

# Think beyond SIL and discover cost-efficient risk management

Speaker: Fred Stay / Safety Consultant at HIMA



#safetygoesdigital



# What is the difference between Safety KPI and KPI of a safety system?





# Safety Performance Indicators

acc. to IEC61511 Chapter 16

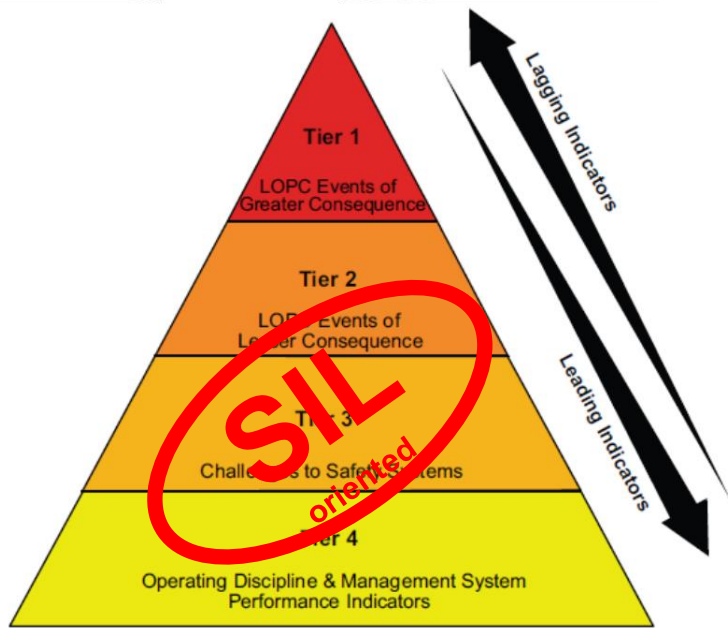
Consequences of deviating from planning schedule





# Process Safety Performance Indicators

acc. ANSI / API RP-754



Process Safety Indicator Pyramid, Source: ANSI / API RP-754

## Challenges to Safety Systems (Tier 3)

The standard provides four indicators for consideration

- Safe Operating Limit Excursions
- Primary Containment Inspection or Testing Results Outside Acceptable Limits
- Demands on Safety Systems
- Other LOPC Events

„Companies may use these four or develop their own“

e.g.

- Number of Bypass Activations (unplanned)
- Exceeded Bypass Activation time
- Etc.

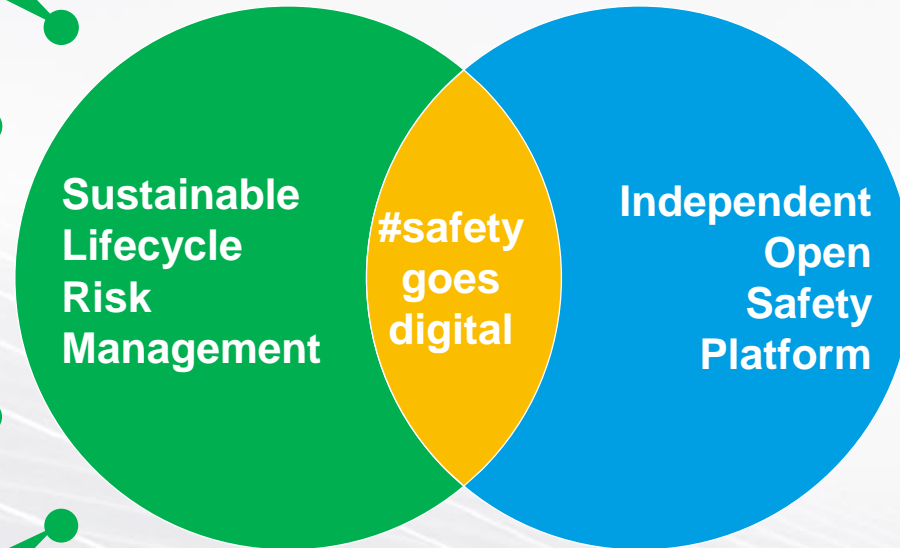
# KPIs of a safety system

# Alignment of perspectives

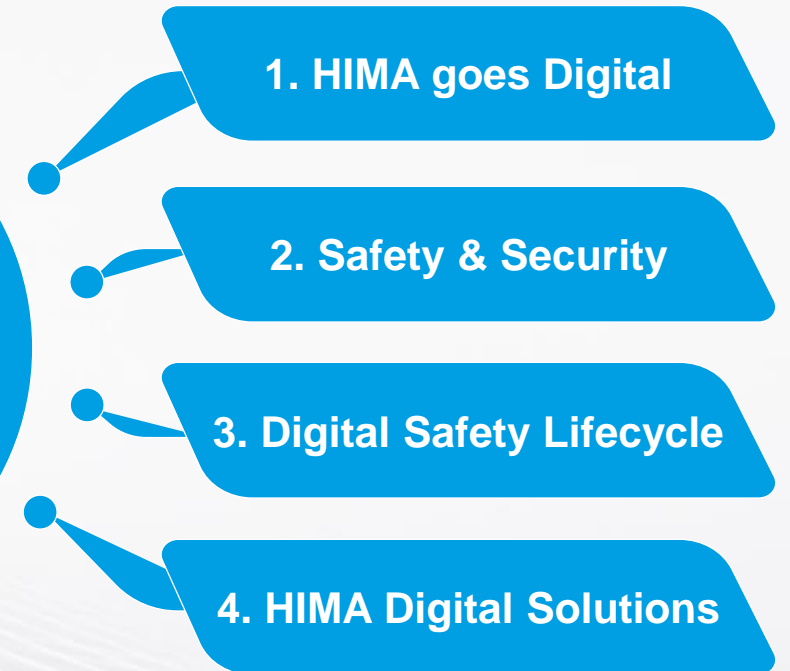
Requirements of the operators for Functional Safety



85th NAMUR  
General Meeting 2022

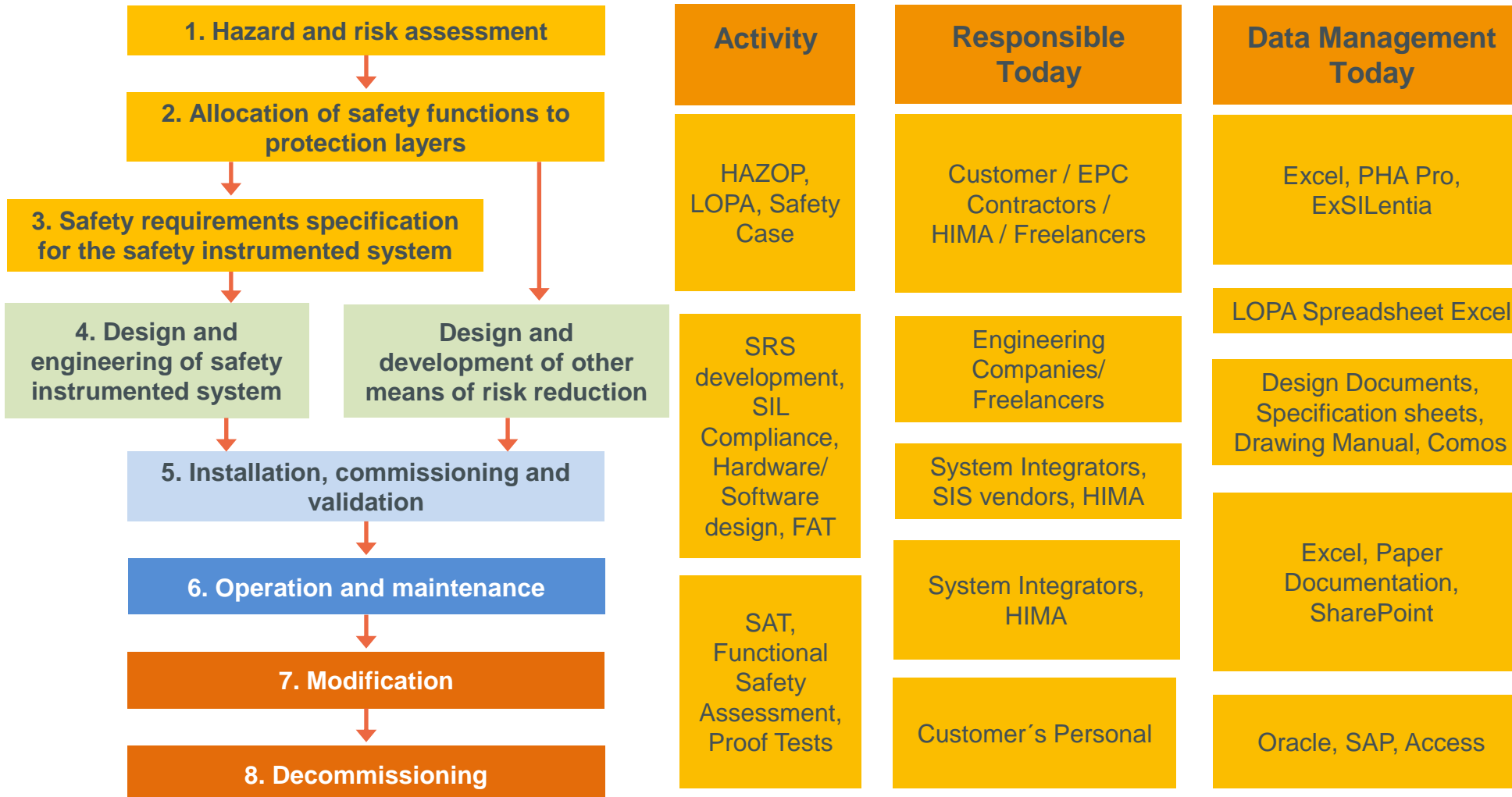


HIMA approach to the digitalization of functional safety



We need to define KPI also for the other areas!

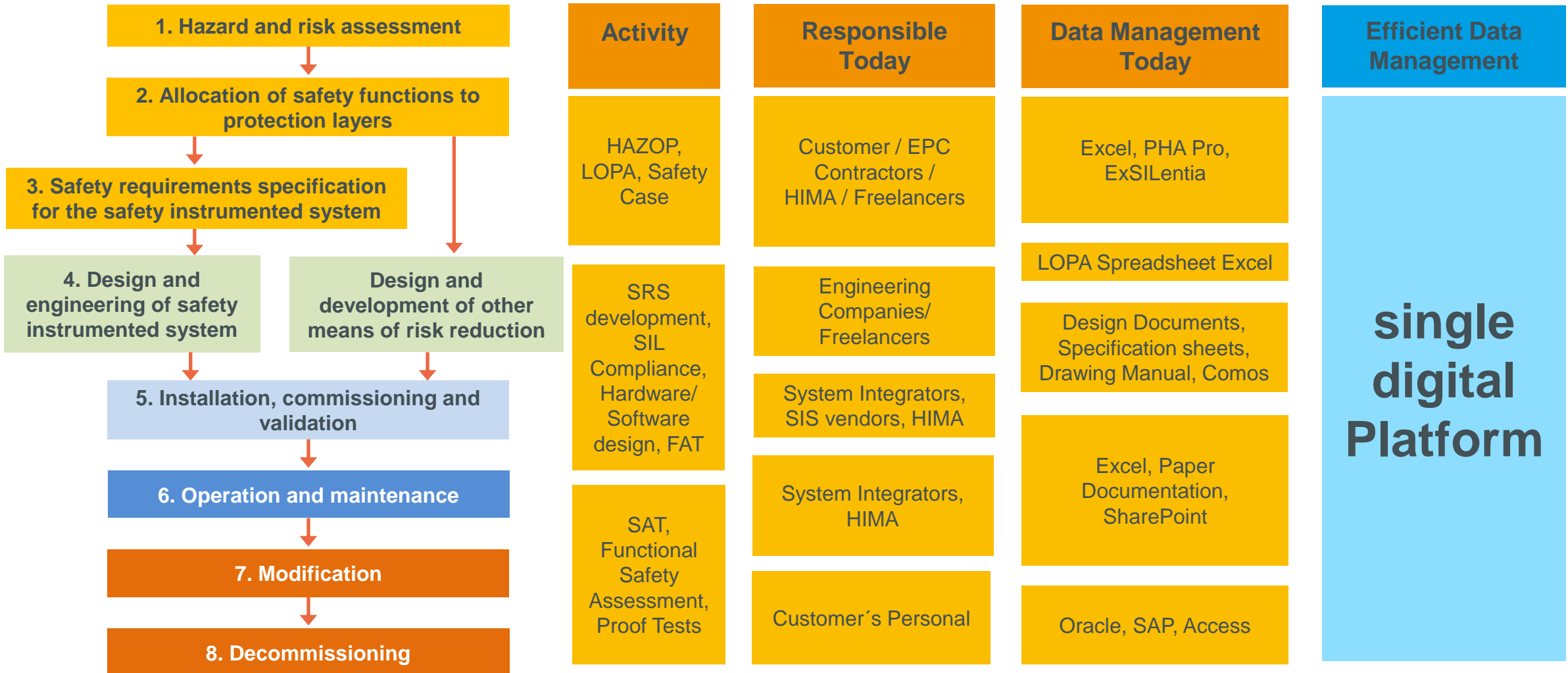
# Problem: Safety Lifecycle Fragmentation



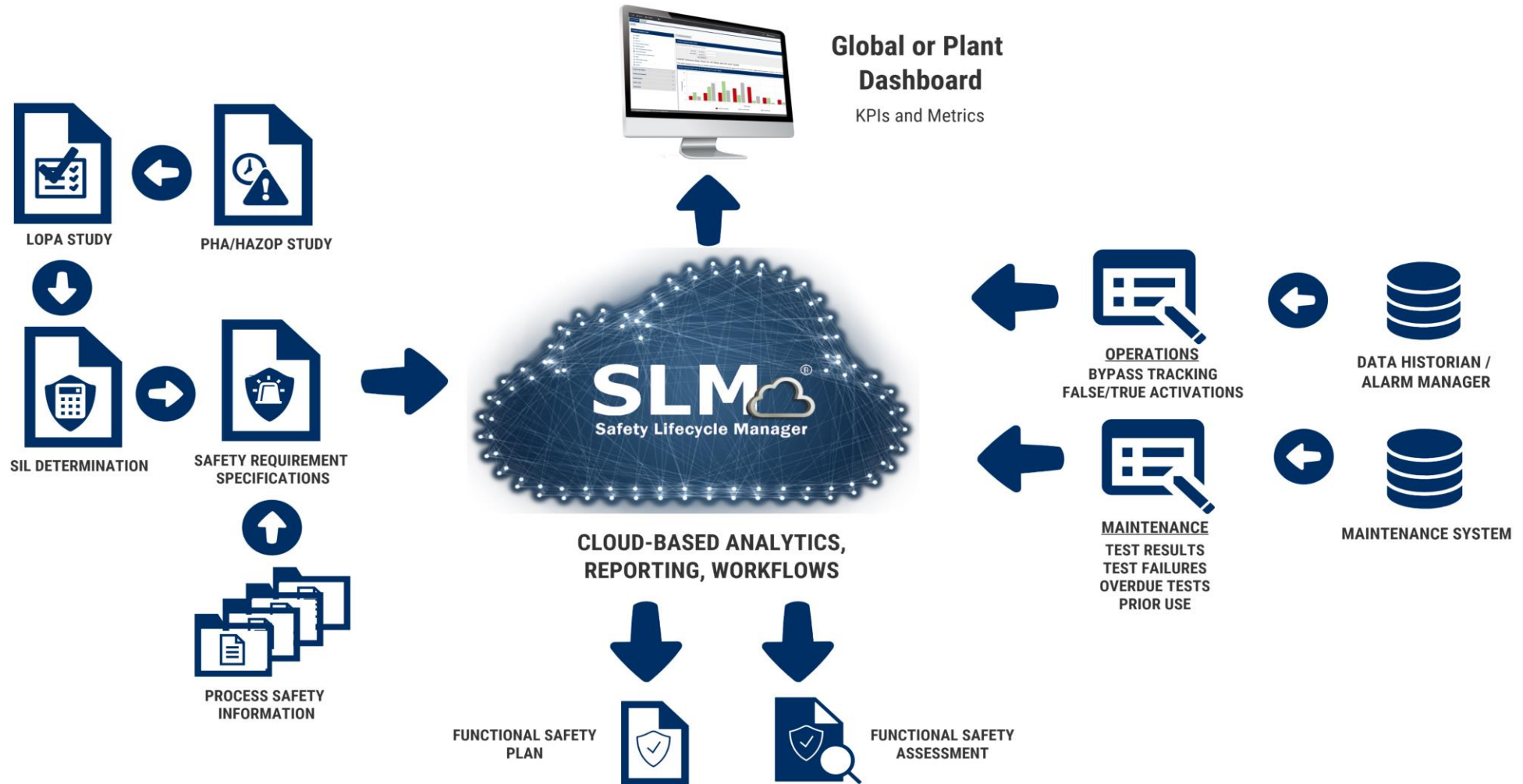




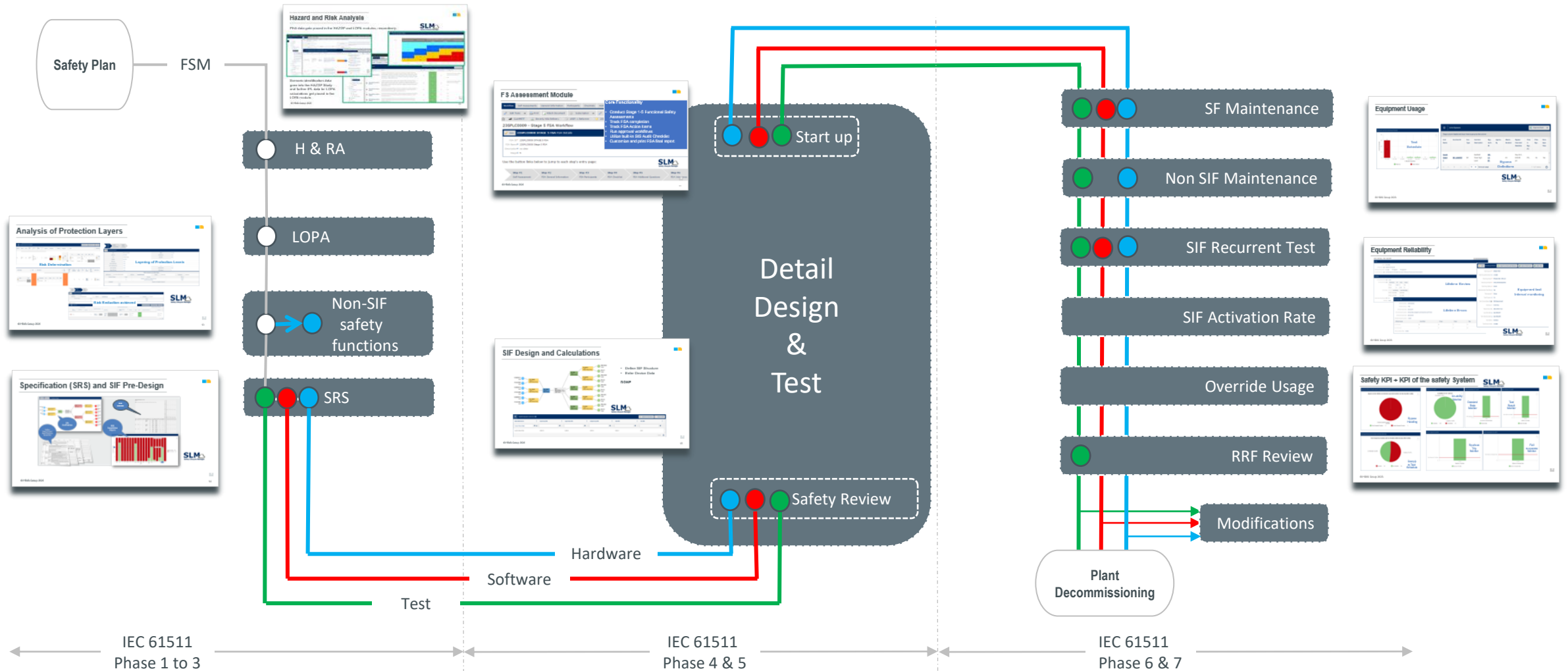
# SL Fragmentation – the Remedy: Digitalization



# Single Source of Truth- Lifecycle Management Platform



# End-to-end Digitalization of all Phases & Workflow



# Hazard and Risk Analysis

PHA data gets placed in the HAZOP and LOPA modules, respectively.



The screenshot displays the HAZOP study configuration. The central table lists deviations such as 'Higher Temperature' and 'Lower / No Flow', along with their causes, consequences, and associated safeguards. The interface also shows a 'Design Intention' section and various management buttons like 'Add Scenario' and 'Export to PDF'.

LOPA Risk Assessment Matrix

	A	B	C	D	E
Severity	Never heard of in the industry	Heard of in the industry	Has happened in the organisation or more than once per year in the industry	Has happened in the location or more than once per year in the organisation	Has happened more than once per year in the location
0	0	0	1	0	0
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	1	0
4	3	6	8	2	0
5	1	10	3	3	0
Frequency	< 1.0E-5/yr	1.0E-5/yr to < 0.0001/yr	0.0001/yr to < 0.001/yr	0.001/yr to < 0.01/yr	0.01/yr to < 0.1/yr

Scenario identification data goes into the HAZOP Study and further IPL data for LOPA calculations get placed in the LOPA module.

The screenshot shows the LOPA study configuration. The tree view on the left includes 'IPLs', 'LOPA Studies', and 'TOPSIDES'. The main workspace displays a list of LOPA studies, such as 'PNP-19-SIEP-19 LOPA-01-02-02-01', with associated hazard descriptions and risk assessment results.

Worksheet ID (*)	Hazard	LOPA of Record	LOPA Result	LOPA Rationalized	IPL Types In Use
PNP-19-SIEP-19 LOPA-01-02-02-01	1. Potential to increase Subsea flow line pressure and increase net flow to MBD-150 Subsea High Pressure Separator. Potential to exceed capacity of MBD-150. Potential to increase pressures in MBD-150. Potential to increase pressures on 600 class piping [rated for 1,415 psig at 150°F]. Potential for pressures up to 2 x MAWP. Potential for 10mm to 25mm leak. Potential loss of containment. Potential fire and explosion. Potential personnel injury.	Yes	Pass	No	RV (fail mode: fail to open); potential fouling service (no rupture disk) SIL1
PNP-19-SIEP-19 LOPA-01-02-02-01	1. Potential to route well fluids at pressures around 1,250 psig to MBD-150 Subsea High Pressure Separator. Potential for high flow rate to MBD-150. Potential to over pressure downstream B-spec piping on MBD-150 overhead gas piping which is rated for 675 psig. Potential for pressures up to 1.85 x MAWP. Potential for 10mm to 25mm leak. Potential loss of containment. Potential fire and explosion. Potential personnel injury.	Yes	Pass	No	SIL1
PNP-19-SIEP-19 LOPA-01-02-04-01	1. Potential for choke surge. Potential to route well fluid at pressures up to 13,000 psig to MBD-150 Subsea High Pressure Separator. Potential for pressures greater than 3 x MAWP. Potential loss of containment. Potential fire and explosion. Potential personnel injury.	Yes	Pass	No	SIL1
PNP-19-SIEP-19 LOPA-01-02-04-02	2. Potential for JT effect across HCV-0148-A1. Potential for temperatures to fall below -50°F the MDMT of the piping. Potential for brittle failure. Potential loss of containment. Potential fire and explosion. Potential personnel injury.	Yes	Pass	No	SIL1 SIL2
PNP-19-SIEP-19 LOPA-01-02-04-03	3. Potential for temperatures to fall below -20°F at the MDMT of MBD-150 Subsea High Pressure Separator. Potential for brittle failure. Potential loss of containment. Potential fire and explosion. Potential personnel injury.	Yes	Pass	No	SIL1 SIL2



# Analysis of Protection Layers



HAZOP Deviations and Scenarios within: REACTOR VESSEL

Guideword	Deviation	Cause	Cause Source	Cause Type	Cause Likelihood	IEF	Consequence	Hazard Register	Risk Ranking	Enabling Events	Barriers	Conditional Mod
High	Pressure high	cause	Equipment Error	Fixed Equipment Failure (e.g., exchanger tube failure)	3	0.1	consequence	S C	S C	S C	IE-4	

## Risk Determination

Conditional Modifiers	Result	Recommendations	Result w/Rec	Process Safety time	Recommend. LOPA Required	Is LOPA Required	Of Record	LOPA Worksheet	Is Risk Graph Required	Facilitator Comments				
Modifier	Applied	Recommendation	Class	Category	Type	PFD	Applied		Yes	Yes	No	LOPA SHEET	No	Comment
Personal present 10% of the time	Yes	Recommendation	HAZOP				No							

Step #1 Initiate Step #2 Applicable Values Step #3 Summary

## Layering of Protection Levels

LOPA Worksheet Properties

Site:	DEMO for SLM CONFIG	Analyst:	Chris Floran
LOPA ID No:	LOPA-SHEET1	MOC Reference:	no data
Unit:	Unit for SLM config	Description:	no data
LOPA Date:	Feb-10-2021	PHA Reference:	no data
LOPA Scope:	no data	P&ID:	No Data
Generic LOPA Process:	no data	Undesirable Event:	no data
Generic LOPA Description:	no data	LOPA of Record:	No
Generic LOPA Sheet:	no data		
Related LOPA Sheets:	no data		

PHA Consequences and Risk Target

HAZOP Node No.	SLM_CONFIG-HAZOP-NODE-0003	HAZOP Link:	Show HAZOP Scenario	Deviation:	Pressure high	Consequence:	consequence
Consequence Category	Severity	Description	TMEL (yrr)				
S	6	Catastrophic - potential for 10+ Fatalities, 30 injuries	0.000001				
C	4	72M-710M commercial impact	0.001				
Consequence	Description of Unmitigated Consequences						
S	no data						
C	no data						

Step #1 Initiate Step #2 Applicable Values Step #3 Summary

## Risk Reduction achieved

PHA Consequences and Risk Target

HAZOP Node No.	SLM_CONFIG-HAZOP-NODE-0003	HAZOP Link:	Show HAZOP Scenario	Deviation:	Pressure high	Consequence:	consequence
Consequence Category	Severity	Description	TMEL (yrr)				
S	6	Catastrophic - potential for 10+ Fatalities, 30 injuries	0.000001				
C	4		0.001				

Hazard: consequence

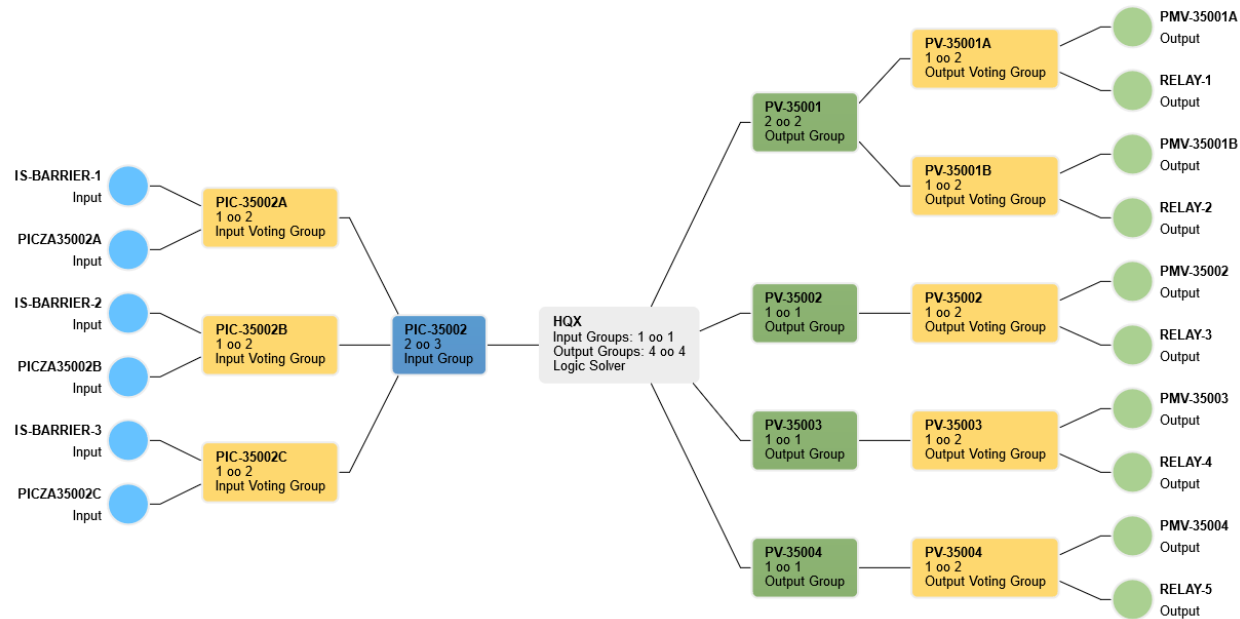
Investing Causes

Short Description	Cause Source	Cause Type	Applicable Enabling Events	Applicable IPLs	Applicable Conditional Modifiers	MEF w/CMs	LO Gap	LO Re.	Applicable Recommendations	MEF w/ Recs			
Cause	0.1	Ignition Probability	Yes	PAH-001 PGRH-001	Yes Yes	1 2	0.1 0.01	Occupancy Factor	Yes	S 1e-006 C 1E-4	1	Pass	S 1e-006 C 1E-4





# SIF Design and Calculations



- Define SIF Structure
- Enter Device Data

**DONE**



Failure Rate Source	Input Group PFD	Logic Solver PFD	Output Group PFD	Total PFD	Total RRF
Custom Failure Rate	2.85E-10	9.29E-6	4.83E-4	4.92E-4	2030

1 items

# FS Assessment Module



Workflow | Self Assessments | General Information | Participants | Checklists | Addi

Edit Tools | Print | Attach Document | Subscription

CLAMPETT | Beverly Hills Refinery | 1REF: 1 Reformer | 23S

## 23SPLC0009 - Stage 5 FSA Workflow

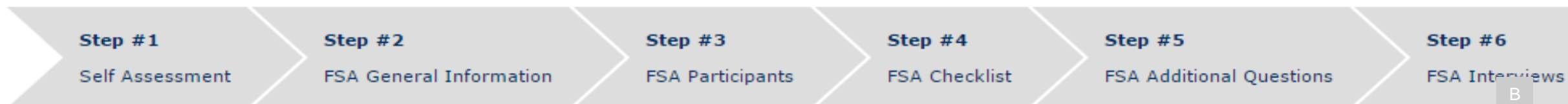
Edit | **23SPLC0008 STAGE 5 FSA FSA Details**

FSA ID\* 23SPLC0008 STAGE 5 FSA  
 FSA Name‡ 23SPLC0008 Stage 5 FSA  
 Description‡ no data  
 Stage‡ 5

## Core Functionality

- Conduct Stage 1-5 Functional Safety Assessments
- Track FSA completion
- Track FSA Action Items
- Run approval workflows
- Utilize built-in SIS Audit Checklist
- Customize and print FSA final report

Use the button links below to jump to each step's entry page:





# Equipment Reliability



SIF O-M Data - SIF-LAHH107

View Instrumented Systems Data

**SIF Data**

SIF ID: SIF-LAHH107

SIF Description: GasStab1 Tower High Level

Performance Requirements: SIL: 3 RRF: .3310 PFD: 3.02E-4

Functional Description: 2oo3 High high level in the GasStab1 Tower shuts in the feed pump P102 and closes the feed valve SDV107

**Testing Data**

SIF Testing Requirements: no data

SIF Testing Intervals:

Test Intervals	SIF	Inputs	Outputs
On-Line	no data	1 yr	3 mo
Off-Line	5 yr	no data	5 yr

SIF Test Dates:

	Last Test Date	Next Test Due Date
On-Line	Sep-14-2018	Sep-14-2018
Off-Line	Jan-11-2019	Jan-11-2024

Partial Stroke Testing Required? Yes

Test Status: Current

Lifetime Review

**Performance Data**

SIF Service Status: Commissioned

SIF Service Hours: 41137

SIF Commission Date: Oct-23-2014

SIF Commissioning Notes: Service Status changed to Commissioned on 2014-10-23

SIF Decommission Date: Dec-03-2013

SIF Decommissioning Notes: no data

SIF Performance	Life of Plant	5 Years	3 Years	1 Year
No. of Failures	8	8	7	0
No. of Demands	7	7	7	0

In Service Failure Rate: no data

Lifetime Errors

**Test Group General**

Test Group ID: PROOF-TEST

Test Group Description: no data

Test Group Type: Periodic Test - Off Line

Test Group Module: Instrumented Systems

Test Group Status: Active

Optimize Next Test Date: Yes

Test Interval: 24 mo

Test Duration: 3 h

Test Interval Basis: SRS Requirement

Test Due In: 0 d (0 mo)

Test Overdue By: 464 d (15.47 mo)

Last Test Date: Sep-08-2017

Next Test Due Date: Sep-08-2019

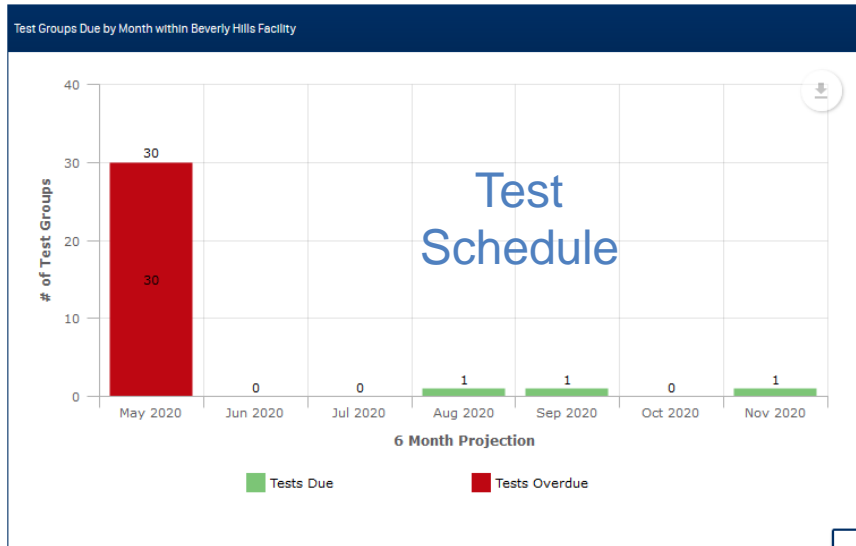
Test Status: Overdue

Test Group Notes: no data

Equipment test Interval monitoring



# Equipment Usage



Active Bypasses

Export to Excel

Drag a column header and drop it here to group by that column

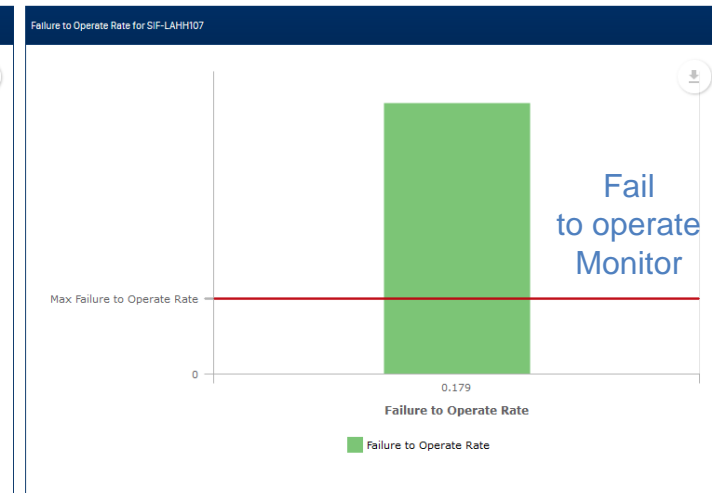
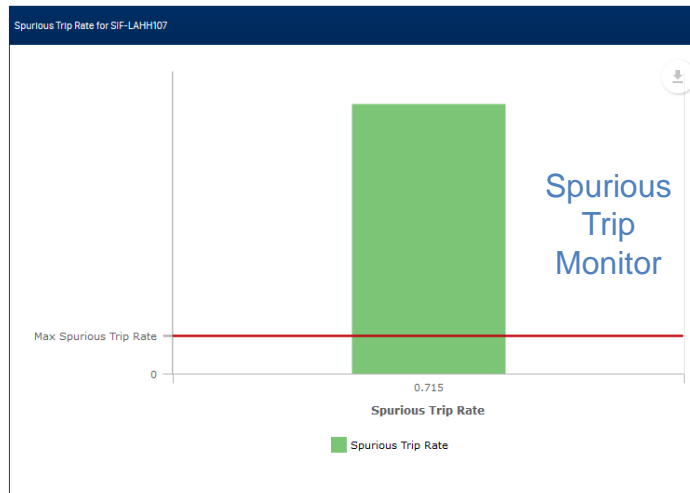
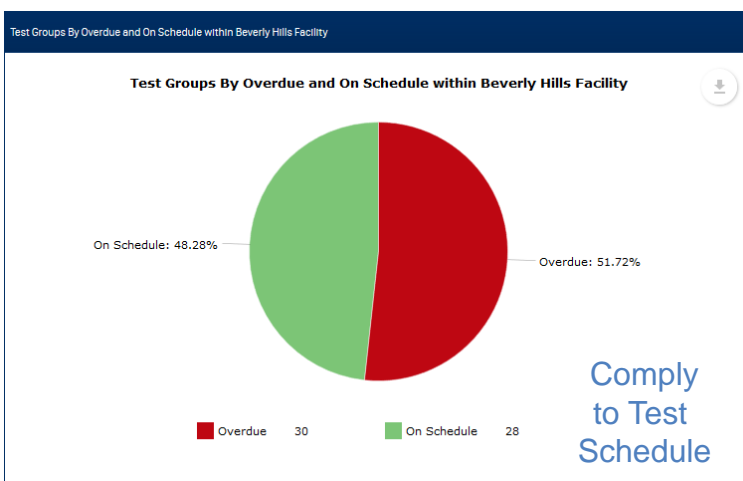
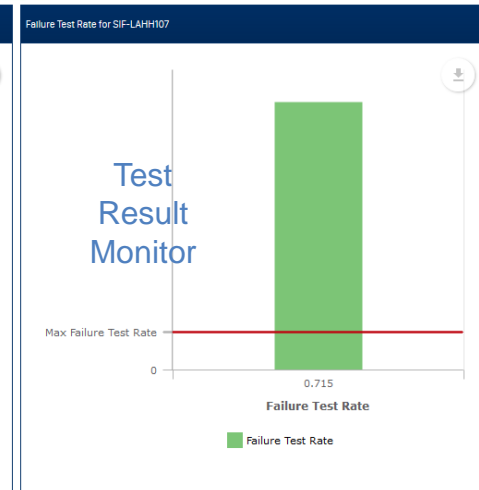
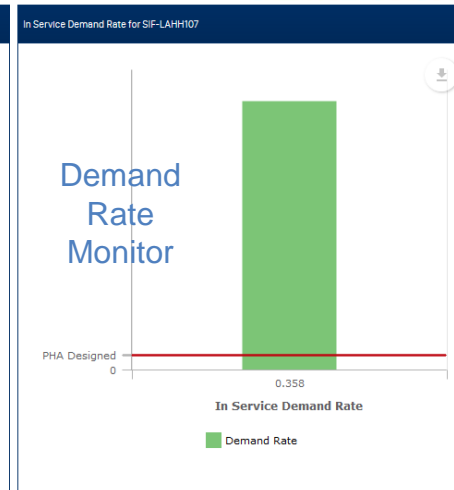
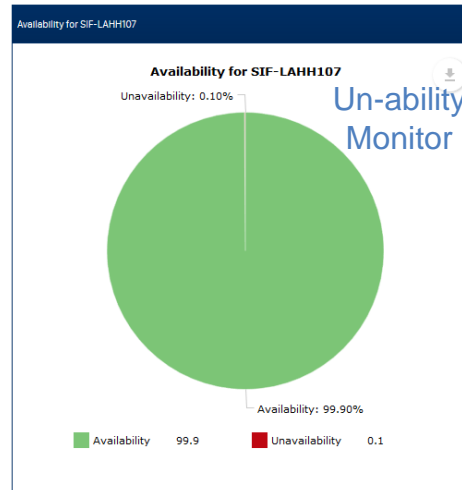
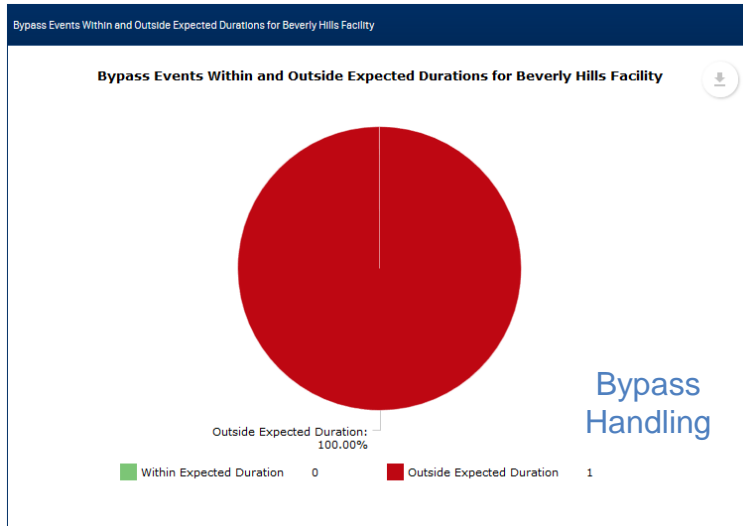
Unit Name	Function ID	Fun... Type	Function Description	Byp... Auth... ID	Approv... By	Maxim... Duration	Bypass Executed Datetime	Time In Byp... (h)	Eme... Byp...	Exce... Appr... Time
<u>Gasoli...</u>			GasStab1	<u>SIF-</u>			May-24-2...			
<u>Stabil...</u>	<u>SIF-LAHH107</u>	SIF	Tower High Level	<u>LA...</u>		4 h	8:00:00 pm	175...	No	Yes

1 10 Items per page 1 - 1 of 1 Items

Bypass Definitions



# Safety KPI + KPI of the safety System



# Added value from Digital Solutions

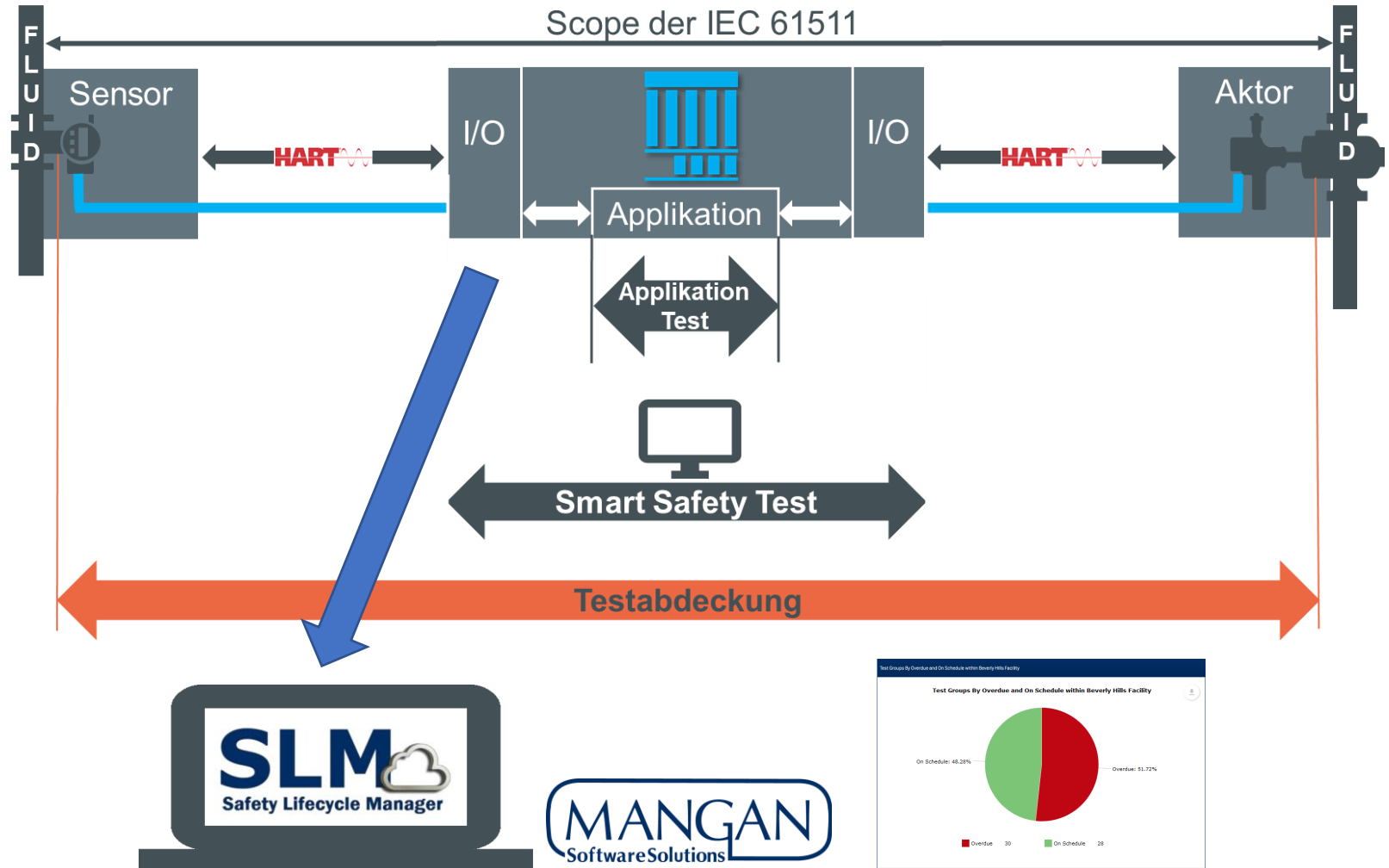
## HIMA Safety Platform with Smart Safety Test

- Evaluate device diagnostics
- Partial or fully automated testing

+

## Safety Lifecycle Manager

- Advanced analysis
- Partially or fully automated reporting
- Initiation and monitoring of resulting work orders





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# Summary

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## **Digitalized Safety Lifecycle** provides

- **Efficient risk management** by combining and displaying the safety key performance parameters in real time
- Reliable **proof of compliance**
- **Source** to be able to **define and to measure also other KPIs**
- Seamless **traceability of safety KPIs** and safety functions back to the original hazard and risk analysis
- "**Single source of truth**" with regard to risk analyses and functional safety
- **Increased efficiency** when using latest technology



# Thank You.

## **Fred Stay**

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