

MONITORING & IMPROVING SAFETY PERFORMANCE

Software solutions to help manage and oversee the operational safety performance of the plant.

MONITOR SAFETY PERFORMANCE

- Safety Systems degrade overtime
- Mounting pressure to have the capability to effectively monitor performanc
- Revalidate your safety systems with real operational data - IEC 61511 Edition 2 (2016)

OPTIMISE OPEX

- Industrial processes require an ongoing assessment of their performance
- Manually documenting and recording safety data is a labour intensive process
- Safety data integrity becomes exposed to errors and inaccuracies

Actively manage operational safety performance without compromising productivity, revenue and cost

SOFTWARE SOLUTIONS TO HELP MANAGE AND OVERSEE THE OPERATIONAL SAFETY PERFORMANCE OF THE PLANT

Processing facilities are required to maintain a means to verify the safety performance of their safety systems that satisfy regulations and standards. They are required to produce detailed reports and evidence that support the regular assessments of their safety regime. This is a labour intensive process, which is hard to manage effectively and consistently throughout the lifespan of the safety system.

In addition, all mechanical portion of the safety loop e.g. valves can degrade over time, which can affect the performance levels of safety equipment and hardware. Therefore, it is important for process owners to be aware of any downgrade in the performance of their safety systems throughout the operational lifecycle.

The level or rate of equipment degradation can be reduced through careful ownership and regular maintenance of equipment. However, operational integrity can also be affected by other internal and external factors. Such factors may emerge over a period time, originating from variations to certain operating conditions or alterations to maintenance cycles (i.e. delay, postpone) which can compromise safety equipment performance when called upon over time.

Therefore, plant owners need to ensure that this operational risk can be maintained within the acceptable limits throughout the operational life of the process.

To make this judgment, the plant owners are

expected to compare the performance data from the safety system during actual operation with the original design targets.

It is important to document any evidence relating to ongoing performance of the safety system and maintain an evidence trail to satisfy the requirements of external certifications, audits and regulatory authorities.

Industrial processes, regardless of complexity and size of safety systems and equipment, require an ongoing assessment of their performance. A means to monitor and track these systems is an effective method of satisfying this requirement and if implemented correctly, can also meet the needs of technical authorities and regulatory bodies.

A dynamic software tool is one approach to safety monitoring which addresses these requirements. In order to monitor safety effectively, plant owners may need a tool to collect, organize and present all safety related data. Only when all safety data is available is it then possible to keep track and analyse key safety performance metrics including, Safety Instrumented Functions (SIF) activations, Independent Layers of Protection (ILP), initiating causes and overrides.

By accessing this safety performance data, the information provided can assist plant managers in the monitoring of safety integrity, identify any potential safety issues, reduce unnecessary maintenance activities and improve the overall safety solution design.



BENEFITS

Process safety is a disciplined framework for managing the integrity of systems and processes. Its purpose is to reduce risk of incidents and to help ensure that process plants are operating within tolerable risk for humans, environment, assets and production continuity.

Through the optimal management of safety risks, businesses are able to establish a reputable safety track record, which is reflective of a company's safety compliance culture and corporate social responsibility. This can reinforce a longstanding relationship with safety regulators, improve the perceptions of public opinion, contribute towards environmental policy and reassure shareholders that their investments are safe.



Improve Safety

Improve Decision Making

Streamline Safety Compliance

Reduce Operational Risk

CHALLENGES

The challenge for many businesses in process industries is how to actively manage their operational safety performance without compromising productivity, revenue, and cost.

Safety Instrumented Systems (SIS) are fundamental to process safety and ensure that a process plant can be taken to a safe state in the event of an unacceptable deviation or failure. The international safety standard expects that safety systems must be upheld and maintained throughout the operational lifespan of the process plant. It is important therefore to establish processes to manage safety applications in an efficient and effective manner without compromising integrity. Procedures that are compliant with IEC 61511 Edition 2 (2016) standards help to ensure that the implementation is fail-safe and deployed using recognized best practices.

It is also necessary to demonstrate to safety authorities how SISs are being designed, maintained, inspected, tested and operated in a safe manner. Evidence and documentation may need to be presented to authorities for scrutiny of key safety documentation, systems and processes.

Producing and interpreting safety status reports is a time consuming and highly labour-intensive task, requiring individuals to convert raw safety data into more meaningful information. Undertaking these assignments consume valuable human resources and are prone to error and inaccuracy. Specific details may not be recorded or available in a timely manner that allows data to be compared against reference information.

IEC 61511 EDITION 2 (2016)

With the release of the IEC 61511 Edition 2 (2016), organizations that operate in the process industries must re-evaluate their approach to the collection, measurement and analysis of safety data, with a much stronger focus on SIS performance. It requires a balanced approach that complies with safety regulations and is maintainable throughout the entire life cycle at an affordable cost. An over-engineered SIS may exceed safety requirements, but may not be a cost effective solution. Similarly, an under-engineered SIS may be more cost-effective, but may compromise safety integrity.

Such cost factors and engineering practices have an impact throughout the entire SIS life cycle from design, engineering, and commissioning to maintenance and upgrade. A well designed SIS that meets safety requirements, optimizes cost and accounts for hardware, software and human interaction is most preferable.



“Yokogawa recognizes the continuous challenges for plant owners to efficiently maintain process safety integrity throughout the entire plant life cycle.”

IMPACTS ON SAFETY PERFORMANCE

There are many factors that might influence the level of safety performance during operations, including the original safety design, system modifications, poor housekeeping, aging and deterioration of plant equipment, human movement and interaction. All these factors can affect the safety systems and thus need to be monitored and managed throughout the process lifespan to respond quickly to changes in operational conditions and ensure safety integrity is maintained and costs are fully optimized.



MONITORING SAFETY PERFORMANCE

Companies are required to produce detailed reports and evidence that support the regular assessments of their safety regime. Safety reports from conventional SISs typically extract records from past events and alarms. However, these records are in a format that are not user friendly or formatted for easy interpretation. Raw data has to be segmented, grouped and analyzed according to the relevant SIFs for it to be associated with parameters such as demand frequency, output response time and the duration that the SIFs are in operational mode, to name just a few.

For larger and older SIS implementations, producing and interpreting safety status reports is a time consuming task. Converting raw safety data is generally a manual process and the quality is very much dependent on the experience and knowledge of the engineer. This labour intensive process is hard to manage effectively and difficult to maintain throughout the lifespan of the safety system. In addition, it increases the exposure to errors and inaccuracies, which has the potential to impact not just the safety system itself, but also the business as a whole.

It is important to re-validate designed data versus actual plant performance data. In addition, new risks not captured during the design phase can be assessed and appropriate counter measures shall be included as part of plant change.

ASSESSING SAFETY PERFORMANCE

Therefore, plant owners need to ensure that this operational risk can be maintained throughout the operational life of the process and safety systems are performing based on performance data derived from actual operation, rather than data within the original design targets. It is essential to document any evidence relating to ongoing performance of the safety system and maintain an evidence trail to satisfy the requirements of external regulatory authorities.

Industrial processes, regardless of complexity and size of safety systems and equipment, require an ongoing assessment of their performance. A means to oversee and track these systems is an effective method of satisfying this requirement and if implemented correctly, can meet the needs of technical authorities and regulatory bodies. A dynamic software tool is an effective approach to safety monitoring which addresses the requirements and helps to maintain and improve safety performance.

In order to monitor safety effectively, plant owners need a tool to collect, organize and present all safety related data. Only when all this data is made available is it then possible to keep track and analyze key safety performance metrics, including Safety Instrumented Functions (SIF) activations, Independent Layers of Protection (ILP), initiating causes and overrides. By accessing this safety performance data, plant managers can monitor safety system integrity, identify any potential safety issues, reduce unnecessary maintenance activities and improve the overall safety solution design in the future.



THE VALUE OF SOFTWARE

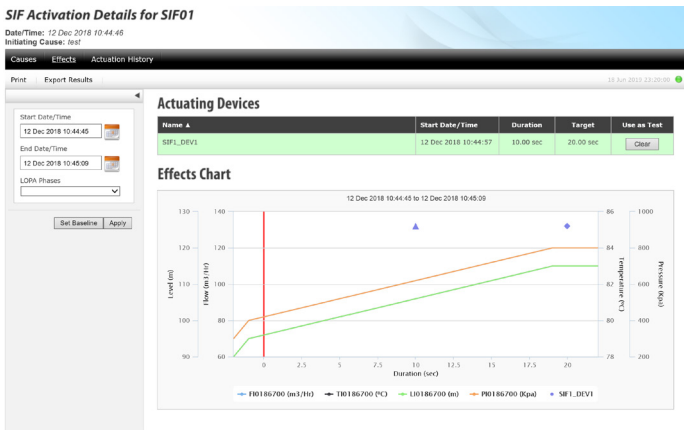
Exaquantum Safety Function Monitoring (SFM) is a dynamic software tool to conveniently measure safety system performance. It highlights and reports safety instrumented systems that have exceeded expected design targets or under performed to benchmark safety performance.

The designed safety performance is compared against the actual operational safety function activity to highlight issues, validate safety design, optimize test scheduling and help users improve safety and availability of the plant.

Safety design expectations are usually derived from hazard analysis and risk assessment data. SFM uses this information to compare against the actual operational safety function activity. For example, a safety valve has been designed to go from an open to closed state during a SIF activation, and

this action has to be performed in a target period of 30 seconds. It is possible for SFM to monitor data relating to this SIF activation and determine if the valve operated within the intended design. By accessing this information and having the capabilities to benchmark safety performance with actual operational safety function activity, SFM can highlight issues, validate safety design intervals and optimize test scheduling.

SFM is also able to monitor demand frequency, which is one of the key components to determine the Safety Integrity Level (SIL) of the Safety Instrumented Function (SIF). For safety managers that are responsible for safety performance at several locations, having a database that automatically manages and documents the changes across facilities is crucial.



SUSTAINABLE SIS

Yokogawa recognizes the continuous challenges for plant owners to efficiently maintain process safety integrity throughout the whole life cycle of their plant. Yokogawa's Sustainable SIS solution is a holistic approach to ensuring that optimum safety performance is realized and maintainable throughout the lifetime of your plant. From a monitoring and analysis standpoint, the quantity of data to be analysed increases with time and it's important to gather critical SIS performance information that does not consume vast quantities of time and resource. SFM is Yokogawa's software tool to monitor and collect all safety related data

in a single location. It provides the necessary information required by regulations without any additional manual overhead costs. By efficiently keeping track of safety systems, it helps to uphold the overall consistency of safety system information throughout the safety lifecycle and addresses the following key questions:

- Did I get the safety design right?
- Is the safety system still performing as designed?
- Should I make some adjustments to optimize safety performance and cost?
- Can I prove it?

Overall SIF Report
18 Jun 2018 to 18 Jun 2019

SIF Details				
Region	UK	Site	IQW-001	
Facility	Gas	Area	Zone 3	Unit 1007
Safety Function	ALZH-3161820 Flash Gas Compressor High Level			Version 1
Associated Tags	ALT-3161820, VZT-3165010, VZT-3165129			
IL Rating	1			
Actuating Devices				
Device Name	Total Actuations	Total Actuations by SIF	Actuation Failures by SIF	
VZS-3165129	5	3	1	
VZX-3165010	3	2	0	
Initiating Causes				
Description	Total Actuations	Design Frequency	Actual Frequency	
Loss of fuel gas due to XGA-1/2 activation.	1	0.00219	0.52292	
Failure of LC-3161821 closing LV-3161821	1	0.00219	0.52292	
Spontaneous opening of NVB-4995098HC.	1	0.2000	0.52292	
Failure of 1st Stage Gas Cooler	0	0.10000	0.00000	
High temperature gas relief	0	0.01000	0.00000	
ZF7 AC-6544228 blocked.	0	0.25000	0.00000	
New Initiating Cause (Enter Details)	1	0.00219	0.52292	
ILPs				
Description	Total ILP Unavailable Periods	% Time ILP Unavailable *	Total Time ILP Unavailable	
LAH-3161821 will alarm high level	5	1.29	4d 17h 0m 0s	
SIF MO/Fault				
Total Time SIF Required (when plant is running)				364d 21h 23m 36s
Total Time SIF not working due to MOS				0d 1h 3m 56s
Total Time SIF is Degraded				1d 3h 5m 30s
Total Time SIF in Fault				2d 10h 14m 10s
Total Number of times SIF was activated				3



MONITORING OVERRIDES

Safety systems are implemented to reduce operational risks and improve process safety; however, there are instances when these safety systems are not available, which can significantly increase the risk levels within a plant. An override, bypass or inhibit is an action that interrupts a safety device from performing its intended function.

The management and monitoring of overrides is a primary area of concern in the performance of safety instrumented systems. Excessive use of overrides creates unnecessary risks and might lead to a catastrophic scenario. During these periods, it is essential to determine if there are any alternative compensating countermeasures that are sufficient during an override to ensure continuous operation at minimal risk.

Overrides are inevitable in the process industry as they are implemented to enable repair work to be carried out during plant operation. During this time, the safety protection level might be compromised, which increases the level of plant risk. In larger and more complex systems, this may involve more than one instrument, thus making risk assessment harder.

In these situations, it can be very difficult to see clearly what the knock-on effects of overrides are and what the potential impact might be on the safety process. This generally requires experienced personnel to investigate and assess these impacts and how they manifest in other areas that is not always easy to define and can be a laborious task. Assessments also need to be documented and supported with evidence as part of an effective safety monitoring process.

In an effort to mitigate against unnecessary risks, it is important that overrides are implemented with a legitimate cause and approved by an appropriately qualified level of authority. IEC 61511 Edition 2 (2016) states that a bypass log is now required so that all bypasses are authorized and indicated.

By having the means to highlight and clearly identify when any unauthorized overrides or bypasses have been implemented, actions can then be taken to address these areas and improve the availability of safety systems.

KEY POINTS

The integrity of a SIS will degrade over time

It is widely recognized that the integrity of an SIS degrades during operation. SIS solutions are regulated by two international standards, the IEC 61508 and IEC 61511 Edition 2 (2016). A key component of IEC 61511 Edition 2 (2016) is clause 16, which requires that the mandatory SIL of each SIF be upheld during operation and maintenance. In addition, the SIS should be operated and maintained such that the functional safety is also maintained. The implications of IEC 61511 Edition 2 (2016) clause 16 on SIS operators and managers are that they must perform and conduct regular maintenance and proof testing of their SIS. Additionally, they must also maintain adequate documentation of process data, proof test records and inspection procedures.

Safety design information needs to be validated with actual operational data

During the HAZOP/LOPA, the likelihood of failure of an initiating event is usually based on Centre of Chemical Process Safety (CCPS) data. This assumption needs to be re-validated periodically (e.g. every 5 years as per OSHA) with actual operational data as described in IEC 61511. IEC 61511 Edition 2 (2016) requires existing safety instrumented systems to be designed and constructed in accordance with code, standards, or practices. Prior to the issue of this standard, the user shall determine that the equipment is designed, maintained, inspected, tested and operating in a safe manner. However, this can be very onerous and time consuming due to the large amount of fragmented data generated over many years of plant operations.

Businesses require a means to optimize their OPEX

Industrial processes, regardless of complexity and size of safety systems and equipment, require an ongoing assessment of their performance. How much time and resources are being consumed to manually document, record and process raw safety data? Does this expose your data to errors and inaccuracies? Plant owners must re-evaluate their approach to the collection, measurement and analysis of safety data to optimize safety performance and costs that can be maintained throughout the plant lifecycle.





Mounting pressure to adhere to safety standards

Within a production environment, maintaining compliance to required standards and processes is not an optional requirement, it is something that must be adhered to, to protect the integrity of the safety system. Perhaps one of the biggest threats to safety system equipment and functionality is the incorrect operation, non-rigorous maintenance and uncontrolled modifications, supplemented by the difficulty in maintaining synchronicity between related applications. Outside of these operational challenges, compliance can also be affected by system knowledge drain and security threats.

Ensure the plant remains at a safe level when safety equipment is unavailable

During operations, it is important for organizations to manage process risks and maintain safe operations throughout the safety life cycle. Safety functions shall be made available at all times. However, there are certain instances when overrides might be applied to certain pieces of equipment or sensors. This bypassing of safety function shall be carried out after risk assessment has been completed and appropriate compensating measures are in place. Therefore, safety systems are essentially bypassed by plant personnel under calculated and intensely watched conditions, with associated risk assessment. Evidence of risk assessment for all bypasses are required for audits by technical authorities and insurance as it shows that organization are proficient in operations and maintenance requirements.

SUMMARY

Process safety is achievable through a disciplined framework of systems and processes to reduce the risk of incidents. Safety Instrumented Systems (SIS) ensure that a plant can shutdown safely in the event of a deviation or failure. It is important that organizations have the capabilities to ensure that these safety systems can be maintained throughout the operational lifespan of the process plant at an affordable cost, without compromising integrity.

An effective monitoring tool can collect, organize and present all safety related data to help keep track and analyse key safety performance metrics for a more sustained approach throughout the entire life cycle.

By keeping track of all safety data during the plant operations phase, organizations are able to verify that design parameters are being met:

- Continuous improvements based on operational data are achievable
- Right sizing of safety, tuned to operational conditions
- Downtime for testing and turnaround can be optimized

Operational conditions within process plants can change rapidly, and it is important for organizations to be able to react quickly to these variable conditions, ensure that risks are reduced and safe operation can be assured. There may also be instances when safety systems are not available through override,

inhibit or bypass, thus preventing a safety device from performing its intended function. Having the ability to monitor and assess the risks of overrides based on current plant conditions is a valuable asset and helps to ensure that the plant is operating at tolerable risk.

Organizations must adhere to the two international standards, the IEC 61508 and the IEC 61511 regarding safety compliance. IEC 61511 Edition 2 (2016) clause 16 specifies that SIS operators must periodically validate designed against actual operation and make necessary modification to ensure evergreen safety performance. Additionally, they must also maintain adequate documentation of process data and certification of test and inspection procedures. By having a software tool to monitor and collect all safety related data in a single location, the necessary information required by regulations can be provided without any additional manual overhead costs.

We have seen why it is important to monitor process safety and a software solution is an effective way of keeping track of your safety systems. With online monitoring capabilities and automatic built-in report generation and a user friendly and agile interface, users are able to quickly access safety related data. A software based monitoring system will increase the dependability of the safety system and provides a cost effective way to improve its performance over time.

