MAKE SENSE OF COMPLEX MACHINE SAFETY UPGRADES

Discover how an industrial firm and its system integrator used the safety life cycle to identify hazards and tasks that required guarding or controls mitigation for legacy equipment to meet current safety requirements.

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>> When an industrial company launched its zero-fatality program in 2009, it had manufacturing facilities with at-risk equipment that required safety upgrades to meet new occupational and machine safety standards. Additionally, multiple OEM safety systems were in place, so implementation of safety standards was inconsistent.

The company asked Polytron, a designated Rockwell Automation Solution Partner, to help it perform equipment safety upgrades. Based on the current safety standards, Polytron and the customer's safety team began the risk assessments for existing equipment to identify all primary hazards and tasks that required guarding or controls mitigation.

Risk Mitigation for Legacy Equipment

Machine safety modifications typically are conducted in one of two ways:

1. With new equipment, the modifications are designed into the equipment.
2. For older equipment, either in-depth modifications are required to the controls, or modifications are added onto the equipment.

Although different approaches exist for applying modifications to new and legacy equipment, both follow the same safety life cycle:

1. Risk Assessment.
2. Function Description Creation and Approval.
3. Design and Verification.
4. Installation and Validation.
5. Training.
6. Maintenance.

Some of the OEMs who originally provided the older equipment were contacted to help with safety modifications. Polytron found that because of the extensive changes needed for the equipment, it would be cost prohibitive to use the original OEM. Therefore, the OEM was only used as a subject matter expert for the equipment being modified.

Older equipment presents more complex issues, such as legacy control architectures that can't support new safety technology, outdated utilities, and the constraints of other systems that interface with the equipment. A few of the legacy components included:

- PLC-5® hardware and control architecture.
- DH+ communication architecture.
- Allen-Bradley® 160 variable-frequency drives (VFDs).
- Nonsafety contactors.

These factors challenged the project team to understand and define the full scope of what was needed. Definition is difficult because of the unknowns that likely would be uncovered as the project begins. It's important to have a thorough plan identifying all possible contingencies in each area before beginning the work.

Machine safety projects are more successful when a system integrator with machine safety expertise is involved. This expertise allows the manufacturer to realize benefits such as:

- Understanding of standards and how to effectively apply technology.
- Minimized machine downtime and impacted systems because of a well-developed plan.
- Cost-effective changes that reduce the equipment's risk level within company allowable limits.
- Increased equipment efficiency and productivity.

High-Risk Palletizer Area

At this customer, risk assessments targeted the palletizer area as a higher-risk area for a stand-alone safety project. Based on Polytron's machine safety mitigation approach, the Polytron team began to conduct the remediation process on the equipment in the palletizer area based on the company's risk assessment.

The team reviewed the risk assessment provided, and began identifying modifications needed to lower the risk level of each hazard to bring it within the company's stated range of tolerance.

The Polytron team developed a functional specification that addressed specific areas identified in the risk assessment and presented the recommended modifications to the customer. The goals in the functional specification were to adjust and modify to lower the risk level on each area, and equally important, to ensure changes didn't inhibit machine operation.

The modifications also provided a consistent system with machine-safety engineering and standardized automation — reducing downtime and increasing availability to diagnostics.

The Polytron team reviewed the design, plan and cost for the entire project, and began the work upon approval from the customer.

Project Implementation

Scheduling the machine-safety project implementation requires extensive coordination because of the evident equipment downtime. Older equipment requires considerable updating to bring into compliance and can incur as much as two to four weeks downtime depending on the project's complexity.

Often, it's a trade-off between the cost of new panels and components versus lost time in production needed to modify existing controls. In this case, the client was fortunate to have parallel systems that provided alternative routing for the line to minimize the impact on production. In most cases, the equipment safety upgrade project impacts the entire line with unavoidable downtime.

The total project included:

- Applying standard controls software components using Rockwell Automation RSLogix™ 5000, including state machine and programmable logic control (PLC) program templates, custom safety Add-On Profiles (AOIs) and standard human-machine interface (HMI) faceplates.
- Adding technology as an enabler that included safety-rated components such as 1756-L62S Safety PLC and 1756-LSP Safety Partner; 1734-IB8S and 1734-OB8S safety I/O; 100S-C and 700S safety contactors, 440N safety proximity switches; PowerFlex® 40P VFD with Safe-Off; 445L safety light curtain emitter and receiver pair; door switches; and 800T e-stop push buttons.
- Using Ethernet communications for safety, including communications modules such as 1756-EN2T Ethernet Card; 1734-AENT communication adapter for POINT™ I/O; and 22-Comm-E Ethernet communication adapter for PowerFlex 40P VFDs.
- Creating multiple, isolated safety zones to more efficiently operate and maintain equipment.

For older equipment, modifications often are made to add machine guarding.

Equipment updates and modifications were completed and validation, and start-up was coordinated with the client. Validation of the technology

Updated human-machine interface (HMI) screens and safety alarm systems help improve operator and machine performance.

and physical machine guarding was checked and verified for machine safety compliance according to the functional specification, and risk mitigation was finalized in documentation.

Climate Change: Critical Training

Risk mitigation creates necessary change for everyone's protection, and in many cases, provides operational improvement.

For operators, a machine that has been upgraded with new safety features should be approached as new equipment — machine operations and maintenance has changed, the HMI is new, the logic is different and new technology has been added. The updates create the need for training and documentation to help ensure safety upgrades deliver the intended outcome.

As a result of the equipment changes for the customer, new manuals were generated outlining new safety procedures and changes in operator tasks.

Polytron's training team conducted specialized safety training for the updated equipment. For example, procedures for isolating hazards within a safety zone changed. Isolated safety zones enable the operator to stop the impacted area, access the jam and remove blockage, and restart the isolated zone.

Without training, the operator would continue to shut down the equipment as before, creating unnecessary downtime. Technology transfer and training is critical to the success of risk mitigation projects, and most importantly for performance continuity and increased operations safety.

Upgrade Success

One year after the safety systems were implemented on the legacy equipment, the customer reported great results. "We have seen an improvement in both efficiency and productivity," says the operations manager. "Since completion of the upgrade, the system has been running more reliably at 80.23% to 91.03% uptime, and also made the controls more operator-accessible, which increased safety."

By following the safety life cycle from risk assessment to validation and beyond, a seemingly complex safety upgrade can be implemented with results that can be seen from the operator working on the machine everyday to the manager of the plant floor tallying the production numbers. □

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