RTP Safety Solutions for the Chemical Industry

Application

Reactor Safety System

Background

A mid-west chemical manufacturer for years had operated the plant process and safety interlock system within the plant BPCS. The company acknowledged ISA 84 as the standard for plant process safety and felt comfortable that the existing system was covered under the Grandfather Clause within this standard.

With the announcement by the BPCS supplier that parts would no longer be available, the company was forced to look at upgrading the existing plant control system. This also meant that the company could no longer enjoy the shelter of the Grandfather Clause and remain compliant to ISA 84. After a through PSM study, it was determined that the plant would implement a stand alone, SIL 2 rated SIS system to assure compliance with ANSI/ISA 84.

Situation

The plant operates sixteen batch reactors utilizing a Formaldehyde and Phenolic resins chemistry to manufacture over 650 industrial adhesives used in the wood and paper industry. The process is exothermic, with an energy release during controlled operation of 50 – 60 million BTU/hr. Chemical injection into the batch reactor is controlled with a minimum mix time of 60 minutes, as the process reaction curve over time is a gradual slope until reaching a point where it moves upward at almost a right angle. The object of the BPCS is to assure that the process reaction occurs at a controlled rate and does not reach this critical point as the consequence would be a run away reaction that could not be brought back under control. Safe failures associated with the process will result in economic losses including raw materials and energy associated with a lost batch and unrecoverable production downtime.

Dangerous failures could lead to an explosion of the reactor, resulting in damage to capital equipment, loss of production due to downtime and potential loss of life within the area of operation.

The temperature SIF is the primary monitored variable for the SIS system and determines if the final line of defense, the reactor deluge system, is initiated. The rate of temperature rise is monitored by the BPCS as well as the SIS, based on a calculated variable, derived from taking 1/second temperatures, comparing these with earlier temperatures and multiplying by a predetermined integer. This “rate of rise” is narrowed as reaction begins to increase over time. If the rate of rise exceeds a predetermined rate, the deluge system floods the reactor with water, effectively quenching the reaction. The flooded batch is pumped to a holding tank where lab samples are taken to determine whether batch can be saved or must be disposed of.

3000 Controller Family

RTP offers a complete family of high-integrity Safety Instrumented Systems, all following the standards of IEC61508. For the highest level of integrity and availability, the 3000-T Triple Modular Redundant System features 2oo3D voting with triple, dual, or simplex I/O to obtain the required SIL rating.

The 3000-D Safety Instrumented System is built on the same advanced technology as the 3000-T, for dual redundant 1oo2D solution. The 1oo2D voting uses advanced diagnostics to assist in results adjudication. According to IEC61508, 1oo2D systems can achieve the same the same SIL rating as 2oo3D systems. The 3000D features dual-redundant processors with triple, dual, or simplex I/O as required.

When processor redundancy is not a requirement, the 3000-S Single processor configuration provides integrity and availability that exceeds that of competing single systems. With its built-in data validation schemes and redundant host communications, secure measurement and control are achieved.

The 3000-T, 3000-D, and 3000-S support up to 16 chassis of I/O providing high availability systems with I/O counts as large as 10,000 I/O.

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Safety Implemented Functions (SIF's)

The plant uses the following key SIF's as a buffer to prevent the process from reaching a point where operation of the deluge system is necessary.

◊ The BTU Control SIF monitors product temperature and process flow through a cooling condenser. The condenser is used to pull heat off the process to keep the reaction within the required control parameters.

◊ Amp Loop SIF's monitor agitator motor amperage, to assure that proper mixing is taking place throughout the batch cycle. Without smooth mixing throughout process cycle it is possible for the ingredients to collect and form pockets within the reactor. It is critical that mixing of large quantities be avoided, as this would cause a large release of energy over a short time with explosive results.

Other inputs will provide SOE reporting to allow for first out analysis for process and maintenance engineers.

Configuration

The final configuration selected by the plant was a SIL 3, dual redundant system with redundant input cards and simplex output cards. This configuration was chosen to assure that any future reclassification of a SIF to SIL 3 could be easily incorporated into the SIS.

Reasons for selecting RTP

The plant engineer responsible for installing and configuring the RTP system sighted the following reasons for selecting RTP.

♦ A TUV certified SIL 3 logic solver out of the box, providing reduced engineering effort and risk

♦ On line hardware additions to allow for groups of reactors to be upgraded over time.

♦ Easily distributed remote I/O to lower home run wiring costs.

♦ Proven safe and secure methodology for interfacing with the BPCS.

♦ Integrity and Availability rating that will allow engineering to effectively "paint the barn door shut" once the system is configured.

About RTP

Founded in 1968, RTP Corp. is a developer and manufacturer of high-performance critical control and safety systems. Markets for RTP Corporation's products include process control and safety systems, and nuclear power plant systems. RTP offers a wide range of rugged hardware and a complete suite of software for industrial control solutions that include seamlessly redundant and triplicated systems for mission-critical applications.