TECHNOLOGY BRIEF

Safety Networking: Safety Stopping Motion

Functional machine safety using discrete wiring is an established way to protect workers from injury, and protect companies from the expense associated with accidents and downtime. Historically, machine safety has been based on wiring redundancy of safety-rated input components (e-stops, light curtains, door interlock switches …) to safety relays. Fundamentally, this technology is easy to understand. The only trouble with these methods is that they are complex unless the safety function is trivial in nature. For instance, most hardwired solutions take the all-or-nothing approach: as soon as one of the safe inputs activates, the entire system shuts down. This may be safe in most cases, but it is certainly not ideal in terms of productivity. Worse than taking a productivity hit is the fact that some well-established hardwired scenarios are actually NOT safe at all.

A large number of safety systems are constructed such that even in situations where a safety input device that has failed closed (i.e. a welded or sticky contact), the machine can be restarted! A setup that exhibits exactly this kind of problem is shown below in figure 1.

In this case a welded contact on the magnetic safety switches can easily go undetected even if the safely relay goes into a safety lockdown state once it detects that only one REED contact opened. Unfortunately, operators can simply "overwrite" this by cycling one of the force-guided e-stops (or any other still functioning safety device on the cable run), thus "resetting" the safety relay. Once this happens the machine can be restarted, even though the faulty safety device is still present.

Safety engineers have known about these kinds of problems—and their solution—for a long time; connecting each safe input device to its one safety relay solves the problem. But the price for doing this is very high, not only in terms of dollars and cents, but also in terms of wiring complexity and cabinet space. Wiring complexity is still the main reason why, even today, safety systems take the all-or-nothing approach instead of deactivating only the necessary machine sections. Examples where a zoned approach is a requirement are everywhere and the following situation can be found in automated drug packaging applications.

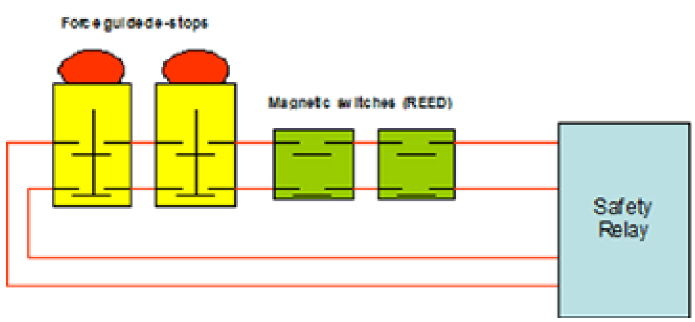

Figure1: *Magnetic REED safety switches (green devices) and safety e-stops (yellow/red devices) are switched in series and connected to the inputs on a safety relay. If one of the safety switches fails with a welded contact, it is still possible to restart the machine by cycling any of the other safety switches. Consequently, the machine will start up even though it is in a state of reduced redundancy. A second failure on the same partially-failed safety device would make the safety function entirely unavailable; certainly not a very good situation.*

Pepperl+Fuchs Group
www.pepperl-fuchs.com
USA: +1 330 486 0001
fa-info@us.pepperl-fuchs.com
Germany: +49 621 776-4411
fa-info@de.pepperl-fuchs.com
Singapore: +65 6779 9091
fa-info@sg.pepperl-fuchs.com
PEPPERL+FUCHS
SENSING YOUR NEEDS

Safety Networking: Safety Stopping Motion

Imagine a machine that fills intravenous pouches with medication. This machine protects workers with protective fences, safeguarded access doors, and e-stops mounted along the system. An electron beam-based sterilization process that is part of the packaging process must be tightly controlled since it creates the radiation needed for the sterilization process but is harmful to exposed operators. The second subsystem interfaced with the safety system is a pneumatic delivery system used to fill the pouches. During normal production, as soon as an e-stop is activated or a door is opened, the safety system must shutdown—both the electron beam and the pneumatic sub system. Nothing special so far. In fact, this application could still be solved using the old all-or-nothing approach typical for safety relays. When things do get a bit more interesting, however, is during regular maintenance.

In this case a safety enabling switch – activated and carried by the maintenance person – must allow the safety doors to be opened without shutting down the entire machine; the electron beam must certainly be deactivated. Enabling switch in hand, maintenance personal can perform adjustments to the pneumatic delivery system while the electron beam sterilization system remains safely deactivated.

This situation is very similar to muting frequently used in light curtain applications. Solving this application problem is certainly possible using the old hardwired approach; unfortunately it is time consuming, labor intensive and difficult to troubleshoot. The good news is that network-based safety solutions like AS-Interface Safety at Work can address all those issues.

When using AS-Interface Safety at Work, safety input devices are simply connected to safety-rated, addressable input modules. Alternatively, dedicated safe-rated devices with integrated AS-Interface chips can be connected directly to the network resulting in the greatest possible time saving and the cleanest possible layout.

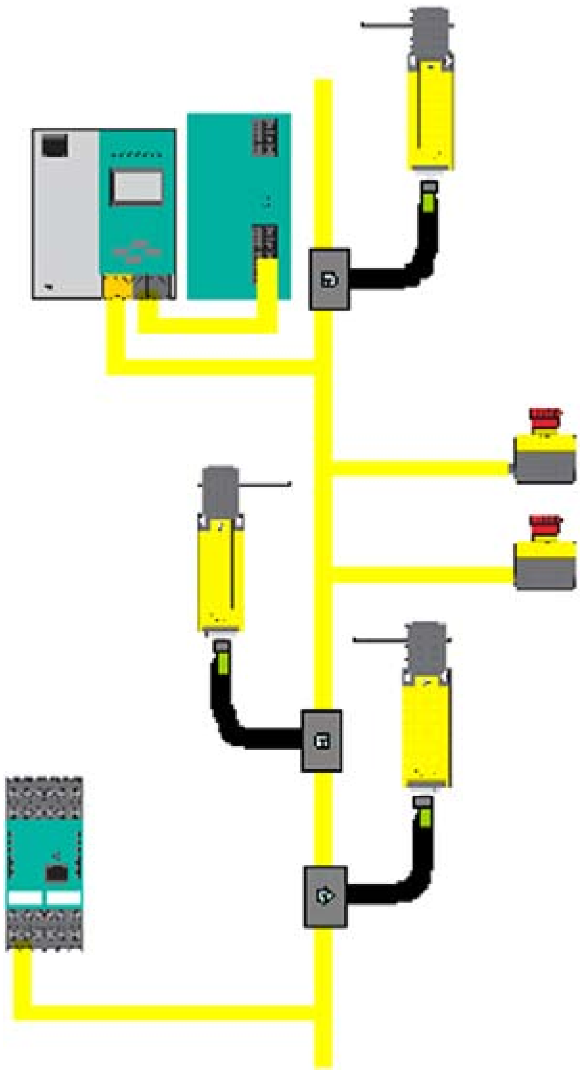

Figure 2: *AS-Interface safety devices are connected directly to the simple, two-conductor network. The gateway (top left) interfaces with any of today's dominant upper level networks (DeviceNet, PROFIBUS, EtherNet/IP …) and allows the PLC to perform annunciation and diagnostics. The SafetyMonitor (bottom left) supports between one and 16 independent release circuits enabling just about every conceivable safety function required in modern automated manufacturing, packaging and material handling system. Because each safety device contains a unique address, resetting an AS-Interface Safety at Work solution with a partially failed safe input from another safe input device is not possible.*

Pepperl+Fuchs Group
www.pepperl-fuchs.com
USA: +1 330 486 0001
fa-info@us.pepperl-fuchs.com
Germany: +49 621 776-4411
fa-info@de.pepperl-fuchs.com
Singapore: +65 6779 9091
fa-info@sg.pepperl-fuchs.com

Safety Networking: Safety Stopping Motion

TECHNOLOGY BRIEF

Irrespective of how the safety input devices are connected to the network, the network is now used to transmit their state to the programmable SafetyMonitor, which takes the place of the safety relay in old, hardwired installation. From here on out, the logic behavior is defined in the software and specifying the necessary functionality is accomplished simply by combining "input blocks" with "logic-functions." Diagnostics is easy and powerful and can be performed by any PLC connected to the network (either via a gateway or by means scanner cards connected to the PLC backplane. Figure 2 show a setup using e-stops and door interlock switches supporting zoned safety on a simple, two-conductor cable run.

This well-established safety solution reduces the amount of wiring by up to 90%, while adding significant flexibility. Finally, there's a reliable system that does not penalize a machine builder who's designing efficient, zoned safety systems. But what really makes AS-Interface Safety at Work a significant consideration for reliable plant safety is the fact that unsafe startups, common on today's hard-wired systems are easily prohibited, controlled and diagnosed. And forget about those daisy-chained safety systems with the welded contacts.

Safety engineers will be very happy to hear that AS-Interface Safety at Work will NOT allow a restart via the indirect means of cycling a nearby e-stop. The problem of deactivating the electron beam while the pneumatic system keeps running is easily solved using this safety networking technology.

AS-Interface benefits control professionals in creating truly safe solutions that remain safe even when parts start failing.

Helge Hornis, Ph.D.
Manager, Intelligent Systems Group
Pepperl+Fuchs
330-486-0001
www.pepperl-fuchs.com
fa-info@us.pepperl-fuchs.com

Motion Control Supplement to NASA Tech Briefs
February 2009

Part No. TDOCT_B002_USA