Using a Smart Safety Instrumented System (SIS) to Make Better Operational Decisions

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Abstract

Traditional safety systems report only analogue and digital process values. But most faults happen in field instruments, and the new generation of Safety Instrumented Systems (SIS) can monitor the health of these devices, and potentially the health of the process, using digital communications.

Introduction

Accidents in process plants occur on a too regular basis. Why? Basic theories and standards for process safety and alarm management are correct and are not the cause of most incidents. The safety standards and methodologies build layers of protection that guard against process incidents and events. The majority of incidents can occur because of the failure of organisations to implement best practices for process safety. Following recent incidents, many companies' safety culture has been in the spotlight.

Safety implementation has a long way to go, one of the main reasons implementation of safety falls short is the problems in getting personnel up to speed. Over time the scope and complexity of control and safety systems have increased, due to the benefits brought by advances in technology. Modern control systems make it easy to add too many alarms – they tend to be constantly added, but rarely deleted. Advances in control systems coupled with alarm management guidelines make it now possible to prioritise alarm types and send them to the relevant people, such as operators or maintenance staff. The problem is not that existing standards are incorrect; they have become obsolete as technology has advanced.

A New World of Safety

Safety instrumented systems consist of basic technologies that are separate and distinct from a plant's Basic Process Control System (BPCS), to isolate them from the problems that they are intended to indentify and prevent. The three basic elements include Sensors, Logic Solvers and Final Control Elements. A well designed system can increase plant availability by reducing the number of spurious "Trips" caused by an SIS that fails to properly evaluate a safety situation and unnecessarily shuts down a process. Determining a target Safety Integrity Level (SIL) through a Risk Analysis needs to consider all components of the safety loop – "Pipe to Pipe".

Data suggests that over 90% of problems in Safety Instrumented Systems can be attributed to the sensors and final control elements, yet the focus of the safety engineers has been on maintaining and supporting the safety logic solver. These systems have historically been unable to provide access to field device diagnostics to help operations and maintenance personnel make better decisions on the information received from Safety Instrumented Systems. This information becomes even more valuable as equipment ages and becomes less reliable, especially in the context when it is installed on a safety critical application. There is a change in the industry with a new breed of Safety Instrumented Systems that can not only provide access to information from the field devices, but can actually use this information in the safety logic.

Unlocking the Potential

This new breed of Safety Instrument Systems has in built digital communications to the field devices to provide access to the device diagnostics. Previously this was only possible through the use of an external device installed in the wiring between the safety system and the field equipment. This allowed software tools, such as an Asset Management System (AMS) or a Hand-Held Communicator (HHC) to communicate with the equipment. One major disadvantage exists with this implementation – the Safety System does not know it is there and has the potential to interfere when a demand occurs.

Furthermore, getting this information into the BPCS, so the operations personnel can make the best operational decisions, has been complex due to the interfacing requirements. Configuring, testing and maintaining these interfaces and gateways have been time-consuming and costly. Add to this the options in performing upgrades over time to keep the architectures current leads to extra requirements.

Diagnostics

When selecting Safety Systems today, there are a number of suppliers moving towards integrated control and safety systems that use the power of field device diagnostics to help make better operational decisions. The integration with the BPCS removes the obstacles of interfacing using protocols such as Modbus and OPC. The availability of the field device diagnostics in the BPCS, via this easy integration, means that operations and maintenance personnel have better access to information in their day to day working environment.

Detecting faults as quickly as possible—preferably before an event actually occurs—diagnosing the underlying problem, and providing assistance to plant operations and maintenance to correct the problem, are the where device diagnostics from Safety Instrumented Systems can help. The longer an abnormal event goes undetected, the more severe the consequences are likely to be. If we can find techniques to detect a potential abnormal situation earlier, to "predict" a potential incident, the operator can take action earlier and better avoid the potential consequences of the situation. The following figures depict the benefits from preventing abnormal situations rather than trying to manage them.

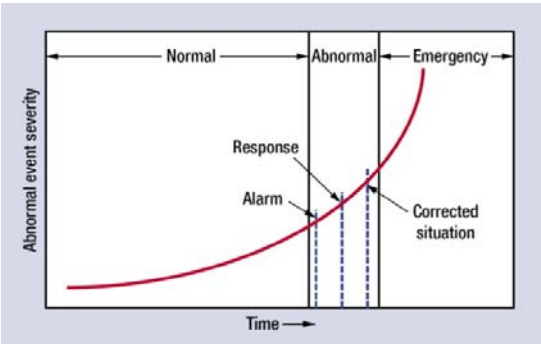

Fig. 1 The longer an abnormal situation goes undetected, the more severe the consequences are likely to be

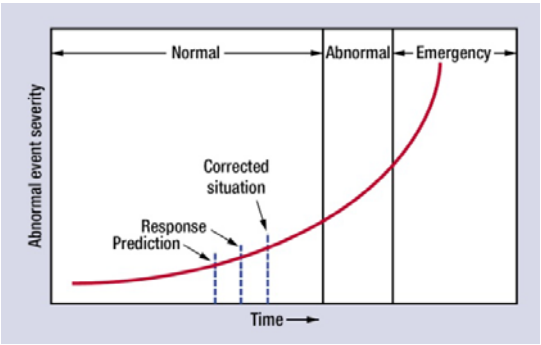

Fig. 2 If the operator can take action earlier, potential consequences can be avoided

Examples of Device Diagnostics

It has been mentioned that the majority of Safety Instrumented System problems can be attributed to the sensors and final control elements in a safety loop. The following are areas where device diagnostics being detected, reported and actioned upon can benefit plant operators in their day to day operations:

- Partial stroke testing of final control elements
- Low supply pressure to final control elements
- Sensor failure and hot-backup capabilities of temperature transmitters
- Earth leakage detection
- Impulse line plugging of a pressure transmitter
- Two phase flow using a flow transmitter
- Degraded voting upon transmitter failure
- Removing personnel from the field while performing device testing

Conclusion

Advances in technology has meant that a new breed of Safety Instrument Systems has been developed by control system vendors. Once the domain of independent third party vendors the trend is for integrated, not interfaced, control and safety systems. Couple this with digital communications technology and advances in field equipment and the stage is set for these new breed of systems to provide operational benefits to plant operators.