

CONTROL ENGINEERING

Reed Business Information.

Vol. 55 No. 5

MAY 2008 Covering control

and automation systems worldwide

New Heights for Safety Sensors **34**

DCS/PLC convergence **40**

Control loop management software **48**

Network products certification **54**

2008 salary survey **60**

Product Research: Industrial Ethernet protocols **64**

PRODUCT EXCLUSIVE: 12

Wireless and/or Ethernet temperature, humidity monitor

Get the latest in Machine & Process Automation Safety

Visit SafetyBase.com

Launching mid-May 2008

Brought to you by Control Engineering; sponsored by Siemens.

www.controleng.com

Safety Rise to

Human life has value, which is why integrated safety systems protect workers, assets, environment, and nearby communities from hazardous workplace conditions. While education helps, smart designs and technologies overcome the ups and downs of humanity - lack of training and lapses of judgment - that cause accidents.

A new industrial elevator design, proven in the test tower shown, is being installed in several applications. Officials from Tower Elevator Systems Inc. provide a high-level view of how industrial sensors and smart designs integrate into a safety system.

Safety sensors create a no-entry area, past which safety sensing technology detects intrusion and sends a signal to attached logic, halting or drastically slowing whatever actuation (hydraulic, pneumatic, electric) might cause injury. Additionally, safety sensors are made to fail safely, meaning if a measurement or signal transmission doesn't occur, the attached logic ensures a safe outcome.

Safety sensors can also include elements of redundancy, so if one element fails, another takes over, avoiding productivity losses from a shutdown. Redundancy doesn't necessarily mean a system is safe, nor does use of safety automation ensure that the assembled system is safe. Safety automation, rated by safety integrity level (SIL4 is safest) adds safety, and certification adds cost; how it's integrated into overall design matters a great deal. Refer to applicable standards, codes, and best practices, and use risk assessments to reduce hazards to an acceptable level of risk. (Nothing is risk-free.) Other articles cited offer help in those areas.

Sensitivities, affordability

Safety sensor or switch products can include automatic safety barriers, edges, electronic safety sensors, emergency stop (e-stop), palm buttons, safety controls, laser scanners, light curtains, mats, optoelectronic devices (single and multi-beam), and two-hand safety controls, among others.

This industrial elevator offers five-way safety, with technologies from Siemens, Profisafe, SEW-Eurodrive, and Tower Elevator (which provided the image).

Sensors New Heights

An integrated safety system, like any control system, contains sensors, logic, and actuation, with I/O connections, networks, and software to tie it altogether. As connected sensors advance in functionality and fall in cost, redundancy and fail-safe designs reduce risk.

Trends in safety sensors include greater integration, such as putting the photodiode and amplifier on the same chip, greater sensitivities in sensing elements, more efficient light-emitting diodes (LEDs), greater affordability, wider selection of available products and suppliers, and greater attentiveness to designing in functional safety and reliability, according to John Drinkard, vice president of engineering, Omron Scientific Technologies Inc.

"Factories can represent extreme environments. The main difference in safety and non-safety products is that, should a component in a safety product fail, or an improper attempt to bypass the safety function be made, the product is designed to detect these conditions and respond safely, with outputs off," Drinkard says. In addition, designs of safety devices have changed to fit specific applications better, such as light curtains with new muting or blanking features, he says; configuration has also become easier, via dip switches or a PC. "We're often looking at incremental improvements of existing products as we develop new safety sensing technologies," Drinkard adds.

3D safety zone

While these existing safety sensor technologies follow the faster, lower power, easier to use, more economical technology trend, invention continues. A technology developer for another major safety automation company said (without naming competitors) that safe-area machine vision technology was the next major safety growth area, and he'd expect other major introductions, using complementary metal oxide semiconductor (CMOS)

image sensor technology.

That observation followed the Pilz Automation Safety LP introduction of what Pilz called the world's first 3D safe camera system for control and monitoring, SafetyEye, in June of last year. Such a sight-based, three-dimensional safety system has

the potential to sense, monitor, and control potentially dangerous work processes more simply than networks of multiple two-dimensional sensors, such as light curtains, and other guarding. Pilz says the SafetyEye 3D system offers more safety with easy-to-configure (on a PC) detection zones, and fast diagnostics for rapid troubleshooting, and no barriers.

"As safety sensor technology continues to mature," says Israel Alguindigue, automotive market manager, Sick Safety Systems Division, "devices have been enhanced with powerful self-diagnostics capabilities that provide information about the health and status of the device, and, in many cases, about the machine. This information can be used by machine users and builders to design robust maintenance schemes that go far beyond reactive maintenance, which aim to maximize machine availability."

For example, Alguindigue says, new safety devices based on vision technology for press breaks collect valuable performance data from the machine, such as the maximum velocity and deceleration, which can be used to assess the health of the press brake. "A history of this information is readily available from the safety device. Because of the precision required to ensure the operators' safety, and the tight interface with the machine, safety sensors can often provide other useful data such as location, angles, and position."

A vertical application helps provide context for how safety sensors help make equipment safer. Tower Elevator Systems Inc. (TESI) applied ASME A17.1 Safety Code for Elevators for freight and

Mark T. Hoske
Control Engineering



ONLINE

With this article May 2008 at
www.controleng.com/archive

More safety products,
articles; risk assessment,
safe designs; process safety
Webcast, vendor links

Sensors enable first safety relay to slow hazardous motion

The new Allen-Bradley MSR (Minotaur Safety Relay) 57 speed monitoring safety relay from Rockwell Automation is said to be the first of its kind designed to allow personnel to enter hazardous areas while motion is present. MSR57, available later this year, works with input devices (e-stops, light curtains, switches, and interlock switches) to stop motion, put the machine into safe speed upon verification, and monitor personnel in the hazardous area during safe speed conditions.

The MSR57 is configured and monitored via the same tools used to program standard drives (Drive Explorer or an HIM device). During configuration, the user can set a variety of parameters to specific application requirements, including type of input devices, door locking and monitoring, enabling switches and a maintenance (safe speed) mode. For instance, the MSR57 can help increase productivity by unlocking doors automatically when zero speed is detected. It supports a variety of drive applications, can be adapted to current installations with standard drives, or use the "Safe Off" feature on Allen-Bradley drives. (Online: See image and link to more info.)

personnel to its industrial elevator. This is the only known industrial elevator system using a safety PLC with TUV SIL category 4 certification. These rack and pinion industrial elevators target industry, broadcast towers, mills, mines, power plant chimneys, oil rigs, refineries, ships, and other applications. They incorporate TESI Smart Reel technology, with redundant safety systems and a Siemens-based hardwired control system running the Profisafe network.

5-way safety

"Engineers try to stick to the rule of three for safety. Our system has up to five redundant levels to provide for safety of passengers and stop the elevator if it's moving," says Mark

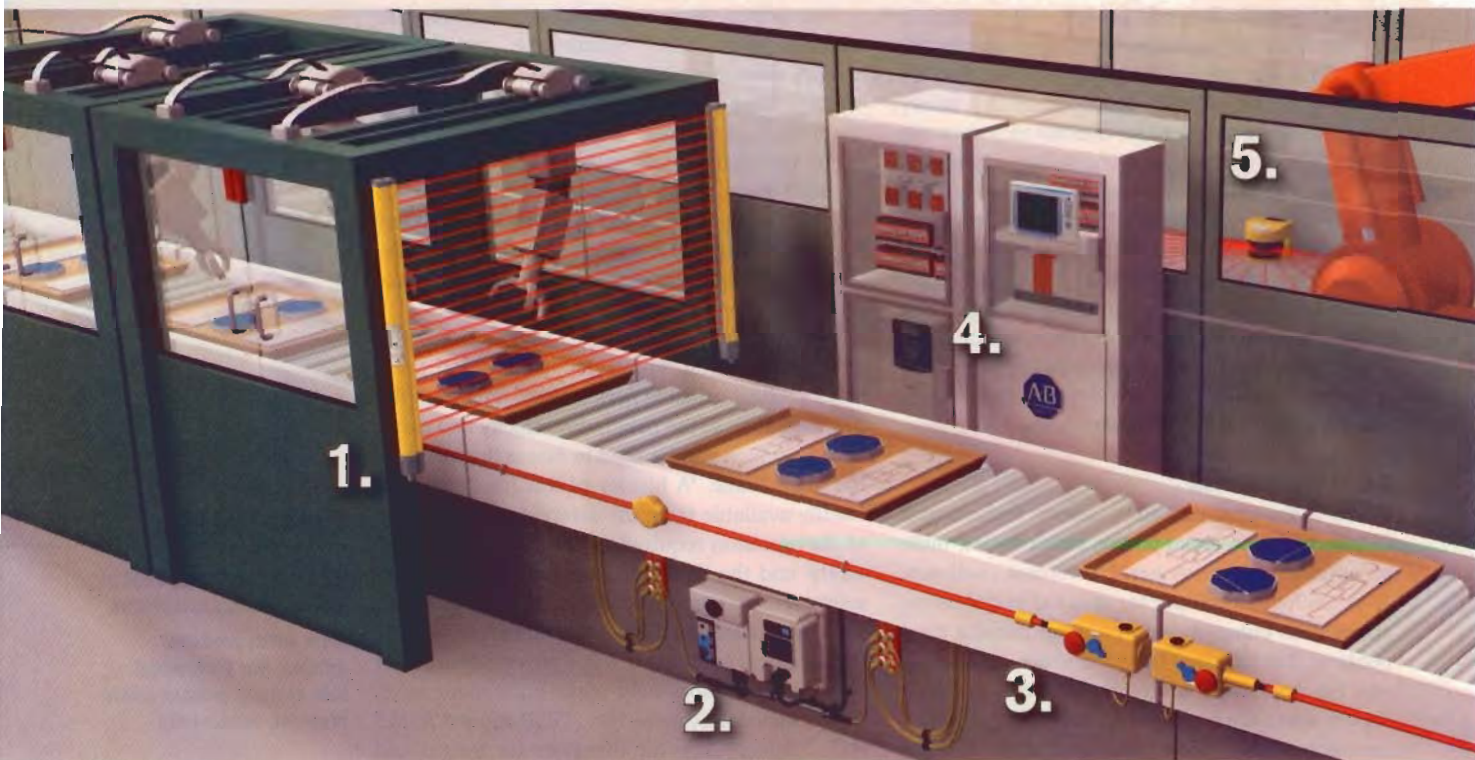
Burnett, TESI control systems manager. "That provides a higher level of assurance. This is an investment in a company's most important asset, its people."

Burnett says the latest Tower Elevator control system provides self monitoring, and fail-safe shut down in case of faults. The controller, with variable frequency drive (VFD) and encoder, checks the car's speed up or down and stops the system if the actual reported speed is not within the expected tolerance, if the VFD senses a problem, or if power is interrupted to the motor or brake.

Mechanically applied safety brakes provide an extra layer of safety. System health monitoring checks the system every time it shuts off, compared to other systems that only may be inspected every year or every five years, depending on local requirements, Burnett says.

Sensors for speed and positioning, says Todd Grovatt, Tower Elevator president and chief operating officer, include the incremental quadrature encoder, non-contact proximity sensors and contact limit switches at the final over-travel stops. Rack and pinion positive mechanical connection to the drive shaft prevents slippage.

The non-contact proximity sensor resets the home position to calibrate and reset the count to zero each time the system returns to the lower landing stop. Another measured parameter is the amp draw on the motor, to tell if the system is dragging too much on the rack.



Redundancy, Integration

Other systems use one set of mechanical limit switches and cams to slow the car, another set to stop, and others to lock and unlock doors. The TC1K controls these and other functions with advanced control system logic and electronic devices. The safety PLC handles all critical functions, such as independent braking with two safety contactors, Grovatt says. The first system using the redesigned safety controller was tested in late March at an 80 foot test tower (cover image) and will be installed before end of June.

Integrated safety systems, in place for the past four or five years in many industrial settings, are expanding into other applications, such as industrial strength elevators, says J. B. Titus, manager of business development and industry standards at Siemens Energy and Automation. Results include increased uptime, safety, cost savings in installation, wiring, and diagnostics, as well as better operations.

Noting the value and growth of safety automation, Rockwell Automation acquired Cedes' Safety and Automation business, said to be a leading European safety light curtain and optoelectronic sensor supplier. Afterward, ARC Advisory Group called Rockwell Automation the leader in machine and process safety technology.

Dan Hornbeck, Rockwell Automation marketing development manager for safety, noted that safety components provide information to the

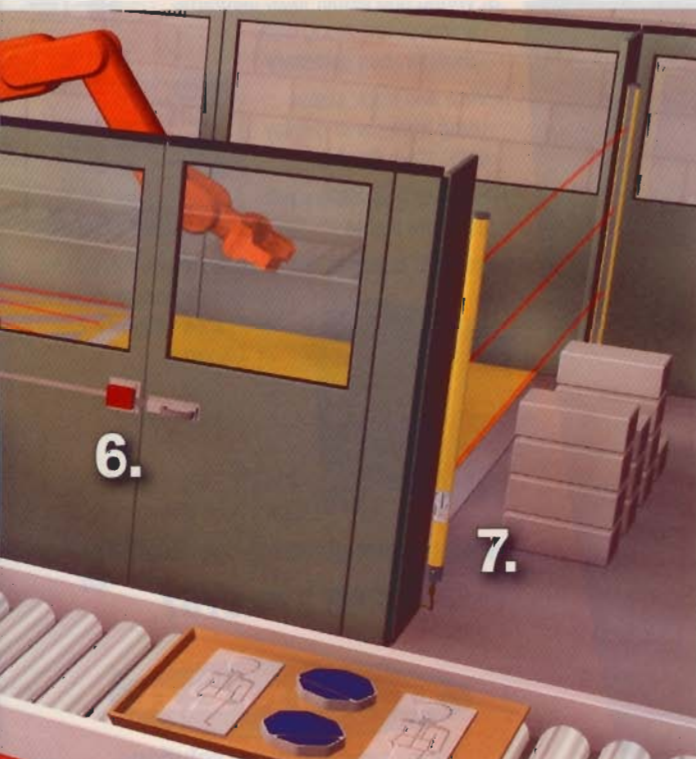
overall safety system, and recent advancements in products help with that.

"If something fails," says Richard Galera, Rockwell Automation marketing manager for safety components, "the system needs to ensure the machine stops and does not injure people or damage the machines." To increase reliability there's redundancy inside safety sensors, such as dual set of direct opening contacts or dual processors. Many older machine designs later wrapped safety around them as an afterthought; such add-ons might be thwarted. Now safety is integrated, mechanically and electronically, from day one of the design, improving safety and optimizing productivity, Galera says. "If you have to keep opening a door, use a light curtain," Hornbeck adds.

Analyzing a machine sensor's outputs can help ensure efficiency and safety, says David

Safety knowledge

A March 2008 *Control Engineering* safety article focused on two applications of safety controllers showing safety system integration: a fiery roller coaster and a beverage can installation. This May article takes the measure of sensors within machine safety systems, while an August article will look at how actuators are integrated. An April Webcast delivers five tips for process safety, and online in June you'll find links to process safety whitepapers. In 2007, safety article topics included networked safety and safe motion, among others. For links to these resources and more on what's mentioned here, visit www.controleng.com/archive, May 2008 and scroll down to the Online Extra section.



Sampling of safety sensing technologies

While there's no replacement for appropriate training, smart safety technologies can sense and avoid harmful interactions.

- 1 & 6. Radio frequency identification (RFID) coded non-contact safety switches and tongue operated guard locking switches interlock the guard doors and shut down any hazardous processes when opened.*
 - 2. Feedback devices in drives can verify anticipated location with actual location based on input from optoelectronic or other fail-safe sensors.*
 - 3. Safety networks help ensure communication of safety critical operating data and status diagnostics. Rope (cable) operated emergency stop devices and emergency push buttons placed at accessible intervals around hazards give shut-down of a hazardous situation once actuated.*
 - 4. Integrated PLCs with safety and automation control allow machine builders, end users and integrators to program, commission, maintain and troubleshoot more efficiently and easily. In smaller applications not requiring a fully integrated system, smaller programmable safety controllers also can be used.*
 - 5. Area laser scanner sets a field across the floor to ensure no personnel or obstacles get within robot's range of motion. Two areas can be programmed. The first is a warning field to notify operators that a person or object is in the vicinity of a hazard. The second is a protection field that once entered the potential hazard is stopped.*
 - 7. Light curtains here (and on the work cell near number 1) stop the robots if their sensing beams are broken. Pressure sensitive safety floor mats (not shown) also may be installed.*
- Drawing courtesy of Rockwell Automation.*



For point of operation or area guarding, the Sick C4000 Select Safety Light Curtain has dip switch configuration, an integrated laser alignment tool, intuitive diagnostics, and ability to cascade three devices.

Bell, SmartSignal's vice president application engineering. Checking vibration patterns from validated sensors ensures that machines (such as hundreds of tons of rotating steam turbine at 3,600 rpm, or mechanical pulping machinery) remain safe. Validated sensors indicate when mechanical or electronic systems begin to fail, suggests Bell. In establishing a baseline signature for how machines operate, it's not unusual for SmartSignal software to find that 3% to 8% of connected sensors are bad.

Sensor data and safety networks can

combine to create safety zones more easily than hardwiring an application, says Helge Hornis, manager, Pepperl+Fuchs intelligent systems group. Doing so can improve productivity. "For instance," Hornis says, "a sheet metal press may have several locations where material can be introduced." If the press design allows the press part to be run safely as one in-feed is interrupted, Hornis says, "it is possible to keep the process going when workers are bringing new material in and adjusting it for feeding into the press."

Ease of use, productivity, safer designs... it looks like no where but up as machine safety sensors continue to advance. **ce**

Mark T. Hoske is editor-in-chief. Reach him at mhoske@reedbusiness.com.

For more information, visit:

www.arcweb.com
www.honeywell.com/sensing
www.pepperl-fuchs.com
www.pilz.com
<http://us.profibus.com> Profisafe
www.rockwellautomation.com/safety
www.sea.siemens.com/safety
www.seweurodrive.com
www.sickusa.com
www.smartsignal.com
www.sti.com Omron STI
www.towerelevator.com



Two hand controls, light curtains, and e-stop buttons can reduce risk. Pilz Automation Safety recently added single beam (light or laser) safety sensors, which are more economical than light curtains for some applications.



Looking for one network standard to integrate both safe and standard I/O functions? Choose PROFIsafe and the WAGO-I/O-SYSTEM to eliminate duplicate hardware, networks, training, documentation, etc. Additional features and benefits include:

- Freely mix safe and non-safe I/O modules in the same node
- Choose from either Profibus or Profinet (in development) bus-couplers or controllers
- Implement as local or distributed I/O, as well as distributed control
- Easily connect e-stops, protective door switches, two-hand control devices, and other safety devices
- Outputs operate safety related actuators with stop category 0 or 1
- Inputs and outputs are cross-monitored for short-circuit conditions
- Built-in status, configuration, and diagnostics in every module
- Approved for use in safety applications up to Cat. 4, SIL 3, or performance level e

For more information on implementing PROFIsafe and the WAGO-I/O-SYSTEM contact WAGO at
 1-800 DIN RAIL (346-7245)
 or info.us@wago.com
www.wago.us/profisafe.htm

WAGO[®]
 INNOVATIVE CONNECTIONS