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PART I

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New Automation Technology **BECKHOFF**

Make the best of an alarming situation

By Rick Rice

Six months of planning and engineering, eight weeks of construction, 72 hours of commissioning, and your machine is finally ready for production. Despite all your best intent, you're three minutes into the first run, and your pride and joy stops mid-cycle. What happens next has everything to do with how well you designed your controls and which features you built in to help the operator get the machine back into operation.

The first thing that you want to happen is something that draws attention to the fact that the machine or process has stopped. The prevailing method of signaling a process stop is sounding an alarm, followed by a light, or series of lights, to give some preliminary information about the source of the stop. Grouped together and commonly known as a stack light, this device should be placed prominently on your machine or process. While little has changed over the years as far as the use of a stack light, the technology has moved along nicely.

Early light stacks utilized full-voltage, incandescent bulbs inside modules of different colored plastic or glass. Variations of the method of illumination have come forth over the years, using both ac and dc voltages of a common theme to match similar control voltages. The advent of light-emitting-diode (LED) technology and more recently the LED array have brought forth a product than can be seen from great distances. One advantage of LEDs is they don't burn out. Incandescent bulb filaments are weakened by the very thing they are intended to do, emit light. The constant heating up and cooling down that happens when

voltage is applied and removed causes the filament to weaken and eventually fail. Additionally, the use of filament bulbs in a process that is subject to vibration will further reduce the life expectation of the filament. The vibration on a relatively fragile element can cause it to break prematurely. LEDs are much more resilient and stand up much better to the normal parameters under which machines function.

Horns or buzzers are used to provide an aural signal to draw the attention of the operator to a significant event. This could be to signal a fault in the machine or system but could also be used to signify the pending startup or change in operating speed. A variety of sound-making technologies have been employed over the years, culminating with products that can be directional, omni-directional and totally enclosed for use in harsh environments.

Here is an example of how one might deploy a stack light. In this situation, there is an alarm horn and a series of lights in red, yellow (or amber) green and blue. The machine/process stops and a solid horn of 3 seconds draws attention to the fact that a stop has occurred. A flashing red beacon indicates a fault has occurred. A solid red light might indicate that a safety device such as an e-stop, light curtain or door switch has been activated. The absence of a red light would indicate that a normal, operator-initiated stop has occurred. A solid yellow light indicates that the machine is in manual mode, and a flashing yellow light might indicate that the machine is in motion while in manual mode. A solid green light indicates that the machine is in motion, while a flashing green light can indicate two different functions. If the flashing green light is accompanied by an intermittent horn in the same sequence as the flashing light, then the machine is preparing to start in automatic mode. If the green light is flashing while the machine is in motion, then the machine is running, but a downstream device is preventing the machine from producing product. A flashing blue light might indicate that a consumable material, such as glue or cartons or pouches, is at a low level and, if not replaced, will cause the machine or process to come to a stop. A solid blue light could indicate that the low-level condition has elapsed and the machine has come to a stop. As can be gleaned from the description above, much can be done with what seems like a simple device to provide immediate information about the status of a machine and, if stopped, gives clues as to the source of the issue and how to respond in the most expeditious method to restore operation.

The use of LEDs in stack light technology has many benefits. An LED produces far less heat and, as such, the package used to house the light source does not have to be as big since there isn't the need to vent the heat. This implies that the light module can

be totally enclosed, meaning it can be used in environments that might be subjected to dust or water vapor. LEDs are small and, as such, can be in close proximity to other LEDs. This gives the hardware provider the option to enclose LEDs of different colors in the same small module. Since LEDs last much longer than incandescent bulbs, replacing a traditional light stack with an LED version will result in less cost and the removal of the need to maintain the light modules. Further, LED light modules are less costly to operate as they are dc-powered.

Many automation vendors have LED light stack products. The popularity of the technology has prompted creative uses of the devices. Some examples of this creativity are:

- multi-color signal modules in a single dome-shaped lens with or without sound
- traditional light stacks with alarm modules that have pre-wired pigtail connectivity
- light stacks with M12 connectivity so that the light module can be easily swapped out by simply disconnecting the cable.

Due to the low power consumption with LED technology, some manufacturers have come up with wireless light stacks. These units use Ethernet or Bluetooth technology to locate light modules on a machine or process that might normally be difficult to wire.

One vendor has taken a different track with their light stacks. The traditional light stack would have a somewhat transparent plastic lens in the color of the desired output. Newer LED versions went with a similar approach where the lens is the color of the intended output. In a further advance more recently, manufacturers are going with an array of LEDs backed by a reflector with the LED in the color of the output. The net result is a light stack that can be seen at much greater distances with far more contrast and illumination than ever before.

The convenience of small packaging for LED devices has opened up a whole new possibility for this technology. If palm-sized devices can be so easily deployed, then the inclusion of touch-sensitive devices to provide input to the process is a natural addition. The same package that provides a multi-color status light can be used for a prompt to touch device where the light turns on to signal that a response is required. The user then touches the device to provide feedback. It's not too hard to see where this is going when a pair of these devices is tied into a control system to provide a two-handed, anti-tiedown input.

Taking the above device into yet another progression, the quick-connect M12 technology allows for a great way to make a dual redundant e-stop button with LED annunciation. One manufacturer has even taken this a bit further by lighting up an LED array around the e-stop button to draw greater attention to the triggered device. These lights, in a ring instead of a simple light on

the palm button, are visible from a distance and are distinctive in that the untriggered device has a green ring around it and the tripped state is annunciated with a red ring.

In a trend that goes against the usual path of new is more expensive, LED light stacks are significantly less expensive than their incandescent predecessors. The great thing about this development is that more stack lights can be used in a design for the same cost as a single light stack of the older technology. With the example of the use of a light stack in mind, it isn't hard to imagine the impact on the ability to get the process back in operation if more lights are viewable around the perimeter of your machine.

In my personal experience, light stacks tend to get ignored if they aren't placed appropriately on a machine. Further, if they aren't relied on due to poor placement, they also get ignored from a maintenance standpoint and often go without getting the lights replaced when they burn out during normal operation. With the use of LED light stacks, especially with the new, mirror-backed LED array technology, a well-placed signal device becomes an integral part of a control system. Couple that with technology that doesn't burn out or have issues with vibration and you get a device that people tend to rely on. Our operators have embraced our standardization of the use of light stacks and often ask to have them added or replace the original equipment that came from our machine vendors. We have taken their use even further and use subtle differences in the sound pattern of the alarm horns on adjacent machines to help the operator avoid responding to signals that aren't relevant to their production line.

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What will 5G do for you?

By Jeremy Pollard, CET

While not the fanciest of gifts, I bought my household an Instant Pot. It's a high-class pressure cooker that promises to make me a better cook.

But the kicker is that it is Wi-Fi-enabled, so it actually counts as technology, yes? That way it doesn't count as buying an appliance but an edge IoT device. That's my story, and I'm sticking to it.

In our sandbox, there will be a new kid in town that will change the face of Iot and IIot, and that is 5G mobile technology. I think it is pretty cool that you can monitor your pot roast from your car or turn the device on so that the pot roast is ready when you get home. 5G will make no difference in that situation.

So what will 5G give us? First off, I have done a lot of reading on 5G and its health effects. Some say that the higher frequencies will cause an abnormal amount of human disruption and cancers. You need to be the judge for yourselves, but some of the information seems quite credible. There is just as much credible information out there supporting the opposite.

At 300 GHz it will have the fastest bandwidth available and is comparable to microwaves. The short wavelength allows for very fast communications between devices, routers, switches and antennas. It just takes a shorter amount of time to travel the same distance as 4G does.

So, why all the hype? Edge devices can now process the data that they are supposed to and fire it to wherever they want using whatever protocol they want. MQTT, HTTP or even FTP can be supported by 5G much better than 4G can do it.

This gives rise to almost real-time data for SCADA, edge devices, analytical data and cloud-based solutions. The new and improved SCADA and edge-located HMI/devices will be able to link to the cloud directly using Microsoft's Azure platform or Amazon Web Services (AWS).

5G will provide the data highway that big data will need as devices get smarter and provide more data to the user for real-time display, historical as well as real-time analytics and pre-processed information for the ability to make informed decisions.

This can be important due to the fact that most companies do not have the staff or the wherewithal to perform these analytics on their own. They will need the devices to provide this pre-processed data to them in a form that is easy to interpret.

This large amount of data will need a big transmission pipe so that the pipe doesn't get clogged, and that's 5G.

The 4G bandwidth simply will not be big enough to handle the data that will be required. Another 5G advantage is the ability to use smaller antennas for smaller areas and larger antennas for larger areas, which can provide long-range data support.

5G is not widely available in all areas, but, as the buildout happens, customers will start demanding more data from their systems for maintenance, operational issues and economic analytics in real time. The old proverb applies here: Work expands to fill the time available. Replace work with data and time with bandwidth, and we have created a new one.

There is a new technology that enhances the 5G core called light fidelity (Li-Fi), which is based on light waves. It is secure and not prone to interference, and it is similar to Bluetooth in its range.

This provides an ability to have a localized small, safe and fast network for devices that support Li-Fi. Fiberoptic cable could be used for connectivity, as well.

I can envision M2M being based on Li-Fi due to the non-electrical nature of the technology. While not widely used in present time, this technology may grow with the rollout of 5G.

Where 5G will excel will be when edge computing and IIoT devices start proliferating in our applications. Edge computing by definition suggests that the device that extracts and processes data and informa-

tion from devices is as close to the source of the data as possible.

That data has to go somewhere, and typically it has to get there in real time, which today can be upwards of seconds or longer. Will new SCADA/HMI systems support IIoT technologies natively to provide the need to have this data? Absolutely, and this is evident with Opto 22's groov EPIC controller which is being marketed as an edge device with built-in HMI supporting various protocols and cloud support.

Depending on the amount of data that the customer wants from this device at the edge of the domain, the distribution model and the definition of real time, 5G may be what is needed to accomplish the goal.

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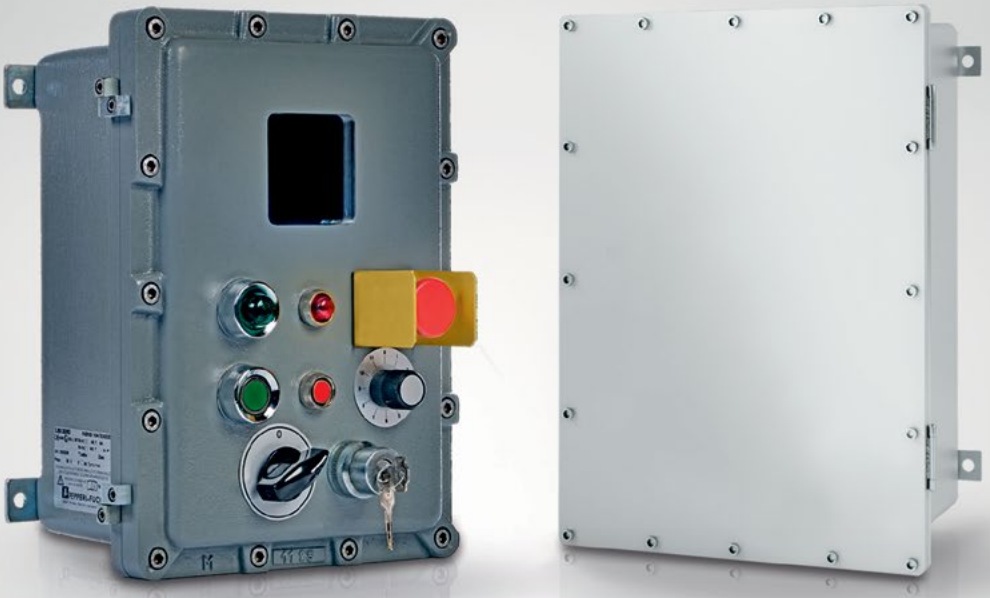

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Wrap it up

What you need to know about enclosures and the NEMA rating spectrum

By Rick Rice

When choosing an appropriate enclosure the NEMA rating should be considered before any other criteria

The electrical enclosure is essentially a metallic box with a lid. To mount components in the box, a back panel on standoffs is added to create the finished enclosure. The application and environment dictate the variations on this base concept.

Starting with the enclosure itself, certain applications may call for a different material of construction. Environments where exposure to caustic or corrosive chemicals or extreme weather is expected, making the box out of fiberglass or polycarbonate ABS is a better option. In normal, dry conditions, a mild steel enclosure is suitable and for wet environments a stainless steel enclosure is best. The National Electrical Manufacturer Association (NEMA), came up with a rating system to describe these applications and environments and some of the main types are described as follows:

Type 1 is a general-purpose enclosure constructed for indoor use. This product protects against incidental contact from dust, light and indirect splashing but is not dust-tight. Type 3R is intended for outdoor use. Deemed to be weather-tight, this type of enclosure is neither rain-tight nor water-tight, meaning that a direct stream of water or rain may breach the enclosure. For this reason, a Type 3R enclosure would be suitable for power or switch-

gear equipment but not recommended for control circuits.

Type 4 enclosures are considered weather-tight (weatherproof). They will protect the contents from falling rain, snow, sleet, dirt, wind-blown dust, splashing or hose-directed water. These enclosures will not be damaged by the formation of ice on the exterior surfaces but are not considered to be corrosion-resistant.

Type 4X enclosures are corrosion-resistant and are made of materials such as aluminum or stainless steel. They have the same properties of the Type 4 enclosure but are intended for extreme environments.

Type 12 enclosures are intended for indoor use and provide a degree of protection against solid falling objects, such as dirt, dust, fibers, dripping or light splashing water. These are usually constructed of mild steel.

Type 13 has all similar properties to Type 12 but adds a degree of protection against oil and non-corrosive coolants.

Generally, types 1, 4, 4X, 12 and 13 can be used indoors, while 3R, 4 and 4X can be used outdoors.

When choosing an appropriate enclosure, the NEMA rating should be considered before any other criteria. Once that decision has been made, the type of access to the component inside the enclosure will dictate the next step in the selection process.

Generally speaking, the risk to personnel when exposed to the contents of the enclosure will determine the type of construction.

A pushbutton station, for example, is primarily a low-voltage enclosure where the lid will rarely be removed. As such, a four-bolt, removable cover is appropriate. A junction box might require infrequent opening (for troubleshooting or to add connections) and is generally mounted in a position where completely removing the cover isn't practical. For this purpose, an enclosure with a hinged door and clamps would be an appropriate choice. The clamps require a screw driver or wrench to loosen the clamps and would provide a degree of protection that is higher than the same enclosure with hinged-lid that uses a quarter-turn latch that could be operated with a coin, for example.

For enclosures that contain voltages higher than 48 Vdc, an interlocked disconnect is required. Generally, there are two such types of disconnect panels. The first uses a through-the-door rotary actuator that locks the door in the closed position if the disconnect is in the ON position. The second uses a side-arm disconnect handle (lever-type) that uses a mechanical lever to prevent the door from being opened while

the disconnect is in the ON position. Both options protect unauthorized or accidental opening of the door while the power is on but have an override feature so that the enclosure and contents may be accessed by trained personnel.

Always remember to follow proper arc-flash procedures when accessing panels above 48 Vdc. These procedures include the wearing of proper personal protective equipment (PPE) including clothing, face shield, gloves and footwear. The rules regarding this type of access are much more restrictive than in years past, so make sure to review the regulations regularly to make sure you are compliant.

As a contract packager of food products, our manufacturing processes dictate the use of pretty much the full spectrum of NEMA types and our enclosures come in all sorts of shapes and sizes. With any organization that has been around for a while, the use of enclosures was far less critical in earlier years, and this leads to a number of situations where the type of enclosure has changed as improvements have been made to our systems. As with all projects, make sure to consult the current rules governing such matters and make sure that you are compliant with the rules as they exist today. Generally, we stick to NEMA 4X for anything on our blending or dumping equipment while NEMA 12 works just fine for our general production equipment. We don't package any corrosive products, nor do we have to consider explosion-proof equipment due to our current product mix. An evaluation of these criteria with each new product offering does give us confirmation that we are minimizing the risk to personnel when we introduce these new processes.

Something that has been of particular interest to my organization of late has been the introduction of products in the NEMA 4X realm, particularly sloped-top enclosures used in our ribbon blender operations. These mixers are used for a great variety of products and, as such, require frequent wet washes between product families. The popularity of gluten-free and organic products, as well as the ever-present allergens have also increased our need to wash (and test on a micro-biologic level) our blending equipment and rooms on a much more frequent schedule than ever before. The existing equipment was installed in 2000 with a more recent addition in 2012. Both the original and the addition use NEMA 4X enclosures, but we have learned that continuous washing over a number of years has rendered the enclosure seals to be less than fully functional. At the time we purchased this equipment, the enclosures came with a permanent seal that is installed at time of fabrication.

A new product (within the past year) has hit the market that directly addresses our current concerns. While still a NEMA 4X prod-

uct, these new enclosures employ features that help to reduce the possibility of getting moisture inside the panels during the washing process. The first feature is a sloped top that, unlike previous version, extends the top surface of the enclosure over the top of the door. Previous versions employed a sloped top that stopped at the usual front face of the cabinet. The door was then a separate assembly that was attached to a flange that was welded to the front face of the enclosure. These new series of enclosures extend the top of the enclosure out over the top of the door to just past the front face. This feature creates a roof or porch over the door to force any water stream out past the top ledge and seal of the door.

The second feature is a new way of sealing the door. The traditional way of sealing an enclosure is a laid-in foam seal that is applied at time of manufacturing. If the seal fails, then one must either replace the whole door, if a current version of the enclosure matches the originals, or a kit must be applied that requires the removal of the old seal, cleaning of the surface down to the original metal and the application of a glue to lay down a new seal in place of the old.

The new seal is not a match for the old seal but is, rather, a roll of seal that must be applied one side at a time with appropriate cutting to length. In our experience, this process inevitably ends up with corners that are not continuous and a means by which water can get into the panel. These new enclosure are sanitary-washdown-rated. The key feature is a replaceable FDA-grade silicone gasket. These gaskets do not replace the existing seals on a non-washdown enclosure but would be used to replace the gasket on a newly installed enclosure. The silicone construction resists bacteria growth and chemical absorption, and the ease of replacement makes them an excellent choice for any new installation where NEMA 4X in a washdown environment is likely.

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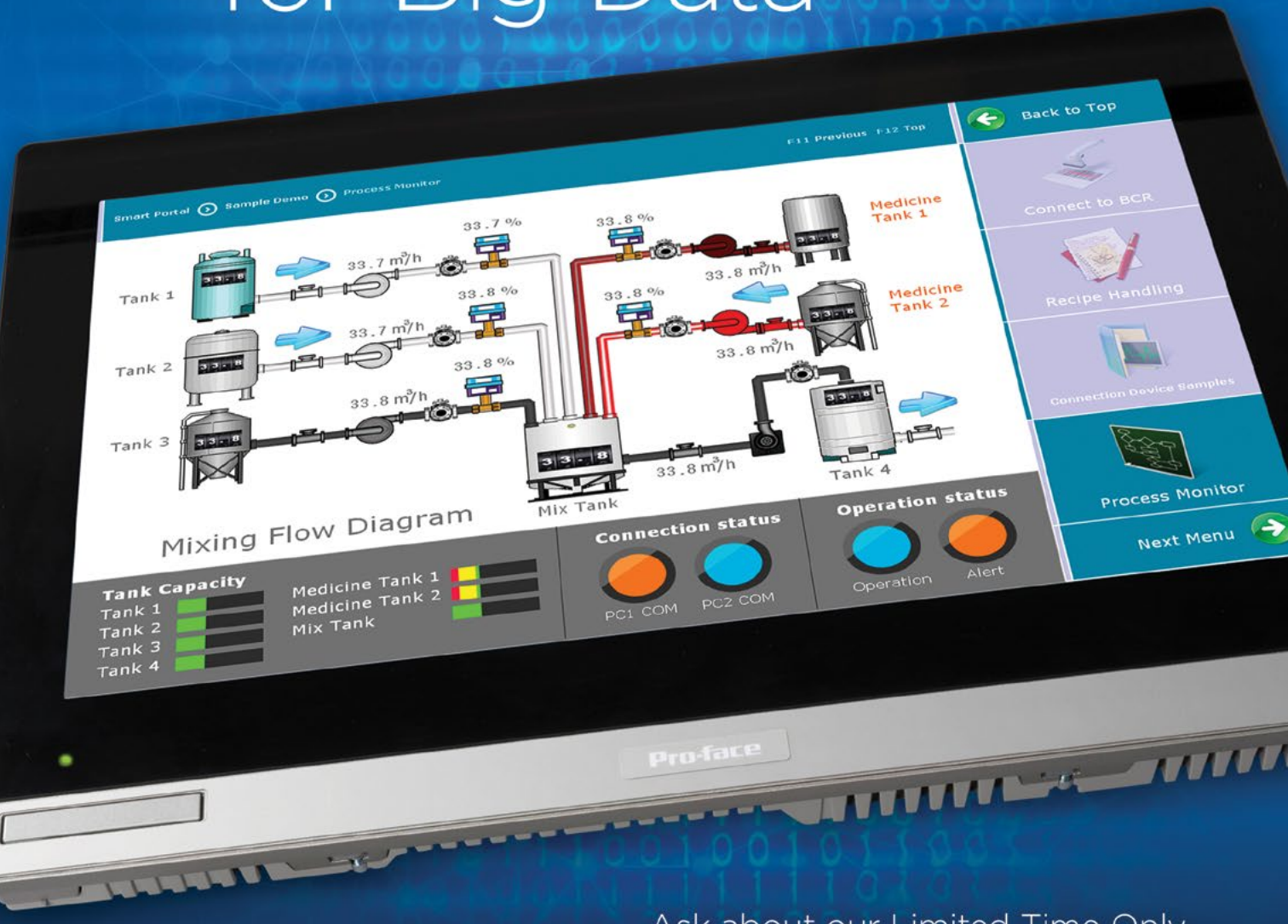

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by Schneider Electric

Savings prove out with intelligent enclosures and universal I/O

By Mike Bacidore

There's been a subtle shift in the DCS market from conventional I/O to universal I/O. The savings on labor and materials seemed obvious, but Bechtel Oil and Gas decided to prove it out before standardizing on ready-made intelligent enclosures with configurable I/O.

An internal study has revealed 15-30% savings on each Bechtel LNG project that has implemented this new technology.

"We get to see a lot of new technologies," said Robert Resendez, control and automation team manager, Bechtel Oil and Gas. "We get to follow a lot of new technologies. We get to implement a lot of new technologies."

In 2013, Bechtel had just come off of seven LNG projects. "One of the biggest challenges was design development because of the changes," explained Resendez. "We were at the factory acceptance test (FAT) for eight to 12 months on all of them because of design development. What could we do to fix this problem? Universal I/O was a no-brainer. I don't have to increase cabinet size. The marshaling cabinets were the big changer because we didn't have to rewire."

The obvious savings come to light immediately, but Bechtel wanted to know the overall impact on costs. The new system also increased certain costs, but the net effect was evident.

"In 2013, we started vetting the systems and looking at them from an engineering standpoint," said Resendez. "In the conventional system, we had a cabinet and then each I/O had to go to a marshaling cabinet, then out to intermediate junction boxes and then copper cable out to the instruments. This is the standard."

With the remote I/O, the intermediate junction boxes were replaced with intelligent enclosures. "All the I/O is now moved out to the field," explained Resendez. "The connection back is now fiberoptic cable, so we've reduced the cable size and the structure by eliminating the copper cable. And the marshaling cabinets have all but gone away."

Bechtel took a project it had just completed with 2,253 I/O signals going to four buildings. "We had an I/O rack room, a utility substation, compressor substation and propane condenser substation," said Resendez. "We replaced the junction boxes with the smart enclosures. Eighty field junction boxes were replaced with 39 Smart I/O boxes." The majority of homerun cabling was eliminated, reducing 195 homerun cables to 16 cables.

"We eliminated 21,000 homerun cable terminations," said Resendez. "We eliminated almost 2 million linear feet of cable. We eliminated all 23 marshaling cabinets, and DCS cabinets went from eight to five. Because we eliminated cabinets, we reduced the footprint from 864 sq ft to 234 sq ft. In some other projects, we've eliminated a whole building."

Despite all of the reductions, Bechtel need to increase other components to accommodate the new technology. With nine clusters of Smart junction boxes, Bechtel had to have redundant power and redundant communication, so they're able to distribute them in the field in this cluster design.

Control system components and instrumentation were reduced. "But we've added quantities to our electrical for fiberoptic communications and power," said Resendez. "Because of the reduction of the junction boxes, the distance from the boxes to the instruments has increased and so the fan-out cabling has increased. But we're getting better at reducing the fan-out cable by improving design now. Also, the increased fiberoptics means fiberoptic terminations have increased slightly. And, because we need redundant power, we added fuse panels."

When Bechtel took all the cost of the material and labor, the savings was very large still. So much so that on every new project the company is now using the new technology.

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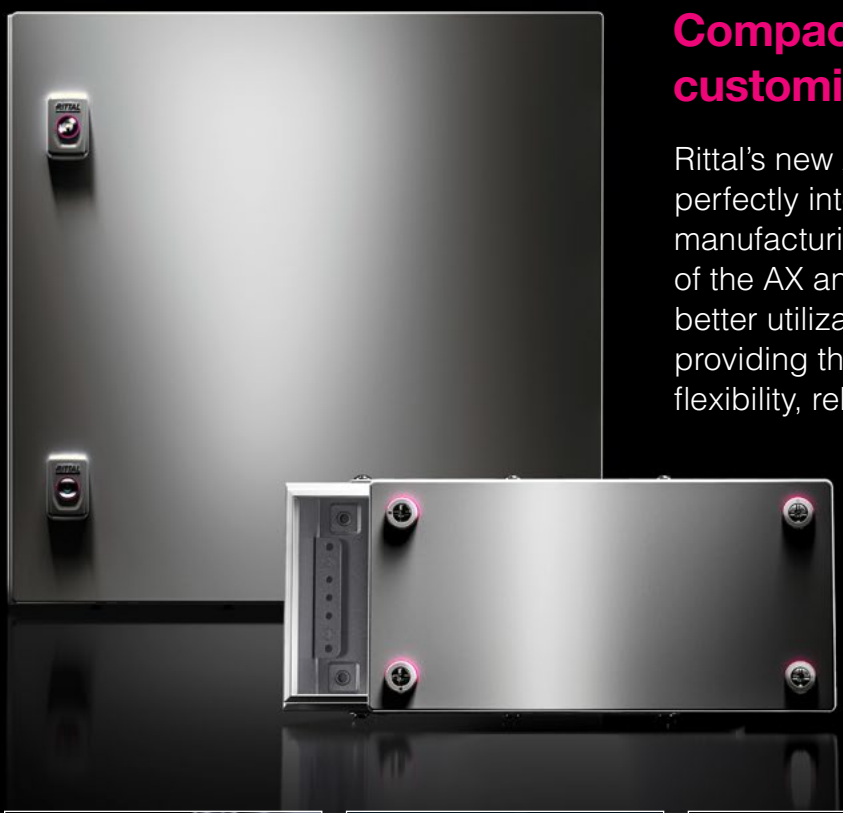

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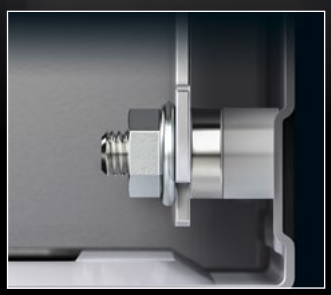

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What and how to document control systems in hazardous areas

When it comes to safely installing a control system in a hazardous area, the designers must document the equipment requirements and then carefully detail the control system design specifications

By Dave Perkon, technical editor

A successful control-system installation in a hazardous area, such as those containing flammable gas or powders, isn't just about following an electrical schematic that details field-device connections to rows of intrinsically safe barriers. Industry best practices start with an equipment-requirement document and a control-system-design-specification document. Whether these documents are combined or separate, the point is that the requirements and how the design will be implemented must be documented before any lines of the schematic are put on paper.

The first time these documents are created can be quite a long and involved process, but it still must be done. There are many national and international standards to follow, as well as ways for the control system to operate safely in a hazardous area. Fortunately, much of the documentation created can be reused as a template for future hazardous-area projects, and it will help ensure things are done right the first time. That should always be the goal.

To start, equipment requirements define "what" is needed, not "how" it will be done. They document, for example, requirements that must be met during acceptance testing, for example. Short, focused sentences about each individual requirement are a must. Start with the area classification, such as the control system must be designed to operate in a Class I, Div. 1 hazardous area. The control system must follow hazardous area classifications in NFPA 497 and/or the International Electrotechnical Commission (IEC) 60079 Explosive

The “how” is covered in the control-system design specification, which documents the design itself.

Atmospheres. Add requirements related to these standards, such as all field devices connected to the control system will be marked as suitable for use in the hazardous area. And there are many more, so be sure to document each equipment requirement as a separately numbered item.

The equipment specification is also a place to document preferred methods to use in hazardous areas. An example of this is the control system must be installed in an explosion-proof housing to prevent combustible gases or powder from contacting internal, energy-producing control components. Since these explosion-proof enclosures are heavy, bulky and difficult to drill and tap holes in for pushbuttons and conduit connections, the equipment requirement can document an easier or preferred method. For example, the control enclosure will include a purged/pressurized system, suitable for use in the hazardous area classification, to remove and prevent accumulation of explosive, damaging and caustic gases. Two of many additional requirement can document that power to the control enclosure will be safely removed if the purge pressure is lost and that control enclosure exterior temperature must not exceed automatic ignition temperatures listed on NFPA 497 for Class I, Div. 1, Group D atmosphere.

Another requirement, often a preference, all field I/O devices will be connected to intrinsically safe barriers, and another is the use of a standard manifold bank mounted in a purged enclosure with bulkhead air fittings instead of using explosion-proof, field-mounted solenoid valve banks.

Continue documenting additional equipment requirements on what is required. The hazardous-area specifications have countless requirements, and all relevant ones should be included in the document. These requirements are used to create the design specification and can also be edited as needed to create an acceptance-testing procedure, which is critical to document and pass before equipment enters production in a hazardous area. With the requirements documented, it is time to document how the requirements will be met.

The “how” is covered in the control-system design specification, which documents the design itself. This includes

specific part numbers and details needed to create the control-system design by defining how to specify devices, how to build and how to wire it. While the equipment-requirements document simply lists that an enclosure will be purged and that intrinsically safe devices will be used, the design specifications provide specific technical information needed to specify components or the actual part numbers and how to wire the system.

Starting with the main control panel, the specification will call out the Class I, Div. 1 purge system provides Type X purge functionality from a brand-name manufacturer, for example. Another numbered line item in the specification could define that the control enclosure will be NEMA 4X, stainless-steel construction. These "how" details should come right out of the NFPA 70, NFPA 497 and related standards with information added for use in the design. Suppliers of hazardous-area control products also have much to say about specifications, such as rigid conduit will run between control enclosures, and an aluminum sealing fitting with ¾-inch FNPT ends will seal the conduit within 18 inches of where it enters the explosion-proof enclosure.

To ensure a proper and safe installation, the control-system design specification should detail how intrinsic-safety circuits are wired if there use are a requirement. To start, all intrinsically safe wiring will be light blue to clearly highlight its special purpose. All intrinsically safe wiring is isolated from non-intrinsically safe circuits by at least 2 inches.

Continue to define and detail how the system will be designed to meet requirements. Whether designing the system yourself or using integrators, consultants, OEMs or manufacturers, get the requirements and specifications documented in detail, even for non-hazardous areas, and only that, build it.

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Integrator grows business with better, faster and modular design and build

By Dave Perkon, technical editor

Time is money, so taking less time to design, program and integrate a system is money in the bank. Inovatech Automation (www.inovatech.com) in Macomb, Michigan, understands this as well as any machine builder does, and it shows in the well-thought-out machines it designs and builds. Both the mechanical design and manufacturing and the control design and programming sides are creating better and more efficient ways to design, build, install and program automated machinery.

"In our business, everything is based off of time—how long it takes to program something," says Travis Buset, director of operations at Inovatech Automation. "It's based on hours; hours mean dollars. The same is true for how long it takes to design and build the machines."

Inovatech is known for its Modular Automation Station System (MASS). Available in several sizes, from tabletop to a large free-standing work cell, these systems are expandable and customizable, with easy-to-change tooling. There is also a robot version available in which Inovatech can integrate a wide variety of robots, depending on customer needs and specifications (Figure 1).

ABOUT A MACHINE BUILDER

In business since May 2016, Inovatech is an automation company that makes modular systems. "Our first way of thinking when we build a piece of equipment is for it to last a long

(Source: Inovatech Automation)

MODULAR BY DESIGN
Figure 1: Inovatech Automation's MASS machines are available in several sizes and are easy to expand and customize.

time," says Buset. "We don't just want to design the machine to run a single product—that will go obsolete. When we build a piece of equipment, we build it to be modular with replaceable components and fixtures (Figure 2)."

It also is good at improving the efficiency of packaging, such as taking parts, putting them in a box and sending them out the door, as well as reducing the cost relative to manpower. While it doesn't make the OEM packaging equipment to erect the box, it integrates the equipment, adding robots, conveyors and other handling equipment, such as robot end-of-arm tooling (EOAT) for a turnkey solution.

FASTER PROGRAMMING

Another way Inovatech saves time is in programming. "I like Pro-face's ease of programming," says Buset. "The software—the HMI and PLC—is all in one, HMI plus control. What took me eight hours with the competitor's PLC usually only takes me half the time and sometimes only a quarter of the time using Pro-face."

The all-in-one program from Pro-face America, GP-Pro EX, makes programming quick and easy, continues Buset. "Some of the competitors out there have separate PLC and HMI programming software—it's separate programs," he says. "The GP-Pro EX software allows programming of the CPU/controller and the HMI all in one."

Much of the addressing is drag-and-drop, which reduces programming time. "For example, if separate software is used to program a button to turn something on, the controller software is used to add the

logic and addressing," says Buset. "Then the HMI software would be opened, the button would be programmed and addressing checked. On the other hand, the GP-Pro EX software allows a normally open contact in the logic section of the program to be dragged and dropped into the HMI graphics. Selection of a button, style of the button and automatic addresses seamlessly follow all-in-one operation. It makes programming a lot easier and quicker."

(Source: Inovatech Automation)

COMPONENTS AND FIXTURES
Figure 2: Equipment is built to be modular, with replaceable components and fixtures.

The GP-Pro EX software combines the HMI and logic development software in a single platform. It's a PLC and HMI all in one and with I/O expansion and more than 125 logic instructions. Inovatech often uses the Pro-face PFXLM4301TAD-DC HMI + Control with 20 inputs and 12 outputs, built-in. To expand the I/O, it uses CANopen.

The Pro-face tools are very powerful, says Buset. "I actually built a system with one PLC/HMI unit and it ran two Universal Robots robot arms, eight conveyors and four different IO-Link networks," he says. "It's very powerful. Why spend $3,000 on an HMI and a PLC when I can spend less than $1,000, and it does the exact same thing?"

The software platform is in the $300 range, and the tech support is free, says Buset. "I had technical questions, especially when I started out," he explains. "Although I learned the bulk of it on my own with the help of YouTube, when I started to get into addressing and integrating the Pro-face, I had a lot of questions. Tech support was able to answer them very quickly."

SEE AND CONTROL

Much of Inovatech's work is in the automotive and medical industries, which uses a wide variety of automated machines. "The Pro-face is my interface to all our machines," says Buset. "Whether I connect to a Uni-

versal Robot, a bowl feeder, a conveyor or a camera, it all gets funneled through the Pro-face unit. It also has a wide range of communication capabilities using, for example, EtherNet/IP to connect to Cognex and Dalsa cameras in vision applications (Figure 3)."

Inovatech integrates a lot of robot arms from Universal Robots (UR). "The Pro-face integrates well with UR with up to two robots connected to one Pro-face unit," says Buset. "It's done all through Ethernet. One wire, one click, and it works well. We also use IO-Link."

Inovatech uses ladder logic, function blocks and scripting in the Pro-face for controlling a machine sequence, interfacing to cameras and robots, and handling data. All the I/O is connected through the Pro-face.

(Source: Inovatech Automation)

CAPABLE CONTROL
Figure 3: A wide range of communication capabilities are available—for example, EtherNet/IP to connect to Cognex and Dalsa cameras.

Buset describes an example application where a machine is installing thermal inserts. "The Pro-face helps the operator to operate the machine with access to functions such as cycle control and machine functions," he explains. "Under a normal sequence, the machine may install 14 inserts. Through a password-protected operator-interface screen, a graphic of the part can be displayed, allowing the operator to select or deselect positions, so only 10 inserts, for example, are installed, simplifying machine configuration. Similarly, recipes can also be programmed."

The Pro-face solution has many built-in function blocks. A few examples included talking to a camera or robot. Inovatech also programs its own function blocks depending on what it is interfacing to.

HMI SCREENS AND GRAPHICS

Inovatech considers pushbuttons and alarming two of the big uses for an HMI. "Letting the operator know something is wrong is one of the most basic requirements," says Buset. "Displaying part counts, such as good and reject, is also common."

Pretty pictures, as Buset likes to call the graphics, is another big use of an HMI. "Machine and sensor status are an important part of this, and Invotech monitors all its sensors," he says. "If a fixture has multiple

It integrates the equipment, adding robots, conveyors and other handling equipment.

cylinders on it, lights are included on the HMI for ease of troubleshooting. If a sensor is intermittent or someone moved the sensor, the graphics helps inform the operator. The user can actually see a graphical representation of the cylinder and the actual sensor position, making troubleshooting much easier."

SECRETS TO SUCCESS

"When I started the business, I did it all," says Buset. "I was the designer; I was the controls engineer; I did all the wiring; I did all the PLC programming; everything."

He even still cleans the bathrooms, when needed. As a matter of fact, if you come to Buset's shop, it is very clean. "I get compliments on the cleanliness," says Buset. "A customer was in the other day, and the first thing he commented on was how clean and organized the shop was. That's good, considering I thought it was messy at the time."

Previously, Buset had worked at an injection-molding company, building all of the machines in-house. The company didn't have to outsource any machines. That certainly made him qualified for injection-molding automation and machine-tending applications. He's also a RJG-certified master molder, so he can also process the molding machines.

It's one of the customer benefits when Buset visits. If the injection-molding machine needs to be automated, he can automate it. Even with minimal customer input and guidance, Inovatech can provide a turnkey project. And, of course, customers with 30-page spec sheets are well served, as well.

For the customers who don't have a spec sheet, Inovatech can create one. "It's the default design, if needed," says Buset. "It includes a Pro-face HMI + Control, which is its standard PLC, as well as standard relay, circuit breakers and related control hardware. We can also create a spec sheet specifically for a customer."

PUT A ROBOT ON IT

The Pro-face solution is actually used to change robot pick-and-place points, instead of using the robot pendant. "The HMI provides access to simple points used to place an insert," says Buset. "So, if we need to insert it further, the Pro-face can send the set point data to the robot. If an insert is being placed, the robot moves down to the insertion point until it sees a force using a six-axis force sensor integrated

Much of the addressing is drag-and-drop, which reduces programming time.

into the robot end effector. The position of the force is recorded, and then the robot moves down an addition 3 mm, for example. This technique drives the insert to a flush or below-flush position, depending on what the specifications require."

The robot moves are programmed on the robot, but, through the HMI, the positions can be edited or offset, continues Buset. "That way, if adjustments are needed, such as a depth of only 2.5 mm, the operator can make a simple adjustment through the HMI and not have to deal with the robot pendant," he says. "It's mostly limited to linear moves, moving to a position, not j-type moves, such as x-y-z and rotations."

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