only users and includes a brief overview of the SLM® system and how the modules work together, a shortened version of Common Functionality, and an overview of the modules the client is interested in. There are no pre-requisites for this course.

- The Professional the SLM® system Course is designed for thorough training of the everyday the SLM® system user. It covers all necessary functionality of each module in the course and ends with an assessment of the trainee's knowledge and capabilities pertaining to the SLM® system. It is comprised of four different tracks: SLM, PSM, MOC, and FSE. There are no pre-requisites for these courses. Additional details for all Professional the SLM® system Courses are shown below.

- The Professional the SLM® system Import Export Adapters (IEA) Course is designed for personnel involved in importing and exporting data using SLM. It covers a refresher overview, review of the SLM® system module connections and object data structures, as well as the full Adapters module. It ends with an assessment of the trainee's knowledge and capabilities learned in the course. This course requires the prospective student first complete a Professional Course certification corresponding with the modules to be used in importing and exporting. Additional details for the SLM® system Import Export Adapters Course are shown below.

- The Expert the SLM® system Course is designed for proper training of personnel in System Administration positions and Subject Matter Experts. It covers the modules and information not included in the Professional Courses and ends with an assessment of the trainee's knowledge and capabilities learned in this course. It is comprised of two different tracks: PSM and FSE. Pre-requisites for this course include a minimum of TÜV FSEng (or equivalent certification) or at least 3 years of industry experience and both the Professional PSM or FSE Courses, respectively and SLM® system Import Export Adapters Course.

SLM

Safety Lifecycle Manager