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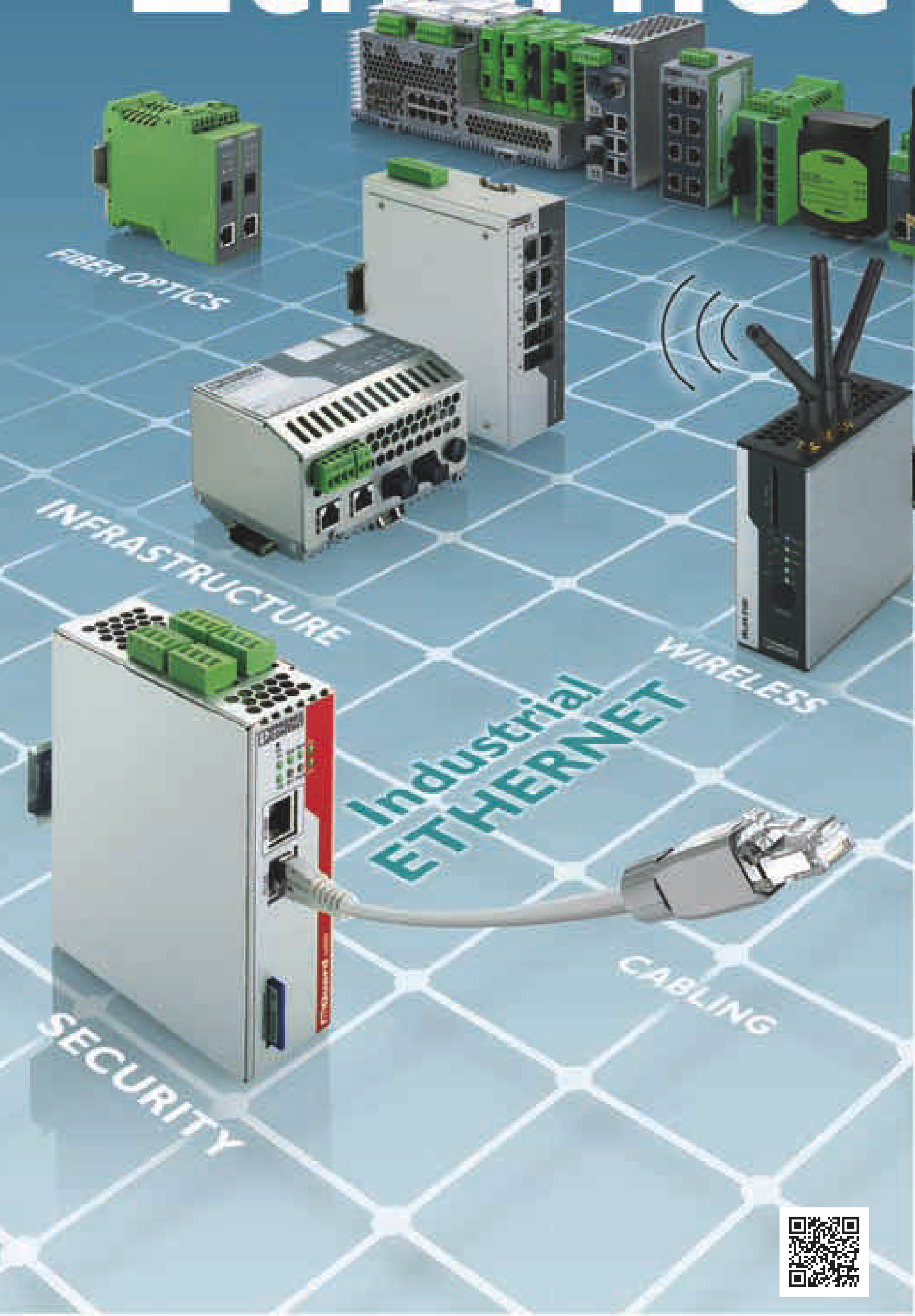

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FEATURES

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DEPARTMENTS

CIRCULATION AUDITED MAY 2011

Chemicals & Allied Products	12,419	Rubber & Miscellaneous Plastic Products	3,499
Food & Kindred Products	11,355	Paper & Allied Products	3,311
System Integrators & Engineering Design Firms	9,261	Stone, Clay, Glass & Concrete Products	1,855
Primary Metal Industries	5,232	Textile Mill Products	1,219
Electric, Gas & Sanitary Services	4,174	Tobacco Products	137
Petroleum Refining & Related Industries	3,789	Total Circulation	60,020
Pharmaceuticals	3,769		

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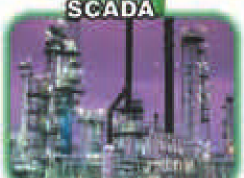

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PERFORMANCE + VALUE = PRODUCTIVITY

Community and Responsibility

WALT BOYES
EDITOR IN CHIEF
wboyes@putman.net

I was walking through Tower Grove Park (www.towergrovepark.org) recently, and reflecting on how it came to be. Like the Missouri Botanical Garden that is adjacent to it, Henry Shaw carved the park out of his huge estate just outside Saint Louis. He donated it to the city, which created the foundation that still runs the park. It is a huge piece of urban landscape, similar to Golden Gate Park in San Francisco or Central Park in New York City.

We often compare the late 19th century to the early 21st century in that there was a similar disparity between the wealthiest Americans and the working people in the United States that exists today. We called those wealthiest Americans "robber barons," and Republicans and Democrats alike banded together to pass legislation to bust trusts, establish unions and curb the financial excesses of the "Gilded Age."

But there are significant differences between those two periods in time.

One of the most significant is that the robber barons had a clear, fixed sight on what it means to be part of the community. Andrew Carnegie endowed a university, along with his financier, Andrew Mellon, and then, not considering that enough, gave dozens of cities throughout the United States the means to erect a public library and stock it with books over which Carnegie exercised no censorship. The great public spaces of New York and Chicago, Shaw's garden and park—all of these were funded, not by taxes, but by philanthropic gifts from the wealthiest Americans back to the community. Community was important, even to the 19th century's "one percent."

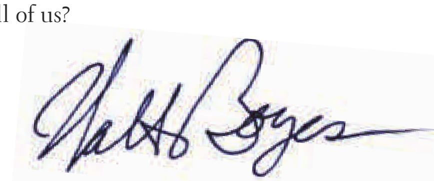
Unfortunately, although the amount of wealth is greater now than then, the wealthiest Americans appear to give less consideration to the idea of community in the United States. The 100 wealthiest Americans saw their wealth increase over 13% in 2011, yet overall, charitable donations and gifts to public works are down. The wealthiest Americans hide their wealth in offshore bank accounts instead of funding communitarian public works. They party like the Gilded Age, but unlike their forebears, most don't establish universities or fund a prize for the advancement of research and of peace.

From the beginning, our Founding Fathers knew there was a dialectic between individualism and communitarianism. This dialectic drove over a half million men to give their lives to set black slaves free. Individuals, in the Ayn Rand sense, would never have flocked to the Union's colors, but communitarians understood that what benefits the poorest segment of the population benefits us all. In manufacturing, there were supporters of unions among the "one percent." In fact, the Republican Party platform on which Teddy Roosevelt ran emphasized the party's support for unions.

Service to the community was, up until the 1960s, a shibboleth in the body politic, but not so much now.

Sure, there was a lot of pure greed then too. In the mines, in the garment industry, in the auto industry, men and women died because of greed and people who just didn't care about the common good. Yet at the same time, you look around and see the magnificent public buildings, from the Ravinia concert venue to the Chicago Public Library, to many more ways the robber barons gave back generously to the land that made them wealthy.

I don't see that happening as much as today. I see more Ebenezer Scrooge than I do Leland Stanford or Andrew Carnegie. Don't you wish that today's "one percent" were as community-inspired as their financial ancestors were? Wouldn't it be nice if the concept of service, of "giving back," was once again a core value for all of us?



Individuals, in the Ayn Rand sense, would not have flocked to the Union's colors. but communitarians understand the idea of shared benefits. .

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Loops at Limit	Number of loops with control output saturated (0% or 100%, or hitting an output constraint.)	_____ out of 20 loops
Oscillating	Number of loops with visible oscillation.	_____ out of 20 loops
Poor Control	Number of loops with poor control. [see note 1]	_____ out of 20 loops
APC On-Time (optional)	What is the average on-time for your APC/MPC Controllers?	_____ % On-time

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Notes:

1. Ask the operator if there are any control problems, such as:
   a. Loop does not follow setpoint
   b. Loop does not respond quickly to upsets
   c. Loop behaves erratically

NANCY BARTELS
MANAGING EDITOR
nbartels@putman.net

Gettin' Social with ControlGlobal.com

Unless you've been living under a rock the last few years, you probably have some form of social media in your life—whether you want to or not. If you're not on Facebook, for no other reason than friends and family have nagged you into it, then you're on Twitter or YouTube or LinkedIn or Google+ or all of the above. And the one lesson you've probably learned is that these sites, while fun and often useful, can be awful time sinks. You begin with the innocent thought, "Time to check my Twitter feed," and the next thing you know, it's two hours later and you're still clicking links. Not good.

I don't have any good answers to this problem. I'm as bad an offender as anyone—if not worse—and the only solution I've come up with is the same one that applies to diet and exercise. You just have to do it. You have to leave these tempting sites and move on to something else, or you'll end up like that sad, iconic character who lives in a dark room, eating junk food and staring at a computer screen 24/7. Bad for the waist line, the complexion and your social life.

Meanwhile, we at *Control* and ControlGlobal.com are shameless enablers of your social media habit. Not only can you access us directly via the Internet and your browser of choice, but you can also make us part of your social network. You can follow us on Twitter, friend us on Facebook, add us to your contacts on LinkedIn, welcome us into one of your circles on Google+ or watch our process automation related videos on YouTube.

Why should you do this? It's just one more way to keep current with what's happening on ControlGlobal.com and in the process automation community. There's so much more to our site than the monthly issue. By linking to us via your favorite social media site, you can keep current about news, stories, products, blog posts and everything else that comes up on ControlGlobal.com without having to remember to log onto the site. Your Facebook page will show a new article from *Control* that might interest you. Your Twitter feed will point you to the latest news item posted. LinkedIn provides you with a forum to consult with other *Control* readers. The ControlGlobal page on YouTube has dozens of videos from our editors and process automation professionals around the world.

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Securing Control Systems in Cyberspace

[Editor's note: The following is a response to a post by Joe Weiss on the "Unfettered" blog, wherein he discussed control system cybersecurity and the appropriate metrics to use to measure its effectiveness. (See "What Is Control System Cybersecurity and What Are the Appropriate Metrics?," http://tinyurl.com/9t82yb9.)]

I think the ISA99 members would agree that is hard to quantify security from their security access level (SAL) work. We're still hoping we can do it along with quantifying risk in the future.

A small nit on your IT security comments. IT security is much more than data protection. There are e-commerce systems where the cost of a minute of downtime is known and very high. There are many corporate systems were integrity is extremely important.

Both IT and operations cybersecurity are about applying technical and administrative security controls to meet the security objectives. Both also fail if you replace judgement with checklists. You will hear very similar complaints about PCI, as you do with NERC CIP.

DALE PETERSON
Digital Bond

One Page Short of a Story?

I have sold open channel flowmeters since 1975. We even sold the DataGator when it originally came out. Why would you not mention the most popular meters that measure both area and velocity for Q. Larry Marsh invented this idea more than 30 years ago, and it has been copied by everyone since. The latest version is a complete non-contact Flo Dar. Check out Hachflow.com. I think your article ("Flow Like an Egyptian," Aug '12, www.controlglobal.com/articles/2012/boyes-flow-like-egyptian.html) was one page short.

TERRY ESTENSON
testenson@nwpeco.com

[Walt Boyes replies: You are correct, I omitted the area/velocity flowmeters from the discussion, and I should have included them. Attached to the online version is a PDF presentation based on my article, and an additional item that includes that topic. See http://tinyurl.com/c9o8gze and http://tinyurl.com/corua4q.]

Twitter Time Well-Spent

Our managing editor admitted in a SoundOff! blog post that she may spend too much time on social media, Twitter in particular. (See "Stories You May Have Missed," http://community.controlglobal.com/content/stories-you-may-have-missed). One reader, at least, offered her some reassurance that her habit may not be so bad after all.

Using Twitter to listen and discover new things is time well spent in my book. It just made for a great post in this case—well done.

JIM CAHILL
Jim.Cahill@emerson.com

Got Something to Say to Us?

If you'd like to respond to any article or column in *Control,* just send a letter or an email to us. Letters should go to "Editor, *Control,* 555 W. Pierce Road, Suite 301, Itasca, IL, 60143-2649. Emails should be addressed to either Walt Boyes at wboyes@putman.net or Nancy Bartels at nbartels@putman.net.

Please include your name and an email address and/or phone number. We will withold your name on request, but we do not publish anonymous letter. Also note that we will edit letters for space.

If you wish to comment on a post to any one of our ControlGlobal blogs, just use the comments box available online. If we use the comment in print, the same rules apply.

IAN NIMMO
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Best Practices in High-Performance HMI Design

Regardless of your starting point for a human-machine interface (HMI) project, we recommend following the ISA-101 Lifecycle Model. Every project should be based on the "HMI Philosophy and Style Guide" document. The role of the philosophy document is to confirm what good looks like and make sure that the process control operator's desktop has consistent and common HMIs across all platforms and manufacturers' equipment in use (Figure 1).

When an operator leaves it until the alarm has sounded, often there is a domino effect, and many alarms initiate in sequence.

The ISA-101 Lifecycle Model

The role of the style guide is to interpret the philosophy in the language of a given vendor, such as Honeywell Experion PKS or Emerson Delta V, etc. The style guide will have a lot of commonality with the philosophy, but the style guide will have vendor-specific language on template windows and color selection.

Hence, it is extremely important to the success of a project that the philosophy document addresses many of the problems described in our August column ('What Is High-Performance HMI?" at www.controlglobal.com/articles/2012/nimmo-high-performance-hmi.html). I have many customers who claim to have a philosophy document for their HMI that is about six pages long.

Our philosophy document spends more than six pages just talking about color, and it's more than 75 pages and covers:

- Display design—human factors engineering principles and functional requirements,
- Display hierarchy,
- HMI elements,
- Alarm depiction and alarm management, which is harmonized with the alarm management philosophy document,
- Guidance on the HMI design process,
- Purpose and use of the HMI style guide and toolkit or object library,

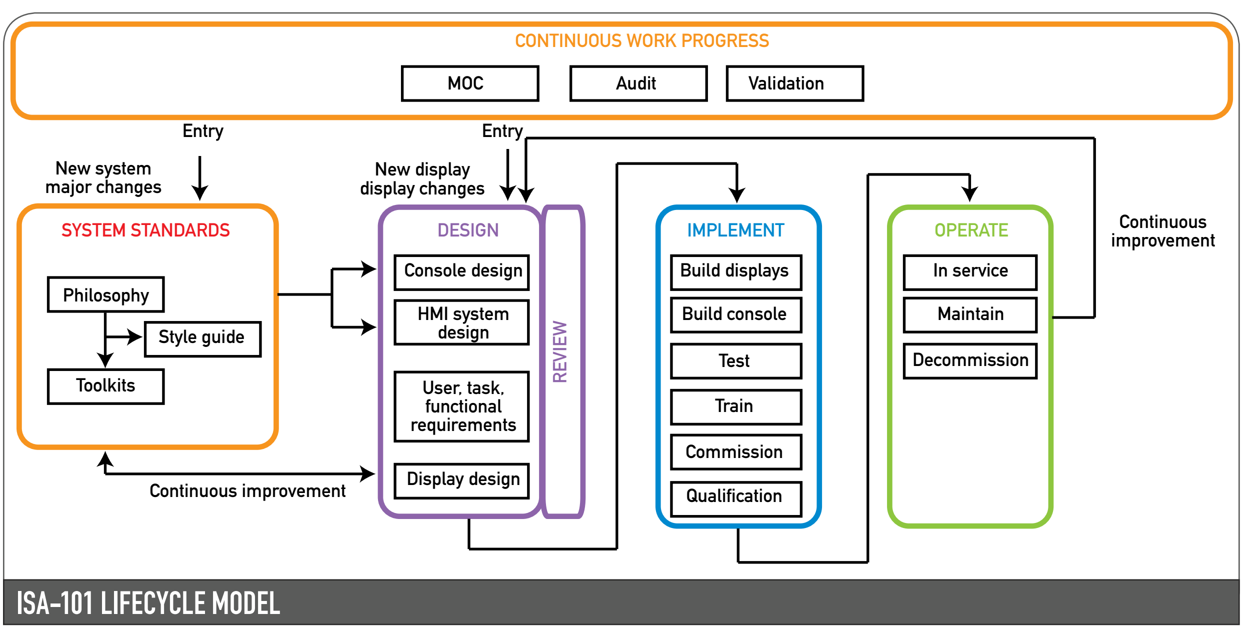


Figure 1. Developing a consistent HMI philosophy and style guide is an important first step to designing a successful high-performance HMI. The philospy defines what constitutes "good." The style guide interprets that philosophy in terms of the particular vendor's equipment being used.

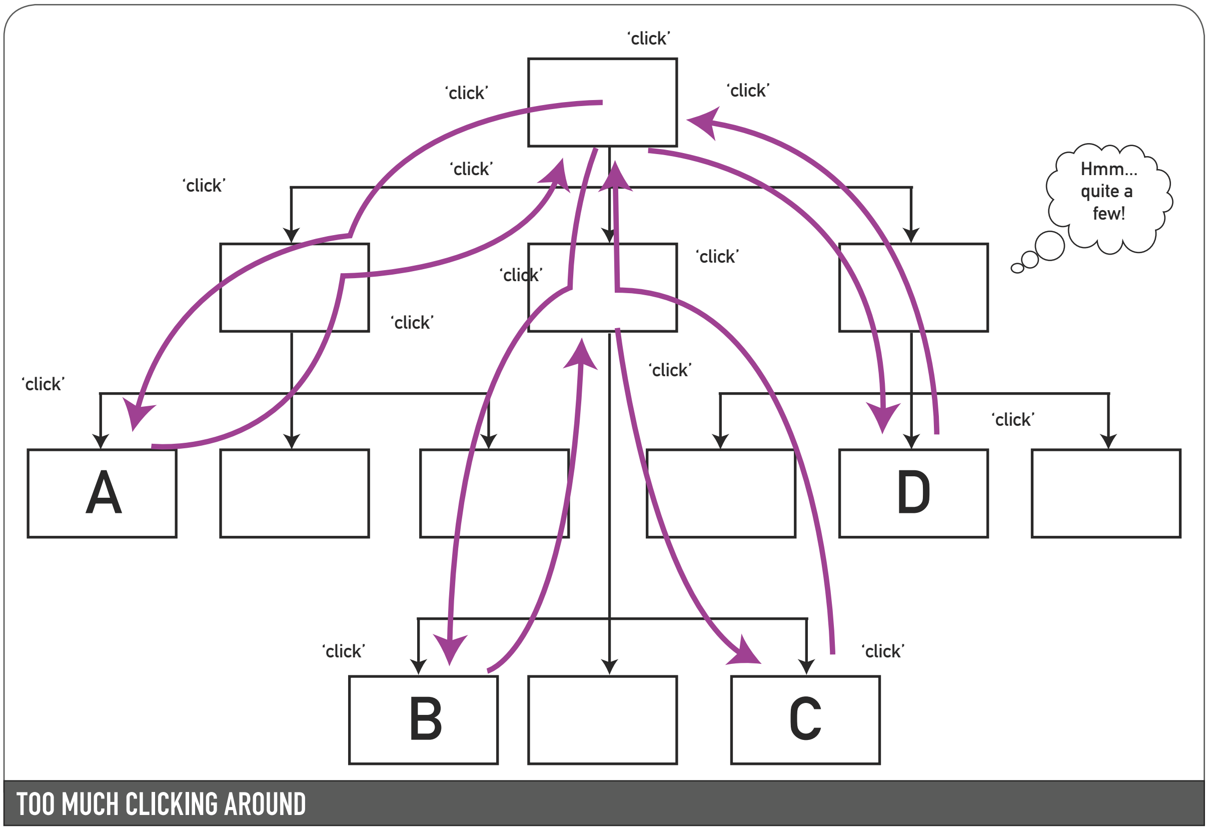


Figure 2. Basing the HMI on traditional P&ID diagrams leads to unnecessarily complex navigation for the operaters. (Drawing courtesy of Mark Green.)

- How to measure HMI performance,
- Management of change of HMIs,
- The impact of control rooms on the HMI, and
- Large-screen display considerations.

It is important that the document is good enough to be the rules for an HMI gap analysis, allowing users to compare their HMI graphics against a detailed guideline with easy-to-use key performance indicators (KPIs).

Having a solid foundation to build on is extremely important, and having an enforced policy that ensures compliance is just as important. Many HMI projects start out with good intentions. However, somewhere along the way, they get derailed, and any coding or design principles get lost in the mix of getting the plant working—and the preference is to do it "my way."

The design process should be guided down the path of getting good requirements capture. This can be done by a variety of techniques, the simplest being a very basic task analysis to the more involved hierarchical task analysis (HTA) promoted by the HMI experts and academia.

This is another important step often left out or substituted by just copying P&IDs and sprinkling live data on top. Doing so leads to information and data being

Many HMI projects start out with good intentions, but somewhere along the way, they get derailed, and any coding or design principles get lost in the mix of getting the plant working, and the preference is to do it "my way."

distributed over many pages of graphics, and makes a simple adjustment very complex because of the navigation issues. For an operator to adjust four controllers (A, B, C, & D), he or she currently has the navigation nightmare illustrated in Figure 2.

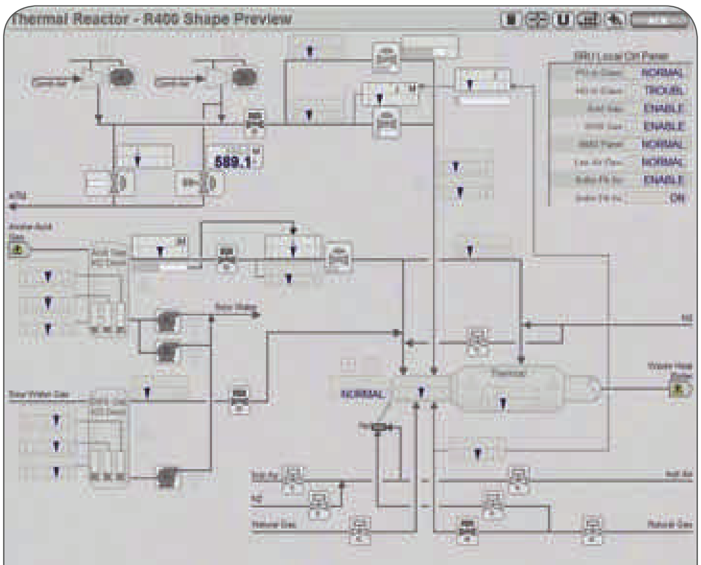
The task analysis should identify the hierarchical information required for each of the displays from Overview, Unit View, Detail View and Diagnostic View. The philosophy and style guide will dictate how the information, based on priority and importance, will be displayed.

The philosophy also dictates how to take advantage of color, brightness, contrast, salience and line thickness, combined with graphical objects designed to transform data into

information. In the past, HMI schematics have relied on operators interpreting lots of data and using high levels of cognition to put the data into context.

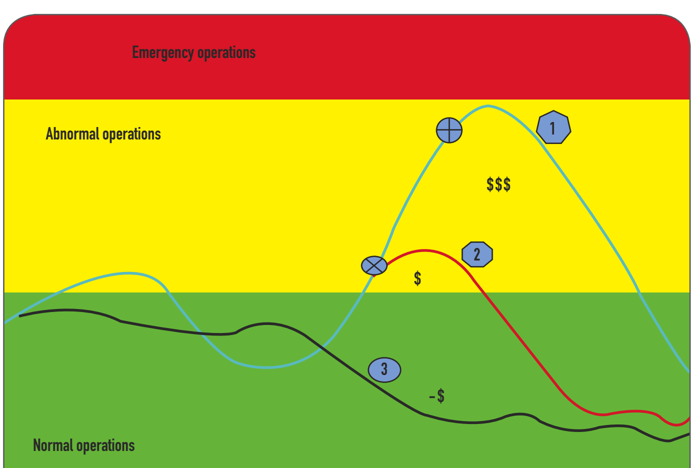
One of the tools control systems consultants, Lin & Associates of Phoenix (www.linandassociates.com), has developed is an analog gauge that supports easy identification of an abnormal condition (Figure 3). When the

It is easy to achieve a 50% improvement in operator performance, which can provide significant ROI and move today's operators from a "reactive" operating stance to a "predictive" or "proactive" operating stance.



ANALOG IS BETTER

Figure 3. An example of a schematic graphic showing analog indicators. When the process being measured moves outside of predetermined or operator-set operating parameters, the gauge changes to a number, indicating that an operator action is required.



WAITING TOO LONG

Figure 4. When an operator does not respond until the alarm sounds, it can cause a domino effect, initiating additional alarms and increasing costs by affecting quality, equipment reliability, economics and production rates.

process being measured moves outside of predetermined or operator-set operating parameters, the gauge changes to a number, indicating that an operator action is required.

Once the schematic graphics have been developed, tested and reviewed by operations, they should be enhanced using an iterative process aimed at continuous improvement. Development of the displays is one activity; delivery of the displays to a console with screens is another important activity.

Console development is an important part of the high-performance HMI, and should be based on solid ergonomics and human factors defined in the International Standard ISO 11064. Most modern displays today use large-screen displays for overview information and four other screens for more detailed information, which includes change zones and diagnostic trending.

This change in approach to graphical schematic design has led to improvements in an operator's ability to detect problems before alarms are activated. It is easy to achieve a 50% improvement in operator performance, which can provide significant ROI and move today's operators from a "reactive" operating stance to a "predictive" or "proactive" operating stance.

Operator Response to an Abnormal Condition

When an operator leaves it until the alarm has sounded, often there is a domino effect, and many alarms initiate in sequence. The operator can only manage these alarms sequentially, so we often get a second alarm and a poor response as shown in Figure 4 by trend 1. The best possible response we can get is shown by trend 2. Either way, the more time we spend in this abnormal band, the more costly it is to our operations. It affects quality, equipment reliability, economics and production rates. Obviously, the more cost-effective response is to detect, diagnose and respond before the alarm condition occurs and being proactive by using trends and the analog meter object described earlier.

This is why we call them high-performance graphics; they improve the operator's performance and ultimately the plant performance by avoiding abnormal conditions. ■


TRUSTED
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One Remarkable Transmitter

JOHN REZABEK
CONTRIBUTING EDITOR
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Twenty-plus years ago, a lot of smart and experienced instrument engineers saw no value in the new generation of microprocessor-based "smart" transmitters. The premium one paid for a smart device bought you a certain amount of flexibility to rerange your instrument within the bounds of its rated capabilities. To do so, you also had to buy a handheld communicator such as the HART 268 or the Honeywell SFC.

Back in the late 80s, the idea of "configuring" an instrument wasn't really part of our consciousness. You "calibrated" an instrument for a service by applying standards on the test bench in the shop. You turned zero and span screws or trim-pots while observing the 4-20 mA (or even the 3-15 PSI) output. It was frequently an iterative process because diddling one trim pot usually shifted the adjustment you just made at the other end. If you did it enough, you might get pretty good at anticipating how much to over- or undershoot a span or zero adjustment to improve your rate of convergence.

The whole concept of calibration was a bit of a misnomer, since the standard of the day was a dead-weight tester, which either wasn't used, and/or hadn't been sent out for recertification in years, if ever. I remember our techs using a Wallace & Tiernan box somewhere between the size of a briefcase and a carry-on bag. It had an 8-in. or 9-in. circular gauge in it and weighed about 20 pounds. While these "calibrators" were fairly precise when shipped, the abuse they took probably rendered them increasingly less so over the months between repairs. After all that, your DP cell was connected to an orifice meter run that was probably sized in 1968 using a slide rule. You can imagine there wasn't a lot of reverence about precision, or even a belief it was possible.

The smart transmitter and its requisite handheld communicator were understandably not a natural extension of these practices. The W-T gauge boxes of that day didn't have LCD displays or "soft keys." The number of steps and complexity of setting up—configuring—a smart device were viewed as confusing and convoluted compared to simply turning zero and span screws. Some of our suppliers even added zero and span screws to their digital transmitters, because the acceptance of handhelds and softkeys was becoming a barrier. "If your guys like having zero and span screws, here you go," said the sales person. Transmitter manufacturers were just beginning to figure out characterization of sensors, so often a re-ranged transmitter retained only a fraction of the accuracy and repeatability of the original calibration, so you needed to recalibrate it anyhow if you wanted to preserve the quoted accuracy and repeatability.

But recently, it's as if that whole decade of handheld heartburn never happened. Today, it's as if all trim pots and zero screws have finally fallen off like vestigial tails. Having finally accepted the fully digital transmitter, we've begotten a new generation that can't be separated from their handheld communicators. Now one can sling a NIST-traceable calibration device over his or her shoulder, and carry a wireless laptop or tablet in the other hand.

When a recent start-up called for a calibration check of a DP flow transmitter we only use for a day or two every two to three years, these were my weapons of choice. The Rosemount 3051C DP cell had been calibrated 0 in. to 100 in. at the factory in 1999, and hadn't seen a workbench since. The rusty plug in its upward-facing unused conduit connection was a little disconcerting, but it was still communicating without errors on its segment. What was remarkable was that, after more than a dozen years of rain, snow, ice, sun and temperatures from -15 °F to +105 °F, it was still reading ±0.05 in. of water column or better.

Twenty years ago, we couldn't foresee the remarkable strides that digital technology has made in the accuracy, reliability and stability of today's field devices. It's worth considering what novel technologies we dismiss today that could become extraordinary achievements in the coming decades. ■

Today it's as if all the trim pots and zero screws have finally fallen off like vestigial tails.

Foxboro User Group Meeting Features New Invensys Execs

First meeting in five years explores Foxboro plans to help users modernize, virtualize automation infrastructure.

There's the forest and then there are trees. Indeed, successful process automation requires both perspectives: a clear vision of automation's value proposition as it relates to the process industries' high-level business challenges, and a foundation and focus on the control, safety and instrumentation building blocks needed to make that vision a reality.

Users of Foxboro process automation systems were treated to liberal measures of both in Boston, August 13-16, as Invensys Operations Management (http://iom.invensys.com) held its first Foxboro User Group meeting in some five years. The meeting was, in fact, the first of five brand-specific meetings this fall, all designed to underscore the company's commitment to its core brands and capabilities.

"We're working together with our customers to define and deliver the future of automation," said Mike Caliel, CEO, Invensys Operations Management, in his opening remarks. "Yet control and safety remain the backbone of our business."

This balanced view is reflected in recent organizational changes, too. Gary Freburger was introduced as president of the systems business, a newly created position. The appointment acknowledges that in a single integrated company with the breadth of capabilities Invensys Operations Management offers, it can be difficult to juggle priorities. "My job is to focus on the systems business, to determine the strategy and investments needed to drive that business forward," Freburger said. In his newly created position Freberger is joined by counterparts Ravi Gopinath, software business president, and Rob Rennie, equipment business president. Industry veteran Chris Lyden also rejoined the Invensys Operations Management executive team as senior vice president of business development.

Gary Freberger, president of systems business for Invensys Operations Management

Currently at $2.1 billion in annual revenues, Invensys Operations Management has recorded double digital growth over the past several years, including 57% of new business from emerging markets, Caliel said. "We want to be known as a company that helps its customers optimize business performance and execute complex projects with innovation, fresh thinking and an unmatched portfolio of brands."

In terms of new offerings for Foxboro system users, the company highlighted its new modernization program—a tiered set of holistic consulting services designed to help users to strategically identify, justify and prioritize modernization decisions—as well as an expansion of its virtualization offering that is designed to further simplify control system maintenance and streamline project delivery.

Holistic Modernization Support

"Today's manufacturers are facing new, more complicated challenges, even as their equipment and workforce continue to age," explained Dave Gaertner, global consulting director, Invensys Operations Management. "In order to comply with increasingly complex regulatory guidelines, minimize downtime and maintain safe, environmentally friendly operations, many companies are seeking to modernize their plants with a holistic view of their business requirements instead of making like-for-like equipment replacements."

For companies that know they need to modernize existing assets, but do not know where to begin, Invensys starts with an assessment to understand the company's business initiatives and issues. The input received is then used to develop a long-range strategic plan that meets the plant's business and technology needs, and helps clients establish return-on-investment targets.

"Invensys consultants carefully reviewed our issues and the results we wanted to achieve, then they quantified them based on information such as replacement power costs and other forms of ROI," said Mike Hull, a computer controls supervisor at Arizona-based Salt River Project (www.srpnet.com), the third-largest public power utility in the United States. "Furthermore, Invensys evaluated which of their products and services could address these issues and achieve our desired results. Invensys Operations Management's modernization program is a game-changer in the industry."

Virtualization Speeds Delivery

Invensys also announced the extension of its software virtualization offering


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to include its Foxboro I/A Series operator consoles and distributed control applications. With a focus on lowering total cost of ownership and promoting overall project delivery excellence, the new offerings are intended to help customers cut implementation costs while delivering projects more quickly and predictably.

"Unlike automation software alone, control and safety systems are more frequently delivered to manufacturing customers as turnkey solutions when the customer undertakes an installation or an upgrade," added systems business president Freburger. "On average, those projects take six to 18 months to complete, depending on their size and complexity. However, virtualizing many of our control solutions, including our Intelligent Marshalling and Intelligent Engineering workbench solutions, significantly reduces implementation costs, cuts project risks, improves scheduling and enhances change agility throughout the project lifecycle. It not only shortens the implementation process, it improves collaboration across the implementation team."

Barry Young, principal analyst, ARC Advisory Group. added, "This represents an important step forward for Invensys and the industry. Invensys' new offering supports a three-point strategy that simplifies efforts and reduces risk when delivering major turnkey projects. This end-to-end concept stands to radically alter the way the industry works with major project customers because it provides greater change agility, more scheduling advantages and deeper collaboration across the implementation team when addressing change orders and meeting production deadlines."

Keith Larson, Putman Media VP-Content

Energy Demand to Fuel Global Pressure Transmitter Market

Pressure transmitter shipments, after returning to pre-recession levels in 2010, saw strong growth in 2011, even besting 2010's growth by several percentage points. Despite the return to positive growth, risks remain, such as continued economic uncertainty in the United States and Europe, and slowing growth in Asia. So says a new report from ARC Advisory Group (www.arcweb.com).

"Although the economy is sending mixed signals, the pressure transmitter market will likely continue to see positive growth. Ongoing demand for energy will require more oil and gas, driving up demand and long-term energy prices. Finding new oil deposits is becoming more difficult and those that are found tend to be more challenging to develop and refine, creating significant opportunities for pressure transmitter suppliers," according to senior analyst Allen Avery, the principal author of ARC's "Pressure Transmitter Worldwide Outlook."


How?
How did Dan receive automatic email alerts triggered by suspect voltage drops at an industrial jobsite—while he was 3 miles away at a different site?
Dan Cole, Scranton, PA
Here's how.
By simply attaching his Bluetooth® adapter to an Agilent handheld DMM, and pairing it to his Android device running a free Agilent app.
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Smart and SIL-Rated Transmitters See Big Gains

Sales of smart pressure transmitters will continue to outpace those of conventional and low-cost devices, as users seek to use recent technological advances to improve visibility into plant operations to help maximize productivity and the availability of production resources. This user focus on asset management also fuels demand for transmitters that incorporate onboard diagnostics capabilities and use digital communication protocols.

Increasingly tough safety and environmental regulations have helped drive increasing adoption of safety integrity level (SIL)-rated transmitters for safety instrumented systems (SIS) to mitigate the risk of such catastrophic events. Pressure transmitters are an integral part of safety instrumented systems, and most leading pressure transmitter suppliers now offer SIL-rated transmitters.

Siemens Canada Turns 100

Siemens Canada (www.siemens.ca) kicked off its 100th anniversary with a celebratory event at its new 110,000-ft^2, LEED-certified headquarters in Oakville, Ontario, to be completed in late 2012. The event, attended by Siemens senior executives, including Siemens AG CEO Peter Löscher, dignitaries and other honored guests, celebrated past accomplishments and launched the company's second century of innovation and excellence in Canada.

Löscher met with leading Canadian energy industry CEOs for a roundtable discussion centering on the nation's electricity challenges and opportunities. Anniversary activities, including several employee-focused events, concluded with a gala at the Royal Ontario Museum.

Siemens Canada's parent company, Siemens AG, was founded in Germany 165 years ago, and conducted its first work on the shores of Canada by laying one of the first transatlantic telegraph cables between Europe and North America, from Ireland to Halifax, in 1874. The company was chartered federally as the Siemens Company of Canada Limited in Montreal in 1912.

Siemens Canada was involved in several important Canadian firsts,


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including the first national telex network; providing early text-based message network communication (1957); building one of the first modern light rail systems in North America (Edmonton, Alberta, 1975); designing and installing the world's first retractable roof at Toronto's Rogers Centre (formerly SkyDome) in 1989; and building the first filmless hospital in Montreal, allowing simultaneous digital image and data viewing in 1998.

Swagelok Broadens Valve Line with IPT Acquisition

Swagelok Co. (www.swagelok.com) has acquired the assets of Innovative Pressure Technologies (IPT, www.in-pressure.com) in Erie, Pa. as part of its strategy to broaden the company's offering of products and services for fluid system technology customers around the world.

IPT is a manufacturer of quality high- and medium-pressure and subsea valves, fittings and fluid control devices used mostly in oil and gas, chemical/petrochemical, waterjet cutting, automotive, water blasting and other demanding applications. Terms of the purchase were not disclosed.

"We're excited to welcome the IPT team to Swagelok," said Arthur Anton, president and chief executive officer of Swagelok. "These products will help meet customer demands for using higher pressures in their applications. The IPT acquisition allows us to offer a more robust valve portfolio."

Headquartered in Solon, Ohio, Swagelok is a developer and provider of fluid system solutions, including products, assemblies and services for the research, instrumentation, pharmaceutical, oil and gas, power, petrochemical, alternative fuels, and semiconductor industries.

Make a Movie for Phoenix Contact

Phoenix Contact USA (www.phoenixcontact.com) has launched a video contest that challenges participants to create a video demonstrating the strength of the company's push-in terminal blocks. The creator(s) of the video that receives the most online votes will win an Apple iPad or Android tablet of his or her choice (up to $700 value.)

According to Eric Johnson, product marketing lead specialist for Industrial Connection Technology–Cabinet, Phoenix Contact's push-in terminal blocks reduce push-in force by 50% compared with similar push-in style blocks on the market. "If they're that easy [to install], how strong can the connection be? We want you to test for yourself and show us the results," said Johnson.

Interested participants can request a sample of Phoenix Contact's PT terminal blocks for use in their video at www.phoenixcontact.com/videocontest. Each entry may be entered by a team consisting of up to three members. Teams have until Oct. 31, 2012, to upload the video (two minutes or less) to the site.

From Nov. 5 through Nov. 9, visitors to the site can vote for their favorite video. The video receiving the most votes wins the grand prize. Second and third place winners will receive $100 and $50 Visa gift cards, respectively. Phoenix Contact will award a maximum of three prizes at each levels.

Additionally, all online voters will be entered into a random drawing for a $25 Visa gift card (one entry per email address.)

The contest is limited to residents of the United States, 18 years of age or older. Online registration and complete rules are available at www.phoenixcontact.com/videocontest.

Linde North America Earns "Responsible Care" Label

Linde North America (http://lindeus.com) has achieved certification of its hydrogen/carbon monoxide (Hy/CO) plant in Clear Lake, Texas, as part of the American Chemistry Council's (ACC, www.americanchemistry.com) Responsible Care program. Responsible Care is a globally recognized management system aimed at helping companies improve performance in areas such as safety, health, environment and security.

Since 2008, 22 Linde plants in North America have been certified under the program. The Clear Lake plant has been operating for 34 years, and produces hydrogen and carbon monoxide for use in chemical manufacturing and oil refining. It produces 45 million cubic feet of hydrogen and 33 million cubic feet of carbon monoxide for customers in the Houston Ship Channel, Bayport and Texas City areas. The plant employs 29 people. ■

Process Analyzer Information 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.

ANALYTIC TUTORIALS

This website contains more than a dozen tutorials on process analysis, as well as important conversion tables. Covered subjects include gas chromatography, infrared analysis, infrared spectrometry, dissolved oxygen basics, pH theory, nuclear magnetic resonance spectroscopy, oxygen analysis, mass spectrometry, total organic carbon, turbidity of solids and more. Conversion tables include moisture content, effective solubility, logD conversion for pH, volume flow, pressure and others. All tutorials are free. No registration required. The direct link is at http://tinyurl.com/brl4hfq.

ONLINE PROCESS ANALYZERS.COM
www.onlineprocessanalyzers.com

TDL BASICS

This free, 70-page, downloadable ebooklet discusses the theory of tunable diode laser (TDL) absorption spectroscopy and how TDL analyzers are being used. This booklet is intended as an introduction to the field of tunable diode laser spectroscopy (TDLS) and its applications for different analytical tasks. A special emphasis is placed on process analytics and the requirements of a range of measurement environments. Included in the booklet are topics such as advantages for TDL in process gas analytics, some of the most common application examples for TDLs in process analytics, signal processing techniques for TDL spectroscopy, and wavelength spectroscopy, among others. Registration is required. The direct link is at http://tinyurl.com/8n7ud8x.

METTLER TOLEDO
www.mt.com

PROCESS ANALYZER SETUP VIDEO

This 7-minute video on YouTube documents the physical setup of a Cerex Model UV3000H multi-gas process analyzer as used to monitor target gases in a process pipe. It's free and no registration required. The direct link is at http://tinyurl.com/8sneled.

CEREX MONITORING SOLUTIONS
http://cerexms.com

MANAGING VAPORIZATION

This tutorial, "How to Manage Vaporization in an Analytical System," discusses challenges of this process. It covers the basics of vaporization and how it affects samples and setting inputs, including temperature, pressure and flow, time delay challenges, and how to troubleshoot problems. The eight-page, downloadable PDF is free, but registration is required. The direct link is at http://tinyurl.com/8sneled.

SWAGELOK
www.swagelok.com

INTRODUCTION TO MASS SPECTROMETRY

This basic tutorial for chemistry students is from the University of Arizona. It covers a brief description of a quadrupole instrument, information provided by an EI mass spectrum (including a table of common isotopes), a listing of other methods, and some helpful websites. It also provides examples, the basic steps required to interpret an EI mass spectrum, and quizzes for students to gauge their progress. The tutorial is free and no registration is required. The direct link is at http://www.chem.arizona.edu/massspec/.

UNIVERSITY OF ARIZONA, DEPT. OF CHEMISTRY
http://www.chem.arizona.edu/

MEASURING TURBIDITY

This technical article defines turbidity, how it is measured, and the effects that suspended particle size, shape, distribution and stray light have on the turbidity measurement. Information is also provided on calibration standards and the different optical configurations that are available. The information is free. No registration is required. The direct link is at http://www.omega.com/techref/ph-6.html.

OMEGA
www.omega.com

NMR SPECTROSCOPY VIDEO

This 5-minute video, prepared by a University of California at Davis student, describes the basics of nuclear magnetic resonance spectroscopy. It's free and on YouTube. The direct link is at http://tinyurl.com/95nakac.

YOUTUBE
www.youtube.com

HOW SECURE IS SECURE ENOUGH?

Where do you draw the line in applying security to your systems?

by Walt Boyes

Industrial control systems are the heart of manufacturing worldwide. Every sort of manufacturing process from semiconductors to oil and gas and in between uses an industrial control system. Some are relatively simple, such as a PLC controlling a work cell on a factory floor. Some are more complex, such as a DCS in a refinery. Others are extremely complex, such as a SCADA system at a mine with more than 100,000 I/O points.

Like enterprise computing, industrial control systems have traveled a path from standalone systems to the modern, highly interconnected world of Ethernet, the Internet and cloud-based computing.

But while enterprise computing and even home computing started confronting cyber attacks a decade ago, the industrial control systems lagged far behind. One of the main reasons is that there is a significant difference between the asset lifecycles in the enterprise computing and the industrial control system spaces. Enterprises see nothing unusual about replacing all their systems every two to three years, but industrial control systems are designed and operated to be replaced every 20 to 30 years, and some are kept going to the end of the useful life of the plant itself.

So, while enterprise IT has managed to keep up with cybersecurity, anti-virus and network defense by continually upgrading its systems, most industrial control systems have relied on what has been called by many cybersecurity researchers, “security by obscurity.”

All of these industrial control systems share a common flaw. “They are all highly reliable, purpose-built and very efficient,” says Patrick Miller, president and CEO of EnergySec (www.energysec.org) in Portland, Ore., a not-for-profit educational institution devoted to improving security in the energy sector. “However, most platforms are not secure. They were never designed with security in mind.”

Beginning in the early 1990s, enterprise computing systems and networks were quickly connected to other networks and the Internet. Industrial control systems didn’t begin to be connected to even their own enterprise networks until a decade later, and in many cases, the connections were done inadvertently.

The media, both popular and technical, have been discussing severe vulnerabilities like the Stuxnet virus, supposedly built as a cyberweapon by the United States and Israel to attack process plants in Iran. Another severely problematic vulnerability is Aurora, which destroyed a piece of electric grid infrastructure.

Marco Ivaldi, senior security advisor from @mediaservice.net, an Italian security researcher and "ethical hacker," says, "I think there is still a long way to go to reach a proper level of security in either the process industries or the electric utility space." Ivaldi went on to discuss several extremely dangerous vulnerabilities in commonly used industrial control system components from a variety of vendors.

In addition, in July, Siemens self-reported three vulnerabilities in WinCC and Simatic Step 7.

And so it continues.

Almost every government has taken steps to try to do something, anything, to improve the security posture of industrial control systems because they are part of the critical infrastructure of a modern economy. It remains to be seen if any of those steps have actually done so.

Are We Any More Secure This Year Than Last?

"This," says Eric Byres, CTO of the Tofino Security division of Belden Inc. (www.belden.com), "is a tough question, because what we have happening is an arms race between the good guys and the bad guys. Both the vendors and the end users are slowly becoming security aware and are starting to provide and deploy good security technologies and practices. Unfortunately, the bad guys are also becoming more aware of the opportunities to attack industrial systems—we can thank Stuxnet for that—and at the same time, the tools available for security attacks on ICS and SCADA systems are rapidly improving."

After interviewing more than a dozen industrial control system security professionals, including end users, security researchers, suppliers and experts in just about every industrial vertical, it is clear that the very best answer to the are-we-more-secure question is a resounding, "maybe, maybe not."

"So the answer to the question," Byres says, "is that many ICS and SCADA systems are more secure than they were last year, but the bad guys are better equipped."

John Cusimano, director of security solutions for exida (www.exida.com) and director of the Repository of Industrial Security Incidents (RISI, www.securityincidents.org), says, "Overall the security posture of most control systems is still fairly weak. It varies significantly by industry, though. Major oil and gas and chemical companies are actually doing fairly well."

What does "fairly well" mean? "These companies started working on this topic pre-Stuxnet and have bolstered their programs since," Cusimano continues. "They generally

have, or are working on, written policies and procedures specifically for ICS security; have firewalled their ICS networks from their business networks; and have conducted internal security assessments of their critical facilities."

Yet Dr. Erik Johansson, senior affiliated researcher at the Dept. of Industrial Information and Control Systems, Royal Institute of Technology (KTH, www.kth.se/en) in Sweden, when asked the same question said, "I do hope so."

Joe Weiss, principal at Applied Control Solutions (http://realtimeacs.com/), and ControlGlobal.com's security blogger (www.controlglobal.com/unfettered) says, "ICS systems in process industries are NOT secure [his emphasis]. The degree of insecurity ranges, depending on the end user. It is not clear if they are more secure than last year, as there are now more identified vulnerabilities and more people aware of ICS cyber vulnerabilities. ICSs in the electric industry are no more secure than in any other industry. In fact, an argument can be made that the NERC CIP process with all its exclusions has made the electric utilities less secure than other industries."

Marcelo Branquinho, executive director of TIsafe (www.tisafe.com/), a security consultant in Brazil with more than 15 years experience in ICS and SCADA systems, piles on. "No, they aren't secure at all." But he goes on, "In Brazil, things are becoming more secure now due to some new government regulations and new government publications such as the 'blue book,' the Guia de Referência para a Segurança das Infraistruturas Críticas da Informação, (*Safety Reference Guide for Critical Infrastructure Information*, http://dsic.planalto.gov.br/documentos/publicacoes/2_Guia_SICI.pdf), a guide for security in ICS that government corporations are starting to follow."

David Mattes, a former end user from the Boeing Co. and now founder of Asguard Networks (www.asguardnetworks.com), says, "I don't have direct experience with the process industries, but I've been paying a lot of attention to the various voices speaking out about ICS security in the different industrial sectors. From what I've heard, not much is being implemented by way of security solutions, but a lot more connectivity is being added, and torrents of vulnerabilities are being disclosed. The sum of the parts then is that process industries are not, in general, secure, and they are less secure than they were last year."

Richard Guida, who retired in 2011 as vice president, worldwide information security at Johnson and Johnson Inc. (www.jnj.com) and is now a part-time consultant in enterprise security, says that control systems are, "less secure, because more PLCs and SCADA systems are being put on internal networks. Hence, they may become accessible over the Internet. So, while the vulnerabilities have not changed, the threats are much worse, given the higher exposure. The risks are much higher now and getting worse every year as more systems get exposed. The attack surface is growing far more quickly than any efforts at securing the systems."

Who Is Attacking? How Do We Defend?

Byres says that there are "Two kinds—dumb mistakes and well-designed advanced persistent threats (APTs). I still see a lot of down time from issues that are caused by simple mistakes—the infected laptop on the plant floor, the consultant connecting in remotely from an insecure home computer, and so on. These are expensive and obvious."

Byres goes on, "Now some people claim that APTs are just marketing hype, but Shamoon, Flame, Stuxnet, Nitro, Night Dragon and Duqu are all good examples of APTs. Trying to wish away APTs as hype is a clear case of sticking one's head in the sand."

Clint Bodungen, security analyst with Amor Group LLC (www.amorgroup.com), says, "Operators should defend against any attack that has a relatively significant chance of success of impact to operations where the consequence is greater than what the operator is willing to accept."

Bodungen goes on, "What does that translate to in terms of attack types? Well that could be different between operators. Operations with Windows machines on the process control network, especially those that allow USB media, should be concerned with APTs such as viruses and worms more so than some 'überhacker' cracking through layers of enterprise security and the DMZ to finally get through to the production network."

Ultimately, and more realistically, Bodungen believes that it is much more likely that a cyber breach will occur as a result of an ill-trained user or poor security procedures rather than some sophisticated targeted attack.

"That being said," he continues, "I don't think there are too many hackers that would say, 'I want to attack this SCADA network, but I hope it's a real challenge with a risk of being caught.' Therefore, any common 'low-hanging fruit' could also be threat. Such threats would be any published vulnerability with a known and working exploit in circulation, especially if it has been released as a Metasploit exploit."

Metasploit (www.metasploit.com) is open-source security software that is the result of a collaboration between the open source community and Rapid7 (www.rapid7.com). Metasploit software helps security and IT professionals identify security issues, verify vulnerability mitigations and manage expert-driven security assessments.

Ivaldi says "Simply put, we should defend against all attacks. To be able to do so, I believe we should shift our focus from threats to operations. Assuming you know what threats exist, when they may hit, how they will come and where they will go is something reserved for risk analysis, which usually leads to variable and likely biased results. Instead the attack surface of and around a target should be thoroughly evaluated in order to understand where the threats, any threats, can attack if they do attack."

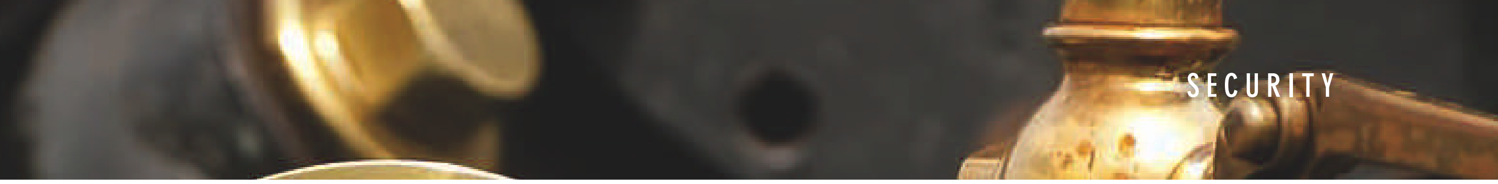
Cusimano points out, "A lot of effort is going into protecting the control system from the business network (or vice versa, depending on your perspective). This definitely makes sense. Although a significant challenge, the biggest threat to control systems is all the 'side channels,' meaning the other ways that digital information can get into the control system besides through the business network. In general, there is a real false sense of security out there being attributed to the firewall between business and control. First of all, most of them [the firewalls] are misconfigured. They are put in, and then everyone requests ports to be opened so their applications can work, and after a while, they look like Swiss cheese. Second of all, they only represent protection of one path into the control system. USB sticks, maintenance laptops, CD/DVDs, remote access, modems, wireless access points—all represent just a few of the many ways a control system can be compromised."

Mike Baldi, security architect for Honeywell Process Solutions (www.honeywell.com), agrees, "There is no easy answer for this. Systems have to be protected from the intentional external attack and from the intentional or accidental insider attack. Locking down USB devices and CD/DVD readers significantly improves the security of the system. Using defense-in-depth, least-privilege-required and separation of duties strategies will greatly reduce the attack surface. Once a system is installed securely, it must be monitored continuously for indications of non-normal events that could signal a cyber incident against the system."

From his perspective in enterprise security and government, Guida says, "I am honestly less worried about another country attacking us, with the exception of North Korea, than I am about the possibility of some miscreant, like a spin-off of 'Anonymous,' just deciding to screw with peoples' lives and bring down some infrastructure 'just for the hell of it.' Unlike a country-level attack, a miscreant attacking really is more likely to be just hacking/intrusion over the Internet. A country-level attack could include physical break-in or sophisticated social engineering or traditional spy-level stuff. If systems are not exposed over the Internet or exposed within the company's network so that a successful attack on that network could leapfrog to systems attached to it, that would greatly reduce the attack surface to miscreant attack."

Is Security Another Y2K Fizzle?

There are many who believe that because nothing really bad happened with Y2K, nothing would have happened, and the whole exercise was a farce. Many of those same people, usually senior corporate leaders, appear to believe that cybersecurity in industrial control systems will turn out to be a similar fizzle.



Byres says, "Some people think it was a big waste of money because nothing fell apart on New Year's Eve 1999. But one reason that nothing went wrong was that people really did their homework to detect the Y2K issues up-front. So security could be like Y2K in the fact that if we do a good job, then people will say we need not have bothered because nothing went wrong."

The prevailing opinion from ICS security practitioners is that it's not like Y2K.

"Y2K was a one-time clock issue that had a very specific fix," says Weiss. "ICS security cannot be fixed with any 'silver bullet.' ICS security issues are real and have had devastating consequences to date. A nation-state targeted attack against the electric systems, natural gas pipelines and so forth could be devastating to this country."

ICS Is Different, Way Different

Guida explains ICS IT: "In an enterprise, you have an infrastructure, endpoint devices and humans with all their foibles. In an environment with PLCs and SCADA systems, you have an infrastructure, endpoint devices, humans *and* embedded systems. So the complexity of the latter is worse—and arguably much worse—because you may not even be aware of where your embedded systems are, what vulnerabilities they possess and how they are exposed."

Mattes explains, "There's a different prioritization between the two environments [ICS and enterprise IT]: The classic availability, integrity, confidentiality (AIC) versus the CIA perspective. ICS security is much more than standard systems, software and processes. Almost everything about ICS security tends to go against IT standards and processes. ICS environments are where enterprise IT was 10 to 15 years ago. We're talking about a high ratio of labor hours to system administrate and support, a lack of management tools, a lack of security capabilities, standards and products, with dynamic networking still in its infancy, and a lack of auditing and compliance capabilities, all with poorly designed software and interfaces. IT personnel need to understand the environment and accept that these environments are often the revenue-generation core of the enterprise."

A SCADA tech for a municipality in Ontario, Canada (who asked to be anonymous) put it pithily: "Explaining ICS IT to an enterprise IT pro is a waste of precious time. If you feel so inclined, see professional help."

For those still inclined, he laid out some rules:

- You cannot interrupt the process. No. Never.
- Do not touch. Ever.
- Here is a nickel. Don't spend it all in one place.
- Protect the process for the next 40 years against any and every eventuality including, but not limited to, the operator running the process, yourself, the equipment which runs the process, and any and all unexpected, uncommunicated, unplanned, last-minute or instantaneous changes to the process.
- Ensure that the documentation suite is clear, concise and understandable by a fourth grader and no more than one page long.
- Now hide all the documentation.
- Expect management to rotate every two years.
- Expect continuous staff rotation.
- Expect you have no time to test.
- Expect changes must be done on live systems on the fly without a safety net.
- Expect there are no spares.

"Explaining enterprise security to an ICS person is simpler,"

he said. "How would you feel if suddenly at midnight, while you are sleeping comfortably in your bed, a data spill occurs halfway around the world? In the blink of an eye, your life savings is transferred out of your account, all credit is maxed and all your non-liquid assets are transferred and mortgaged to the hilt."

What Are the Metrics for Security?

Jeff Potter, director of security architecture for Emerson Process Management (www.emerson.com), says, "Security metrics are continuing to prove extremely hard to create, so a pure ROI calculation—I've spent N, and my security is X better—is not available. I'm not sure when it will be—we'd need many more incidents occurring to get a statistically valid sampling, and I hope that situation never occurs!"

Bodungen breaks it down very clearly: "Obviously, if you don't have a breach, then one way or another you have enough security—whether that means you've covered all of your bases, or you happen to have just the right mitigation for the specific attack being performed," he says. "Unfortunately, it's difficult to know the sophistication of the attacker and what attacks he will use, and covering all of your bases with the maximum level of comprehensive security is very resource-intensive. Therefore, at the most basic level, it boils down to this: You have to know what your vulnerabilities are. For each vulnerability, you have to have a good idea of the likelihood that it could be exploited. You have to have a good idea of the consequences or impact to your business should that exploit cause a breach. You must know the estimated cost to mitigate or reduce the risk. Implement mitigation where the consequence exceeds the cost to mitigate, beginning with those vulnerabilities that would have the highest impact to operations and with the greatest likelihood of exploitation."

But how do you measure the result of security improvements? Potter says, "The ISA99 Task Group working on this issue has struggled to create a useful product, and although there are some narrow metrics that have value, like patch frequency and training, I've not seen anything that is remotely comprehensive."

Our anonymous operator from Ontario, Canada, has a different point of view. "For high-severity incidents," he says, "security is *always* a subset of safety. Therefore, safety metrics apply. That is, you track near misses; track found issues over time; estimate remaining latent issues; and assume there are always latent issues."

"The security metric," says William Miller, president of systems integrator MaCT (www.mact-usa.com), should be considered from a perspective that with contemporary approaches using anti-virus and firewalls, the endpoints will be vulnerable to cyber attack. If you look at the problem, it can be seen that today's TCP-enabled systems are insufficient."

Branquinho explains TiSafe's approach. "We normally

> "IT personnel need to understand the environment and accept that these environments are often the revenue-generation core of the enterprise."
>
> – David Mattes, Asguard Networks

follow these steps," he says. "Conduct a quantitative risk analysis of the plant to be protected. With this analysis we can have a very precise vision of the value of the assets of the plant and especially of the total risk the plant suffers in case of security incidents. Based on the risk analysis, we do the summation of values in dollars of the risks classified as critical. We use this value as the basis for calculating the investment. We named it risk analysis value (RAV). Then we calculate 5% to 10% of the RAV as the acceptable range of investment in automation security. We developed this methodology just because there wasn't any metric available for this."

Guida concurs. "To paraphrase a famous person—I think it was Benjamin Disraeli—there are lies, damned lies, statistics and worst of all, ROI calculations related to security. It is simply not possible to come up with reasoned ROI calculations because every situation is unique, and there are no reliable data like those traditionally used for actuarial studies."

How Much Security Is Too Much?

Obviously, there is some contention between experts on how much security a plant should have. If security gets in the way of operating the plant, that may be too much.

Jeff Potter says, "How much security is enough is dependent upon a risk assessment, including the consequences (monetary, HSE, other) associated with a security incident. One can obviously put a dollar value to a production outage, but this is less clear-cut when one is dealing with an environmental release, where there are reputational issues as well as monetary fines, or injury or death of personnel."

> "There are lies, damned lies, statistics and, worst of all, ROI calculations related to security."
> – Richard Guida, Enterprise Security Consultant

Eric Byres says, "I think we make this too complicated. Start by looking at the potential consequences of a deliberate cyber attack. This is completely company/operation specific—if you operate an automatic car wash, then the consequences you face are low, and the money you spend should be low as well. However, if you operate an off-shore oil platform, the consequences are significant, and your security investment needs to be significant as well."

He adds, "You can also look at the probability of an attack, but that is hard and changing fast and for the worse. Therefore I would simplify things and assume that in the next few years, the probability for cyber events will approach that for physical events, such as theft, vandalism, sabotage or accidents. Of course, this is also company/operation specific—the carwash will not have the same enemies as the oil company, but for a specific company the adversaries will likely be similar."

"Now assuming your company has figured out a reasonable risk benefit equation for physical events, and assuming that the consequences and the adversaries will be roughly the same over the next few years, then the cybersecurity spend should be the same, too," Byres says. "Maybe not dollar for dollar, but as an executive at an oil company once said to me, 'If we spend $50 million for fire suppression on our offshore platforms, and we spend $50,000 for cybersecurity on those same platforms, and both types of incidents have the same consequences, then we have a problem. Either we are spending too much on fire suppression or too little for cybersecurity." ■

Walt Boyes is Control's editor in chief.

Simulation Pans Out for Goldmine

Barrick Gold is using Mynah's MiMiC software to simulate multiple processes for training operators and improving performance at its new, $3.7-billion gold mine in the Dominican Republic.

by Jim Montague

Christopher Columbus was more on target than he realized—but technologically more than 500 years too late. In fact, the first large island he and his fellow crew landed on in 1492, Hispaniola, had lots of the gold they were seeking, along with a western passage and spices from Asia.

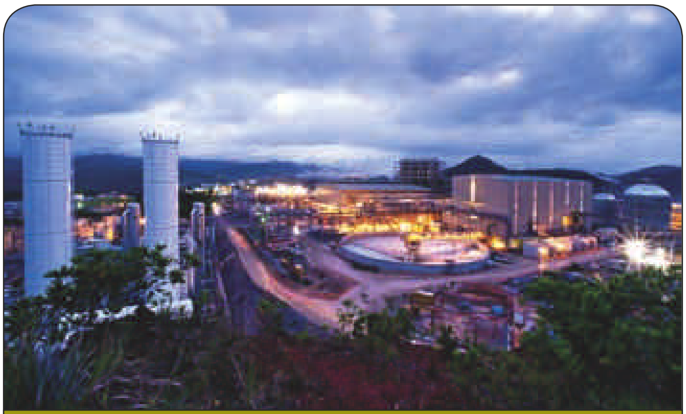
However, then and in the centuries since, gold-bearing deposits on the island that includes the Dominican Republic and Haiti were too thinly and widely spread, and so were not worth trying to recover. However, at today's $1,700-per-ounce prices, that calculation is beginning to change, and simulation software is enabling training and optimization to optimize large-scale mining and recovery.

For instance, Barrick Gold Corp. (www.barrick.com), based in Toronto, Ontario, Canada, has been building its huge, new Pueblo Viejo gold and silver mine on the 11-km-square site of a former mine that's been closed for about 10 years, and is located in the middle of the Dominican Republic about 100 km northwest of the capital of Santo Domingo. Barrick operates and owns 60% of the mine, while Goldcorp (www.goldcorp.com) owns the rest (Figure 1). Meanwhile, Fluor Corp. (www.fluor.com) and Hatch (http://hatch.ca) provided engineering, procurement and construction management (EPCM) services for the project.

The mine and its processing facilities cost about $3.7 billion to build., and with proven and probable gold reserves of 25.3 million ounces, they're expected to process about 24,000 metric tons of ore daily, and annually produce about 1 million ounces of gold, 5 million ounces of silver and 6100 tons of copper and generate about $1 billion in annual revenue. During construction of the plant, more than 16.4 million metric tons of ore—representing approximately 1.9 million contained gold ounces—were stockpiled. And, Barrick reported on Aug. 14 that Pueblo Viejo had achieved the first gold production with ore now being processed through the first two of its four autoclaves.

Managing Multiple Processes

Though much of the site's ore is located close to the surface,



SHINY FUTURE

Figure 1: The Pueblo Viejo gold and silver mine cost about $3.7 billion to build and is expected to produce about 1 million ounces of gold per year and generate about $1 billion in revenue annually.

Pueblo Viejo still requires about 20 diverse sub-processes to extract gold, silver and copper from it. These include crushing, rough grinding, high-pressure oxidizing, counter-current decantation (CCD) washing, carbon-in-leach (CIL), sulfide precipitation and many others, all of which require various operator skills and experience.

For example, the autoclave circuit at Pueblo Viejo houses four of the world's largest vessels for the pressure oxidation of sulfide gold ores (Figure 2). Steam and oxygen are injected into the autoclaves to oxidize the ore. Each autoclave is almost 6 x 40 meters, and ore is retained in them for 60 to 75 minutes at 230 °C and 3450 kilopascals. This process for improving autoclaving was pioneered earlier at Barrick's Goldstrike mine in Nevada, where it helped increase gold recovery from 35% to 85%.

Pueblo Viejo's many ore-processing applications are controlled by approximately 11,000 I/O points or device signal tags (DSTs), which are managed by a DeltaV distributed control system (DCS) from Emerson Process Management (www2.emersonprocess.com) and PLCs from Rockwell Automation (www.rockwellautomation.com).

To help optimize Pueblo Viejo's many processes beginning at start-up, process systems engineer Paul Yaroshak reports that Barrick decided to simulate about 10 processes to help train its operators before the facility began processing ore. However, because of economic and time constraints, Pueblo Viejo couldn't simulate all of its processes, so it decided to focus on those with appropriate complexity, criticality and similarity to other processes, such as limestone crushing, which is representative of other crushing processes at the site. Other simulated processes include copper recovery, pressure oxidation in the autoclaves, iron precipitaion, cyanide destruction, acid wash/stripping and the CIL circuit (Figure 3).

Most of the operators were new to mining and Pueblo Viejo's equipment, and there were also some language barriers among the staff. As a result, Pueblo Viejo's Ready for Start-Up (RFSU) program was developed, and included training on process fundamentals using computer-based interactive modules and simulator-based training, as well as field demonstrations and hands-on practice.

"Though the site's overall deposit was exploited previously, we expanded it, so this is a new mine and a totally new processing plant. Our management wanted a safe and secure transition from project construction to regular operations," says Yaroshak. "So the main driver for this simulation system was to prepare our operators for start up with unified, hands-on training before the plant was up and running."

SERIOUS EXTRACTION

Figure 2: The autoclave circuit at Pueblo Viejo houses four of the world's largest vessels for pressure oxidation of sulfide gold ores. Steam and oxygen are injected into the autoclaves to oxidize the ore.

Securing Simulations

Consequently, the dynamic process simulation system, MiMiC from Mynah Technologies (www.mynah.com), was supplied and implemented jointly by Lakeside Process Controls (www.lakesidecontrols.ca), an Emerson distributor that also provided project management support, and the Pueblo Viejo process group. MiMiC was picked because it provided required low-, medium- and high-fidelity levels as needed; integrated seamlessly with DeltaV; was already being used by the EPCMs for checking I/O; was intuitive; and allowed easy change for model and control system enhancements.

Pueblo Viejo's MiMiC simulations consist of 10% low fidelity with basic I/O tiebacks and simple tuning; 60% medium fidelity with engineering first principles and conservation of energy and mass; and 30% high fidelity with mass/energy transfer equations, differential equations and empirical models. Models for the each of the plant's 10 processes to be simulated were built using an iterative process, which begins with a first-principle Excel model; adds the DeltaV configuration; uses MiMiC to perform simulation conversion and I/O tie-backs; creates medium- and high-level models; builds trainee screens; and finally conducts an initial review, makes changes, and completes a final review.

"We picked these 10 processes because they're complex, critical, often involve high temperatures and pressures, impact other process, and require high degrees of customization during operations," says Yaroshak. "So, simulating each of these processes gives us a solid base of training modules that can be used to prepare operators for scenarios they could encounter in the real-world plant, and gives us a lot more bang for our buck."

The plant's simulation environment includes DeltaV Simulate software that simulates the DCS's controllers on a PC where all DeltaV's logic and operators graphics remain intact, while MiMiC simulates I/O to the controllers in DeltaV Simulate Process models to give a realistic process response. Combining DeltaV Simulate, MiMiC and actual DeltaV control logic and graphics creates a complete, virtual plant environment for training and testing (Figure 4). Meanwhile, the operator training system includes four DeltaV workstations and a MiMiC server, which allows the instructor to launch four training scenarios at the same time, including introducing potential problems and failures to gauge operator response.

Unalloyed Advantages

Thanks to implementing its multiple simulations, Yaroshak reports that Pueblo Viejo reduced commissioning time by finding usability and logic issues earlier, and enhanced the new operators' familiarity with their equipment and processes. Many HMI issues were also discovered through extensive use of the simulators with operations staff that were consequently fixed and tested well ahead of commissioning.

"The key challenge in mineral processing control is dealing with the variability of ore, such as varying hardness, mineral content and other elements that can help or hurt recovery," adds Yaroshak. "Our processes need robust logic to effectively respond to these changes, and simulations help us to better understand process interactions, remove bottlenecks, and provide insight for managing variability.

"Likewise, our training simulations include using actual screens

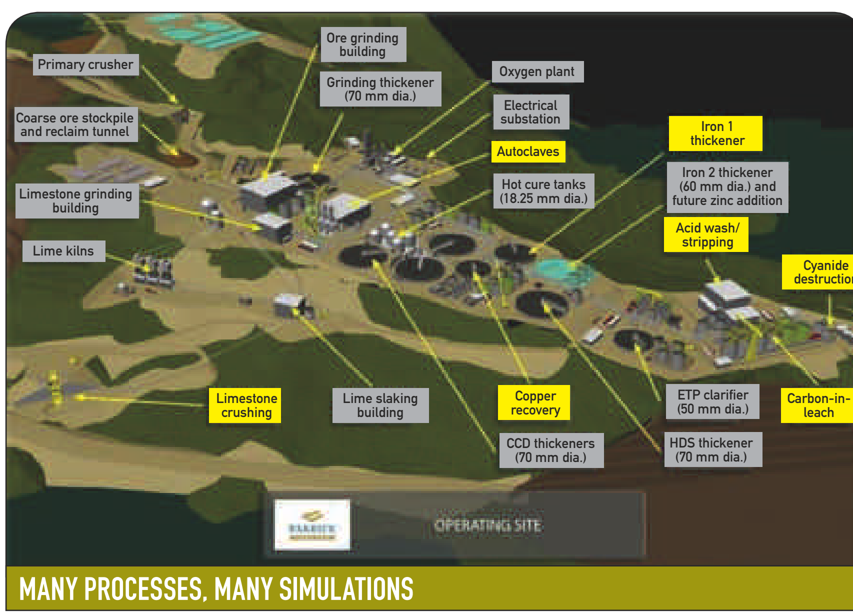
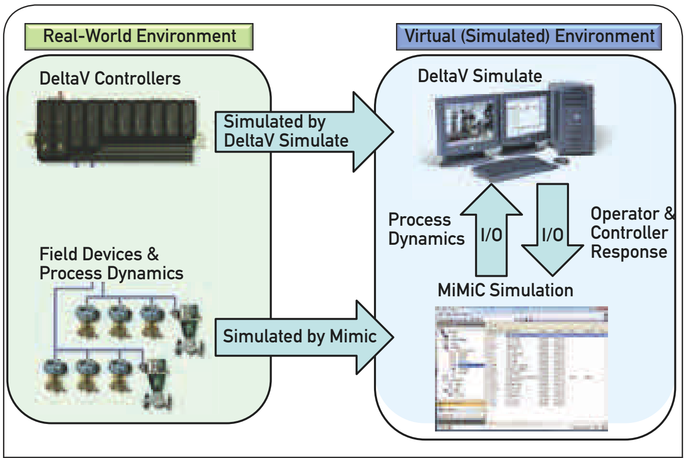


Figure 3: Barrick's engineers focused on simulating processes with appropriate complexity, criticality and similarity to other processes, such as limestone crushing, copper recovery, autoclaves, iron precipitation, cyanide destruction, acid wash/stripping and carbon-in-leach (CIL) circuit.



PARTNERS IN VIRTUAL TRAINING

Figure 4: DeltaV Simulate software recreates controllers on a standard PC where all DeltaV logic and operator graphics remain intact, while MiMiC's process models simulate I/O and process dynamics from field devices to the controllers to provide a realistic process response. Combining DeltaV Simulate, MiMiC and actual DeltaV control logic and graphics creates a complete, virtual plant environment for training and testing.

How to Build a Gold Mine

There are two informative videos about how Barrick Gold, Fluor and their many partners built the Pueblo Viejo gold, silver and copper mine. They're located at:

- www.fluor.com/about_fluor/Pages/videos.aspx?channel=4&videoid=114
- http://www.barrick.com/GlobalOperations/NorthAmerica/PuebloViejoProject/default.aspx

and graphics with realistic process dynamics and responses, which force operators to react in real-time to different alerts, alarms and process interlocks, and prepares them to handle many situations and failures. The old way would have been to wait until the plant was running to do this kind of training, so the simulations buy us a lot of time. We're also using our simulation to develop testing of configuration and function logic within our DCS, so we can evaluate and fine tune interactions between different elements of the control system, and make sure they're working together as designed and intended."

Jim Montague is Control's executive editor.

Bidirectional Flow Measurement

The right flowmeter Is a balance between technical needs and cost-efficiency.

by Ruchika Kalyani

Flow measurement plays a critical role in chemical, petrochemical, oil and gas plants. Criticality of flow measurement in the plants has become a major component in the overall economic success or failure of given processes. Accurate flow measurements ensure the safety of the process and profits in plants. Better measurement can only be achieved by selecting the best/most suitable flow technology for each flow application. Sometimes the accuracy required by the end users is the most significant factor for the specific application. The challenge is to find out the value of the product stream being measured, thus providing the most reliable and cost-effective solution to the end users. Instrument engineers should convince the end user to not install a flowmeter that is more expensive than the yearly value of the stream and the potential loss of money caused by inaccuracies.

A diverse range of flowmeters, along with the turndown factors, is available for various flow applications, such as regular flow control (steam, gas, utilities, etc), process flow rates, fiscal or custody-transfer metering, and others. Most of these applications will be unidirectional, but some will be bidirectional.

The measurement of unidirectional flow rate is possible with all types of flow technologies, but the bidirectional flow measurement capability is required to measure the flow rates within the same flow loop in opposite directions. This sometimes creates difficult situations, challenges, process interruptions and/or measurement inaccuracies that can significantly affect the production and profitability of the plant.

We will further discuss the selection of the appropriate metering for bidirectional situations and applications, limitations, advantages and disadvantages, maintenance and installation costs.

Bidirectional Flow Measurement

Bidirectional flow lines are not very common in refineries and petrochemical plants, but if they are needed, they are always difficult. For bidirectional flow, the piping scheme uses the same line to accomplish delivery and/or control functions for flows moving in opposite directions (forward or reverse flow), depending upon the process conditions and objectives.

Examples of bidirectional flow are

- Raw water feed to two or more water treatment plants,
- Bidirectional steam lines supplying steam from one unit to another unit in the plant,
- Utility and circulating pumping of dielectric fluid into underground electrical cables in order to dissipate heat generated by high-voltage power lines,
- Gas injected or withdrawn from the gas storage field or reservoir,
- Purging and blanketing of nitrogen in plants, and
- Chilled water plant decoupling headers.

Bidirectional Flow Measurement Using Volumetric Flowmeter Options

The selection process of bidirectional flow metering depends on application requirements, process demand, end-user accuracy requirements and physical design constraints of the flowmeter itself. Various flowmeters are available with bidirectional flow capabilities, such as DP transmitters with an orifice, the Venturi or wedge element, Coriolis, ultrasonic, vortex, pitot, turbine and magnetic flowmeters.

Instances where a bidirectional flow measurement is required include

- Possibility of having two different flow rates in either direction, due to the process and design conditions, and both flows need to be measured,
- Reverse-flow accuracy is required by end user or by the process,
- The need to measure reverse flow in the process,
- Bidirectional flow measurement using dual DP transmitter options.

For bidirectional flow measurement between two process units in a process plant, for example, when two steam units are linked to each other, at the time of deficiency of steam in one unit, the other unit will supply the required steam to the deficient unit and vice versa. If reverse and forward flow rates are identical in both directions, and precise accuracy is not required, then dual transmitters, one for each flow direction, are the best solution for measuring the steam flows in/out of the plant. Two DP transmitters with an orifice plate, along with temperature compensation, can be used for the bidirectional flow. In this case, a non-beveled, square-edge type orifice plate should be used, and the two edges of the orifice should comply with specifications for the upstream edge mentioned in the ISO 5167 standard. It's also necessary to make sure of the full "upstream" straight lengths on both sides of the flow instrument. This must be clearly communicated to the piping design team during design reviews and before construction begins.

With this combination, do not expect high accuracy and turndown. This combination will provide the lowest installed cost with acceptable accuracy, as it is easy to maintain and replace. Also, this dual transmitter combination option will be ideal in cases where the transmitter will experience reverse flow once every four or five years for a four- or five-day period.

Bidirectional Flow Measurement with a Single DP Transmitter

A single DP flow transmitter coupled to a primary element option, such as the special orifice plate mentioned above, can also be adopted for cheap reverse-flow measurement. This

arrangement will cut down the expense of installing another (second) DP transmitter, orifice plate, additional hardware, meter installation requirements and the complexity of signal switching.

The square root function is complicated by the one-transmitter option because reconfiguration of the transmitter signal (4-12 mA and 12-20 mA) requires added function blocks and, subsequently, corresponding function blocks or logic at the distributed control system (DCS) side.

In cases where it's only a matter of knowing the reverse flow direction, and accuracy is not important, then the existing DP set without configuration can be used. At zero flow, 4mA is shown, and an output less than 4 mA can be used to alarm for reverse flow even when the square root function is on.

With newer, smarter flowmeter techniques, transmitters are equipped with a feature that allows reconfiguration of the DP transmitter range, such as split-range output signal (4-20 mA) to the system side (DCS, PLC). The bidirectional function, such as square root functions, can be directly applied to the transmitter by either installing special bidirectionality software at the control system side, or by using the built-in capability of the flowmeter to be used in both forward and reverse flow directions.

With equal or unequal flow rates, flow direction will be indicated as the output value (4-12mA = Reverse and 12-20 mA = Forward). With equal flows, zero flow point is established based on the DP range of forward and reverse flow, and for unequal flow rates, zero flow point will be a calculated value.

Bidirectional Flow Measurement with Vortex Flowmeters

The other option of two vortex flowmeters can also be used for steam bidirectional flow if higher accuracy is required than can be achieved using the orifice solution. However, this application is limited to smaller line sizes because vortex meters are more economical up to 4-in. (100-mm) pipe size. Beyond this size, orifice plates are more economical. In addition, the selection of a vortex-shedding flowmeter may increase the maintenance and installation cost.

Wherever higher accuracy is required, vortex flowmeters are not a good option, as vortices shed by both bluff bodies propagate really far beyond the pipe and may affect the other meters' readings. Another drawback is that the straight pipe run distance required between two vortex meters is unpredictable. For example, in the case of no obstructions, the meter required the run of 10 D (diameters) to 15 D, and if there is a control valve in either direction, the meter may require a higher run of 25 D to 30 D or even more. In comparison to the options of dual transmitters for bidirectional flow measurement between the two process units, DP flow measurement may be the most cost-effective solution.

Bidirectional Flow Measurement with Turbine and Magnetic Flowmeters

Bidirectional flow measurement is always a challenge when there are changes in process parameters, such as viscosity, conductivity, etc. It is always worth keeping these specific situations in mind while selecting any flowmeter technology, but with bidirectional flowmeter applications, it is especially important. DP type meters are usually not really well-suited to handle these process parameter variations.

Again, an example is utility pumping and circulating plants pumping dielectric fluid into underground electrical cables in order to dissipate heat generated by high-voltage power lines. This application requires flow rate monitoring upstream and downstream because it involves dielectric fluid; therefore, it requires viscosity compensation as the temperature of the dielectric fluid changes. In this application, turbine flowmeters can provide the solution for bidirectional flow measurement with moderate accuracy. However, drawbacks associated with this technology include a poor response of the flowmeter at low flows due to bearing friction; lack of suitability for high-viscosity fluids because the high friction of the fluid causes excessive losses; as well as the requirement for regular maintenance and calibration to maintain its accuracy.

The magnetic flowmeter can also be used for bidirectional flow measurement. It has the advantages of no pressure drop, linear output, short inlet/outlet pipe runs (five diameters upstream of the electrode plane and two diameters downstream), and good turndown. Magnetic flowmeters are relatively expensive and are mainly limited to conductive fluid applications, such as acids, bases and slurries, as well as water. A pre-requisite for this type of flowmeter is that the fluid is electrically conductive with an absolute minimum conductivity of 2-5 µSiemens.

Bidirectional Gas Flow Measurement with Ultrasonic Flowmeters

At gas storage fields or natural gas reservoirs, accurate gas flow measurements are required for tasks such as injection and withdrawal of gas from these reservoirs. Reservoirs are used as buffers between suppliers and consumers. In order to maintain the balance for the entire reservoir, it's necessary to monitor bidirectional flow at the wellhead.

For this purpose, conventional DP flowmeters with an orifice are far from a suitable solution, as they lack accuracy and reliability. Orifice plates are subject to wear and tear. Secondly, regular inspections and maintenance are required. While measuring the dirty gas, the pressure taps of the orifice plates are particularly exposed to clogging due to the solid particles which may be present in the dirty gas. These will definitely distort the accuracy of measurement.

In these cases, an ultrasonic flowmeter may be a far better solution because this type of flowmeter has no pressure drop, no flow blockage, no moving parts, and is suitable for high-volume bidirectional flow and also for low-flow measurements where other types of flowmeters do not provide the required results.

The advantage of using the clamp-on gas flowmeter transducer on the outside of the pipe is that it doesn't require any pipe work or any kind of process interruption. With this type of flowmeter even a little moisture content present in the gas can't significantly affect the measurement.

The reliability, negligible maintenance with highest accuracy and long-term cost of ownership are the major benefits of this technology.

Bidirectional Flow Measurement with Coriolis Mass Flowmeters

In the process industries, Coriolis technology has set the standard for flow and density measurements. This technology is used for various applications, such as mass balance, monitoring of fluid density and custody transfer, but also to reduce maintenance, and for bidirectional flow measurements.

In refineries, there are bidirectional applications, such as import and export of product, product transfer to storage and to petrochemical plants, and where the accurate measurement is more important than cost.

Coriolis mass flowmeters can be used for accurate and reliable measurements of all streams in and out of the plant. This is critical for accounting and profitability. End users should take into account that inaccurate measurements sometimes may cause them to give away more product than they are being paid for. This can result in a significant loss of profit.

Conpared to the traditional use of volumetric flow technology for bidirectional measurements, the use of Coriolis mass flowmeters eliminates various well-known drawbacks of volumetric technologies, such as the requirement for significant upstream and downstream straight piping length and the reduction of potential errors that occur in compensation for temperature, pressure, viscosity or specific gravity. The Coriolis mass flowmeter technology does not require that compensation.

Coriolis meters measure mass flow. They do have their own inaccuracies, but these tend to be low relative to other types of flowmeters. The turndown of Coriolis meters is high compared to other types of flowmeters. Another advantage is that no recalibration is required when switching fluids or for changing process conditions.

Purchase Price vs. Cost of Ownership

It's important for control system engineers to evaluate accuracy required for applications before selecting any bidirectional flowmeter technology, as more accurate and precise flow measurement often results in higher cost of the flowmeter.

The control system engineer must understand that price is always the consideration. However, there are some important distinctions to be made in terms of price. A flowmeter can have a low purchase price, but can be very expensive to maintain. Alternatively, a flowmeter can have a high purchase price, but will require very little maintenance. In these cases, the lower purchase price may not be the best bargain. Other components of price include the cost of installation, the cost of associated software, the cost of training people to use the flowmeter, the cost of maintaining the meter, and the cost of maintaining an inventory of any needed replacement parts. All these costs should be taken into account when deciding what flowmeter to buy. This should be the one reason for many users to look beyond purchase price when considering flowmeter costs. ■

Ruchika Kalyani is a control system engineer at Fluor Daniel India Pvt Ltd.

Crude Oil Pipeline Control

This column is moderated by Béla Lipták (http://belaliptakpe.com/), automation and safety consultant, who is also the editor of the *Instrument and Automation Engineers' Handbook (IAEH)*. If you would like to become a contributing author of the 5th edition, or if you have an automation related question for this column, write to liptakbela@aol.com

Q We are happy users of your invaluable series of handbooks for instrumentation and process control. There is something we could not find in Vol. 2, Chapter 8.34, about control of pumps. What would be your recommendation for the control of two pairs of reciprocating pumps installed in series (booster/main arrangement pump) used in a crude oil pumping station? In the attached PFD (www.controlglobal.com/1210_ATEPDF.html) you will be able to understand better the addressed control problem.

The pumping station delivers crude oil to the pipe line, and has two pumping stages, booster and main (each one in a redundant configuration—two operative and one cold standby—with a total capacity of 300 KBPD). All pumps (both boosters and mains) are of the positive displacement type. The boosters are 1200 hp and the mains are 3000 hp each. Each pump has its own hydrodynamic speed driver for velocity control whose setpoint is provided by a selector control between the total flow and the discharge pressure for the booster pumps. For the main pumps, the selector is between the total flow, the suction pressure and the discharge pressure, and, therefore, the controller with the lowest demand will set the velocity to the respective pump. Our questions are as follows:

1. For a pumping configuration with reciprocating pumps in series, each one with its own speed control, is it possible to maintain an accurate and stable pressure control just using speed control?
2. If a booster pump or a main pump shuts down, would this control system be able to respond in time in order to maintain pressure balance on the system?
3. Someone suggested to us to include a control pressure valve to recirculate oil at the intermediate manifold between boosting stage and main stage, which will fast-actuate in order to stabilize the pressure if needed. Would this work?

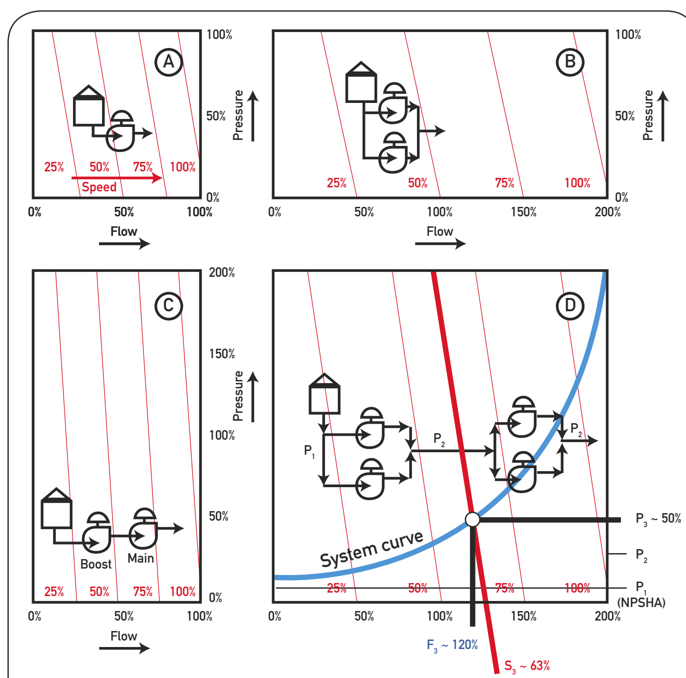
We appreciate your suggestions and critique. There is too much debate here at my company about this point.

LUIS FERNANDO BETANCUR
lbetancur@tipiel.com.co

A You are right, Chapter 8.34 in Vol. 2 does not answer all your questins, you also have to read Chapters 7.4 and 8.35 to get the full picture.

Your solution of using variable-speed (VS) positive displacement (PD) pumps, instead of throttling bypass control valves, is the correct one, because the pipeline process is a mostly friction one, and you would be wasting a lot of energy in the form of valve pressure drops. With PD pumps, cavitation also is less of a problem.

As to installing a recirculating control valve back to the supply tank from the intermediate manifold, this is reasonable if you want to mix the tank contents before start-up (to reduce settling and achieve uniform density) or to gradually increase the booster discharge pressure during start-up to the required inlet pressure of the main pumps before they are started, but not for normal operation. The relief valves should take care of overpressures. You need those plus blocks and check valves on each pump. In addition to the pressure safety valve



PUMPS IN TANDEM

Figure 1. The pump curves (red) of various combinations of positive displacement pumps are displayed on plots where the abscissa is flow in % of the maximum capacity of one pump, and the ordinate is pressure in % of the maximum discharge pressure of one pump. Blue is the system curve (pressure-flow relationship) of the pumping station, and where the blue and red lines cross is the operating point. Once we control one of the variables (flow or pressure), the other one is fixed.

(PSV) opening in the bypass, the booster pumps have to shut down any time the main pump trips, and, similarly, the main pumps have to trip to prevent the development of low suction pressure, when the boosters trip.

I assume you have selected the booster pumps that require a minimum inlet pressure (net positive suction head required, NPSHR) that is lower than the net positive suction head available (NPSHA). To determine this minimum, you determine NPSHA using the minimum possible supply tank level and oil density in combination with the maximum oil density expected.

The purpose of the booster pump is to keep the main pump suction pressure constant by compensating for supply tank level, viscosity, etc. If we understand "the personality"of the pipeline process, the required controls become fairly obvious. As you can see in Part A of Figure 1, the pump curves (in red) of all VS-PD pumps are very steep parallel lines, because flow changes very little, even with large changes in discharge pressure. If you have a pair of pumps in parallel, pump flows are added (Part B), and if you have a pair of pumps in series, pump pressure is added (ΔPs are added in Part C). In your case, you have both series and parallel operations (Part D), so the combined pump curves are as shown by the parallel red lines. For sake of this illustration, I have assumed that all pumps are the same (which obviously is not the case), but it simplifies the explanation.

Because your process is a "mostly friction" one, with only a small elevation ("static head") component, your system curve is basically a parabola (blue in Part D). If you select an operating point on Part D by controlling the discharge pressure (or flow) at a particular value, you have, in effect, also set the other. For example, in the sketch, I have picked a flow controller (FIC) setpoint which equals 120% of the full capacity of one pump. This automatically sets the discharge pressure also P3 = 50% of one pump) and the speed at 63%.

Obviously, in your actual configuration the four pumps are not the same, (the main pumps are nearly three times as powerful as the boosters) and, consequently, the combined pump curves will be different from the ones I have shown in Part D, but the concept is the same.

Now, let me turn to the control of the the pumping station. If you want only stable operation, you can modulate the speed of the booster stage to maintain the suction pressure for the main stage, and can throttle the speed of the main stage to keep the discharge (flow or pressure) constant. This, with safety limits and start-up/shutdown logic is all you need.

What I will describe below is the system you should consider if you want to maximize the efficiency (minimize the energy consumption) of the pumping station. To do that, we have to understand that this process has four degrees of freedom (total load, boost/main load ratio, and load distribution in both pairs of pumps) and, therefore, we can place four controllers on it without causing excessive interaction ("fighting") among them. Also, because the oil is incompressible, the loops are fast, so I usually tune these loops for mostly integral behavior (very little proportional gain).

The first loop controls the discharge pressure of the main stage. I usually use a "neutral gap" PIC, so that the controller output remains unchanged as long as the pressure is within ±1% of setpoint. This stabilizes the loop, which has fast measurements, but relatively slow speed controller response, and is, therefore, noisy or interacts with other loops.

The second loop controls the load distribution between the boost and main stages (booster % = (P2-P1)/(P3-P1)) to guaranty maximum station efficiency. This interstage (booster discharge) pressure controller compares the above optimum desired setpoint with the actual value of (P2-P1)/(P3-P1), and adjusts the load on the booster stage until it is optimum. Naturally, this PIC setpoint is limited (high selector), so that it can not drop below the minimum suction pressure requirement of the main stage.

Similarly, we can optimize the other two loops by optimizing the distribution of the flows among the two pumps within each stage. This is accomplished by measuring the individual flows, and because we know the optimum flow distribution (optimum setpoint = F1/(F1 + F2), we can modulate the speeds to achieve that. In this configuration, the output of the stage pressure controller becomes the cascade master of the more efficient pump's flow controller, while the less efficient meets the remaining load.

To implement his type of optimized control system, the pump supplier has to provide reliable efficiency data for the pumps. If they can't do that, or if the unique piping configuration of the particular pumping station is to be also considered, efficiency data can be accumulated on the basis of past operating performance. This is done by comparing the kWs that were needed to deliver the same flows at the same ΔP at different pump loading combinations in the past, and selecting the least energy-demanding one. This strategy can also be used to signal the need for "pigging" (cleaning) the pipeline if the pumping power required to deliver the same load rises.

Such an optimizated variable-speed pumping station can reduce the energy cost of operation to one half of a constant-speed pumping station using control valves.

BÉLA LIPTÁK
liptakbela@aol.com

A This is fundamental cascade control. Control of the booster pump is the inner loop, compensating for such things as tank level, suction pressure, etc. The goal of the booster pump is to provide a constant input to the main pump.

VICTOR WEGELIN
pmaconcept@aol.com

For more answers, go to www.controlglobal.com/1210_ATE.html.

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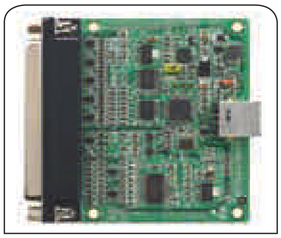
WIRELESS I/O



The ADAM-2000Z series of I/O modules use the IEEE 802.15.4 standard I/O and latest sensor technology while supporting 2.4-GHz mesh networking. The series includes five modules, a Modbus/RTU gateway, router node, I/O and sensor devices. It features low power consumption, ensured data integrity, Modbus/RTU protocol support and a wireless site survey tool in the ADAM utility.

Advantech Corporation
888/576-9668; www.advantech.com/ea

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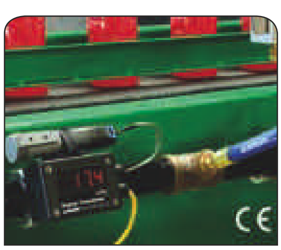
The USB-1608FS-Plus is a high-speed, multifunction USB DAQ device with sampling rates up to 400 kS/sec (800 kS/sec burst mode). This new module offers twice the throughput of our current USB-1608FS at the same price. It provides eight, 16-bit, simultaneously sampled analog inputs, eight digital I/O (high-current 24 mA), and one counter input.

Measurement Computing
(508) 946-5100; www.mccdaq.com

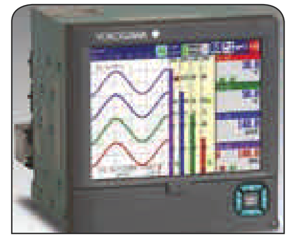
USB DATA LOGGER FOR FLOWMETERS



Exair's new USB Data Logger maintains a history of the company's Digital Flowmeter measurements for analysis. Use the included software to configure the Data Logger to record your flow rate. Record from once a second up to once every 12 hours. Data can be viewed in the included software or exported directly into Microsoft Excel. The Data Logger is available pre-installed on the Digital Flowmeter.

Exair
800/903-9247; www.exair.com/data.htm

PAPERLESS RECORDER



The new FX1000 paperless recording system delivers a high level of measurement, recording and networking functionality in a compact package. The shallow 6.5-in. case depth behind the panel allows for installation in tight locations and easy system integration. Up to 12 universal input channels are available with optional alarm relays, loop power supply, remote control inputs and 24-V AC/DC power.

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

SCADA EVERYWHERE YOU WANT IT

InduSoft Web Studio v7.1 offers enhanced interface capabilities for use on a variety of smart phones and tablets. It works with any HTML.5 web browser to display alarms, trend and critical tag values. It also adds widgets (gauges, switches and text boxes) to monitor and interact with process values (tags) on any current browser, including those found on iPads, iPhones (iOS Safari), Android phones and tablets.

InduSoft
512/349-0334; www.indusoft.com

SD-EQUIPPED ETHERNET 2.0 CONTROLLER

The 750-880 EtherNet 2.0 programmable fieldbus controller features 1 MB of program and data memory and an SD port for up to 8 GB of extra memory. The removable SD card transfers device parameters, boot files or other file types from one controller to another for back-up and restore. Accessible via FTP, the SD card also functions as an additional drive or data backup.

Wago
800/DIN-RAIL; www.wago.us

WIRELESS TRANSCEIVER

The NL5000-T transceiver series provides increased throughput and longer range for multiple address systems. Transparent and direct asynchronous communication offers real-time communication. They are field-configurable as a master station or remote radio and can operate as a half-duplex or simplex radios. Fully compatible with JSLM and JSLM2.

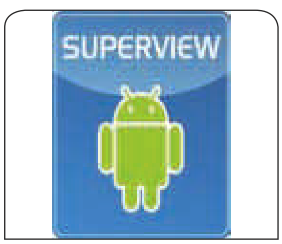
RF Neulink
800/233-1728; www.rfneulink.com

ALIGNED DAQ AND MOTION CONTROL

Sensor Fusion is a 3U DAQ device integrated with the Automation 3200 motion controller for precise time alignment of motion and data acquisition functions. Data collection is synchronized across all cards so there is never a need to align data after collection. Setup, data recording and data playback can be done through .NET, C, LabVIEW, MATLAB or AeroBasic programming language.

Aerotech
412/963-7470; www.aerotech.com

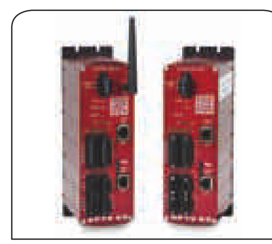
DAQ ANDROID APP



SuperView Mobile Lite is a free Android remote monitoring application for Novus data loggers. This mobile version of the SCADA SuperView Mobile app enables users to remotely supervise their industrial process using a smart phone or tablet. Available at Google Play for Android v. 2.1 and up, it allows users to remotely read values from devices using Modbus TCP protocol.

CAS DataLoggers
800/956-4437; www.dataloggerinc.com

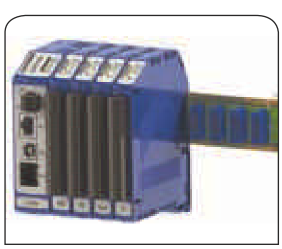
DO YOU KNOW WHERE YOUR ENERGY IS?



The OptoEMU Sensor DR is a compact unit for monitoring energy usage. Connected to utility meters, plant equipment and facility systems, it gathers real-time energy consumption and demand data and delivers it to enterprise business and control systems and web-based applications for monitoring and analysis, helping businesses take advantage of lucrative demand-response (DR) programs.

Opto22
951/695-3000; www.opto22.com

DAQ AND CONTROL SYSTEM



The MAQ 20 industrial data acquisition and control system is a family of DIN-rail-mounted, programmable, multi-channel, rugged signal conditioning I/O and communication modules. Features include 1500 Vrms channel-to-bus isolation; ±0.035% accuracy; operating temperature of –40 °C to +85 °C; CE and ATEX certification and UL Class I, Division 2, Groups A, B, C, D pending.

Dataforth
800/444-7644; www.dataforth.com

ECONOMICAL CPMS

The CPMS is an economical cathodic protection monitoring system. It monitors the critical current and voltage levels of one- or two-transformer rectifiers in impressed current cathodic protection systems, including the monitoring of specific Vdc, mV and mA inputs, and dual Modbus RTU (master or slave) and Ethernet—required for monitoring impressed current systems.

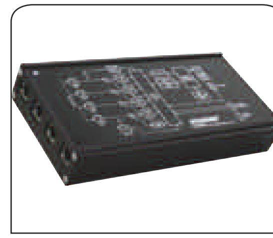
Moore Industries International
818/ 894-7111; www.miinet.com

COMMUNICATIONS GATEWAYS

The PLX30 gateways support multiple I/O connections to EtherNet/IP-enabled PACs, providing real-time transfer of up to 4000 words of data between devices such as HMIs and SCADA systems, power monitors and flow computers. All Modbus serial ports are individually configurable for master or slave, RS232, RS422 or RS485 and provide a flexible host or device interface solution.

ProSoft
661/716-5287; www.prosoft-technology.com

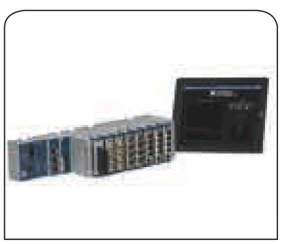
STRAIN-AND BRIDGE-BASED USB MEASUREMENT MODULE



The DT9838 strain- and bridge-based, bus-powered USB acquisition module offers high-speed performance in a compact form factor. It removes the need for an external power supply and offers 24-bit resolution; direct connectivity; 52 kS/s simultaneously sampled analog inputs; full-, half-, and quarter-bridge completion; up to 10 V internal excitation; and channel expansion to synchronize up to four DT9838 modules.

Data Translation
800/525-8528; www.datatranslation.com

HIGH-PERFORMANCE, COMPACT DAQ



The CompactDAQ platform with stand-alone data acquisition systems is compatible with over 50 sensor-specific I/O modules for flexible, mixed-measurement data logging. It includes a built-in dual-core Intel processor and onboard storage to deliver high-performance processing in a single, portable system. Using NI LabVIEW, engineers can customize a data-logging or embedded monitoring solution.

National Instruments
800/258-7022; www.ni.com

MULTICHANNEL TRANSMITTER

The Liquiline CM44 Series transmitter models accept inputs from up to eight Memosens digital analytical sensors, including nitrate, spectral absorption coefficient (SAC), pH, ORP, conductivity, oxygen, turbidity and ion-selective electrode sensors. Outputs include up to eight 4-20mA current outputs with HART, Ethernet, Profibus, Modbus TCP or 485 networks.

Endress + Hauser
888/ENDRESS; www.us.endress.com

STATE OF THE DATA LOGGER

The OM-CP-STATE101A state data logger is a low-cost, battery-powered data logger that records input transitions or contact closures from transducers or state initiators. This CE-compliant product has a 10-year battery life, 4-Hz reading rate, a multiple start/stop function, ultra-high-speed download capability, 406,323 reading storage capacity, optional memory wrap, battery life indicator and more.

Omega
800/TC-OMEGA; www.omega.com

NO MORE PAPER

The X-series of paperless recorders enables electronic acquisition and storage of data. Their graphical display makes them ideal for use by plant managers, engineers, maintenance and quality control personnel and operators. Three models are available. Each one displays various combinations of horizontal and vertical charts, digital values and bar graphs.

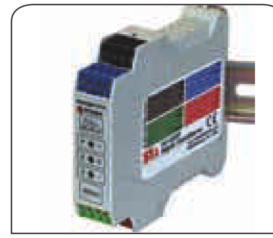
Honeywell Process Solutions
800/343-0228; www.honeywellprocess.com

BATTERY-POWERED VORTEX-SHEDDING FLOWMETERS

Battery-powered CoolPoint vortex-shedding flowmeters for water, chemicals and corrosives run on 3 AA alkaline or lithium batteries. The expected battery life is six months for alkaline or two years for lithium. They indicate flow rate or total on an LCD screen, and range in size from ¼ in. to 2 in. with maximum flow ranges from 4 gpm to 200 gpm, maximum pressure of 300 psi, and temperature ranges from 32 °F to 210 °F.

Universal Flow Monitors
248/542-9635; www.flowmeters.com

ADVANCED AC-LVDT SIGNAL CONDTIONER



The S1A AC-LVDT signal conditioner offers smart, fast LVDT setup with built-in null indication and simple front panel pushbuttons to set zero and full scale. It works with the widest range of AC-LVDTs, RVDTs and inductive half-bridge sensors, including three-wire GE LVRTs and gas turbine LVDTs. It offers a choice of four excitation frequencies, eight analog DC outputs (6 DC voltage and two current loop outputs) and RS-485 digital communications.

Alliance Sensors Group
856/727-0250; www.alliancesensors.com

OUTSIDE-MOUNT, LIQUID-LEVEL REED SENSORS

Three new versions of the LS03 liquid level sensor can be mounted from the outside. The three models, DL, DK and GZ, are ideal for liquid container monitoring in household, automotive, test and measurement—and control technology. All three models offer a switching voltage of 180 V and a switching current of 0.5 A. The DL and DK models are available in both polypropylene and polyamide. The GZ is available in polyamide.

Standex-Meder Electronics
866/STANDEX; www.standexmeder.com

EVEN MORE ULTRASONIC SENSORS

AutomationDirect's ultrasonic sensors offering now includes additional 18-mm, round, plastic, DC models. The UK1 series are IP67-rated with a 15 to 30 Vdc operating range. It offers six different output types: single PNP, dual PNP, 4-20 mA only, 0-10V only, PNP and 0-10V, and PNP and 4-20 mA, and is available in four different sensing ranges: 50 mm to 400 mm, 100 mm to 900 mm, 150 mm to 1600 mm, and 200 mm to 2200 mm.

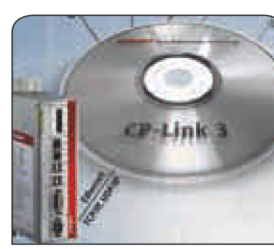
Automation Direct
800-633-0405;www.automationdirect.com

HAZARDOUS-AREA CONDITION MONITORING

The new 9147 series of ISpac Ex i isolators have transmitter supply units that enable the use of vibration sensors in hazardous areas. The new 9147-type supply units support a very wide range of Ex-i vibration sensors and transmitters. An easily accessible rotary switch allows for quick and easy configuration. They're available as single units on a DIN rail, with a common power supply and collective error message via the cost-saving pac-Bus or in pac carriers.

R. Stahl
800/782-4357; www.rstahl.com

ONE PC, MANY HMIS



The CP-Link 3 for HMI installations has a new display and visualization concept for flexible connection of up to 255 Ethernet panels or panel PCs with one industrial PC. CP-Link 3 is based entirely on standard Ethernet and IP-based protocol for transfer of images. Networking can be done using standard Ethernet cables (Cat 5) which are suitable for drag chains. It's a pure software solution based entirely on 100-Mbit/s Ethernet and IP protocol.

Beckhoff Automation
952/890-0000; www.beckhoffautomation.com

Bringing Advanced Process Control Home

Greg McMillan and Stan Weiner bring their wits and more than 66 years of process control experience to bear on your questions, comments, and problems. Write to them at controltalk@putman.net.

GREG MCMILLAN
STAN WEINER, PE
controltalk@putman.net

Greg: I have had the pleasure of talking to Arnold "Marty" Martin sporadically over the years. Whenever I have the opportunity to talk with him, I am always impressed with his enthusiasm and knowledge. I feel supercharged after our conversations. Marty is now manager of advanced process control in the Americas for Air Liquide. I called Marty to do a Control Talk column interview from my home in Florida. Hey, Marty, what's happening?

Marty: I am commissioning a model-predictive controller remotely from home. I can analyze and improve an advanced process control system (APC) and take a model-predictive controller (MPC) in and out of service by remote access. I love the immediate knowledge and results of continuous processes. With batch processes, especially bioreactors, you have to wait 10 days for the batch to complete, plus a few more days for lab results on the product. In the separations business, you can make changes and see the results right away.

Stan: How do you avoid the perception of APC as a threat?

Marty: You don't force something down users' throats. You reassure them that more automation will not take away their job, but will free them up to help solve problems in the field.

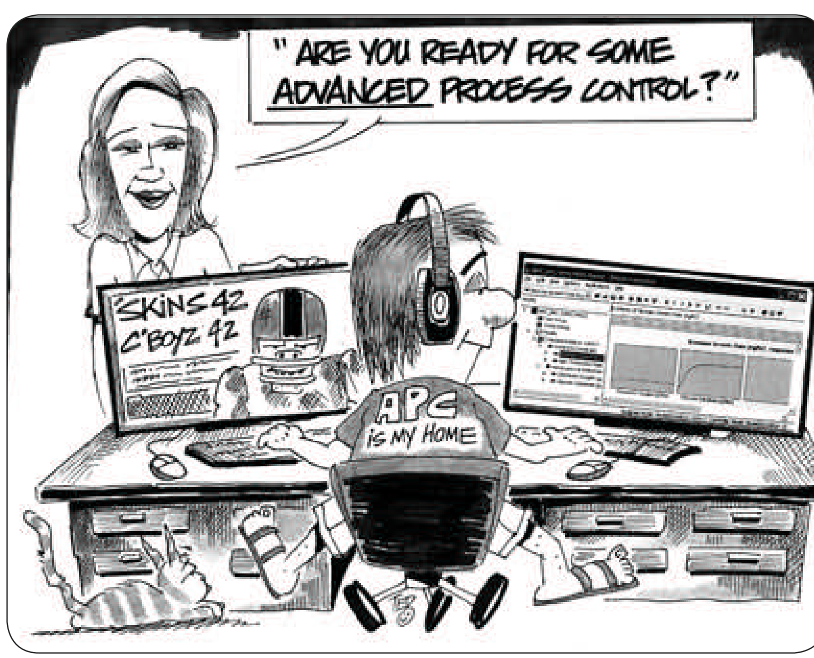
Stan: How do you help operations gain confidence in APC?

Marty: We had to prove what APC can do, be there, and reassure operations they aren't getting the typical APC taillight guarantee (we're done when you see my taillight, so we can jump to the next sexy project). I promised in 2008 we would not let go. We could not guarantee how fast or how a problem would be fixed, but did guarantee we would see and solve the problem. MPC is now the standard, and APC is viewed as essential.

Greg: How do you help operations when things go wrong?

Marty: We can support our plants anywhere and at any time of the day. When operations is having problems, your virtual presence in the control room is worth its weight in gold. When the process has changed or is in a zone never seen before, we need to know before operations takes the full brunt of the impact. Often the explanation from operations is really not the cause. Since we often do not speak the same language, seeing the same thing makes a world of difference.

Greg: On a personal level, what has remote access meant to your group?



Marty: We've cut travel time by 40% for our group. We're decreasing burn out and saving marriages! You must have a very understanding spouse to be gone 70% of the time. Initially, new employees spend more time in the plants, but graduate to remote access as soon as it makes sense, and the proper relationships with the plant personnel have been built. It takes credibility and trust from operations to make changes to the system without being present.

Stan: What have you done to prevent hardware from holding you back?

Marty: Currently, we have sourced computers with a set specification (motherboard, memory, drivers, operating system, etc.) for APC use. We have spare replacement computers should a plant APC computer fail. We maintain image backup of the APC computers, and can reimage a replacement computer for quick installation. However, we're now in the middle of going to a VMware solution. We'll be able to run as many virtual machines as we need. We wouldn't be limited by RAM and processor capacity. We'd have high reliability by redundancy. It's expected that hardware failures will be less common. The hardware becomes less critical. Outside of remote access, virtual computing has the potential of making me the happiest in the last two years. I will no longer have to take care of the computers in the plants.

Greg: What kind of people do you have in your group?

Marty: I'm fortunate to have three silver foxes. The youngest is 50. These guys carry a lot of weight in the plants. They have extensive regulatory control and practical process knowledge in addition to APC knowledge. There is one guy in his 60s. He's able to break down complexity to simple things in many buckets, and pours them together to reformulate the problem. I told him when he retires I go too. We are so lucky we have people who love what they are doing.

Greg: How do you bring new engineers up to speed?

Marty: To be effective quickly, prospective hires must have a solid foundation in regulatory control and a willingness to learn the process right away. We can teach what they need to know about APC. New engineers gain the practical process knowledge they need by sitting with operations, and it often takes many months. They ask a lot of questions and show they care. They learn what the operators do when they have an upset and why. They find the best handle, especially when a quick correction is needed. The most obvious handle is not always the best.

Stan: How does this knowledge affect MPC design?

Marty: You want a steady-state controller to properly handle changes (robustness) and abnormal situations. Otherwise, the operator says the MPC is not working. The solution may need to be put in advanced regulatory control. Even if you could get a model and handle the problem in the MPC, with a 1-minute execution time and a few missed calculations, the MPC may end up taking too long to make the full correction. Also, some deviations you need to just leave alone and not chase. High-speed disturbances that exhibit some level of self-correction are better left alone because chasing them may create a bigger upset than just ignoring them.

Stan: What is your typical MPC?

Marty: The average MPC has six to eight manipulated variables and 12 to 14 controlled variables. Some of these are for minimization and maximization rather than control at a target. For control at target, we have greater move penalties when at a steady state. Our MPC execution is once per minute. We push as much as possible to the regulatory control. For poor measurements (e.g., flowmeters with too much noise or not enough rangeability), we write directly to the control valve.

Greg: What are you doing for flexible manufacturing?

Marty: The MPC does an excellent job of ramping plants automatically based on customer or pipeline demands. The MPC enforces the mass balance, which prevents chasing analyzer signals during the transition. When at the new steady state, the MPC lets the analyzer do its thing, unless the analyzer is trying to put the process too far away from the mass balance. There are a few analyzers, such as purity to customer, that must take over. When a plant is being ramped, the MPC models do not always hold, and confusion reigns. We want newer analyzer technology to help us. The older analyzers typically don't have symmetrical loading, causing the MPC to over-correct if model differences are not accounted for.

Greg: How can you tell if an MPC needs improvement?

Marty: We have a grading system with key performance indicators (KPIs). Our R&D department developed an in-house solution using innovative MPC statistics. We're able to see ahead of time if MPC performance is deteriorating from rising prediction errors. The statistical measure takes into account whether the CV is for maximization, minimization or control. As a result, by considering limits and targets of these CV, we can keep false alarms at a minimum.

Greg: Go online (www.controlglobal.com/1210_ControlTalk.html) to see this complete interview and "Top 10 Reasons to do APC from Your Home." ■

AD INDEX

EQUIPMENT & MATERIALS

JIM MONTAGUE
EXECUTIVE EDITOR
jmontague@putman.net

Innovation in Orlando

I'm not usually much of a Disney fan. The characters from Snow White onward were fantastic, but they were almost always pure good or all bad. Sadly, this black-and-white ethos always seemed kind of flat and artificial, like early Superman or DC comics or Lawrence Welk's robotic performers. I always leaned towards more fleshed-out characters like Bugs Bunny, Spider-Man, Oscar the Grouch or Bart Simpson, who exemplify the world's negatives as well as its positives, and seemed a lot more human to me. Plus, I didn't appreciate Uncle Walt's busting some of his best artists to the U.S. House Un-American Activities Committee for trying to unionize in the 1950s. Heck, even the Little Mermaid is 23 years old, so I'm rooting for Pixar's cast to keep breathing new life into Disney as a whole.

Consequently, I was encouraged by the opening keynote at ISA Automation Week 2012 on Sept. 25 at the Orange County Convention Center in Orlando, Fla. Greg Hale, PE, chief safety officer at Walt Disney Parks and Resorts (http://corporate.disney.go.com), charted many of its efforts to use automaton and process control at its theme parks and the unexpected paths its engineers have followed as a result.

Hale began by reporting that Walt Disney constructed Disneyland in Anaheim, Calif., because he wanted to transform his animated films into an even more immersive experience, and this vision grew into the parks the company runs worldwide, each of which requires all kinds of process controls, safety components and vast quantities of goods and raw materials.

"To achieve required capacity and throughput, we sometimes have two to four rides operating in one site," explains Hale. "It's not well-known, but Space Mountain is two intertwined roller coasters running in the same space. We also operate brake zones between sections of many rides, which allows us to run several sets of vehicles at once to increase capacity."

For example, the Big Grizzly Mountain ride at the California Adventure park in Anaheim includes 460 sensors that monitor position and speed, and these perform safety checks 20 times per second. Hale works with a 5000-member maintenance cast that performs thousands of pre-opening checks and maintenance tasks each day, which are all scheduled and tracked by Maximo software. Similarly, RFID chips in many rides work with interlocks to call out vehicles when they exceed allowed number of laps.

Hale reports another innovative program began when Disney World sought to improve the park's immersive experience for its handicapped guests. About 10 years ago, it developed and offered handheld HMIs to display captions for deaf guests and then devised another handheld with audio descriptions for blind guests. These proprietary devices allow each group to experience more of the "stories" that go along with each ride and other attractions in the park. The handhelds use Bluetooth, WiFi, global positioning, radio and Disney's own SyncLink technology to cue up the right caption or audio based on each user's location. More recently, Disney began offering similar handhelds in five languages and inserted the same components into its Pal Mickey and new Glow Ears toys, so young children can enjoy the same dialog.

Of course, many industrial plants and manufacturers could likely make use of the same or similar interfaces. And, Hale adds, 15 national parks, George Washington's Mount Vernon, the Coke Museum, Dallas Cowboys Stadium and the National Safety Council have already licensed Disney's handheld technology.

'We try to pursue innovation in our world, but we've learned that each of us can make a difference in everyone's world.'

"We try to pursue innovation in our world, but we've learned that each of us can make a difference in everyone's world," says Hale, who also sits on the board of FIRST Robotics (www.usfirst.org), which has held several of its national events for high school and elementary students at Disney World. "You engineers are the rock stars of these technologies and can help the next generation get inspired by them." What did I tell you? Another typical Disney happy ending. ■