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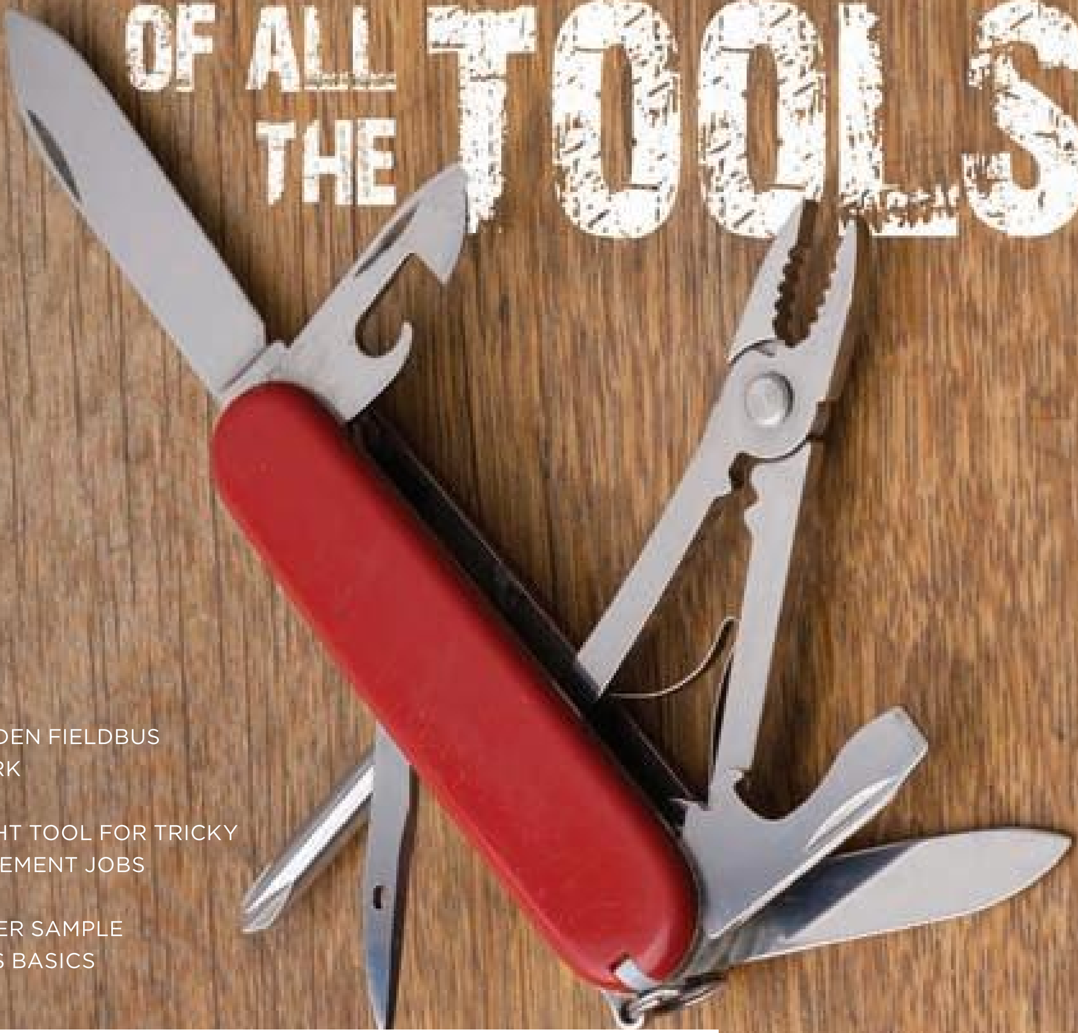

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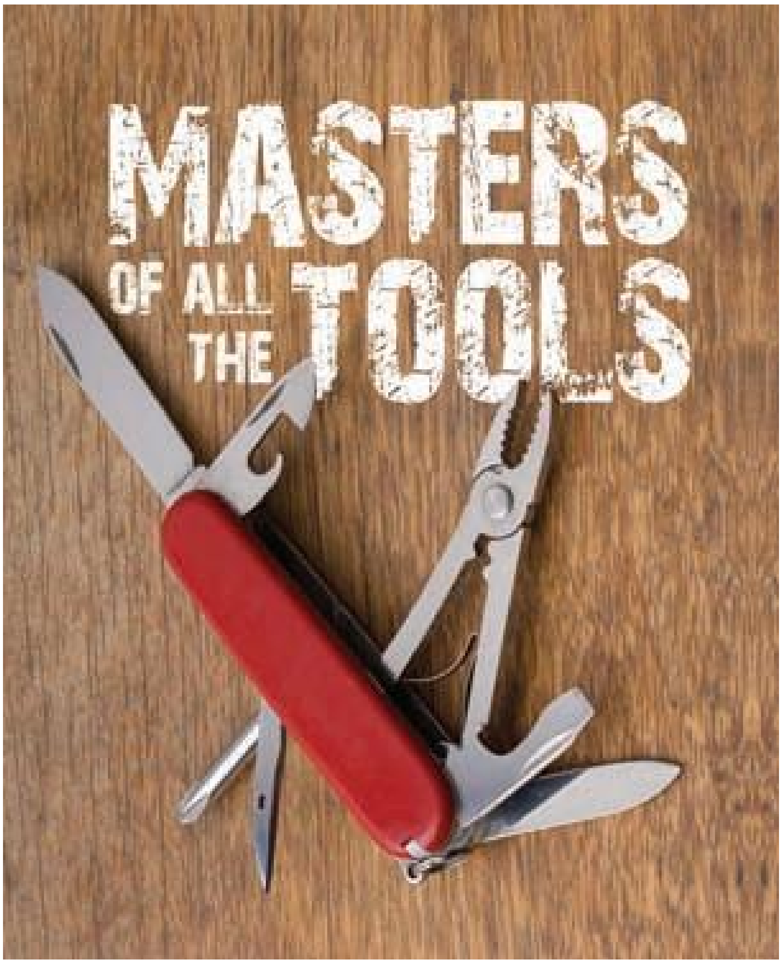
CONTENTS

FEATURES



WEB EXCLUSIVES

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www.controlglobal.com/1102_Peters

Nick Denbow of *Industrial Automation Insider* reports on process control across the Atlantic.
www.controlglobal.com/IAI

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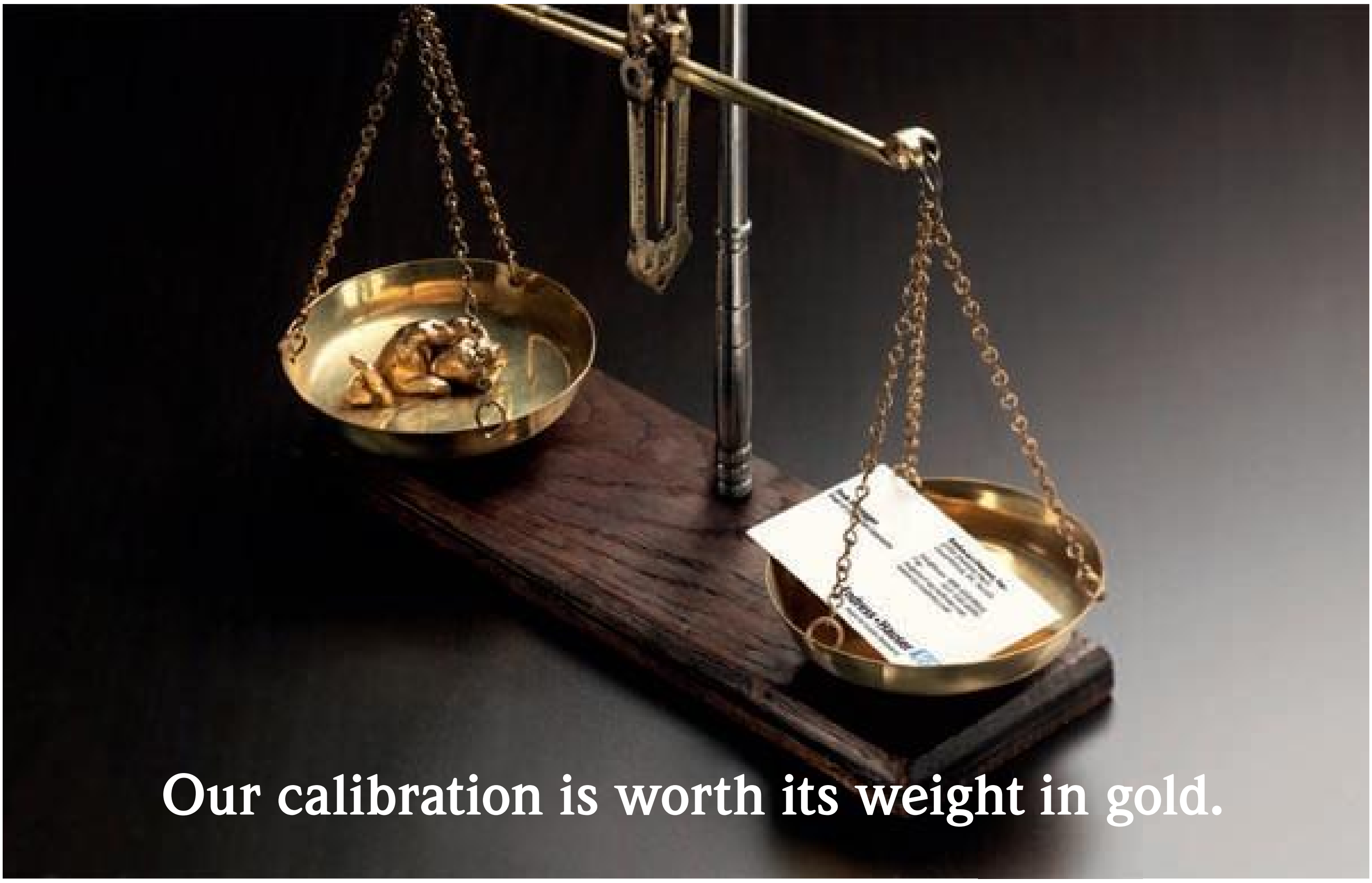

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February 2011 • Volume XXIV • Number 2

CONTENTS

DEPARTMENTS

IN PROCESS

GE Intelligent Platforms' CEO, Maryrose Sylvester, announced its acquisition of condition-monitoring specialist company Smart Signal.

PRODUCT SHOWCASE

Weidmuller's addition to its marking system family, the MPC Basic Plotter.

CIRCULATION AUDITED JUNE 2010

Chemicals & Allied Products	12,548
Food & Kindred Products	12,638
Paper & Allied Products	3,470
Primary Metal Industries	5,445
Electric, Gas & Sanitary Services	3,116
System Integrators & Engineering Design Firms	8,912
Rubber and Miscellaneous Plastic Products	4,403
Stone, Clay, Glass & Concrete products	2,057
Textile Mill Products	1,361
Petroleum Refining & Related Industries	3,877
Tobacco Products	115
Total circulation	63,006

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The Nice Thing About Standards...

WALT BOYES
EDITOR IN CHIEF
wboyes@putman.net

Professor Andrew Tanenbaum famously said, "The nice thing about standards is that you have so may to choose from." ● Clearly this cynical attitude is the one many automation vendors take toward producing systems that conform to standards. The problem with this attitude, and with the products that are fostered by it is that the entire burden of the costs of working with multiple standards is placed squarely on the shoulders of end users worldwide. This is not a new thing. ISA50 became the standard-less standard that spawned the Fieldbus Wars. There are dozens of implementations of ISA88 and ISA95 that aren't exactly according to Hoyle. And, of course, there is the embarrassing case of ISA100.

For over a year now, the end users have been speaking very loudly for convergence between ISA100.11a (which has not yet been accepted as an ANSI standard, let alone an international standard by the IEC) and IEC62591, which is the only internationally accepted field device wireless standard. IEC62591 is better known as WirelessHART.

Martin Schwibach, of BASF, and chairman of NAMUR Working Group 4.15 Wireless Automation, put it extremely well in a recent post to the ISA100 mailing list. "NAMUR users are supporting very strongly the convergence process, as only a unified standard will be, from NAMUR's point of view, the basis for sustainable multi-vendor use cases." Schwibach is not alone. Other end users have said much the same thing. For years now.

It appears, however, that the management and editorial team of ISA100 (Working Group 3), don't seem to care very much about that. They told ISA100.12 that they didn't want its activities to interfere with the fast-tracking of ISA100.11a, and since ISA100.12 hadn't finished its report, the .11a committee was justified in ignoring anything that had to do with convergence.

ISA100.12 expects to have those recommendations available after February's face-to-face meeting. But in their hurry to establish ISA100.11a as a standard, the committee management has already taken it to committee-wide ballot, which passed. So, no convergence for you, end users. Bad, bad, no biscuit.

But, you know, it isn't only the fault of vendors who want to shortsightedly push their own proprietary agendas as a pseudo-standard. It is also the fault of end users, who have sat back and complained in user group meetings and in social situations, but who haven't made it clear to the ISA100 committee that they want a single standard or they'll vote with their feet. But they're walking!

Data that I've compiled indicate that there are already well over $100 million worth of IEC62591 devices in the field. Estimates are that that number will rise to above $500 million by the end of this year. As Josef Stalin reportedly said, "Quantity has a quality all of its own."

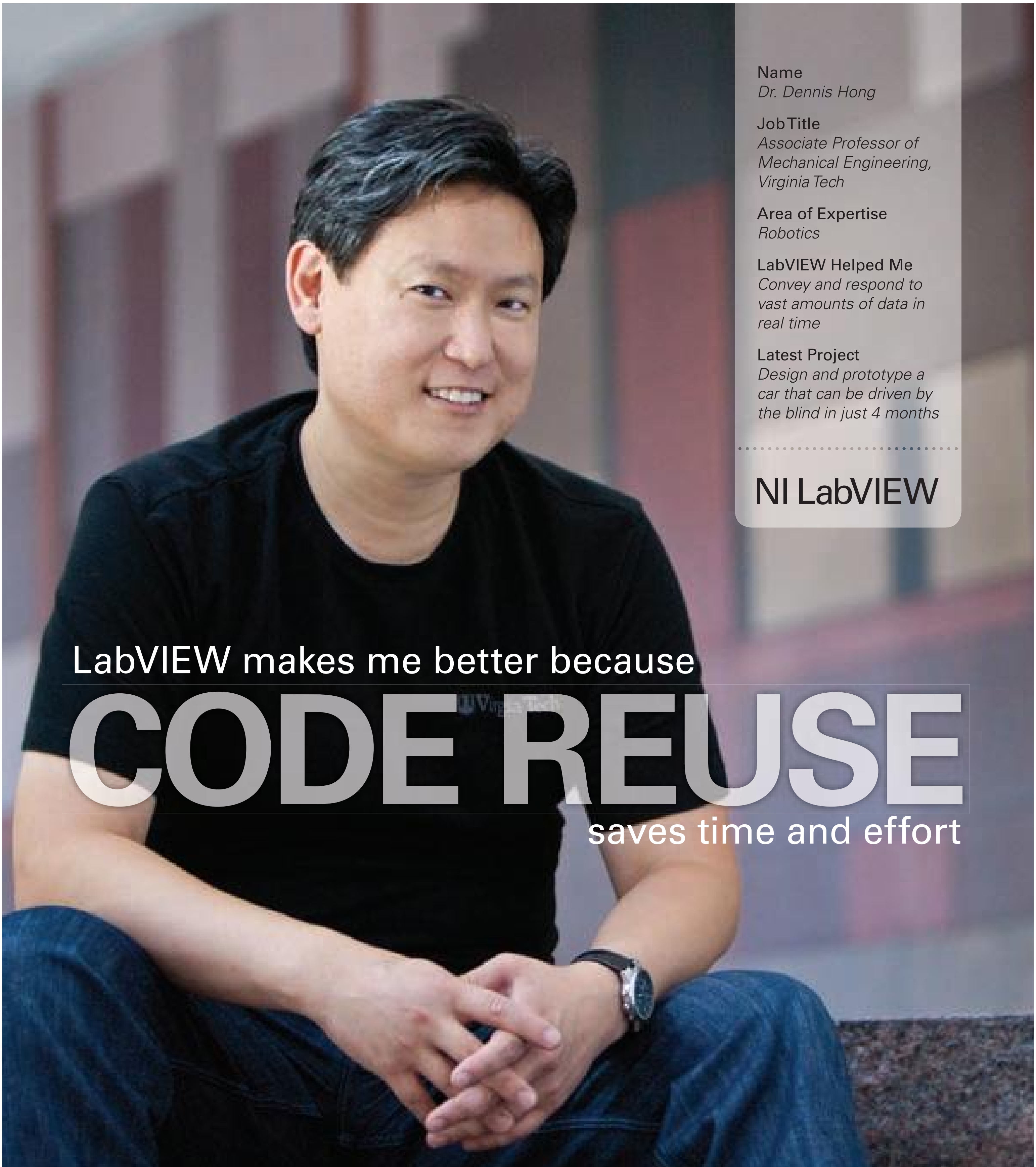
ISA100 will unnecessarily complicate the standards situation for wireless field devices, but it won't slow down the global migration to IEC62591 (WirelessHART). That ship has sailed.

I can only add my voice to NAMUR and to the other end users, who have been begging the ISA100 committee to achieve convergence.

Wireless field device sales are incremental revenue to the billions of dollars you vendors have been making in the automation industry. The more barriers you set up between you and your end users' dollars mean that that revenue will grow slower than if you made it easy for them to decide to go wireless. This has always struck me as a no-brainer. Obviously, some vendors disagree with me. They appear to be devotees of Tanenbaum's Law.

Bad vendors. No biscuit for you either!

So no convergence for *you*, end users. Bad, bad, no biscuit!



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NANCY BARTELS
MANAGING EDITOR
nbartels@putman.net

What the Tweet?!

If you're a regular reader of ControlGlobal, I'm sure you have noticed the blue boxes that pop up regularly with the invitation to "follow" ControlGlobal on Twitter.

Why would you to do that? Why would you follow anybody? In real life, that behavior can get you arrested. Why does it seem like anybody with an Internet connection keeps asking you to follow them? Why should you? Why have anything to do with an entity with a lame name like "Twitter"?

Because Twitter, once you master the basics that takes all of five minutes, is a streamlined way personalize the Internet just for you. Via Twitter, you get news from peers, people with interests or hobbies in common with you, businesses you might want to work with, magazines you read, societies you belong to, your favorite sports teams and just about anything else you can think of.

Here's how it works. Each post, or "tweet," is a 140-character blast—that's characters, including punctuation and spaces, not words. It can be as lame as, "I'm having oatmeal for breakfast," or as interesting as the link I found to a *New York Times* story on the last hours aboard Deepwater Horizon. Links are key. There's not a lot you can say in 140 characters, but thanks to the miracle of the URL shortener, you can pass along reams of interesting, important or newsworthy information.

The social media gurus focus on Twitter as a powerful marketing tool for businesses—and it is that—but it's more as well. It's become my all-purpose news and idea feed and one of my go-to places to find out what's happening in process automation and everywhere else. And the neat thing is that it's the people you follow who do most of the work because they're passing along links they've found.

Even if you rarely "tweet" or post an item yourself, selective following of others gives you great connectivity to the outside world. For example, last week, I got on to the Tunisian rebellion and was following events via tweets from people on the ground there before most of the media realized anything was happening.

More to the point for process automation folks, by following selected people and organizations, such as @controlglobal.com, you get links to white papers, news, magazine articles, blog posts, reports from user and professional society meetings and new product announcements. If you also follow @waltboyes, @katherinebonfante or me, @nancybartels, you will get links from items we "retweet" or pass along, from the folks we follow in process automation and elsewhere. It doesn't take long for the multiplier effect to go to work.

Twitter does have its downside—the Twitter hole. It's a giant time sink that can suck up hours if you're not careful. But, if you have the self-discipline to turn your Twitter feed off when necessary, you can have the parts of the Internet that interest you most at your fingertips when you want them. So follow us at @controlglobal and let the multiplier effect begin. ■

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Where to Go for Training

I recently found your Internet site. I must tell you it's one of the best sites on I&E that I've ever found. Having said that, it leads me to believe this is the right place to help me with my dilemma.

I want to learn more about my trade, but I'm unable to find any acceptable online courses. My goal is a bachelor's degree in process automation engineering or at the very least an associate's degree. However, accrediting problems and/or bad reviews of courses found have prevented me from starting. Can you recommend any online schools that offer what I need? The most important factors to me are that the school is recognized in our industry as being of good quality, and that I get quality in the material I'm learning.

RICK FIELDS
EL NIDO BIOMASS

[Walt Boyes responds]
You might take a look at www.eit.edu.au. This is the website of the Australian Engineering Institute of Technology. It has, in collaboration with IDC Technologies, the best online automation engineering courses. It offers a degree program, but you need to talk someone there about the value of it in comparison to the American bachelor of science.

Also, you could consider doing the EIT courses and then take the ISA Certified Automation Professional (CAP) exam. Both certifications would get you pretty much what I think you're looking for. You might even be qualified to take the Engineer-In-Training exam and the PE in control systems engineering.

Béla Needs a Fact Check

It seems that this reader will not be spared one edition from Mr. Lipták's mantra of inexhaustible, clean and free renewable energy. An inexhaustible thing is worthless unless it is also abundant. Renewable energy is scarce, intermittent, inadequate; hence, its high relative cost. The recent study by the DOE of levelized costs of competing electrical generation technologies (www.eia.doe.gov/oiaf/aeo/electricity_generation.html) confirms that solar photovoltaic is three times more costly than nuclear fission, in contradiction to Mr. Lipták's published statements. This is hardly free.

Gen III and IV nuclear reactors are safer, more reliable and more efficient. With deployment of breeder reactors, nuclear fuel reserves will be extended by hundreds of years, more than enough time to develop nuclear fusion. Mr. Lipták's position on breeder reactors and nuclear fusion? Deny their existence, and they will go away.

If you ignore the facts and especially the costs, the global marketplace will punish you. As the United States and Europe persist in a self-destructive energy policy, 90% of new nuclear reactors are being built in Asia and the Pacific Rim. All of those jobs proclaimed by Mr. Lipták and the other misguided adherents of renewable energy will be outsourced to our saner trading partners.

Mr. Lipták's answer to global competition? Create a global energy dictatorship (master controller) to save man from himself. Need I say anything more?

AL ROGERS, PE
APPLIED CONTROL ENGINEERING, INC.
rogersja@ace-net.com

[Editor's note: Béla Lipták is writing a multipart series on renewable energy in our Lessons Learned column. All the columns are available at www.controlglobal.com.]

Correction: Turck is on Top 50 List

We do our best to not let things like this happen, but unfortunately Turck Inc. was left off the Top 50 list inadvertently due to a typographical error.

On the Global list, its $490.0 million in 2009 puts it in 35th place. On the North American list, its $122.5 million puts it in 30th place.

We sincerely regret the error.

JOHN CUSIMANO
DIRECTOR,
EXIDA SECURITY SERVICES DIVISION
jcusimano@exida.com

Demanding Software Security Assurance

In an October 2010 article at SearchSecurity.com, Mark Weatherford, vice president and chief security officer at NERC, was quoted as saying, "Addressing Stuxnet goes beyond using quality security controls. The industry needs to demand higher quality software that is free from defects. Companies who develop products and write code need to continue to mature their development processes to become more secure."

He went on to say, "This is not an indictment of [the] control system industry; it's an indictment of the IT business in general. We're still seeing products that come out that are susceptible to vulnerabilities that quite frankly have been in the wild for quite some time."

It is refreshing to see a point of view that recognizes that industrial control system security is not just a problem that owners and operators of industrial facilities need to address. Of course, owners/operators are ultimately responsible for the safety and security of their facilities, but that responsibility needs to be shared with their automation equipment suppliers.

These suppliers have a responsibility to ensure that their products are safe, secure and reliable. But, while they undoubtedly all strive to meet this expectation, achieving it has become increasingly difficult, as even the simplest of products have evolved to rely on sophisticated software that often isn't even written by the supplier. Couple the increased vulnerability of automation products due to software complexity with the emerging threat posed by viruses such as Stuxnet, and it is easy to see why Weatherford is calling for suppliers to focus on software security assurance for their customers.

> Users wonder, "How dependable, trustworthy and resilient is my supplier's software?".

ISO/IEC 15408-1 through I5408-3	Information technology — Security techniques — Evaluation criteria for IT security — Part 1 through Part 3
IEC 61508 Part 3	Functional safety of electrical/electronic/programmable electronic safety-related systems: Software Development
RTCA/DO-178B	Software Considerations in Airborne Systems and Equipment Certifications
ISBN-13: 978-0735622142	The Security Development Lifecycle, M. Howard, S. Lipner, Microsoft Press , 2006
OWASP CLASP	OWASP CLASP (Comprehensive, Lightweight Application Security Process)

TABLE 1: REFERENCE STANDARDS FOR SOFTWARE DEVELOPMENT SECURITY ASSESSMENT

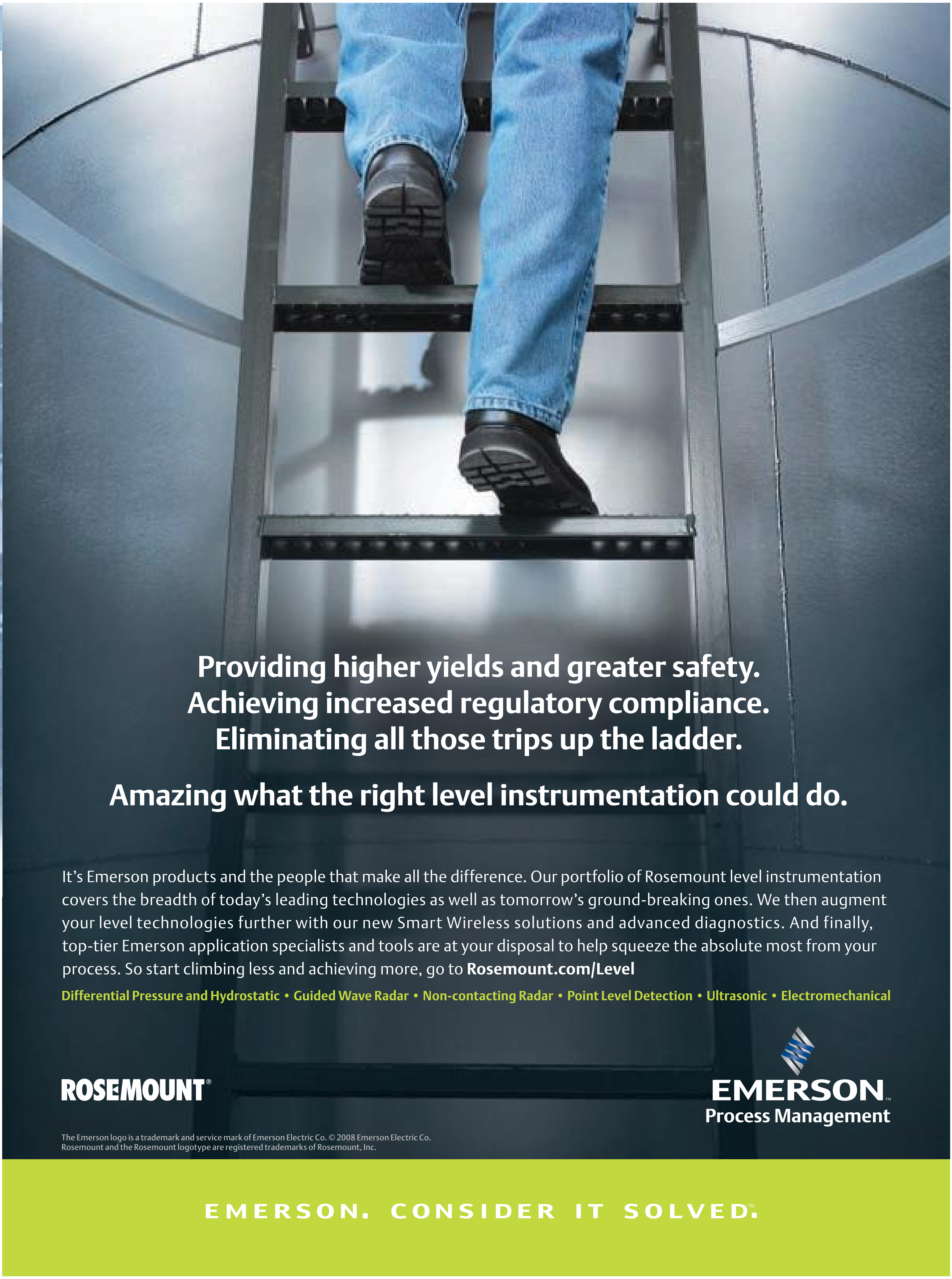
SDSA Reference Standards from Goertzel, Karen, Theodore Winograd, et al., *Enhancing the Development Lifecycle to Produce Secure Software: A Reference Guidebook on Software Assurance*, October 2008.

Wikipedia defines software security assurance (SSA) as "the process of ensuring that software is designed to operate at a level of security consistent with the potential harm that could result from the loss, inaccuracy, alteration, unavailability or misuse of the data and resources that it uses, controls and protects."

SSA is best achieved by integrating security into the software development lifecycle (SDLC). Excellent guidance on how to do that has been available for many years. For example, Microsoft published the Security Development Lifecycle (SDL) in May 2006. SDL is Microsoft's methodology to help reduce the number of security defects in code at every stage of the development process from design to release.

The U.S. Department of Homeland Security and the Department of Defense Data and Analysis Center for Software published "Enhancing the Development Lifecycle to Produce Secure Software: A Reference Guidebook on Software Assurance," (https://www.thedacs.com/techs/enhanced_life_cycles/). Both documents provide software development organizations with a description of the key elements of a secure software lifecycle process and how to apply them.

Many automation system suppliers have already modified their SDLC processes to incorporate security. However, the level of integration and rigor with which they are applied can vary dramatically, leaving users who rely on these products wondering, "How well has my supplier integrated security into its software development lifecycle? How well has it followed its process on the products I use? How dependable, trustworthy and resilient is its software?"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Security Management Process	This phase specifies a process for planning and managing security development activities to ensure that security is designed into a product. For example, this phase incorporates requirements that the development team has a security management plan and that the developers assigned to the project are competent and have been provided basic training in good security engineering practices and processes. Also includes requirements that the project team creates and follows a configuration management plan.
Security Requirements Specification	This phase requires that the project team document customer-driven security requirements, security features and the potential threats that drive the need for these features.
Software Architecture Design	This phase requires the project team develop a top-level software design and ensures that security is included in the design.
Security Risk Assessment and Threat Modeling	This phase requires the project team determine which components can affect security and plan which components will require security code reviews and security testing. It also requires that a threat model be created and documented for the product.
Detailed Software Design	This phase requires the project team design the software down to the module level following security design best practices.
Document Security Guidelines	This phase requires the project team to create guidelines that users of the product must follow to ensure security requirements are met.
Software Module Implementation & Verification	This phase requires the project team to implement design by writing code following security coding guidelines. It ensures that software modules are implemented correctly by conducting security code reviews, static analysis and module testing.
Security Integration Testing	This phase requires tthe project team to perform security specific tests such as fuzz testing and penetration testing.
Security Process Verification	This phase requires an independent assessment that all required software development processes have been followed
Security Response Planning	This phase requires the project team to establish a process to be able to quickly respond to security issues found in the field if and when they happen.
Security Validation Testing	This phase requires that the project team to confirm that all security requirements have been met, preferably by test or by analysis.
Security Response Execution	This phase requires the project team respond to security problems in the field by taking both preventive and corrective action.

TABLE 2 : DEVELOPMENT LIFECYCLE PHASES

The general IT marketplace attempted to address these types of questions several years ago with the Common Criteria for Information Technology Security Evaluation, better known as simply Common Criteria (CC, www.commoncriteriaportal.org/). CC is an international standard (ISO/IEC 15408: 2005) for computer security certification that provides a framework in which computer system users can specify their security functional and assurance requirements. Suppliers can then implement and/or make claims about the security attributes of their products, and testing laboratories can evaluate the products to determine if they actually meet the claims.

An attempt was made in 2004 by the National Institute of Standards and Technology (NIST) to incorporate industrial control systems into Common Criteria by publication of a System Protection Profile for Industrial Control Systems (www.isd.mel.nist.gov/documents/stouffer/NISTIR_7176.pdf). Unfortunately, this effort was unsuccessful, most likely due to the lack of universal adoption of Common Criteria.

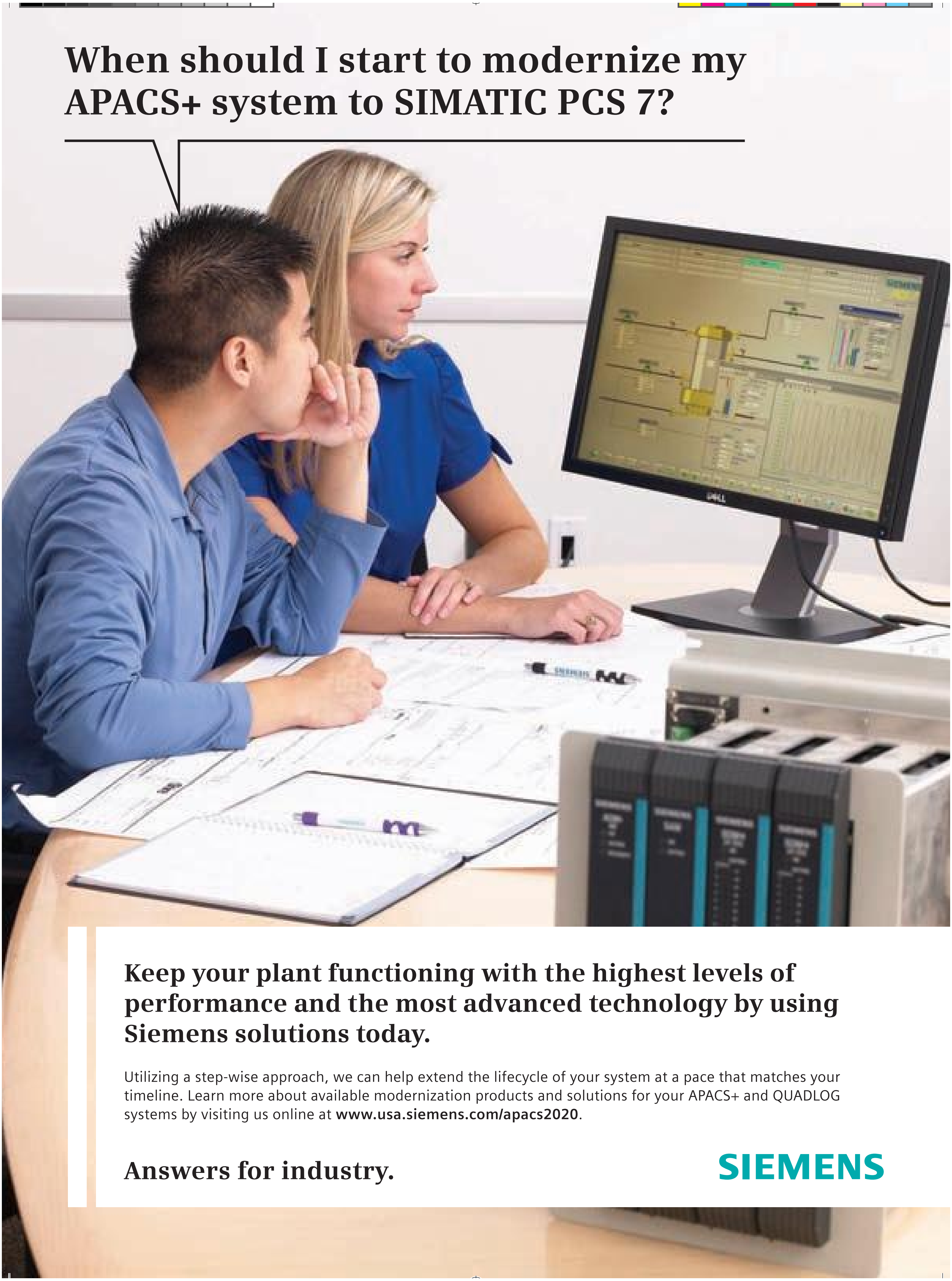
Frustrated by the lack of standard security conformance criteria for industrial control system products, industry leaders formed an organization in 2007 to establish a set of specifications and processes for the security testing and certification of critical control systems products. The organization, the ISA Security Compliance Institute (ISCI, www.isasecure.org), developed the ISASecure Program based on the security lifecycle concept for automation controls certifications using the framework of the ISA99 Standards Roadmap.

Availability of the first ISASecure certification program, called Embedded Device Security Assurance (EDSA). was announced in 2010. EDSA focuses on the security of industrial control system devices such as PLCs, DCSs, SISs and SCADA controllers, and addresses device characteristics and supplier development practices for those devices. The certification consists of three elements: a device functional security assessment (FSA), a device communication robustness test (CRT) and an organizational software development security assessment (SDSA).

All three elements of the EDSA are important and necessary to provide a holistic assessment of the security of a control system product, but we will focus on the SDSA. The purpose of the SDSA is to provide verification and validation that software for the device or system under test was developed following appropriate engineering practices. The SDSA consists of 170 requirements derived from several existing reference standards listed in Table 1 and organized into 12 development lifecycle phases (Table 2).

An auditor from an accredited certification laboratory performs an SDSA audit based on documented evidence submitted for the certification and a site visit including interviews of development personnel and managers. A basic criterion for passing an SDSA applies at all certification levels, and becomes more rigorous at higher certification levels. Full details of the ISASecure EDSA program and the SDSA specification can be found at www.isasecure.org.

In summary, the ISASecure Software Development Security Assessment (SDSA) provides the ability for industrial control system users to determine if their industrial control system suppliers have adequately integrated security into their software development lifecycle. It also provides a mechanism for suppliers to be recognized for the efforts they have made to deliver on Weatherford's call for suppliers to focus on software security assurance. ■.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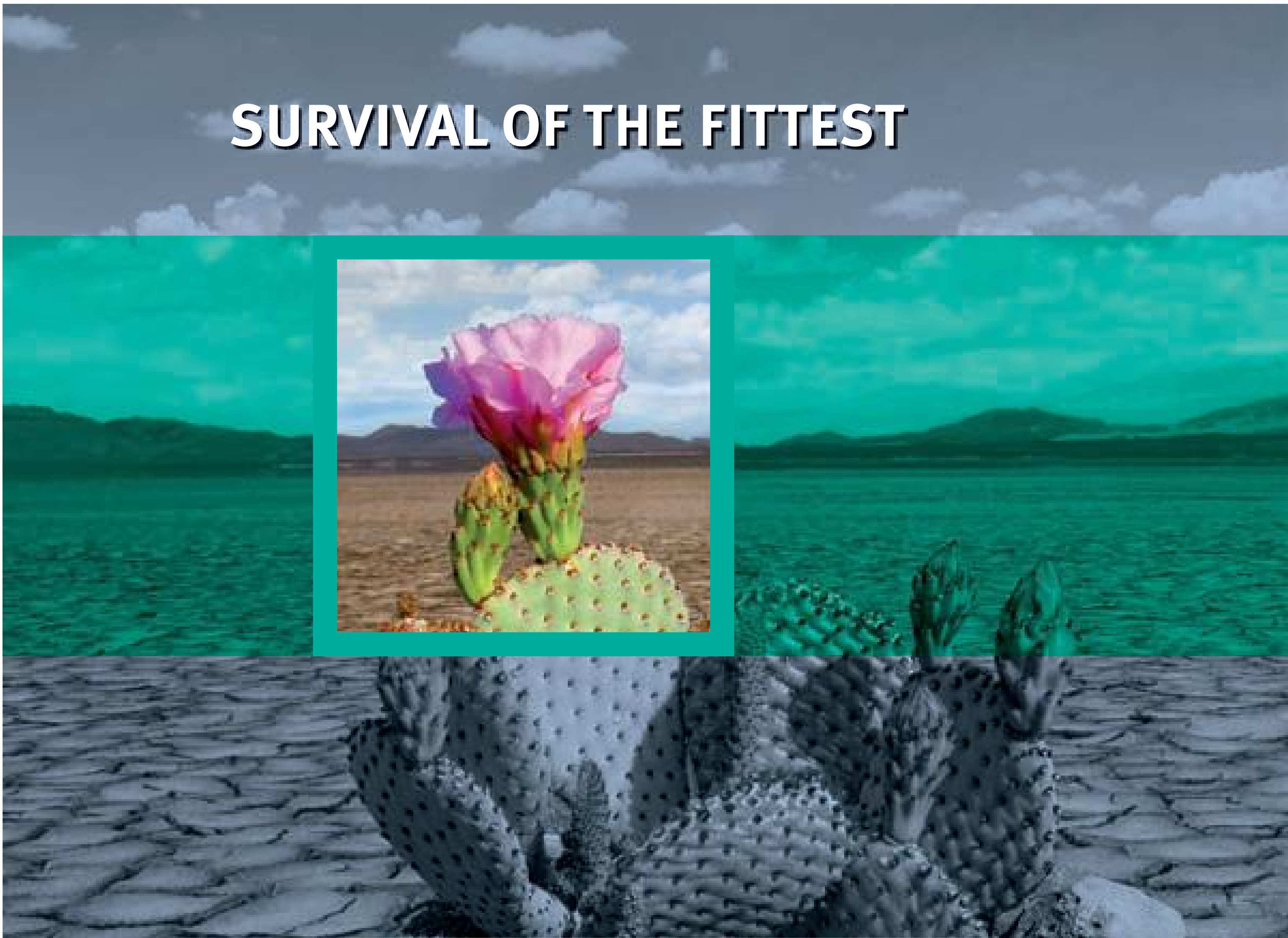

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Fieldbus — Where's the Love?

To the dismay of some in the engineer/procure/construct (EPC) world, fieldbus can add complexity that was automated out of the point-to-point world decades ago. One's ability to execute a project "cookie-cutter" style, can be diminished noticeably.

JOHN REZABEK
CONTRIBUTING EDITOR
jrezabek@ispcorp.com

Back in the day, a "conventional" job meant the instrument department could work on data sheets and bid tabs for weeks, while the piping designers determined where their process connections were going to be. Provided the client didn't make a gaggle of changes during detailed design, the flow of work from piping to instruments to I&E design was orderly and relatively free of uncertainty. The decisions and choices their client needed to make were also familiar and transmitted at well-known milestones during the effort. This orderly progression from concept to construction is a great comfort to contract consultants, and when you separate them from it, you don't get a lot of love.

How does fieldbus bring flux and uncertainty where there used to be order? Part of the equation—a big part—is that there are still relatively few firms with a critical mass of expertise in executing fieldbus jobs. On both the client and consultant side, inexperience and uncertainty breed ultra-conservatism. For example, there are recent threads on the Fieldbus Foundation end-user forums (http://forums.fieldbus.org) and LinkedIn groups about counting virtual communication relationships (VCRs). By and large, you have to go pretty crazy with your segment loading (greater than 16 devices or eight to 10 multi-input devices) before you even need to learn the acronym. If you must do it at all, just do it for the single worst case (most total I/O on a single segment) and call it a day. The section on VCRs was dropped from the latest revision of the AG-181 Systems Engineering Guide. Do yourself and your consultant a favor and fuhgeddaboudit.

Segment loading is another area where client fears and consultant inexperience can make both of them feel stuck in a bad romance. Early adopters—present company included—spent a lot of effort and ink worrying about ranking valves and loops, making sure they didn't have to exchange any packets with lower-caste devices. Then we found this to be largely a waste of time; the newest release of AG-181 says simply to shoot for 12 devices per segment, which leaves you a healthy 25% spare capacity for late changes and future additions. Final elements (e.g. valves) still need to be on the same segment with their associated process variable, but only a few are ever geographically diverse—more than a stone's throw away. Save the grey matter and highly compensated hours for these latter cases, as they will also be the ugly stepsisters of segment and spur length.

Examining segment and spur length can also burn scarce hours that aren't abundant when the electrical designers are finally able to start locating, filling and CADD-ing junction boxes. But this is another effort where only a handful of worst cases—segments with the most devices, the most distant from the host and the "geographically diverse"—really need to be examined rigorously before declaring the rest will work.

Segment loading also can have an impact on speed of response, so if your licensor insists on some phenomenal execution speeds, only obsess about it for those few where it makes a difference, and use "control in the field." The rest are likely to run happily with 1-sec macrocycles, the default speed for most legacy DCS controller loops. A cursory look at some segments with multiple control valves should suffice to see whether PID and AO execution times need to be specified for positioners.

Making some key choices early and sticking with your decisions can eliminate the late-term flux and rework dreaded by project managers and engineers. Next month's column will examine a few of the other key areas where a little early focus can pay dividends later in the game. ■.

Do yourself and your consultant a favor and forget about counting virtual communication relationships (VCRs).

GE Intelligent Platforms Acquires SmartSignal Corporation

Remote monitoring specialist seen as catalyst to expand GEIP's operational intelligence vision.

GE Intelligent Platforms (GEIP) has completed the acquisition of SmartSignal, a privately held analytics software company based in Lisle, Ill. SmartSignal specializes in providing remote monitoring and diagnostics solutions to the power generation, oil and gas, and other industrial sectors.

SmartSignal provides predictive diagnostic software and monitoring services. The company has more than 40 product and technology patents and has won more than 25 awards for product excellence.

SmartSignal detects and identifies abnormal equipment behavior and provides exception-based notifications of developing problems along with diagnoses and prioritizations. Its solutions are device-agnostic and are found on equipment from GE, Siemens, Rolls Royce, Alstom, Flowserve, Waukesha, Byron Jackson, Cooper-Bessemer and others.

"The acquisition of SmartSignal shows our commitment to continue investing in GE Intelligent Platforms' Software and Services business and will serve as an important catalyst to rapidly expand the capabilities of our Operational Intelligence platform," said Maryrose Sylvester, president and CEO for GE Intelligent Platforms. "SmartSignal is a recognized leader and innovator with technology that detects looming equipment problems early and with confidence. This acquisition complements GE's existing capabilities in diagnostics and equipment analytics, and gives us the ability to cover a much wider range of asset types and equipment manufacturers for our customers."

And Bently Nevada?

One question the acquisition raises is where this leaves condition-monitoring veteran Bently Nevada, purchased by GE in 2002. Erik Udstuen, GEIP vice president of Software and Services, said it's a complementary relationship. "Bently Nevada products are performing specific functions around vibration analysis. Smart Signal tends to operate at a lower frequency and long time frame, and will cover a broader range of metrics and assets. Smart Signal provides another layer of protection on top of Bently Nevada. A company could use both of them. In fact, they have many joint customers."

Udstuen adds that the "The integration of SmartSignal's proven monitoring and diagnostic technologies will play a significant role in delivering on GE Intelligent Platforms' vision of providing comprehensive operational intelligence solutions to customers. It is a proven remote monitoring and diagnostics solution that aligns nicely with the Proficy architecture to help customers address availability and efficiency challenges in a robust way. The SmartSignal team also brings tremendous domain expertise in predictive diagnostics that aligns very well with GE's key vertical industries."

Wil Chin of ARC Advisory Group commented, "With this move, GE will be able to combine the asset intelligence from SmartSignal's EPI*Center with GE Energy's Bently Nevada machinery protection and monitoring systems for improved insight into the health of not only physical assets, but process assets as well. More importantly, leveraging this solution with GE Intelligent Platforms business solutions, such as Proficy Maintenance Gateway and others, will allow GE to provide comprehensive turnkey asset performance management solutions for any asset intensive industry."

According to Udstuen, GE will maintain Smart Signal's offices in Lisle. "We fully intend to grow that office. We see that single location as a great advantage. We have the GE brand as a strong and valuable brand and that will always be in the lead of what we offer to the market, but many aspects of the Smart Signal brand we'll keep. At least in the short term, existing customers will see little change."

GEIP SHOPS SMART

Maryrose Sylvester, president and CEO of GE Intelligent Plaforms announced the purchase of Smart Signal.

Alliance Success Story

Smart Signal is one of the bright success stories of the alliance between the University of Chicago and the U.S. Dept. of Energy's Argonne National Laboratory. It was originally started by the U of C based on technology developed at Argonne. Alan Thomas, director of UChicago-Tech, the university's Office of Technology and Intellectual Property, said, "It's great to see technology from Argonne that was incubated through the University of Chicago be adopted in a much wider way by such a prominent company. This is the innovation process at work."

UTEP Boosts Engineering Curriculum

The University of Texas El Paso is moving ahead with its plans to become a center for advanced engineering and manufacturing education. With the aid of some government and industry grants and charitable donations, it is


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adding an advanced manufacturing technology research center and a new engineering curriculum focus to its College of Engineering.

Texas governor Rick Perry has announced that the state will invest $3 million through the Texas Emerging Technology Fund to help create new integrated 3-D systems technologies through the Structural and Printed Emerging Technologies Center (SPEC) in the UTEP College of Engineering. Industry partner Lockheed Martin Aeronautics will contribute $3 million toward five-year operating costs of the new center, and the University of Texas System has pledged $3 million in construction and equipment funds—for a total of $9 million—to launch the state-of-the-art advanced printed electronics research facility.

The SPEC Center, as it will be called, will take advantage of and build upon the existing world-class rapid-prototyping or additive manufacturing equipment and research available now in the college's W.M. Keck Center for 3-D Innovation.

Additive manufacturing—making a part or product by adding layers of material in an efficient way that results in less waste—and other technologies are already being used at the Keck Center to build a variety of 3-D devices. The new SPEC Center will combine these manufacturing technologies with printed electronics technologies to build entirely new functional products. The SPEC Center will initially focus on printed electronics, but will have the capability to produce devices of nearly all types, sizes and materials, limited only by a researcher's imagination.

The SPEC Center will be directed by Kenneth H. Church, a well-known expert in the printed electronics field who holds a Ph.D. in electrical engineering from Oklahoma State University. The SPEC Center will be co-directed by Professor of Mechanical Engineering Ryan Wicker, Ph.D., the current director of the Keck Center.

The SPEC Center will be supported by an industry partner, aerospace company Lockheed Martin Aeronautics, which will tap the expertise of engineering faculty for a number of projects based on 3-D layered fabrication, printed electronics and other advanced technologies.

UTEP's manufacturing-technology facilities also include the NanoMaterials Integration Laboratory (NanoMIL), where researchers are integrating nanoscale or submicroscopic materials into microscopic assemblies to create

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unique electronic devices and components and the new Research Institute for Manufacturing and Engineering Systems (RIMES), which produces advanced software tools for best-practice design of complex products and systems, such as those used in the aerospace and defense industries.

A separate donation from UTEP alumni Bob Malone, president and CEO of First National Bank of Sonora, Texas and former chairman and president of British Petroleum (BP) America, and his wife, Diane Malone, along with Halliburton, will fund a new program that will be a model for how engineering is taught around the country. Their combined gift of $2 million will fund development of the program and scholarships for engineering students.

The Leadership Engineering Program includes a broad-based curriculum of engineering design, project management and innovation, along with an emphasis on business, communication, ethics and social science. It is expected to launch by the fall of 2012 and represents a new paradigm for engineering education.

"What some people are calling renaissance engineers, we call leadership engineers," said Richard Schoephoerster, Ph.D., dean of the College of Engineering. "The overarching goal is graduation of a new pedigree of qualified engineers with the professional skills, business acumen and strategic foresight in addition to engineering prowess to meet the needs of industry in the 21st century."

The new program will educate engineers through a "liberal-technical" approach, featuring a new curriculum designed to capture the interest and imagination of talented, young leaders looking to turn their ideas into a reality.

ABB's Baldor Purchase Cleared by DOJ

ABB and Baldor Electric Company have announced that the Antitrust Division of the U. S. Department of Justice has cleared ABB's acquisition of Baldor pursuant to a cash tender offer for all of the outstanding shares of common stock of Baldor at a price of $63.50 per share net to the holder in cash, without interest and less any required withholding taxes. This antitrust clearance satisfies the last remaining regulatory condition to the tender offer, which has now closed. ■

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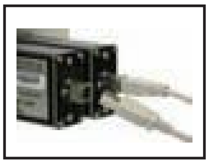

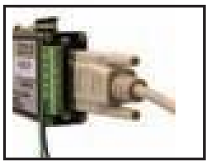

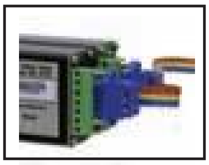

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Hot Temperature Resources Online

Control's Monthly Resource Guide

Every month, *Control's* editors take a specific product area, collect all the latest, significant tools we can find, and present them here to make your job easier. If you know of any tools and resources we didn't include, send them to wboyes@putman.net, and we'll add them to the website.

TEMP MEASUREMENT AND CALIBRATION

FLUKE
www.fluke.com

What every instrument tech should know. This article answers questions, such as: How do I measure temperature? How accurate is my measurement? What temperature range is required? And, what type of device best measures temperature? It also covers types of measurement devices: liquid in glass thermometers (LIG), thermocouples (TCs), thermistors, resistance temperature detectors (RTDs), platinum resistance thermometers (PRTs) and standard platinum resistance thermometers (SPRTs). There is also a section on calibration. The direct link is at http://tinyurl.com/49dlzs3.

THEMOCOUPLE HOW-TO

NATIONAL INSTRUMENTS.
www.ni.com

Part of National Instrument's "How-To Guide for Most Common Measurements" series, this tutorial, "Temperature Measurements with Thermocouples: A How-To Guide" covers the basics of thermocouple theory and practice. It includes an overview of thermocouples and sections on "How a Thermocouple Works," "Considerations for Accurate Thermocouple Measurement," "Connecting a Thermocouple to an Instrument" and more. The direct link is at http://tinyurl.com/4oy6qu5.

TEMPERATURE CALIBRATION

COLE-PARMER
www.coleparmer.com

"Temperature Calibration in Industrial Processes" provides an overview of the calibration process, including discussions of internal and external references, system or component calibrations and accredited calibration services. The direct link is at http://tinyurl.com/33zf5y3.

TEMPERATURE MEASUREMENT PITFALLS

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This whitepaper answers the question: what do you need to know to select the best temperature measurement solution for your test and control application? It discusses some of the latest technology, such as LXI (LAN eXtensions for Instrumentation) and 24-bit Sigma-Delta A/D converters. It also covers eliminating random noise to get usable data, making data easily accessible, and the application interface. The direct link to the white paper is at http://tinyurl.com/4cmzxmz.

TEMP TUTORIAL

SCRIBD.COM
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This is a downloadable lecture on temperature measurement covering definitions and standard calibration; thermal expansion methods; bimetallic, liquid-in-glass and pressure thermometers; the law of thermocouples, common thermocouples, reference junction considerations, measuring circuits and thermopiles; RTDs, RTD materials, three- and four-lead RTDs; junction semiconductor sensors; digital thermometers; radiation thermometry; radiation fundamentals, total radiation type and optical pyrometer; ratiometric type; and quartz crystal thermometers. The direct link is at http://tinyurl.com/4cpulr9.

INTRO TO TEMPERATURE MEASUREMENT

OMEGA ENGINEERING
www.omega.com

Temperature can be measured via a diverse array of sensors. All of them infer temperature by sensing some change in a physical characteristic. Six types with which the engineer is likely to come into contact are thermocouples, resistive temperature devices (RTDs and thermistors), infrared radiators, bimetallic devices, liquid expansion devices and change-of-state devices. This paper discusses each of these devices and its uses. The direct link is at http://tinyurl.com/y8jy48h.

THERMOCOUPLES AND RTD TABLES

INSTRUMENTATION.COM
www.instrumentation.com

This site has 35 different temperature vs. electromotive force (EMF) and temperature vs. resistance tables. All are viewable on the web or downloadable as PDFs. They cover Fahrenheit and Celcius conversions of multiple RTDs, including platinum, copper, nickel and nickel-iron RTDs, for Types B through T thermocouples and specifications for various thermocouple types. The direct link is at http://tinyurl.com/4dldurk.

PROCESS AUTOMATION HALL OF FAME

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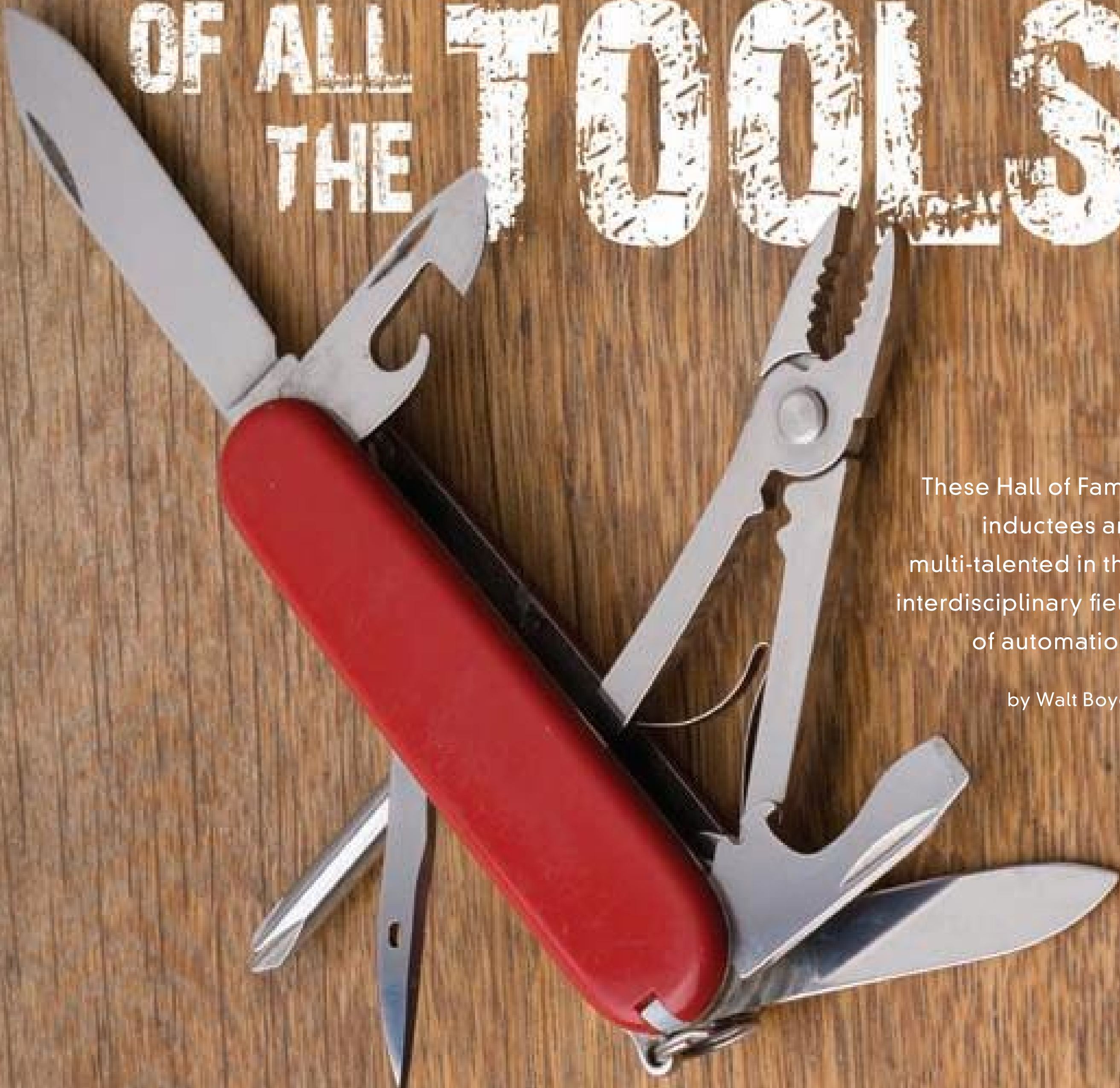

These Hall of Fame inductees are multi-talented in the interdisciplinary field of automation.

by Walt Boyes

It's time, once again, to introduce you to the new inductees into the Process Automation Hall of Fame. It's a truly international group this year. This year's inductees are John Berra, former chairman of Emerson Process Management, Sigurd Skogestad, professor of chemical engineering at NTNU, Trondheim, Norway, and Maurice Wilkins, former Honeywell fellow, WBF chairman and now vice-president for global marketing services at Yokogawa Electric Corp. It is a diverse and eclectic group, as you can see, but there are themes that run through the lives and careers of all three.

These masters of the process automation arts have come to the field in sometimes unusual ways. Automation is a multidisciplinary set of skills, and these skills are hard to acquire in any one place, be it university, trade school or on-the-job training. These three men managed to acquire their exemplary skills and then work their entire careers to extend the skills and the reach of automation in manufacturing and especially in the process industries.

The Business Visionary

John Berra

"I graduated from Washington University in St. Louis with a degree in system science in June of 1969," says John Berra, former chairman of the board at Emerson Process Management. "At that time, there were two paths you could follow with this sort of degree—aerospace and process control. I interviewed with many companies and came to the conclusion that the space program wasn't going to be as active once a man walked on the moon. So I decided to join Monsanto as an instrument engineer."

Berra worked in the corporate engineering group at Monsanto and received excellent training in what process control was all about. Monsanto's training program of that era has produced a significant number of inductees into the Process Automation Hall of Fame. Berra's first projects were pneumatic instrumentation and some very early analog electronic control loops.

"Monsanto was good," he says, "but I wanted to move faster, so I took a job with J. F. Pritchard, an engineering contractor in Kansas City. I learned a lot there and got to spend time in the field on start-ups. I spent a lot of time ringing out wires!"

From there, Berra took a sales engineering job at Beckman Instruments (now Beckman Coulter Inc., www.beckmancoulter.com) and then joined a company called Rosemount (now the Rosemount Measurement Division of Emerson Process Management, www2.emersonprocess.com), which had some radical new pressure-sensing technology.

"The rest, as they say, is history," Berra recalls. "I grew up with the company and was promoted several times

The Process Automation Hall of Fame

The Process Automation Hall of Fame was established in 2001 to honor pioneers of process automation technologies and luminaries of the discipline. Each year, the previously inducted members nominate and select three to five automation professionals whose contributions to the profession have made them significant. Anyone can propose a nominee, but only the inductees vote on the final selection.

Here are the members of the Process Automation Hall of Fame in the order of their induction:

Marion "Bud" Keyes
Béla Lipták
Greg McMillan
F. Greg Shinskey
Terry Tolliver
Harold Wade
Karl Astrom
Lynn Craig
Charles Cutler
Terry Blevins
Thomas M. Stout
Ted Williams
Richard H. Caro
William G. "Bill" Luyben
R. Russell Rhinehart
Edgar Bristol II
Richard E. Morley
Wyman "Cy" Rutledge
Kathleen Waters
James H. Christensen
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Angela Summers
Vernon Trevathan
William M. Hawkins
Dale E. Seborg
Hans D. Baumann
Renzo Dallimonti
J. Patrick Kennedy
Carroll Ryskamp
Cecil Smith
Joseph S. Alford
John Gerry
Willy Wojsznis
Yutaka Wakasa
John Berra
Sigurd Skogestad
Maurice Wilkins

before becoming the president of Rosemount."

When Emerson, which had acquired Rosemount just a few months after Berra joined, decided to purchase Fisher Controls from Berra's alma mater, Monsanto, Berra became head of the combined Fisher and Rosemount controls business, then called Fisher-Rosemount.

"We ultimately launched DeltaV during my time as president," Berra says modestly. Other Emerson employees, though, recount stories of his deep and intense involvement in the design and creation of DeltaV, which became the model for the second generation of DCS products worldwide, and one of the most successful.

At the same time, Berra was responsible for the development of two of the most successful digital communications busses in process automation. "I am a geek at heart," he says.

First, under his direction, Rosemount developed HART, which has now over 30 million devices installed. Then, after personally working with the ISA SP50 standard committee, he helped launch (and became chairman of) the Fieldbus Foundation (www.fieldbus.org)—which is, especially in the petrochemical industry, growing as a powerful vendor-non-specific communications and control platform.

Berra has been a champion of the independent standards movement, personally in his involvement in ISA standards, as well as in his role as business leader providing the impetus for Emerson's involvement in standards work.

After Rosemount developed the HART protocol as a proprietary technology, Berra led the development of the HART Communication Foundation (www.hartcomm.org), and deeded the patents on the HART technology over to this not-for-profit organization. "The HART protocol was conceived at an offsite meeting that I chaired," he says.

"OPC also began on my watch," Berra notes. "I remember going to Microsoft and meeting with Mike Maples, who was then head of technology there. We were trying to stir up some interest at Microsoft in process automation."

"More recently," he continues, "I was associated with wireless technology and was proud to launch wireless products and WirelessHART during my time as business leader."

"Clearly no single person does all of this, and I am not the engineer who did the technology," Berra says. "But I am very proud of my leading role in all of these things that changed our industry. Automation is better because of these innovations, and it is very gratifying to know that I have been a part of it. My other source of pride is the people that I've hired and developed over the years."

Berra has been married to his wife Charlotte for 41 years, and they have three children and three grandchildren. "The grandchildren are the highlight of our life," he says. "I was a pretty decent tennis and basketball player in my younger years, but now my sport is golf."

Berra's idea of retirement is typically busy. He sits on the board of directors of two public companies, Ryder and National Instruments, and is a trustee of the Dell Children's Medical Center in Austin, Texas. "I sponsor four scholarships each year at the Washington University School of Engineering, [where he and Charlotte did their undergraduate work, and where they met—ed.]," he said.

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THE ACADEMIC VISIONARY

DR. SIGURD SKOGESTAD

Dr. Sigurd Skogestad took three classes from the electrical engineering department at the Norwegian University of Science and Technology (NTNU) in Trondheim, Norway, when he was in the Norwegian army. "However, these were rather theoretical, and during my following three-year career in the process industry, I did not find any use for these courses."

He was much more interested in thermodynamics, so when he decided to go for his Ph.D., he directed his studies towards that or process systems engineering.

"I had no plans of getting into control engineering," Skogestad recalls, "but then Professor Manfred Morari of CalTech came to visit our company [Hydro, www.hydro.com] and gave some lectures on the pinch method for heat exchanger network design. I was very impressed with him, and I joined his group at CalTech. The main focus of his work was control, and I became fascinated with the power of feedback control."

Skogestad relies on his four years of experience at Hydro's research center in Porsgrunn, Norway, to shape his work. "I have always had a strong interest in doing work that engineers may find useful in their daily work," he says, "and my first control paper was a paper on PID tuning that was written during my first year as a Ph.D. student." In fact, this paper has been so useful that it is still Skogestad's paper with the most citations in other works. "Presently at 365 citations," Skogestad says.

Skogestad was born in the small town of Flekkefjord, Norway, but moved to South Africa with his family for the next five years. Moving back to Norway, he finished high school in Porsgrunn, certain that he wanted to study engineering. "I ended up in chemical engineering because my father was a chemical engineer and working in large chemical plants seemed interesting and challenging," he says.

Sigurd married Anne-Lise when he was still a student, and they have two boys and two girls. Since he returned to Norway in 1987, he has been a professor of chemical engineering at NTNU and has been head of the chemical engineering department for some time. He is an avid cross-country skier and hunter, mostly of grouse. He is also a fan of orienteering, or "running with compasses." Skogestad is also active in local politics, as well as being a coach and umpire for girls' baseball.

"I think my main contribution," he says, "and one I am still working on, is to take control theory and make it workable in practice. As you can see if you look at my home page (www.nt.ntnu.no/users/skoge/bio.html), 'the object of our research is to develop simple, yet rigorous methods to solve problems of engineering significance. We would like to provide the engineer with tools to assist in problem solving.' "

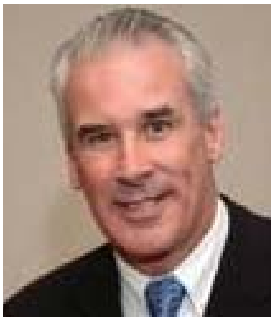
Skogestad has been working on plant-wide control for 25 years. "I am trying to find a systematic approach for finding the right control strategy, especially for finding the best controlled variables (CVs). I expect to keep working at least for another 15 years."

You can find his paper, "A Systematic Approach to Plant-Wide Control" at www.controlglobal.com/plantwidecontrol.html. "The paper summarizes my efforts so far…" he notes.

The Batch Wizard

Dr. Maurice Wilkins

"It was 1978," says Dr. Maurice Wilkins, vice-president of global marketing services for Yokogawa Electric of America (www.yokogawa.com/us/), "and I was just finishing my Ph.D, when a friend of mine who had graduated the year before to join Esso Chemical Ltd. in the New Forest area of southern England called to tell me about a cool new project he was working on using a new control tool called a DCS."



It was a Honeywell TDC2000 with eight loops and a single data entry panel.

Wilkins continues his story: "At the time I knew nothing about process control—we had done some on the chemical engineering course I had taken—but not much, and my Ph.D. studies had been on the control of water pollution using activated charcoal cloth. He said that Esso was looking for one more control engineer and 17 process engineers, so I decided to apply, and got the job. I was on a Honeywell training course while still writing my Ph.D. thesis. I remember my first day at Esso Chemical—my boss pointed to a line of columns and told me that I would be responsible for putting all of them onto TDC2000 and adding advanced controls—and so began my first project."

"Esso was *very* good at giving basic control training to its engineers," Wilkins says, "and then throwing them in at the deep end—and boy, did I learn a lot quickly." Like Berra, Wilkins spent lots of time working on every type of process unit. Then he was sent to Esso's additives plant called Paramins, and this changed his life. He was sent there to learn the ins and outs of batch control.

"It was seen as 'relegation' by the continuous control 'elite,' " Wilkins remembers, "but boy, did I have some fun there."

Wilkins took his new found batch expertise on the road, teaching process automation for KBC Process Automation's (now Honeywell Process Solutions) batch group for the next three years. He spent 18 months working on a huge batch project for Shell with Foxboro NL, the Dutch subsidiary of Foxboro (www.foxboro.com), and while there he learned about Easybatch, a Foxboro product far ahead of its time that used subroutines to control operations in the way ISA-88 later used phases. Moving to Honeywell (http://hpsweb.honeywell.com), he became involved in creating Modular Batch Automation, which was a forerunner to ISA-88.

"During this period, I became a Honeywell Fellow—a position bestowed on very few people in their organization," Wilkins said. "In 1993, I was transferred to Honeywell's EU HQ in Brussels to head a European Batch Center, and while in this position, I attended the inaugural World Batch Forum "Meeting of the Minds" held in Phoenix in mid-1994, which was another event that would eventually be life-changing."

After a period of time as a global consultant for Honeywell, a short engagement at SimSci just before its acquisition by Siebe, and a stint with his own consulting company, Wilkins bumped into Tom Fisher at the 2000 WBF North American Conference. "Tom Fisher was really the father of ISA-88 and revered in the batch community. I had never met him but he said, 'so *you* are Maurice Wilkins! I have read several of your papers on modular batch automation!' It was one of the most humbling experiences of my life. Following the conference, Tom asked me to join the WBF board, where I eventually became chairman."

Wilkins cycled back to the end-user side of things next, with a position at Millennium Specialty Chemicals (now part of LyondellBasell, www.lyondellbasell.com) in Jacksonville, Fla. At the same time, he served as WBF chairman from 2004 to 2009. "I am still the longest-serving chairman," he said, "having seen the organization get to the brink of extinction, and then with the help of a great board of directors, pull it back to viability once more."

In 2006, "consulting came calling again," and Wilkins joined ARC Advisory Group (www.arcweb.com) as vice president of consulting services. He had always wanted to have an influential position at a DCS vendor, and in 2008 such a position came up at Yokogawa. "I could not say no," Wilkins says. "I thoroughly enjoy working for Yokogawa and being an internal consultant for the organization."

In addition to his role at WBF as "Chairman Emeritus," Wilkins is also co-chair of ISA-101, the HMI standard committee, and he is a member of the Standards and Practices board. He is co-managing director of ISA-88 and ISA-95, and was instrumental in the formation of the ISA-106 standard committee for procedural automation. With ISA-88, the issues around the automation of batch processes had been addressed, but although ISA-88 could apply, it had not addressed purely procedural operations in continuous processes—start-ups, shutdowns and grade changes, for example. "So, along with Dave Emerson and Walt Boyes," Wilkins says, "I did some market research and found that there was a need for this standard, and we cajoled ISA into launching ISA-106 in April 2010."

Dr. Wilkins is married to Sara and lives in the Dallas suburb of Allen, Texas. "I have two daughters living in England, and three stepsons living in Belgium—and we also have two of the most adorable dogs in the world, both rescues," he said. "Sara and I love to run together, and we both enjoy traveling together and eating good food and drinking good wine."

THREE VISIONARIES SEE THE FUTURE

"I think that taking the knowledge I received from being involved with and consulting on modular batch automation, ISA-88, WBF and human factors, and applying all of it to the formation of the new ISA-106 standards committee will prove to be my most important contribution to the automation profession," Wilkins says. "I would also like to think that through my leadership I helped WBF—an organization vital to the batch and procedural automation world—to survive a very difficult period over the recent recession and to be reborn around ISA-106—in addition to its excellent work with ISA-88, ISA-95 and the BatchML and B2MML schemas."

"I think we still have quite far to go in implementing the advances and developments that have already been made," Skogestad says. "Even with retuning PID controllers, one can get large improvements in most plants, and if one looks more carefully into controlling the right economic variables—which I call 'self-optimizing' variables—then even more can be gained. Thus, I see the need to streamline the theory to make in accessible for engineers."

He continues, "A fundamental problem is that chemical plants are complex and modeling is costly. This, plus the fact that almost every plant is different, puts limitations on the use of advanced control. Maybe plants should be built to modeling specs, rather than the other way around."

Wilkins says that he sees a huge growth and diversification in sensor technology as "computing power improves and miniaturizes, and as wireless sensors become more and more ubiquitous."

"I see a time," he goes on to say, "when a group of sensors could 'act' together to address process issues and prevent process upsets before they even arise. I also see the control room as we know it disappearing, as we move more and more to mobile devices and tablet PCs. And of course, I also see the adoption of ISA-106 influencing the design and operation of procedures in the process industries and helping these industries to retain (and repeat) the knowledge of the retiring workforce."

John Berra says, "I gave an interview to Walt Boyes [www.controlglobal.com/multimedia/2010/AutomationPillar1010.html] that touched on some of this. I am a strong believer in wireless and see it playing a more and more important role in the future. My belief is not based just on the wiring savings. Predictive intelligence can make process plants run safer, use less energy and be more productive. Wireless opens many doors to enable better and more comprehensive predictive intelligence."

Like Skogestad, Berra believes in the power of modeling. "I also see a growing role for simulation," he said. "Simulation will get better and better, and will move from its largely training role to being a part of the automation system itself. Plants will be modeled, and the models will run faster than real time. It will give engineers a way to run things through the simulator to see what will happen before they actually do things to the process. It will be the ultimate way to conduct safe tweaks to the control scheme without causing upsets. It will also be a big boost to predictive intelligence."

Berra continues, "Finally, there is another trend underway that I believe will continue. I call it 'smartening up dumb things.' For example, if you think about it, operating a process plant is a lot like being asked to play chess blindfolded. You have to make the moves, but you can't see the board. A lot of what is going on today is about revealing more of the board, and that will certainly continue."

In addition, all three of this year's inductees to the Process Automation Hall of Fame believe that strong efforts are necessary to entice young people into the engineering professions as well as process control and automation. Skogestad put it succinctly, "The students do not see challenges in this field. We need to tell them that these exist." ■

You can read more of the inductees comments on their careers and the future of automation in the process industries online at www.controlglobal.com/1102_coverextra.html.

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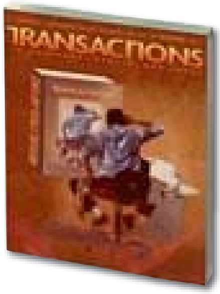

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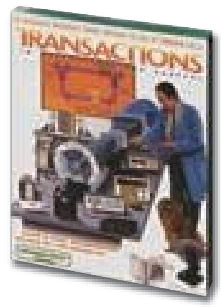

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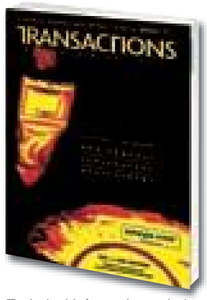

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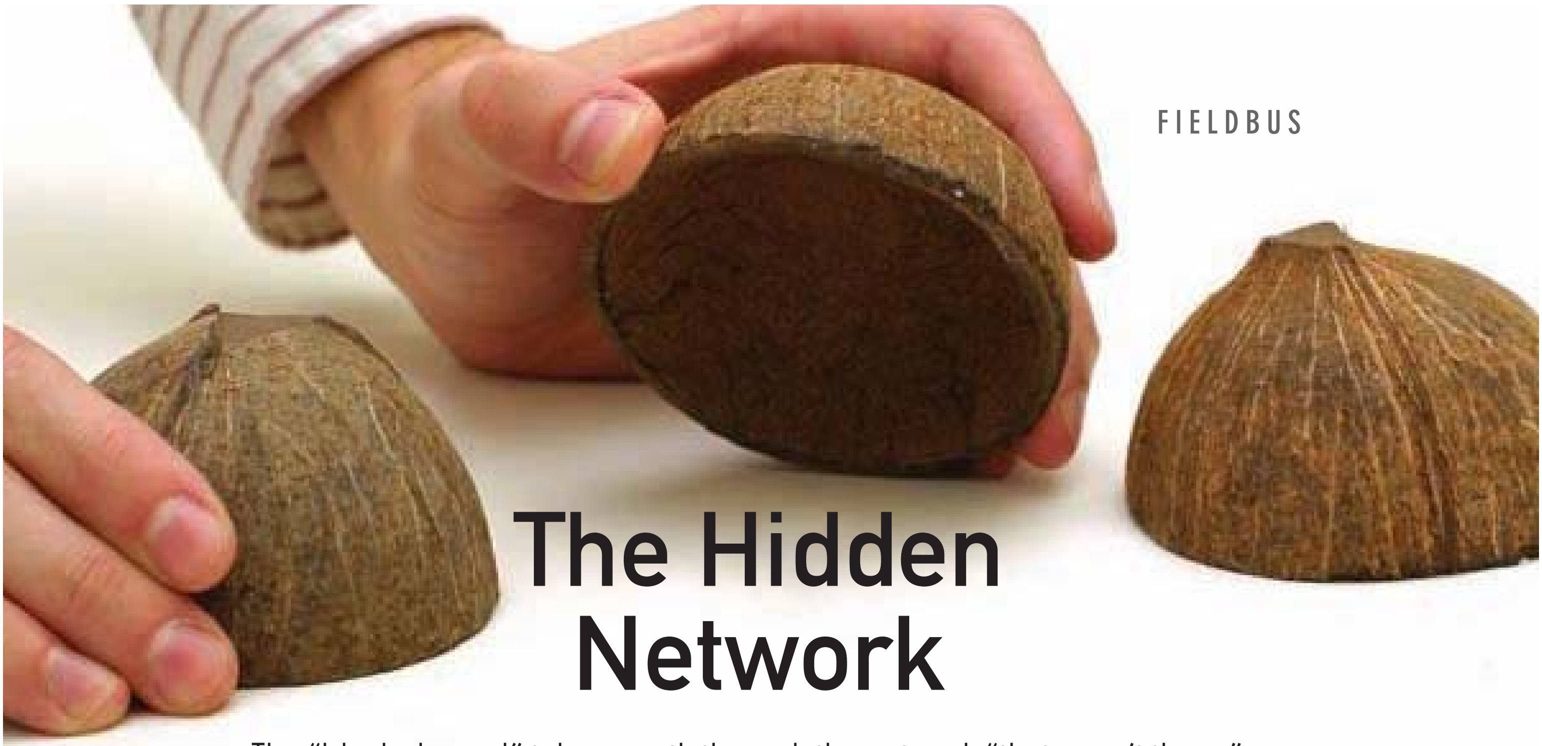


The Hidden Network

The "black channel" takes a path through the network "that wasn't there."

by Ian Verhappen

Practically all the fieldbus protocols take a "black channel" approach to their safety bus. However, defining a black channel is almost a black channel itself; everyone talks about it and uses it, but descriptions of it are mostly absent.

The name black channel is derived from the concept of a black box. The intent of both a black box and a black channel is that what goes in one end does not "see" anything between the inlet and outlet as it passes through the device. The difference is that, rather than a piece of hardware, it is the network itself that must appear to "not be there." The bus system, therefore, does not perform any safety-related tasks, but only serves as transmission medium.

Following a white-channel scheme would require that the bus networking and protocol be designed from the ground up for safety. All the network components would have to be safety-related and would need the associated approvals. The black-channel concept uses a non-trusted transmission system; the network gear is not safety-related. As a result, the advantage of the black-channel concept is that we can reuse regular network hardware for safety networks without having to modify more than the devices or nodes themselves.

No changes to the physical layers means the safety measures must be added as a safety layer on top of the Open Systems Interconnection (OSI) protocol Layer 7. The new layer is responsible for the transport of safety-relevant data. The remainder of the application layer is responsible for the acquisition and processing of user or process data.

As shown in Figure 1, the black channel uses a safety layer between the communication stack and the application per IEC 62280-1. The safety layer performs safety-related transmission functions, and checks on the communication to ensure that the integrity of the link meets the requirement for SIL 3 continuous, high-demand mode. Though it is an unlikely scenario, it is possible to use the black-channel

	Measure			
Error	Consecutive Number (sign of life)	Time-out (with acknowledgement)	Codename (for sender and receiver)	Data Integrity (CRC)
Repetition	X			
Loss	X	X		
Insertion	X	X	X	
Incorrect Sequence	X			
Data Corruption				X
Delay		X		
Masquerade (standard message mimics fail safe)		X	X	X
FIFO errors in intermediate routers		X[a]		

[a] No acknowledgement from routers (lower levels of OSI Model)

MEASURES TAKEN TO IDENTIFY COMMUNICATIONS ERRORS

Table 1. From *The Industrial Communication Technology Handbook,* Richard Zurawski, CRC Press 2005, pp. 28-1–28-19.

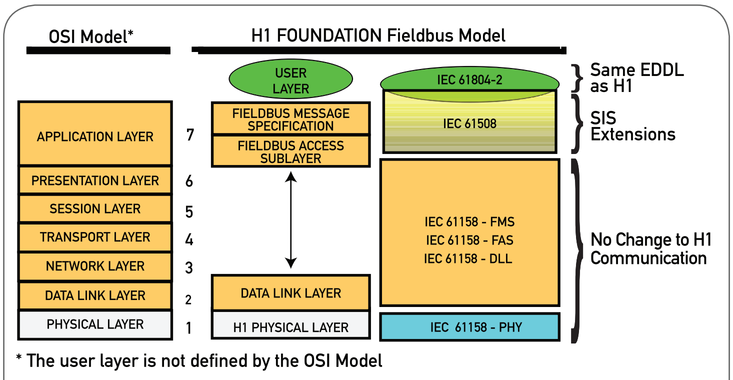
concept with some non-safety related devices sitting on the same bus and sharing the communication media so that if somebody accidentally connects a non-safety device to the safety bus, it will not negatively impact the safety operation.

To comply with the relevant safety standards, a safety-bus frame must be passed completely unmodified from a safety sender to a safety receiver, no matter what kind of transmission system both nodes are using. Thus the safety measures are encapsulated in the communicating end nodes/devices as shown in Figure 2.

This means that none of the error detection mechanisms of the chosen communication technology are taken into account to guarantee the integrity of the transferred process data. Basically there are no restrictions with respect to transmission rate, number of bus devices or transmission technology—as long as the given safety application reaction times can tolerate the additional overhead parameters.

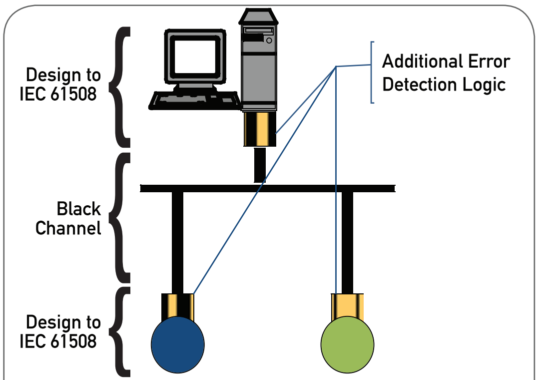
Detecting corrupted data bits through an additional cyclical redundancy check (CRC) plays a key role in meeting safety bus reliability requirements. The necessary probabilistic examination can benefit from the definitions within IEC 61508 that consider the probability of failure of the entire safety function. Because a safety circuit includes all sensors, actuators, transfer elements (this is the safety bus) and logic processes that are involved in the safety function, and the IEC 61508 standard defines overall values for the probability of failure of the system for different safety integrity levels, some fraction, typically 1% to 2%, of the overall SIL rating is assigned to the transfer element, which is the network equipment or black channel. For SIL 3, the probability of failure is 10^{-7}/hour, and if transmission uses 1% of the permissible probability of failure, the probability failure rate for the safety bus system must be 10^{-9}/hour. By selecting appropriate CRC polynomials for the intended frame length, the resulting residual error probabilities of the undetected corrupt data packets are guaranteed to meet or exceed the required limits (in this example 10^{-9}/hour). Therefore. we are no longer depending on the error detection of the standard fieldbus protocol (white channel) because we have added the supplemental checks shown in Table 1.

The measures in Table 1, other than CRC for data integrity, are indicated in the appropriate column check for a range of other types of communication errors that can arise during transmis-



AN ADDED LAYER OF SAFETY

Figure 1. The black channel uses a safety layer between the communication stack and the application.



THE SAFETY CAPSULE

Figure 2.The safety measures are encapsulated in the communicating end nodes/devices as shown.

sion of a message between any two points. Each of these measures, as implied by the short explanation in brackets, provides the following benefit and increase in confidence of the reliability of the transmitted information:

• Consecutive Number – Confirming that the message transmitted is received and reassembled in the proper sequence is important, especially for messages that have more than one route option to get from point A to B.

• Time Out – Many buses have some form of acknowledgement mechanism, however, the majority of the Industrial Ethernet protocols use UDP, which does not support message acknowledgement. Therefore, an independent dedicated tool must be used.

• Codename – This is a way to be sure that messages are transferred between the two end devices/nodes for which they are intended and no others.

Using a safety layer as just described provides the advantage of easy and fast implementation and also allows safety margins to be ideally dimensioned and machine clock rates to be increased to meet the overall system safety/SIL requirements.

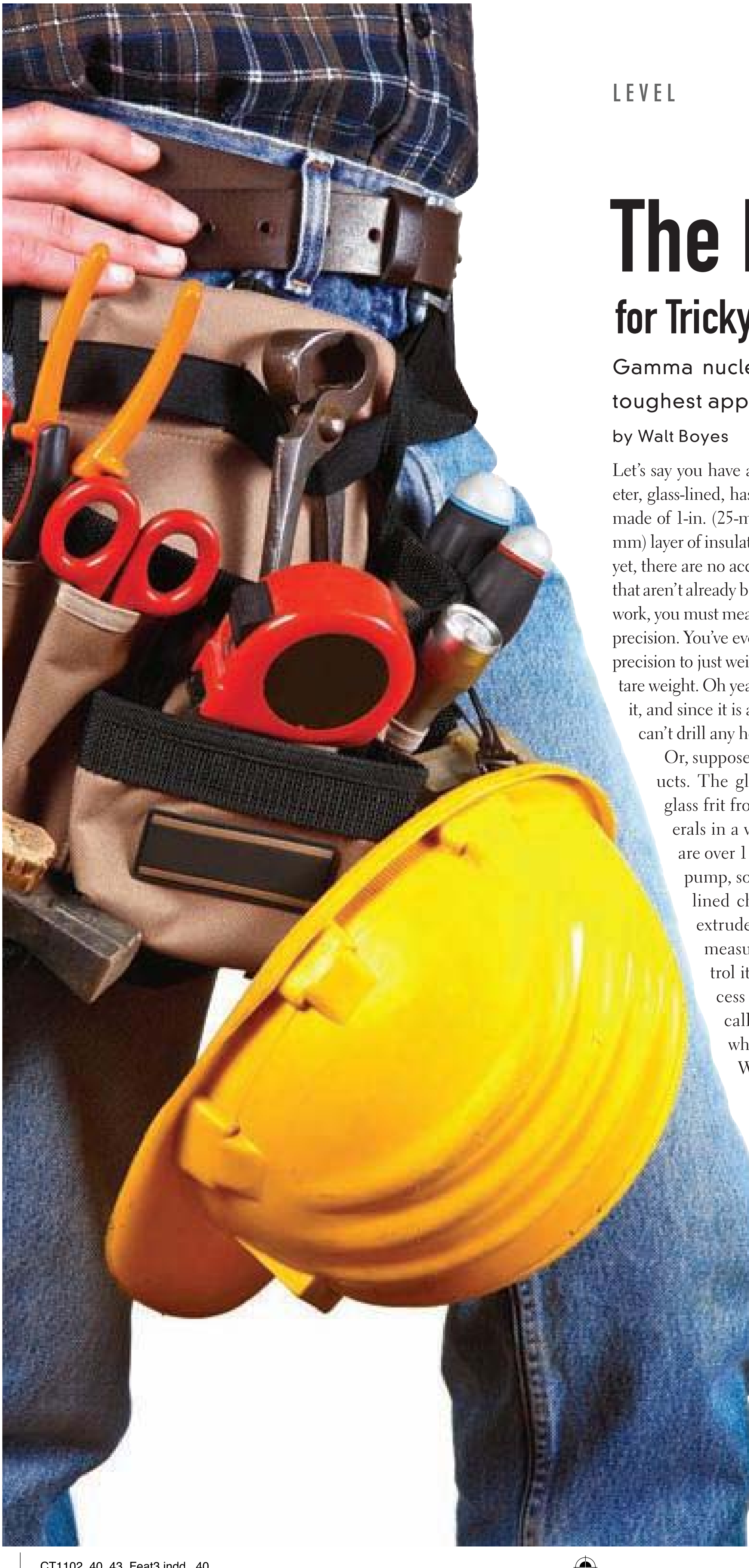
The functionality of the safety protocol is not concerned which transport protocol is used, because all safety-related mechanisms are integrated exclusively on the application layer of the protocol, and the safety bus functionality is thereby independent of the underlying transport layer.

The safety bus network does not benefit from any error detection mechanisms of underlying transmission channels, and thus supports the securing of whole communication paths, even backplanes, inside controllers or remote I/O.

Using the black channel approach ensures that the safety quality is independent of the communication channel.

Is the black channel concept really "black magic"? No. At most it is "sleight of hand," since just like the black box, it moves responsibility for making the "trick" work from the medium or messenger to the parts of the system actually doing the work and having the intelligence to tell the difference. ■

Ian Verhappen, P.Eng., is an ISA Fellow, ISA Certified Automation Professional and an authority on Foundation Fieldbus and industrial communications technologies. His website is www.industrialautomationnetworks.com.



The Right Tool

for Tricky Measurement Jobs

Gamma nuclear level gauges handle the toughest applications.

by Walt Boyes

Let's say you have a reactor vessel. It is 6 ft. (1.8 m) in diameter, glass-lined, has a big agitator in it, and has both a jacket made of 1-in. (25-mm) copper cooling coils and a 4-in. (100-mm) layer of insulation covered with thin steel lagging. Worse yet, there are no accessible entrances into the top of the vessel that aren't already being used for something. For the process to work, you must measure the level in the vessel with significant precision. You've even tried weigh cells, but there isn't enough precision to just weigh the contents of the reactor, with all that tare weight. Oh yeah, and you can't stop the reactor to modify it, and since it is a glass-lined and code-stamped vessel, you can't drill any holes in it either. What do you do?

Or, suppose you're making glass for a variety of products. The glass is produced by melting silica sand, glass frit from recycled bottles and some trace minerals in a very hot furnace with firebrick walls that are over 1 ft (300 mm) thick. The glass is too hot to pump, so it must flow by gravity down a firebrick-lined channel to where it is cast or molded or extruded. Your requirement is that you have to measure the level of the molten glass and control it to ±0.0005 in. (±0.013 mm), or the process doesn't work. Glass castings have holes called holidays in them, and extruded glass, whether tube or sheet, has flaws and holes. What do you do?

You are responsible for the air pollution control system for a very large coal-fired power plant. You have electrostatic precipitators that remove the fly ash from the stack gas before it gets released into the atmosphere, causing international pollution incidents and costing your utility millions in air-pollution-control violation fines. But the hoppers that hold the precipitated fly ash keep plugging up, and fly ash is very hot and also acts like concrete and sticks to everything. You need some way to tell when the hoppers are full, so you can empty and clean them, but anything you stick into the hopper just gums up and fails so fast that you have given up. What do you do?

Sound familiar? Nearly every plant, from mining to wastewater and every process vertical in between, has a level application that is both critical and difficult, if not impossible, to measure.

Enter the Gamma Level Gauge

Since the 1950s, the answer to all of these applications has been the proper application of a gamma level gauge. Gamma gauges work based on both the inverse-square law—radiated energy decreases with the square of distance—and the fact that dense materials absorb gamma energy—1 in. (25 mm) of steel, for example, cuts the energy from a gamma beam by 50%.

Very early on, engineers came up with the idea that rising material or liquid would change the amount of energy reaching a detector on the other side of the vessel from an emitting source. In the case of a point level switch measurement (Figure 1), rising material would simply trigger a relay if the energy beam were interrupted. In the case of a continuous level measurement (Figure 2), the rising material would cause a decrease in the intensity of the energy beam reaching the detector that could be calibrated to be proportional to the rise in level, and when the level fell, then the energy would likewise increase.

Designing to Fit

In order to figure out how much energy will reach the detector, essentially all you have to do is to add up the densities and thicknesses of all the materials between the energy source and the detector, and make the energy beam intense enough to pass through all that material and reach the detector. Safety requires that the intensity of the energy beam be designed to be as small as possible and still make the measurement.

"Modern detector designs have made it possible to use significantly lower activity sources than in previous years," says Mick Schwartz, business unit manager of Berthold Technologies USA LLC (www.berthold.com), a manufacturer of gamma level gauging products. "This means that the risk of exposure to gamma energy for personnel is minimized and amenable to proper safety precautions. Gamma energy does not cause any of the measured product or the vessel to become radioactive."

All manufacturers of gamma level gauges have software that makes the calculation of energy source size straightforward. You or the vendor plug in the numbers for the thicknesses and densities of the material, not forgetting the air gap between the walls of the vessels—air has density, and energy decreases with the square of distance—and the software spits out an optimized energy source size and, in most cases, the appropriate housing design and detector selection.

Gauging in the Real World

So let's look at how to do the level application in the jacketed vessel we talked about earlier. This is not quite as easy as putting a source and a detector across from each other because there are vessel internals, including an agitator, that have to be missed. The way to do this application is to "shoot a chord" of the vessel's diameter—that is, put the source and detector off to one side of the diameter. Because the thicknesses that the energy beam will shoot through will be greater, the source activity that will be required will be greater by some amount than shooting the diameter would be. The blades of the agitator

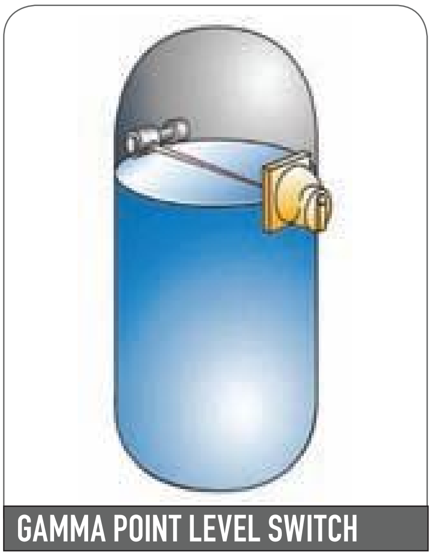


Figure 1. Rising material triggers a relay if the energy beam is interrupted.

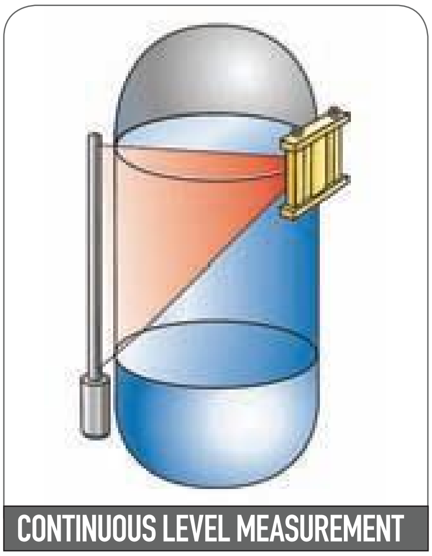


Figure 2. Rising material decreases the intensity of the energy beam.

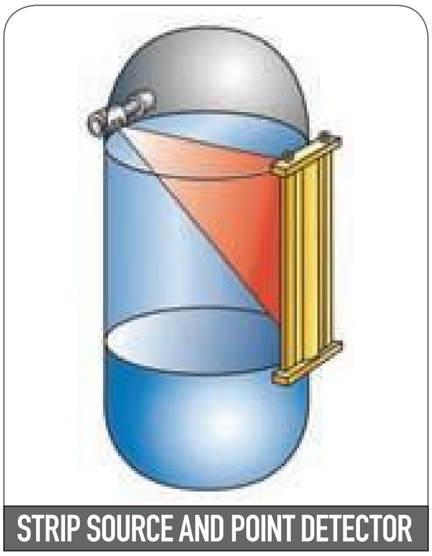


Figure 3. Here the apex of the triangle is aimed at the point detector.

Figure 4. A narrowly collimated conical beam is aimed across the vessel at the point detector.

need to be considered, and, if possible, eliminated by shooting the chord between the blades and the vessel wall. If that isn't possible, many gamma level gauges can be programmed to ignore the repetitive density fluctuation caused by blades swinging into and out of the beam. It just makes the signal noisy.

Now let's look at the glass level gauge. There's a lot of firebrick on either side of the glass channel, so it may be necessary to drill holes in the firebrick to reduce its thickness. This will cause the temperature on the outside to rise, so the detector must be water-cooled to bring the internal temperature of the electronics down to the normal range.

There are three geometries that can be used in continuous gamma level measurement. The most common is a point source that is collimated to produce a right-triangle-shaped beam with the 90° angle at the top of the detector. Next is a strip source that is characterized to produce a similar shaped beam, but with the apex of the triangle at the point detector (Figure 3). Third, there is the geometry of a strip source and a strip detector. This geometry is often used for highly precise level measurement on small diameter vessels or pieces of pipe, such as vertical risers.

In point level applications (Figure 4), the source produces a narrowly collimated conical beam that is aimed across the vessel at the point detector. In most point level applications, the reason a gamma gauge is being used is because the inner walls of the vessel are subject to vibration, corrosion, abrasion, or fouling or coating with material. Fly ash hoppers are classic examples of this kind of application. The energy activity of the source must be sized, so that the point level gauge continues to work correctly through a reasonable thickness of fouling or coating, perhaps as much as a couple of inches.

How to Measure a Tank of Tomato Paste

Larry Fontes, maintenance and production supervisor at Ingomar Packing Co. (www.ingomarpacking.com) in Los Banos, Calif., uses a gamma level gauge on a very difficult food industry application. "We were using a dual remote diaphragm seal system with chemical T diaphragm seals and a 4-20 mA DC HART transmitter to control a valve, which would control the level in a holding tank," Fontes says. "The holding tank is 38 in. (nominal 1 m) in diameter and about 30 ft (9.1 m) tall. The product inside the tank is tomato paste with a specific gravity of about 1.134 at 210 °F to 215 °F (a little over 100 °C) at a flow rate of approximately 250 gallons per minute."

"After a 100-day processing season," Fontes continues, "the diaphragm seals would become coated due to the temperature of the product, and the level indication would begin to drift as the diaphragm was unable to pick up the change in pressure as the level changed."

Fontes reports that the problem became so severe that product spilled out the vent on top of the tank, while the transmitter reported little or no change in percent level.

Fontes looked into other level technologies, including radar. "I was looking for a level system that wouldn't be affected by the properties of the product due to the thermal processing," he says. "We had used a [gamma] device to measure soluble solids from Berthold Technologies, so I was somewhat familiar with the technology. Berthold worked with the consulting engineer we had contracted for the expansion of our aseptic processing system. [Process Resource Inc.. www.processresource.com]

"Berthold provided onsite start-up and training for myself and several of our operators," Fontes goes on. "The installation was made much easier with the help of all the individuals from Berthold. We operate the gauge under the general license in the Code of Federal Regulations."

And how has it worked out? "Since the installation of the Berthold level gauge (Figure 5) in 2007," Fontes reports, "we have had instances during a couple of processing seasons that would have resulted in the same issues as before. The dual diaphragm system level indication began to drift, while the gamma level gauge remained constant."

Fontes concludes, "The Berthold level gauge in-

Figure 5. During a 100-day processing season, the gamma level gauge remained constant.

stallation was part of a $1.3 million expansion to the flash cooler, which is part of our aseptic processing.

The Business of Using Gamma Level Gauges

Similar to every other device that uses nuclear byproduct material, even the smoke detectors in your house, gamma level gauges are required to be licensed. This means that applications, paperwork and rules have to be known, understood, followed and kept current. However, once you are set up to do this, licensing can be relatively simple and not too onerous.

"Many gamma level gauges can be distributed under the general license in most states in the United States," says Berthold Technologies' radiation safety officer (RSO), Mark Morgan, "but the general license does not exist in other countries, and the U.S. NRC plans to do away with it in one to three years anyway, in favor of specific licensing. The NRC plans to make the specific license procedure simpler and more streamlined."

The general license has less paperwork, but has restrictions on gauge geometry, exposure levels, shielding, and other environmental health and safety issues. The other kind of license, used globally as well as in the United States is called a "specific license." This means that you, as the gauge owner, are licensed to do several specific things with the gamma level gauge you own.

So what does this mean for operations and maintenance? Maintenance on the electronics, including the detector, can be done by any plant-qualified instrument tech or maintenance tech. No license is required by persons doing that level of maintenance. Since a gamma energy source is basically a steel-jacketed lead box with a capsule the size of a horse-pill inside of it, maintenance on source housings is minimal. A trained, licensed person is required to change the geometry of the gauge or to move it.

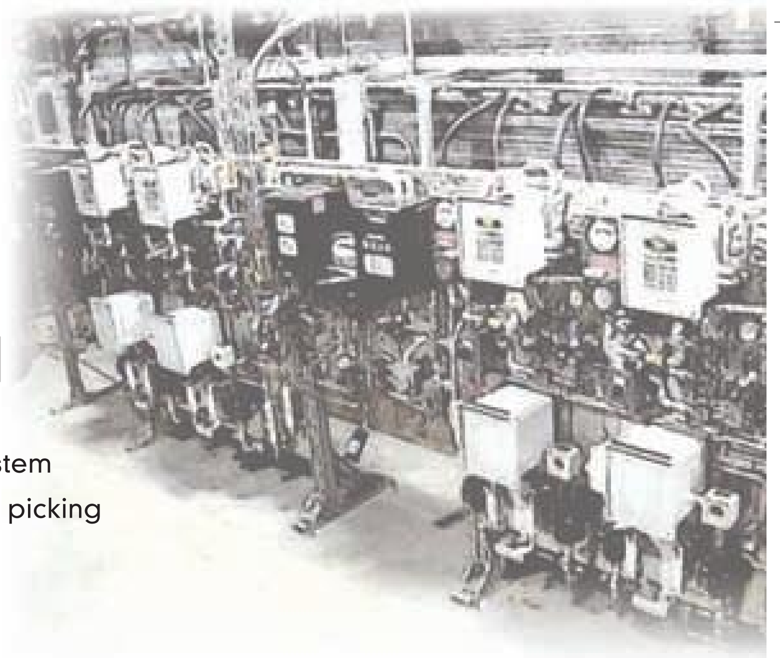
And when you aren't using it anymore, you are required to dispose of it properly—not just send it to a junkyard. Most manufacturers of gamma gauging instruments will accept a returned source, take title to it (so you and your management don't have to keep track of it forever), and send you a document saying that you are no longer responsible for it.

Knowing these simple rules in advance can mitigate management's reluctance to undertake a new regulatory duty.

So There You Have It

Gamma level gauges are a good long-term solution to many of the most difficult level applications you will run into. They will operate with fewer maintenance headaches and, in some cases, operate where nothing else will. ■

Walt Boyes is Control's editor in chief.



Basics of Analyzer Sample Systems, Part 1

Here's how to know your process conditions by calculating dead spaces, system lag time and system pressure drop, simplifying a planned system and picking the right equipment for it.

by IAN VERHAPPEN

If you had to design and install a process analyzer sample system today, how would you do it? First, remember that an analyzer system includes the sample tap, sample system, analyzer, sample return, signal transmission and control system. If any of these components fail, your company won't gain the economic benefits the system was supposed to produce. And don't forget, it's generally accepted that sample systems are victims of the Pareto principle, which is that 20% of a system consumes 80% of the resources because they're responsible for 80% of analyzer system problems.

While the engineer's golden rule of "keep it simple, stupid" (KISS) also applies to sample systems, this time it also stands for: Know your process conditions; Involve the right people; Simplify the system; and Select the right equipment.

Get the Right People

In addition to process engineers, a project team will involve several other people as well. A likely group will include the following:

A chemist—A representative from the laboratory who will not only provide the stream composition but also know the present method of analysis used on the stream.

Maintenance/Analyzer Technician—A person, or group of people who must be involved from the beginning, not only to gain get a sense of ownership of the process, but also to understand the technology and equipment before it arrives on-site to get commissioned. P

Project Manager—A person who coordinates the entire project, gets the funding, arranges for necessary approvals and other important duties as they come up.

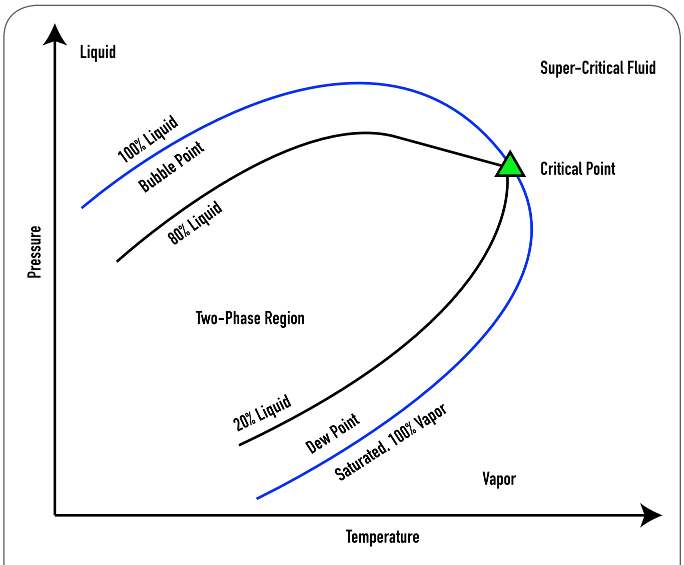
Know the Process Conditions

It's important to understand the process conditions, not only at the sample inlet, but also at the analyzer and all along the sample loop. To do this, three basic calculations must be made: 1) dead spaces; 2) system lag time; and 3) system pressure drop.

Using this information, a phase diagram (Figure 1) should be generated for all sample streams. This diagram represents how the fraction of liquids, solids and vapors change as a function of pressure and temperature. It is invaluable when trying to determine if there are condensable products in the stream that can later be vaporized as the pressure decreases. This is similar to checking for cavitation in control valve sizing, only in reverse, since rather than looking for vapor in a liquid, one is looking for a momentary liquid phase in a vapor stream. A process or chemical engineer can generate this diagram, along with a range of pressures and temperatures over which the system may be operating, from the stream composition.

Dead Spaces Often Overlooked

One of the biggest and often overlooked items when designing a sample system is dead spaces or volumes. Dead spaces are parts of the sample system where pockets of fluid can be-



THE ESSENTIAL PHASE DIAGRAM

Figure 1. The fraction of liquids, solids and vapors change as a function of pressure and temperature.

come trapped and can't move along with the remainder of the sample. Perfect places for dead volumes are tee fittings, separators or any other sharp-edged flow change. To minimize its effect, use the following rules:

- Minimize tee fittings in the system;
- Purge the sample system three times for each analyzer cycle;
- Use the smallest size fittings able to do the job within other constraints;
- Use the minimum number of fittings possible, which reduces dead time and minimizes potential leak or failure points;
- Operate your continuous sample systems in the turbulent flow regime.

For example, the first column of Figure 2 shows a configuration designed to minimize dead volume. The three-way valves eliminate elbows, and when a stream isn't flowing to the analyzer for measurement, it's still flowing to a vent or sample return point, ensuring a continuously fresh sample at every point in the system. The second two columns show the configuration when streams AX-1A and AX-1B, respectively, are being analyzed.

Lag Time Depends on Velocity and Volume

The second item to consider and one of the first things to calculate is the system lag time. System lag time is the sum of the analyzer cycle/measurement time and the sample lag time. Meanwhile, sample lag time is the amount of time it takes for the sample to travel from the sample point to the analyzer sensor. It's simply the volume of the sample system divided by the velocity of the flow and can be calculated using Equation 1.

$$t = \frac{V \times L \times P_a \times Z}{F_s \times T_a}$$

Where:
t = time
V = sample system volume
L = distance from the sample point to the analyzer sensor
P_a = absolute pressure
Z = compressibility factor
F_s = flow rate under standard conditions
T_a = absolute temperature

Compressibility Is a Factor for Gases at Higher System Pressures

For liquids, compressibility is negligible and the compressibility factor is Z = 1.0. However, in gas systems operating at more than about 35 to 50 psia, compressibility must be considered. For gases, compressibility changes as a function of pressure and temperature according to the rules of the ideal gas law, as shown in Equation 2

$$Z = \frac{P_a V}{nRT_a}$$

Where:
Z = compressibility factor

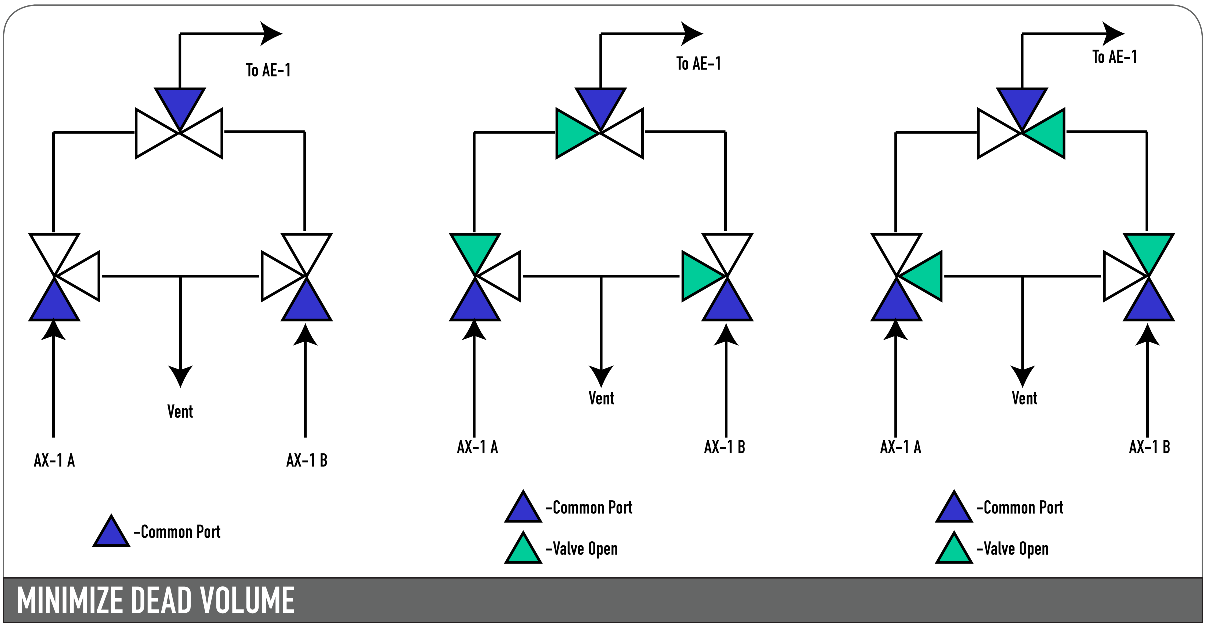


Figure 2. Analyzer systems should be designed to so that a fresh sample is available at every point. Careful arrangement of three-way valves and vents can ensure this.

P_a = absolute pressure
V = volume
n = moles of fluid
R = gas constant
T_a = absolute temperature

The compressibility factory Z can be determined from compressibility charts and the associated reduced temperature T_r and reduced pressure P_r.

The reduced temperature and pressure are calculated as follows:

$T_r = T_a/T_c$

$P_r = P_a/P_c$

Where:
$T_c = y_1T_{c1} + y_2T_{c2} + y_3T_{c3}$ … (y_x is the mole fraction and T_{cx} is the critical temperature of component x)

$P_c = y_1P_{c1} + y_2P_{c2} + y_3P_{c3}$ … (y_x is the mole fraction and P_{cx} is the critical pressure of component x)

In addition, don't forget that the ideal gas law uses absolute pressures (P_a) and temperatures (T_a), so calculations must be done in psia or kPa (abs) and degree Rankine (R = F + 460) or degrees Kelvin (K = C + 273.15). Also, by combining and rearranging Equation 2 at two conditions and neglecting n, which remains constant, it is also possible to estimate the effect of pressure or temperature on volume.

$$\frac{Z_2}{Z_1} = \frac{P_2V_2T_1}{P_1V_1T_2}$$

Thus,

$$\frac{V_2}{V_1} \approx \frac{P_1}{P_2}$$

$$\frac{V_2}{V_1} \approx \frac{T_2}{T_1}$$

Where:
Subscript 1 refers to the inlet condition
Subscript 2 refers to the outlet condition.

Calculate Sample Flow

If you have a certain size and length of line and want to figure out an appropriate sample flow rate (F_s), at standard conditions, rearrange Equation 1 as shown in Equation 3

$$F_s = \frac{V \times L \times P \times Z}{t \times T}$$

Once you know the volumetric sample flow rate (F_s in liters/min), you can determine the velocity (v in ft/sec) of a stream using Equation 4.

$$v = \frac{F_s \times 0.1079}{D^2}$$

Where:
F_s = volumetric sample flow rate (liters/min)
0.1079 = a conversion factor to get the final result into ft/sec
D = internal pipe diameter (inches).

As a general rule of thumb, the sample system velocity should be in the range of 1 to 2 m/s (3 to 6 ft/sec) to ensure that any components in the sample are carried along with the sample proper and do not drop out of solution.

System Pressure Drop Depends on Velocity

The pressure drop in the system can be calculated using the sample system velocity calculated in Equation 4. This is not as difficult as it sounds, although it is important. Often the hardest part of the exercise is getting an estimate of the stream properties. The equation for pressure drop per 100 feet of tubing is shown in Equation 5.

$$\Delta P_{100} = \frac{0.13 \times f \times \rho \times v^2}{D}$$

Where:
ΔP_{100} = pressure drop per 100 feet of tubing (psi)
f_d = Darcy Friction Factor
ρ= density (lb/ft^3)
v = velocity (ft/s)
D = pipe diameter (inches)

To calculate the Darcy friction factor (f_d) we need to calculate the Reynold's number, as shown in Equation 6.

$$Re = \frac{\rho D v}{\mu}$$

Where:
Re = Reynolds number
ρ = density
v = velocity
μ = viscosity

[*Editor's note: There are two ways to calculate the Darcy friction factor, and they will lead off Part 2, which will run in the August 2011 issue of* Control. *To view both parts now, go to www.controlglobal.com/samplesystems.*] ■

Ian Verhappen is an ISA Fellow, a CAP and principal at Industrial Automation Networks (www.industrialautomationnetworks.com).

More on BP Oil Spill: Restriction Orifice Sizing

"Ask the Experts" is moderated by Béla Lipták, process control consultant (http://belaliptakpe.com) and editor of the *Instrument Engineers' Handbook* (IEH). He is recruiting contributors for the 5th edition of the IEH. If you would like to contribute by updating an existing or preparing a new chapter, or if you have questions for our team of experts, please write to liptakbela@aol.com.

Q In the August 2010 issue (www.controlglobal.com/articles/2010/OilBlowouts1008.html), you described how the BP blowout could have been prevented by correctly designed controls. My question is this: Once the blowout started, could properly designed safety controls have prevented the loss of the 11 lives?

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CONDITION	ACTUAL RESPONSE	CORRECT RESPONSE
Violent Pressure "kicks"	Rig was shut down for 9 days, yet the blowout preventer (BOP) was not tested or inspected because testing is "expensive."	Immediately do maintenance inspection of BOP
Well is tested to see if it is leaking or properly plugged.	Replacing heavy mud with light sea water above plug—"daring the well to blow."	Compare the lifting force to weight of mud column before its replacement with sea water.
If blowout is detected or observed. . .	Close BOP. This too was under MANUAL control.	AUTOMATICALLY close BOP. If it does not close in 2 minutes, activate hydraulic shear button (HAS).
BOP did not close after 2 minutes from activation or any time later.	None. The HAS was not pressed. Another MANUAL operation.	AUTOMATICALLY activate HAS immediately
Neither BOP nor HAS operates.	None. Initiation of emergency system (ES) required MANUAL operation of 30 buttons.	AUTOMATICALLY activate ES immediately.
Hydrocarbon gas detected by many sensors.	None. Even sparking electrical equipment, engines, motors, fans and generators were kept running in MANUAL.	Presence of flammables should have AUTOMATICALLY caused shutdown of all sparking equipment.
BOP has failed, and fire is observed on deck.	Did not actuate general master alarm (GPA); another MANUAL operation.	AUTOMATICALLY initiate "abandon rig" GPA alarm.
Fire is spreading on deck and explosions are heard.	None. Did not activate emergency disconnect (EDS), which was also a MANUAL operation.	AUTOMATICALLY activate EDS to disconnect the rig from the BOP and the well.

WHAT WENT WRONG AT DEEPWATER HORIZON

Table 1: The correct responses should be specified in a new national standard for undersea drilling.

A The absolute minimum safety requirement in any industrial application is to detect the presence of flammable gases and ***automatically*** shut down all ignition sources, including electric devices if they are present. Flammables or smoke should be detected by multiple sensors configured in redundant or voting systems. All safety devices should also be tested quarterly.

In case of the BP rig, neither the regular nor the safety controls were properly designed or maintained. As I wrote in August, the BP operators first injected foam cement into the well to plug it, and because they knew the integrity of the cement job was questionable (the cement was unstable), they checked if the plug would hold by using the "let us see if it blows" method. In other words, they reduced the force (the weight of the column of heavy mud) holding down the cement plug by replacing the mud with a column of light sea water to see if it still held. It did not.

Once the well started to blow, the emergency safety responses were even worse because there was no automatic response at all. It was left to the operators to manually activate the blowout preventer (which did not work, because it was neither tested nor maintained). They also had to manually shut down all ignition sources, including sparking electrical equipment when the presence of flammable vapors was detected. Even after the operators smelled the gas, these potential ignition sources were kept in operation.

In addition, even if the operators attempted to activate the shutdown controls, it would have required the operation of 30 switches and buttons to do so. Similarly, it was left to them to manually activate the switch that would have disconnected the rig from the well so that it could move away. Finally, even after the explosions and fire, the "abandon rig" alarm was still not activated because it too had to be manually activated. In short, lives were lost because the safety controls were badly designed and because they were operated under manual control.

The lesson to be learned is that all life-protection safety controls should be fully automatic. This is an absolute requirement, because if their activation is left to panic-stricken and poorly trained operators carrying out vague instructions, such accidents are unavoidable. The argument that false alarms due to sensor failure can be expensive is no excuse. The answer to such arguments is to select reliable sensors, use them in a redundant or voting configuration, and properly maintain them.

Therefore, it is not the operators who should be held responsible, but the designers of the control systems and the inspectors whose job should have been to check the design and operation of the safety systems. Naturally, the ultimate responsibility falls on the owners, who considered cost and schedule to be more important than safety.

The lesson to be learned from this disaster is that the entire deep sea drilling industry should be regulated and be forced to live up to the requirements of a predetermined minimum safety standard which includes the requirement that all life safety systems must be completely automatic (see Table 1). Process control engineers and the ISA should play a major role in developing the required safety standards.

BÉLA LIPTÁK
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Q What are the globally accepted standards and formulas used for sizing restriction orifices. I understand that there is some formula in the Miller's handbook. Is this the only method?

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A The restriction orifice is just another orifice which is installed not to measure, but to limit the flow (see chapter 2.15 of the *Instrument Engineers' Handbook*). In the case of gas flow, as long as the pressure upstream of the orifice is more than twice the pressure downstream of the orifice, the gas flow through the oriface will be "choked," and the gas will flow at ultrasonic velocity.

Under choked flow conditions, the flow through an orifice is proportional to the upstream pressure. It should be understood that choked flow limits only the velocity. Therefore, if the upstream gas pressure increases, the density of the gas also increases; and, therefore, the mass flow rate also increases. If you know the up- and downstream pressures and the properties of the gas, you can calculate the area of the restriction (A) for any discharge coefficient (C) or if (A)(C) is known, you can calculate the flow by using the equation below:

Mass flow, *kg/s* =

$$C\,A\sqrt{k\,\rho\,P\left(\frac{2}{k+1}\right)^{(k+1)/(k-1)}}$$

C = discharge coefficient, dimensionless
A = discharge hole cross-sectional area, m^2
$k = cp/cv$ of the gas
ρ = real gas density at P and T, kg/m^3
P = absolute upstream pressure of the gas, *Pa*.

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A ISO 5167, Part 3, is the international standard for orifice plates. It can be found at http://tinyurl.com/4w3s23o.

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Q I would like to know if a new version of ANSI/ISA - 5.01.01, containing the primary element symbols that are shown in 4th edition of Volume 1 of the *Instrument Engineers' Handbook*, on page 24, is already available.

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A ISA 5.1 was released in the fall of 2009.

IAN VERHAPPEN
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A No, the 5th edition of the *Instrument Engineers' Handbook* has not been published yet. The 2009 edition of ISA's "Instrument Symbols and Identification" (ANSI/ISA-5.1-2009) is available and costs $120 to ISA members and $145 to non-members. It can be ordered at http://tinyurl.com/4aytp8j. The minor changes that have been made to flow symbols in the 2009 edition are described in Mr. Jamieson's answer.

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A I was the co-author of Chapter 1.1 of the IEH with Alberto Rohr, and also have been active on the ISA-5.1 subcommittee for Instrumentation Symbols and Identification for more than 10 years. It took many years to get the latest version approved (ANSI/ISA-5.1-2009).

As to changes made in the 2009 edition concerning the primary flow element symbols, we now have 31 instead of 22 in the previous edition. One difference is that the connecting pipeline symbols in and out of the flow element are not shown. As to changes to the previous 22 symbols, only two minor changes were made. One change involves the sonic flowmeters, which in the 2009 issue are shown as a rectangle with a single vertical backwards "S" inside it. The other change is in the symbol for variable area flowmeters, which now is a vertical rectangle with a "float" symbol inside it.

The rest of the flow symbols in the 4th edition of the IEH are correct, except that some have a second or alternate symbol in the ANSI/ISA-5.1-2009 version.

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Siemens
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Sealevel Systems Inc.
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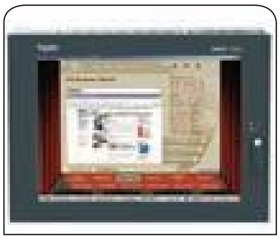
SMART AND NO MOVING PARTS



The Magelis Smart+ is the first industrial PC with Windows XP Pro that requires no maintenance and contains no rotating parts. It has a 15-in. Type 4X (IP65) touchscreen, an Intel Celeron M 1 GHz processor, 1 GB of RAM and two Ethernet ports. It has been certified to UL 508 for industrial control equipment, UL and ATEX for hazardous locations and marine.

Schneider Electric
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Rockwell Automation
www.ab.com/eoi/

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Beckhoff Automation
www.beckhoff.com/controlpanel

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717/767-6511; www.redlion.net

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ProSoft Technology
661/716-5100; www.prosoft-technology.com

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Daisy Data Displays
717/932-9999; www.d3inc.net

TOUCHSCREEN SOFTWARE

Automation Organizer is a software suite that combines IDEC's PLC WindLDR and OI WindO/I-NV2 software with new system configuration software (WindCFG), giving users a powerful and easy-to-use tool to design, debug and document control systems. WindLDR and WindO/I-NV2 have new graphic user interfaces and a total redesign of the menu icons. A free 30-day demo is available.

IDEC
800/262-IDEC (4332); www.idec.com/software.

APPROVED AND CERTIFIED HMI

The VisuNet HMI system is now available with IEC approval. All VisuNet components can be used in environments that correspond to Zone 1 (gas) and Zone 21 (dust) as specified in the IEC standard (touch screens: Zone 22, dust). The system is also ATEX-, NEPSI-, EOST R- and Gosgortehnazor-certified for use in China and Russia.

Pepperl+Fuchs
330/486-0002; www.pepperl-fuchs.us.

Compact HMI

The AGP4100 Series Compact HMI has six models of 3.4-in. touchscreen-equipped operator interfaces. It offers full graphic touchscreen interfaces at text display prices, and uses a full range of features such as switches, lamps, graphs, alarm display, security and visibility animation to provide clear application feedback to the operator. PLC, servo, temperature and robot controller drivers are available.

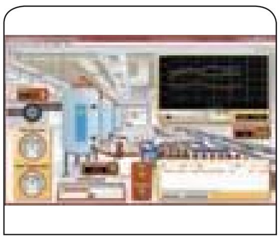
Pro-face America
847/296-2009; www.profaceamerica.com/AGP4100

WIDESCREEN HMI

Phoenix Contact has added 16:9 widescreen options to its WP series of HMI panels, providing up to 40 percent more visualization space than 4:3 aspect ratio panels. The panels have 800-by-480 pixel native resolution. Available in 7-in., 9-in. or 12-in. screen sizes, the panels feature a color TFT touchscreen and an integrated micro-browser. It can connect via Ethernet to ILC 100 or 300 controllers.

Phoenix Contact
800/322-3225; www.phoenixcontact.com/usa_home

ON DISPLAY



Opto 22's PAC display is an HMI development application used to create graphical interfaces that mimic a process. It offers support for alarm management, recipe handling, operator logging, real-time and historical trending, multimedia and unlimited tags. This functionality puts PAC Display on a par with HMI development applications costing thousands of dollars more per seat.

Opto 22
951/695-3010; www.opto22.com

LOW-COST TEMPERATURE TRANSMITTER

Acromag's Model ST131 is an ASIC-driven RTD signal conditioner that combines the simplicity of a digital USB setup and calibration interface with the performance advantages of analog signal conditioning. Selling for just $89 with free Windows configuration software, this DIN Form B head-mount instrument converts the input signal from any 100-ohm platinum RTD sensor to a loop-powered 4-20mA output.

Acromag
248/295-0880; www.acromag.com.

COMPACT CORIOLIS FLOWMETER

The Cubemass Coriolis flowmeter is a small, lightweight, flowmeter that is ideal for installation in spraying or coating equipment, engine test stands and process skids. It measures mass flow, volumetric flow, temperature and density in a single unit and communicates to controllers via pulse, frequency, 4-20mA current with HART and Modbus RS485. It is available in four pipe sizes, from 1⁄24-in. to ¼-in. (DIN 1 to DIN 6). It has ATEX, IECEx, NEPSI, NEC/CEC and TIIS approvals..

Endress + Hauser
317/535-1329; www.us.endress.com

SOLID LIGHTING

The UPA-130S model provides solid-on LED lighting and alert capabilities for applications requiring enhanced NFPA70E and OSHA safety compliance. It pre-verifies electrical isolation from outside the control panel before its re-verification with a meter. The series operates over a standard range of 40 VAC to 750 VAC (30 VDC to 1000 VDC) line-to-line or ground-to-ground, is phase insensitive and offers high surge immunity protection.

Marsh Bellofram
304/387-1200; www.marshbellofram.com.

PORTABLE PLOTTER

The MCP Basic Plotter complements the MultiCard identification markers for terminal blocks, wires, cables and other electrical equipment. It is compatible with MultiCard marker formats and works with Weidmuller's M-Print Pro software. Lighter and smaller than the MCP Plus, it comes with a travel case for easy transport and storage, making it an ideal choice for customers with low volume or on-site printing requirements.

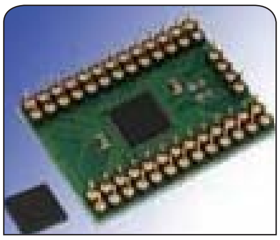
Weidmuller
800/849-9343; www.weidmuller.com

OPC-UA DATA LOGGER

Software Toolbox's newest version of the OPC Data Logger includes support for OPC-UA connectivity. This expands the options for OPC Data Logger connectivity, enabling it to connect securely to OPC data sources with the latest standards. Wizard-driven configuration dialogs make setup and customization quick and easy. It is designed for applications where a full-featured historian isn't required or practical.

Software Toolbox
888/665-3678; www.softwaretoolbox.com

UNIVERSAL USB CONTROLLER



IO-Warrior56 is a universal USB controller that allows easy access to input or output functions via a USB bus. Featuring 50 generic I/O lines, IO-Warrior56 is also an I2C/SPI master, allowing interface with a wide range of available ICs. It has a full-speed USB 2.0-compliant interface, 50 general-purpose I/O pins, 1000-Hz rate (input or output) and a SPI master interface, up to 12 MBit/sec, throughput up to 62 Kbytes/sec. It operates at temperatures between -40 °C and +85 °C.

Saelig
585/385-1750; www.saelig.com

WAFER-CONE FLOWMETER

McCrometer's advanced Wafer-Cone Flowmeter is ideal for gas or liquid service in line sizes from 1 in. to 6 in. Space-saving and field-proven, it can be installed virtually anywhere in a piping system or be easily retrofit into an existing piping layout, resulting in significant installation flexibility and initial cost savings. It is also ideal for other applications, including natural gas wellheads, burners or ovens, cooling systems, HVAC and more.

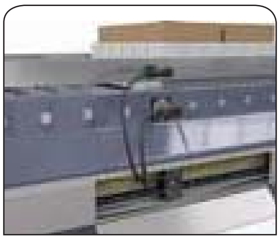
McCrometer
800/220-2279; www.mccrometer.com

ANTI-FOULING TRANSDUCER

The KPSI Series 705 level transducer has a double thickness of Teflon on its sensing area to further reduce material penetrating the diaphragm. The non-fouling submersible hydrostatic level transducer is ideal for use in highly viscous applications, including lift stations, slurry and pump control. It is available in custom level ranges from 6 ft, H_2O to 115 ft, H_2O, with analog outputs of 4 mA to 20 mA, or 0 VDC to 5 VDC.

Pressure Systems
800/328-3665; www.pressuresystems.com

CONNECT AND DONE I/O



The G10 family of Ultra-Compact I/O modules with Connect & Done technology can eliminate mounting requirements in many applications. The world's smallest AS-Interface I/O module with IP68/69K protection, at just 40 mm x 27 mm x 22 mm, the G10 fits easily into any cable duct and enables quick, convenient sensor connections using the integrated M12 pigtails. All versions are equipped with bright diagnostic and status LEDs that are visible from all directions.

Pepperl + Fuchs
330/486-0001; www.pepperl-fuchs.us

BANSHEE PROTECTION

The Banshee343 ultrasonic gas leak detector provides wide-area gas detection (toxic and/or combustible) coverage in any hazardous-area application where pressurized gas is present—regardless of environmental conditions. It only triggers an alarm when inaudible, ultrasound—only produced with the release of highly pressurized gas—is detected. The analog, relay or modbus outputs can communicate directly with any existing plant control system.

Net Safety Monitoring
www.net-safety.com.

TWO-WIRE MAGNETIC FLOWMETER

The ADMAG AXR is the world's first two-wire magnetic flowmeter employing the "dual frequency excitation" method which cancels process-generated noise without sacrificing response time. It can be installed in a loop-powered system, eliminating the need for a second conduit run, extra wiring, a separate power supply and additional engineering, drastically reducing the meter's installed cost. It has a full dot-matrix LCD display, an electrode adhesion level diagnosis function and multi-lingual capabilities.

Yokogawa
800/888-6400; www.admagaxf.com

CERTIFIED PRESSURE TRANSMITTERS

Winters Instruments' newest line of industrial pressure transmitters come with CSA, CE, RoHS and ATEX worldwide certifications and feature all stainless steel construction and ceramic sensors, ensuring a compact yet robust level of performance They are available in vacuum to 10,000 psi pressure ranges and have 0.25% and 0.5% accuracy ratings, in 2- and 3-wire output configurations and a wide range of mechanical and electrical connections.

Winters Instruments
800/WINTERS; www.winters.com

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Write to them at controltalk@putman.net.

GREG MCMILLAN
STAN WEINER, PE
controltalk@putman.net

Stan: The operator is the most underutilized resource in the plant. I think most operators would appreciate a greater understanding of the process and playing a bigger role in improving its performance. This is not to say operators don't already do a tremendous job in dealing with the inevitable unknowns and problems to keep a plant running nonstop.

Greg: When we did opportunity assessments, we found the production units at one plant consistently out performed the units at other plants. The difference was that the operators knew the practical limitations to production better than the technical support engineers, and were the initiators of most of the ideas for process control improvement. If the people on the front line who have to resolve problems on a minute-to-minute basis have an understanding of the process relationships, the result can be truly remarkable. The knowledge developed can be put into the automation system. Advanced control is, after all, the embedding of process intelligence.

Stan: The key to unleashing the true capability of a plant is the operator training system (OTS). Most companies realize an OTS is essential for getting the operators to make maximum use of an upgraded instrumentation and control system. The more astute companies realize it offers an ongoing role for exploring and understanding problems and capturing and disseminating knowledge, not only to operations, but also to technical and maintenance support functions. Probably the least recognized opportunity is getting maintenance and operations on the same page. As we said in our March 2010 column, the first question asked when production changes is, what maintenance was done.

Greg: To maximize the performance and benefits of an OTS, we continue our discussion with the president of Mynah, Mart Berutti.

Stan: What are the job functions and skills of people who build and deploy an OTS?

Mart: Operator training systems require process simulations that are dynamic and real-time. Because the purpose of both OTS and testing and system acceptance testing (SAT) is to provide realistic responses at the operator glass, the control system platform is very important to the overall performance. We find that the best developers of these systems are process control engineers, who understand the process and process dynamics. If they have advanced control background, they are often very good candidates for developing dynamic simulations. Of course, plant operations involvement is also essential. In many cases, the most experienced operators and operations supervisors

can best dictate the use cases and acceptable performance for the dynamic simulator used in the SAT and OTS.

Greg: What type of simulation building environment do your customers find most useful?

Mart: Since we are working with control system engineers more so than process design engineers, we like to use IEC1131 programming languages such as function blocks and structured text. This allows the control system designer to make the transition to dynamic simulation developer without learning a completely new configuration environment. The only new paradigm the user needs to adopt is the use of process equipment objects in the IEC1131 function block environment. In addition, process equipment objects are not connected with wires carrying signal values, but with streams conveying dynamic process information (pressure, flow, temperature, density and composition).

Stan: What are the relative advantages and disadvantages of various methods of communication between the model and the DCS?

Mart: Most offline control systems have an OPC server, a Modbus TCP/IP or an Ethernet/IP slave interface. The dynamic simulation system needs to have an integrated OPC client or Modbus TCP/IP Master or an Ethernet/IP Scanner. Ideally, the simulator will have all three options and an I/O service that runs independently of the simulation engine. This allows the user to integrate I/O by tag name and not by the DCS I/O path. Utilities should allow the user to generate the dynamic simulator's I/O definition and low-level models, such as tiebacks, so that the I/O definition in the dynamic simulation matches the one in the distributed control system automatically

Stan: Do you run your models standalone before the configuration is ready, and, if so, what control loops do you put in place, and how do you initialize the DCS loops?

Mart: So the OTS simulation can be developed in parallel with the DCS configuration, we run the dynamic model by including the basic control loops in the simulation via IEC1131 control blocks in our library. In order for volumes not to overflow or run dry, and for pressures to be in the operating range, the level and pressure loops are immediately put in Auto. Next the temperature loops are put in Auto because these loops are often the key to getting the composition right, in addition to regulating the energy balance. With these loops, the model can be fully explored, tested and documented by a library of operating conditions captured by snapshots. When the configuration is ready, the control can be readily transferred to the actual distributed control system, and a new library of snapshots created for restoring and resuming operating scenarios.

Greg: What do you do for really slow processes, such as distillation columns and bioreactors, to simulate periods of greatest interest?

Mart We use snapshots of abnormal situations, upsets and interesting points in the batch cycle, start-up and continuous operations, to "restore and resume" and eliminate the need to wait for a model to reach these operating conditions. The virtual plant also has the capability of running about 10 times real time for a control module execution time of one second.

Stan: Mart, what type of abnormal situations do you simulate?

Mart: We allow the user to introduce scenarios that include simulated valves that are stuck or that have failed closed or open by simply putting the analog output in manual and setting its output. We can do the same thing with discrete outputs for on-off valves and motors. For transmitters, we put the analog input in manual and set its signal to simulate failure as last value, upscale or downscale. We can also create a huge variety of process disturbances by changing incoming stream flows, temperature, densities and compositions, and by changing model process parameters, such as a heat transfer coefficient and catalyst activity. Introducing sudden changes to atmospheric conditions can also be very effective events for operating training.

Greg: How do you measure operator performance?

Mart: We keep track of the time it takes each operator to solve a similar problem. We get rid of outliers and generate a plot that represents the composite learning curve for the set of operators. We can repeat these tests and generate the composite learning curve for a different type of problem to see if improvements in operator graphics are making a difference. We allow the user to define the expected results for each operator training scenario. Scoring conditions can be weighted and set for each expected results. There is no limit on how the user can define his operator scoring. Conditions can be set based upon operator tasks, such as acknowledging alarms or changing the setpoint or valve position on critical loops. Scoring conditions can be set to evaluate the health of the simulated process by evaluating key parameters in the dynamic simulation. The training session results (including scoring) are automatically saved for each student.

Greg: For more, including the benefits of an excellent OTS and the Top 10 Signs of an Excellent OTS, go to www.controlglobal.com/1102_ControlTalk. ■

AD INDEX

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EQUIPMENT & MATERIALS

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EXECUTIVE EDITOR
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Sumo Showdown on Security

Before all the big games, hyperventilating commentators often say, "It all comes down to this!" The backdrop for today's contest is the ongoing organizational earthquakes triggered as microprocessor-based data processing forced its way onto the plant floor. This upheaval has fueled years of wrenching technical and corporate changes as many controls and automation engineers learned to use PLCs, DCSs, PCs and more software-based monitoring, automation and controls.

Many mechanical, electrical, controls and other engineers were crowded together, of course, and they in turn were shoved together with system integrators, corporate managers and even IT technicians. This has sparked years of rivalries and turf battles. Fortunately, as the years passed, many former opponents learned to get along—at least on the surface.

However, different people and organizations are still at different stages of understanding, and many silos and their barriers remain. So, it seems like whenever a new technical challenge shows up, all the old bile and barbs come out again. One of the latest bones to be fought over is process and network security. When a destructive computer worm such as Stuxnet shows up, controls and IT staffs start to square off again like sumo wrestlers, this time about network segmentation, firewalls and patching policies. I can just hear the thighs being slapped, the feet stamping, flab colliding and the buildings shaking.

Unfortunately, there's evidence this infighting makes process applications and networks even more vulnerable to outside attacks.

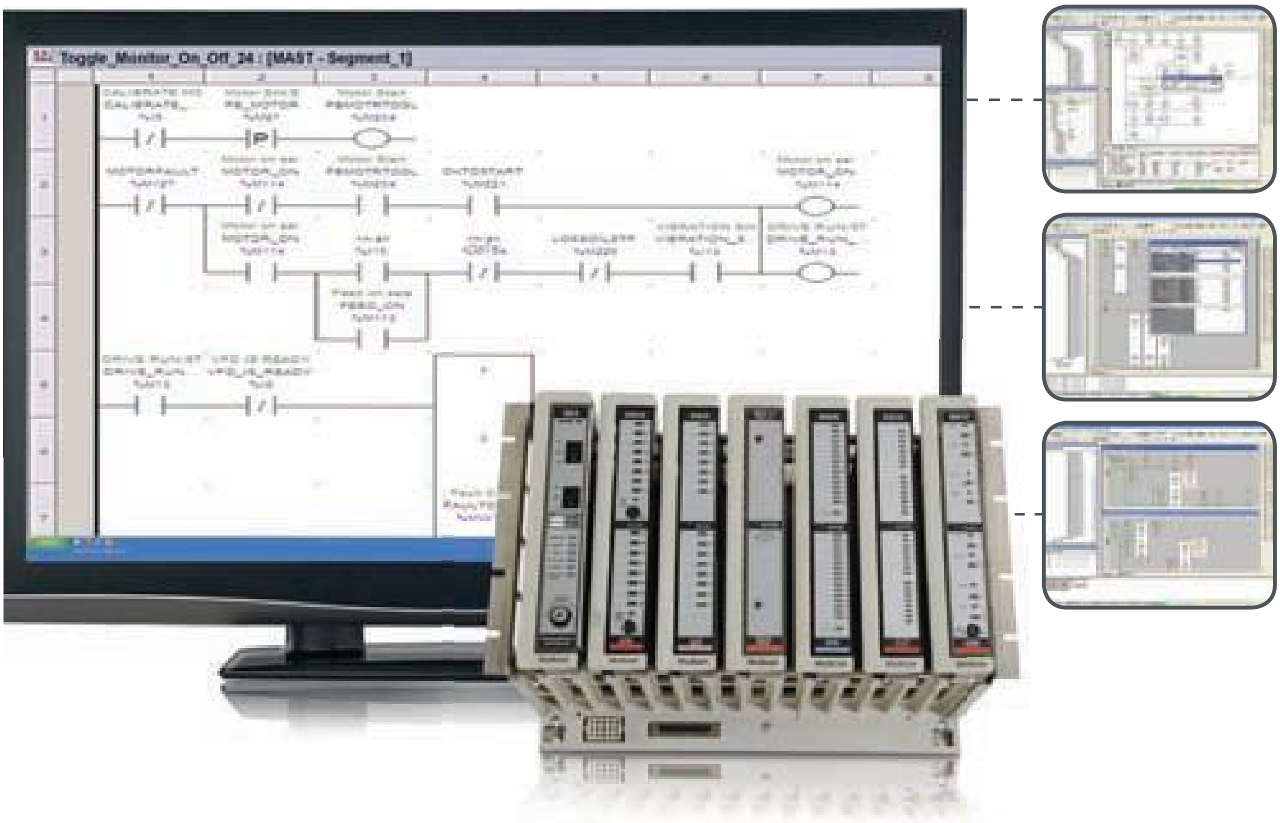
"There are many acknowledged cases where IT network scanning tools shut down controls and production systems. This is because many legacy devices don't have full IP stacks, and so network scans can trigger an infinite loop in a PLC and disable it," says Joe Weiss, PE, CISM of Applied Control Solutions (www.realtime-acs.com) and author of *Control*'s Unfettered blog (community.controlglobal.com/unfettered). "IT covers general network security, but we still haven't dealt with what's unique and different about control systems, and how to address them to improve security. For example, IT wants everyone to change their default passwords periodically. However, when you change the hard-coded default passwords on a PLC, it may not be able to access its applications. Stuxnet used this to its advantage.

"Likewise, the U.S. Department of Homeland Security's (DHS) U.S. Computer Emergency Readiness Team (US-CERT) issued recommendations in September on how to deal with the Stuxnet worm. They covered how Stuxnet is using vulnerabilities in Windows as its delivery vehicle, but didn't give enough guidance on controls. There's been no additional guidance from DHS or even discussions about the PLC attack since late September. Since it is the PLCs and other field devices that can cause equipment failures and injuries and deaths, why have there been so few efforts by DHS and the U.S. Department of Energy to address securing field devices?"

Weiss adds there is only one investor-owned utility whose board of directors wants to do more than meet the North American Electric Reliability Corp.'s NERC CIP rules, and actually secure their facilities. As a result, Weiss is developing control system cyber security policies for all of the utility's mission-critical equipment. In almost every audit he's conducted, Weiss reports that he's found modems and wireless access points for control systems that the utility didn't know it had.

"Control and IT people must cooperate to look at the design and implementation of their networks, including control systems, because some of these viruses or worms can't be stopped," adds Weiss. "And, if an intruder can get in and manipulate controls, then users must have some physical safety system that's separate from their regular controls, in addition to segmenting their network with firewalls around vulnerable areas." That way, everyone wins. ■

> True security for process control networks will require users, engineers and suppliers to cooperate far more closely than ever before.



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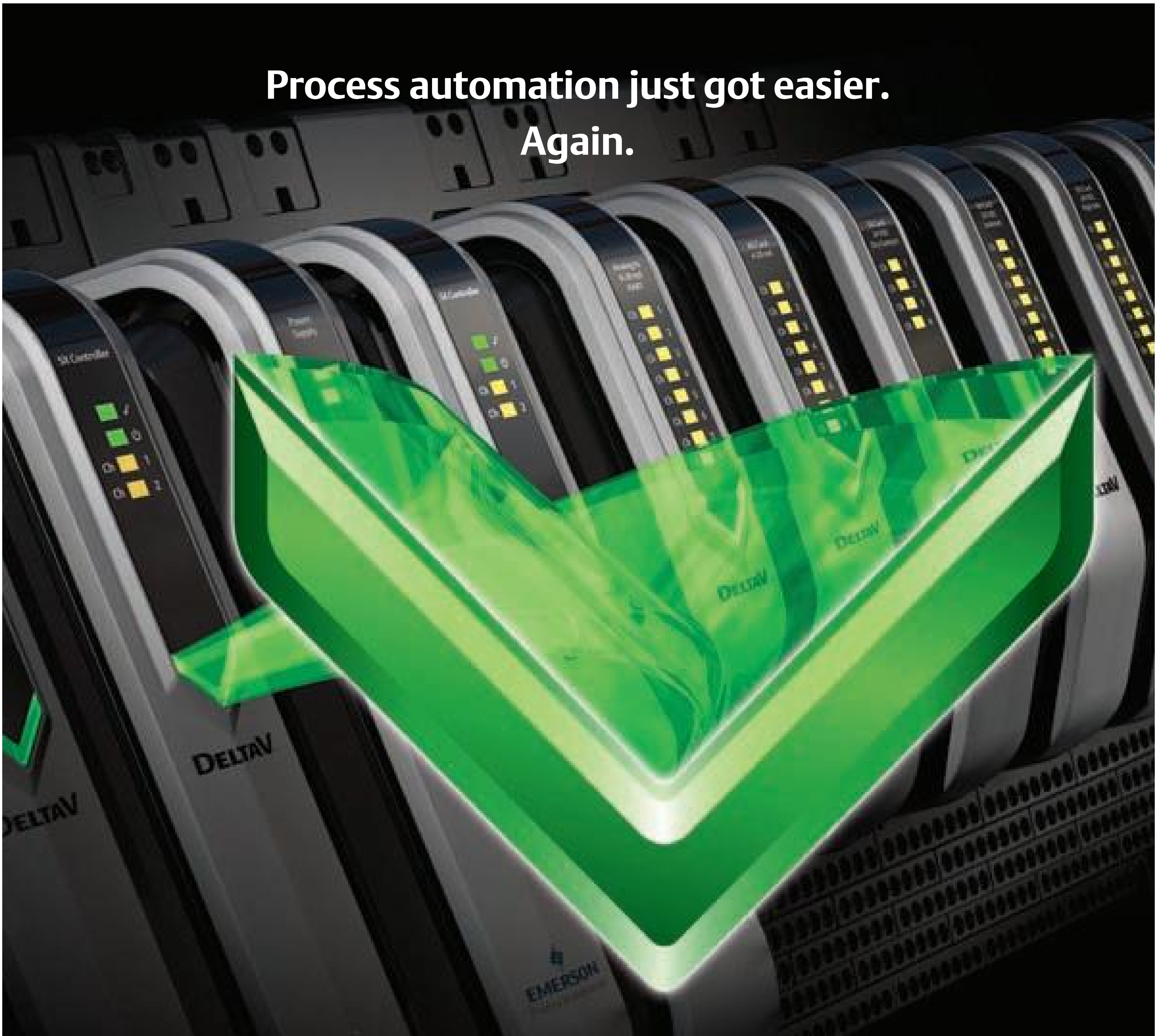
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