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Conference Highlights from the 2019 EMERSON GLOBAL USERS EXCHANGE

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A YEAR OF GROWTH AND PROMISE

By Paul Studebaker

"I see before me 2,600 of the world's best people—our customers, partners and employees," said Lal Karsanbhai, executive president of Emerson's Automation Solutions business, in his keynote at the opening of Emerson Global Users Exchange 2019 this week in Nashville.

Karsanbhai's promotion to executive president was announced at last year's event and, he said, "It's been a big year, for our industry, for our company, and for me personally." During the past year, he has visited many Emerson and industry facilities, and met with customers around the world. "Each of your companies faces unique challenges and problems, but you have a lot in common in your goals and opportunities," he said.

The oil and gas industry is experiencing capacity constraints and a volatile market, and needs to reduce costs, improve asset performance and develop its people. Upstream supply is seeing higher downstream demand, and needs to expand safely and reliably. Liquefied natural gas (LNG) is growing globally, and "40% of the world's expansion is in North America," Karsanbhai said. Regasification capacity is increasing in Europe and Asia, and shippers are raising capacity.

Meanwhile, the power industry is dealing with a new mix of generation, including renewables. Pharmaceuticals and specialty chemical are integrating new processes, raising demands on controls and quality. Packaging and automotive industries are seeking greater flexibility to meet changing customer demands.

"Focus on the things you can control: safe operations, increasing reliability, optimizing production," Karsanbhai advised the audience. "Automation professionals have a direct impact on company performance."

How it's growing

Karsanbhai stressed Emerson's long history of and continuing efforts to truly understand the industries and customers it serves, and described its increasing array of hardware, software and services to meet their changing needs. Innovations over the past couple of years include last year's introduction of DeltaV v14, "the most intuitive and scalable DCS ever built," he said. Ovation 3.7 for power and water has advanced control, cybersecurity and analytics, and Guardian Support v13.2 prognostic service provides a DCS health score that reflects safety and security risks.

For data management, Plantweb Optics v1.5 does historian and trending with increased scalability, Plantweb Insight has additional health analytics, and AMS Device Manager v14 offers smart commissioning with higher security.

Emerson has also recently developed digital isolation valves for critical safety applications, two-wire Coriolis meters to simplify installation for improved measurement, hygienic instrumentation for food and beverage applications, and ultrasonic plastic joining for precision welding applications.

Along with product expansions and improvements, "We've made eight key acquisitions this year," Karsanbhai said. "Last year, we acquired Pentair valves, and now have AE Valves for cryogenic applications, Circor

"Focus on the things you can control: safe operations, increasing reliability, optimizing production. Automation professionals have a direct impact on company performance." Emerson's Lal Karsanbhai kicked off the 2019 Emerson Global Users Exchange in Nashville.

for steam traps and regulators, and Permasense for erosion and corrosion sensors." The additions of Aventics smart pneumatics and Asco valve have increased the range for factory automation.

"A year ago, we acquired GE Intelligent Platforms to bring in traditional PLC applications in hybrid and discrete automation," Karsanbhai said. "Integrating PLCs with DeltaV and Ovation is a significant step toward fully integrated solutions across your facility and organization."

Data management acquisitions include KnowledgeNet for machine learning and analytics, iSolutions for data management consulting, Bio-G for cloud SCADA, Zedi for life science analytics, GeoFields for pipeline integrity, Paradigm for exploration and production, and ProSys for alarm management.

At your service

Emerson now has 4,000 people around the world involved in project engineering, management and execution. "We have 700 specializing in pharmaceuticals, and a dedicated LNG team," Karsanbhai said. The company's 300 global service centers include two new ones, one in the Permian basin, and one in Vaca Muerta, Argentina.

With its expertise in industries and applications, and its growing hardware, software and services capabilities, the company is positioned to help solve virtually any automation-related problem, as well as facilitate improvements in most areas of plant operations. "Our ability to serve you essentially depends on the trust you place in us," Karsanbhai said. "Tight alignment and trust accelerates progress, and brings real value."

CELANESE UNLOCKS STRANDED DATA

By Mike Bacidore

Some things are just meant to be. When chemicals-maker Celanese began its digital-transformation journey, it wanted to find a way to liberate isolated data and make better business decisions.

Over the course of 100 years, Celanese has evolved from a backyard experiment in Switzerland into a global specialty-materials giant, making intermediate chemistry products, cellulose derivatives, emulsion polymers, food ingredients and engineered materials.

"The problem is having siloed information," said Greg Aguilar, senior principal instrument engineer at Celanese. He spoke at the 2019 Emerson Global User Exchange in Nashville, Tennessee. "We need to unlock that data and couple it with the business cases for predictive maintenance (PdM), process optimization and energy management."

Celanese identified more than 50 potential use cases and prioritized them based on feasibility before narrowing it down to two for pilot projects. The use cases were developed with input from people in the units to identify pain points on a day-to-day basis, so they had buy-in. "We included them in every step, from brainstorming to identifying who the solution provider would be. Culture changes are difficult. The successes we've seen helped a lot, but it's still an ongoing battle because people find change to be difficult," said Aguilar.

"We needed to identify a partner," he explained. The vendor landscape was vast. "We did a deep dive of 43 vendors in the Industrial IoT (IIoT) space," he said. "We wanted an analytics platform that could be deployed on premises. We narrowed it down to 12." Further honing brought the candidates down to six and then two. Finally, Celanese chose KnowledgeNet (KNet) software, but, when Aguilar notified the company, he was surprised to receive a reply from Emerson, which had acquired the software provider. The change was fortuitous for Celanese, however, as the company was already operating numerous Emerson systems, including the DeltaV distributed control system (DCS).

Data analytics spotlights process problem

Using its PdM use case as an example, Celanese set out to test the system with a pilot project analyzing the lube-oil temperature on a rotating piece of equipment. "It looked relatively flat, but the system identified this equipment as an issue," explained Aguilar. "Looking at the two-month trend, we were still below alarm levels. But, zooming out over the course of two years, the system identified a change in the temperature level. Because the temperature rise occurred over a period of time, no one noticed it on a day–to-day basis. It had gone unnoticed for months before the system picked it up."

The facility had installed a vacuum dehydrator to remove moisture. "The particular failure we identified had been in place for nine months," said Aguilar. "It wasn't seen as a degraded system at the time."

"Two years ago, I maybe wasn't great friends with our IT department, and now people think I work in the IT department." Greg Aguilar of Celanese spoke of how the company has successfully unlocked siloed data at the 2019 Emerson Global Users Exchange in Nashville, Tennessee.

If the temperature had continued to rise unnoticed, it could have shut down the unit. "We were able to make a decision to add it to our upcoming turnaround scope," explained Aguilar. "About a month ago, the valve became unstuck, and the temperature dropped 20 degrees. The technology proved it could identify hidden failures."

The success of the pilot project instilled the type of confidence that the new technology needed. "We're no longer pushing the technology from corporate down to the sites," said Aguilar. "Now, they're asking for it. We're building institutional knowledge. It gives us a launching point. The technological value accelerates. We are creating a data-driven culture for making decisions."

The principle-driven failure mode and effects analysis (FMEA) and the system's linear regression identified the potential damage to bearings. "That particular valve was not considered an issue until the system identified it," explained Aguilar. "We operate at 100% uptime. We don't want to take outage time unless necessary. Because we understood the health of the asset, we put a mitigation in place and removed it at the next turnaround in six months. It affected the compressor a bit, but we had the information available to make those data decisions."

The KNet tool is intended to augment the ability of Celanese technicians and operators. "It's about freeing up their time to do more value-added tasks," explained Aguilar. "For instance, in the use case scenario we were considering 80 different variables. One engineer isn't able to do that. We try to focus on equipment that has repeat failure issues. With the power of the KNet system and the FMEA approach, you can get a lot of value out of it."

Collaboration with IT has been very important in the system implementation, as well. "IT-OT convergence is happening," said Aguilar. "Two years ago, I maybe wasn't great friends with our IT department, and now people think I work in the IT department. The initial journey has been about a year and a half. Over a five-year period, we hope to have a scalable solution."

ANALYTICS KEY TO DIGITALIZATION REWARDS

By Paul Studebaker

According to myriad articles, studies and white papers, analytics is now "the topic" for any business application, from supply chain optimization to pricing and distribution. But while this firehose of news and information has eased the way for applications in industrial operations by gaining the attention of the C-suite, it has made it more difficult to navigate the path to a successful implementation.

"It presents a major opportunity, but also major confusion. Emerson favors a practical, pragmatic approach," said Peter Zornio, chief technology officer of Emerson's Automation Solutions business, in a press conference at the 2019 Emerson Global Users Exchange in Nashville, Tennessee.

Analytics has the potential to deliver more than $4 trillion of growth in industrial manufacturing, according to Gartner Group. But potential users are confused, asking questions like where to start, what supplier to use, what types of models to apply where, what types of problems it can solve, and how OT analytics fits into IT.

"On the supplier question, one of our customers identified more than 900 resources," Zornio said. Fewer are involved in industrial IT and OT, focused on plant-level benefits. For a manufacturer, those are the biggest opportunity, with potentially high-return applications in productivity, reliability and energy efficiency.

Emerson's portfolio of operational analytics focuses on the greatest source of value for industrial manufacturers—the production process itself. Operational analytics with embedded domain knowledge can impact and improve performance of simple equipment, complex assets and process units, and entire production plants.

"We recommend addressing the high impact, known problems first," Zornio said. "By using proven models that make analytics accessible to the personnel responsible for the performance of assets, our customers can act quickly to solve problems faster. For example, Emerson's solutions can detect and address 80% of the equipment failure modes contributing to production loss in a plant in real time."

Analytics can be broken down into two classes: traditional and data-driven. "Traditional analytics are principle-driven, where you know the mechanisms—the mechanistic models," Zornio said. You know that equipment and units are designed a certain way, so these analytics can be rule-based: if something goes wrong, you probably know the cause, for example, by failure modes and effects analysis (FMEA).

Data-driven analytics build a model from analysis without knowing the physics, using standard statistical analysis, Zornio said. "Here is where advances in computing have driven excitement, with machine learning (ML), enhanced pattern recognition and mathematical correlations."

Emerson's enhanced portfolio includes ML and artificial intelligence (AI) that can be used to identify new discoveries and deepen insight to impact business performance. These tools provide perspective previously unattainable with traditional analytics.

"We have more than 6,200 equipment models with 500 FMEAs. Some 80% of equipment can be done using existing first-principles analytics." Emerson's Peter Zornio on some of the use cases where data analytics is not the best solution.

Deriving the benefits

Plants are complex systems, with components that roll up into assets that become process units, a whole plant, and often, a fleet of plants. Users ask, "Where is the opportunity? How do we apply analytics?" Zornio said.

"We already have analytics we can apply to lower-level assets. We need to do more at the plant level," Zornio said. "If we have knowledge about the plant—as it is, not just as-built—we can use first principles. Then we need to get the analytics output to a person who will implement change based on the results—people who will actually do something."

Where first principles are not understood, or not enough, it makes sense to turn to data-driven analytics. "The question about data-driven analytics is, why use which where?" Zornio said. Using a car as an example, "It takes until the third time you run out of gas for machine learning to learn cars need gas to run," he said. "We have more than 6,200 equipment models with 500 FMEAs. Some 80% of equipment can be done using existing first-principles analytics."

Before turning to data-driven analytics for a product or equipment class, decide if you can use packaged analytics. "Some engineers want to develop their own analytics, but a known answer to a known problem is probably a better solution," Zornio said. You can hire a data scientist, but it's probably more important to have someone familiar with the equipment.

"We know our devices and their operational analytics," Zornio said. "We started building solutions into DeltaV in the 1990s, with fuzzy logic and neural nets. We've added simulation and digital twins, and now we have a generic toolbox for data-driven analytics and AI."

With the company's acquisition of KNet and its integration into the company's Plantweb Optics asset performance platform, "Emerson can provide not only some of the most advanced machine learning and AI tools in the industry, but also the connection to people and workflows, which are critical to digital transformation success," Zornio said.

Emerson's portfolio now provides both pre-packaged analytics solutions as well as a complete analytics toolbox for users to develop their own applications. This portfolio is supported by Emerson's Operational Certainty consulting practice and robust data management capabilities that provide a foundation for analytics success.

DIGITAL PILOTS MOVE TO PRODUCTION AT 3M

By Dave Perkon

The Film and Material Research Division (FMRD), an internal 3M specialty chemical and adhesive supplier, supports five different manufacturing sites and was looking at its future digital transformation plans.

What it saw was a perfect storm. "There was aging equipment, a less-experienced workforce for many reasons, and health and safety pressure to drive excellence across the globe, all with increasing demands for production," said Robert Sentz, FMRD manufacturing technology engineer at 3M's Cottage Grove plant in Minnesota.

Factory-of-the-future initiatives were looking at different ways to use technology to fill some of these gaps, said Sentz at Emerson Global Users Exchange in Nashville, Tennessee. "3M corporate management created an initiative called PACESetter to drive a common approach to solve these problems across all of our manufacturing sites," he said.

PACESetter, an acronym that includes proprietary process technology, automated processes, connected data, efficiency, and safety and sustainability, is designed to drive quality, service and value to all of its customers.

Fortunately, 3M is very supportive in using advanced technologies to create the most efficient and engaged operations. Innovation is an integral part of 3M's culture; and its many brand names, such as Scotch, Post-it, Scotchgard, Ace and Nexcare, to name a few, were created based on some of its more than 170,000 patents. These and other products are spread throughout more than 230 manufacturing sites in 70 countries that share more than $3.5 billion in yearly R&D and capital investments, including digital transformation.

"It's very difficult to just dive right in to digital transformation," said Sentz. "You must have a solid and robust foundation in place to transform. To start the journey, step one is an assessment of what you have today and where you want to go in the future—a road map. Then you need to build your foundation so you can add the technologies that are much more advanced. You need to define the problems you want to solve and then implement those technologies."

Within FMRD, 3M chose four different key technologies to solve problems in manufacturing, continued Sentz. "Across the corporation, other divisions had other problems and solutions," he said. "For us, one of our four key initiatives was batch automation and advanced control programming, which is key for operations, safety and productivity. Our second initiative was process analytical technology for real-time process analysis of our chemistries and processing. Our third initiative involved workflow and providing an operator-guided work experience—standard work. Our fourth initiative was related to reliability/analytics to extend the life of our equipment."

To execute these factory-of-the-future initiatives, 3M piloted different technologies. "We wanted to prove that it works and get wins," said Sentz. "It's much easier to sell to management if there are wins that show the technology works and has real benefits."

"With less-experienced operations personnel, we are running safely and remaining productive even though many of the experienced operators have changed positions, retired or moved on." 3M's Rob Sentz describes one result of his group's digital transformation at Emerson Global Users Exchange in Nashville, Tennessee.

Throwing all four digital-transformation initiatives at one plant was not possible as there was a concern nothing would get done. "No one plant had all the resources to try out the technologies at one time," said Sentz. "I worked with different people in different plants to pilot these technologies. I chose the people based on their interest, their expertise, and whether they had a problem that they wanted to solve."

All sites used and piloted a variety of Emerson digital technologies. For example, the Site 1 team piloted AMS Device Manager including ValveLink and Smart Meter Verification. The Site 2 team piloted Process Analytical Technology (PAT) and Plantweb Advisor. At Site 3, the pilot program team focused on reliability and analytics with wireless vibration, online vibration, Plantweb Insight and Plantweb Optics.

"Once we proved the technology worked, we looked to expand our technology over several years and into the future, said Sentz. "We went to other units, other areas in the site or different plant sites across the globe."

Some of the benefits seen to date include supporting increased production volume, said Sentz. "With less-experienced operations personnel, we are running safely and remaining productive even though many of the experienced operators have changed positions, retired or moved on," he said. "Our reliability program is starting to predict the health of assets before catastrophic failures occur. And we are supporting some key new, specialized processes that have come online where the health of the equipment is critical for us to continue the process."

The perfect storm was real for 3M. "We had been living though it," said Sentz. "The 3M corporate PACESetter initiative is driving a common approach to implementing these technologies across the corporation. The assessment, building the foundation and defining the roadmap are critical first steps to move forward with your digital transformation. Tracking progress and getting wins is also critical to get funds from management to continue the transformation. As part of the digital transformation, we have aligned with corporate teams for resources and analysis internally, but we have also partnered with key suppliers, such as Emerson, to implement many of our key technologies."

5 COMPETENCIES OF DIGITAL TRANSFORMATION

By Jim Montague

Responding to floods, earthquakes or other natural disasters requires everyone to pitch in and help. This all-hands-on-deck approach is also needed to handle most upheavals or other huge changes, including successfully achieving digital transformation in process control and automation applications. These epic challenges are likewise where neighbors, responders and other partners can provide the most assistance and value, which is why Emerson unveiled its Digital Transformation business at Emerson Global Users Exchange 2019 in Nashville, Tennessee.

"There's a lot of hype and confusion surrounding digital transformation, its impact and how it's progressing. People want to know what's real and how to get started. They need clarification to develop practical solutions, so we define digital transformation as smart, connected technologies used to solve problems, usually involving changes in business practices," said Stuart Harris, group president, digital transformation with Emerson's Automation Solutions business. "Digital transformation must be guided by specific problems, but it won't work unless people are engaged and appropriate technologies are adopted."

Harris reported the five essential competencies of digital transformation that can unlock performance and enable employees to perform at their best. They include automated workflows, decision support, workforce upskilling, mobility and change management. Meanwhile, the three critical success factors of digital transformation are technology decisions driven by business outcomes; scalable approach, guided by vision, instead of doing it all at once; and technology investments that are also seen as investments in people.

"However, we're still at a critical stage because, even though many companies have gained the vision to pursue digital transformations, they don't know where to start and can get frustrated," added Harris. "Other companies are doing pilot programs, and some are seeing early benefits, but everyone needs to connect their businesses and digital transformation strategies with practical applications. Strategy and business cases are what come first with digital transformation—not the technology. Once return on investment (ROI) is captured for a solution, it can be scaled across the whole enterprise."

Combined tools = easier digitalization

The $650-million Digital Transformation business consists of a dedicated organization focused on related, digitalized technologies and programs, and it brings together resources to help manufacturers develop and implement practical digital-transformation strategies and achieve industry-leading or top-quartile performance and measurable results.

"Digital transformation is urgent because it can help users achieve top-quartile performance, add two weeks of uptime, cut maintenance incidents in half or reduce safety incidents by 30%." Emerson's Stuart Harris explains the benefits of digital transformation at Emerson Global Users Exchange.

It also includes:

- operational certainty consulting with facility- and enterprise-level roadmap strategies and implementation to improve reliability, safety, production and energy utilization metrics
- operational analytics with a comprehensive portfolio of predictive diagnostics and advanced analytics, providing insights on health and performance of operational assets
- industry solutions with deep, industry-specific expertise on solutions to drive key performance indicators
- pervasive sensing with the industry's largest portfolio of smart, easy-to-deploy, connected devices, including wireless instruments
- project management with best practices, tools and resources to confidently implement digital-transformation projects.

Harris reported users can employ Emerson's digital transformation capabilities to accomplish projects, such as reliability of equipment and systems, process safety, production optimization, energy monitoring, maintenance, corrosion monitoring and others. "Our Digital Transformation business provides customers with the engineering and solutions to solve known problems," explained Harris. "The initial problem for many users is they try to take a big-bang approach to digital transformation that tries to solve everything at once, invest in technology without considering specific problems or objectives first and often end up lacking ROI and becoming frustrated."

Pilots help scale-ups take off

Once digital-transformation initiatives define their problems/solutions and goals, they must develop proofs of concept and pilot projects that can demonstrate some of that much-needed ROI, Harris reported. This not only encourages further commitment and investment, but helps participants to scale up their solutions to many more applications that can achieve similar advantages and benefits.

"Many digital transformation pilots can get started for $50,000 to $100,000 in one or a few processes, prove themselves and then scale up to many processes and save millions or tens of millions of dollars," said Harris. "Emerson benchmarks many industries, and we've learned that digital transformation is urgent because it can help users achieve top-quartile performance, add two weeks of uptime, cut maintenance incidents in half or reduce safety incidents by 30%."

People crucial to transformation

Beyond specifying problems, goals and technologies, digital transformation can't happen without the deep and continuous engagement of people, especially those on the plant floor, Harris explained. "Executive support is essential, and IT has to be involved; but it's most important for the operations folks to be engaged because they have the domain knowledge about where it's best to apply digital transformation," he added. "Every functional group can contribute and take on new roles. They can serve as bridges connecting lines of stakeholders or develop internal academies to train colleagues how to use new analytics tools. We provide technical resources and curriculum development to more than 350 educational institutions to help people develop the skills that employers need.

"Customers are looking for a partner that can help them on their digital-transformation journeys, and establishing our Digital Transformation business puts Emerson in a better position to be that credible partner that can help customers achieve measurable business impacts."

UP DIGITAL-TRANSFORMATION PROFITS

By Paul Studebaker

It's becoming clear that taking profitable advantage of digital transformation depends on the ability to draw on the right set of a vast and evolving array of technologies. No one facility needs them all, at least not right away, but the odds of success will rise with wise selection.

Numerous presentations at Emerson Global Users Exchange in Nashville, Tennessee, made it clear that Emerson has been working to make available a full range of "digital transformation technology enablers," according to Peter Zornio, chief technology officer, by extending the company's portfolio of "operational analytics," the technologies that bring results where the greatest profit potentials are commonly identified: reliability, performance and energy efficiency.

Zornio announced four new Plantweb Insight applications, providing templates for monitoring, troubleshooting and optimizing cooling towers, pressure relief valves, networks and power modules. Plantweb Optics v1.5 asset performance management platform expands connectivity and increases collaboration, and new Digital Twin software-as-a-service for well exploration and production has added a model for subterranean systems.

Advancing the operational analytics portfolio

"Customers want to use analytics to look at data, convert it to information and use it to improve plant performance," said Manasi Menon, product manager, analytics and machine learning with Emerson's Automation Solutions business.

Operational analytics often use principles-driven analysis on individual units and data-driven analysis on the plant—a combination of units. Principles-driven analytics are for equipment or systems that follow known physical principles, such as gearboxes or steam traps. Data-driven analytics use statistics and tools such as artificial intelligence (AI) or machine learning to derive correlations and probable causes where interactions are not as well-defined.

Plantweb Insight principles-driven analytics are available for common and some less common assets, from pumps and heat exchangers to corrosion and cooling towers, including the recent additions of power modules and network management.

Integrating KNet software, acquired in April, brings data-driven analytics and first-principles failure mode and effects analysis (FMEA) templates for 492 asset classes. Data and information acquired through standard connectors such as OPC, control systems (DCS or PLC), process flow diagrams, FMEA and historians can be processed by KNet process and asset models, machine learning and online analytics to provide actionable failure mode analyses, workflows, predictive insights and key performance indicators (KPIs).

For example, on a debutanizer, Reid vapor pressure (RVP) is controlled to maintain efficiency. "KNet can

"Get answers from your hidden data, and make them available through PlantWeb Optics." Manasi Menon, product manager, analytics and machine learning with Emerson's Automation Solutions business.

calculate and predict RVP, using root cause analysis embedded in decision and fault trees," Menon said. "The 492 FMEA templates can be embedded in the fault trees for faster analysis."

Going forward, "KNet will be integrated in Plantweb Optics so customers using Optics can embed more predictive maintenance," Menon said.

As a result, "former silos are integrated," Menon said. For example, information from AMS Device Manager (instrument and valve health), DeltaV (control loop performance), KNet (first-principles and data-driven analytics) and AMS Machinery Manager (machinery protection and health) can be presented to mobile devices and augmented-reality (AR) systems, integrated with computerized maintenance management system (CMMS) workflows, and rolled into Plantweb to provide persona-based content delivery to operators, engineers and technicians.

"Augmented reality, external data and enhanced Optics for faster views are coming, and services are available to develop these systems for you," Menon said. "Get answers from your hidden data, and make them available through PlantWeb Optics."

DIGITAL TOOLS IMPROVE COLLABORATION, SPEED AND PRODUCTIVITY

By Dave Perkon

Emerson is transforming how its customers work through the personalized digital experience called MyEmerson. "Expectations are changing, and digital is enabling those expectations," said Brad Budde, vice president of digital customer experience with Emerson's Automation Solutions business, during Emerson Global Users Exchange in Nashville, Tennessee. "U.S. households are spending more than six hours a day with digital media, and the same kind of trend is happening in e-commerce. The consumer expects speed and a wide range of options and choices, and they don't have time to run errands. Those expectations, personally at home, are being brought to work."

Speed and preferences to use a self-service, personalized tool to complete tasks and conduct business are important, especially to engineers, said Budde. Emerson identified three key personas getting value out of these digital capabilities. These include engineers working with CAD drawing downloads and engineering tools who are digitalizing to size and select products; procurement managers and departments looking for digitalization to create operational efficiencies; and plant technicians digitalizing the way they do work to be more informed when they go on-site and use mobile tools, digital processes and workflows to execute their work.

"Improved collaboration, speed and productivity are realized by moving historically off-line work processes online using digital tools," said Budde. "In reaction to that, Emerson has announced MyEmerson as a personalized online user experience. We have had this capability for a few months now and are rolling it out publicly." It currently has more than 7,000 active users.

MyEmerson has been a seamless experience for customers, and has several key capabilities. It includes MyWorkspace, where engineers can size and configure products, create drawings and collaborate. The MyTransactions component allows information to then be shared with the procurement department for price, quotes, planning and order history. The resulting information is moved to MyAssets to view asset records, access product documents, maintain assets and schedule service. MySoftware provides "front-door" access to download and manage licensed software. MyTraining lists training records and relevant training courses. And, finally, MyPreferences lets the user tailor the experience.

"MyEmerson provides a customer a single place to do work," said Budde. "For example, the digital experience may include specific content for a flow asset based on its serial number. However, it's more than just a singular

"Improved collaboration, speed and productivity are realized by moving historically off-line work processes online using digital tools." Emerson's Brad Budde announces MyEmerson as a personalized online user experience at Emerson Global Users Exchange in Nashville, Tennessee.

personal experience. It's also important to collaborate with your peers."

An example of how that would work may start with the installation of a wireless pressure gauge for pump-seal monitoring. "Once the ROI is proven, the reliability supervisor may decide to scale it across the enterprise," said Budde. "Using the digital experience, supervisors can look at MyAssets to understand how the original solution was implemented. That information can seamlessly be used in the MyWorkspace environment, where they can collaborate with engineers and change any specification needed to localize it as needed. They can then pass the information on to the procurement manager, who can help plan delivery in MyTransactions based on lead times, delivery dates and order histories. The procurement manager then coordinates and communicates with the plant technician to ensure successful delivery. The technician can then install the device and the operations team updates the workflows and applies analytics to realize the ROI at scale. This whole loop brings together operations and all the other people who work together using these digital tools in the MyEmerson collaboration environment, meeting the digital expectations in the workspace."

MyEmerson is significantly faster than the traditional off-line methods of the past, said Budde. "For example, compared to the off-line method of creating CAD drawings based on the information found in catalogs, the new digital capabilities of simply downloading a drawing and importing it into the CAD system is 93% faster, saving several hours," said Budde. "Digital engineering tools show a similar time savings. Building the part configuration using a visual configurator is very fast. Digital procurement tools are fast, as well. Instead of passing several emails to get all the information and quotes needed to get a part ordered, it can be done immediately online."

The digital experience can help plant technicians, too. "In the old way, the technician would find the serial number and go to the manufacturer to try to get the history of the device," said Budde. "In the new way, the technician can look up the serial number in MyEmerson and receive the content immediately."

The field-service tools already deployed have helped technicians get the right information, the right processes and the right training in advance of executing that service, continued Budde. "What we found is, in the old way, our first-time fix rate was 75%," he said. "With the new digital tools in MyEmerson, the first-time fix rate went up to 85%. We are better executing service using digital tools."

WIRELESS GIVES DIGITAL TRANSFORMATION WINGS

By Jim Montague

Many ingredients, such as software, networking, microprocessors, cloud computing and the Internet of Things, combine to make digital transformation possible, but the one that can help as much as the others and might be overlooked is wireless technology. Because it can take industrial networks into previously inaccessible locations and gather signals that used to be stranded, wireless can give users more of the data and benefits needed to boost their digital-transformation efforts and justify investing in them.

"We believe there are three main elements in using wireless to aid digital transformation. These elements include secure connectivity and choosing the right wireless network for transferring data to where it can be analyzed; determining how the infrastructure will support pervasive sensing; and, in our case, two new Plantweb™ digital ecosystem applications in the areas of asset health for pre-configured analytics and workforce effectiveness for digitally enabled users," said Tom Bass, product management director for wireless with Emerson's Automation Solutions business, at Emerson Global Users Exchange 2019 in Nashville, Tennessee.

Choose wireless wisely

"There's been a massive deployment of wireless in the process industries during the past 12 years, and this has led to an increase in choices. However, users still need to decide which wireless to invest in and what criteria to use," explained Bass. To determine which wireless infrastructure is most suitable, it must:

- fit with the user's existing security architecture
- possess simplified network management
- be certified for hazardous locations and conditions
- have deployment flexibility
- be future-proof.

"Field and plant networks must work seamlessly to successfully deliver operational analytics solutions, but their users also have to address some unique industrial automation features," added Bass. "For example, plant networks have to account for different data rates and ranges and whether they're licensed or unlicensed protocols. Meanwhile, field networks have to address update rates, battery life and scalability issues."

Hardware lends a hand

To give its users some tangible assistance in deploying wireless for digitalization in those fields or plants, Emerson is bringing its 13 years of experience in pioneering and implementing wireless to bear and partnering with longtime collaborator Cisco on a new wireless-networking solution. Combining Emerson's expertise in industrial automation and applications with Cisco's innovations in networking, cybersecurity and IT infrastructure, the new Emerson Wireless 1410S Gateway with the Cisco Catalyst IW6300 Heavy Duty Series Access Point combines the latest in wireless technology with advanced WirelessHART

"There's been a massive deployment of wireless in the process industries during the past 12 years." Emerson's Tom Bass reminds users to choose wireless wisely at Emerson Global Users Exchange.

sensor technology, delivering reliable and highly secure data, even in the harshest industrial environments.

Wireless 1410S Gateway access point provides enhanced Wi-Fi bandwidth necessary for real-time safety monitoring, including Emerson's Location Awareness and wireless video. These applications enhance personnel safety practices, improve plant security and help to ensure environmental compliance. A reliable and fast connection between devices and people streamlines decision-making by providing real-time analytics. It also enables a mobile workforce to virtually come together, collaborate and resolve critical issues quickly. Wireless 1410S Gateway also supports mobile applications that offer immediate access to process control data, maintenance information and operation procedures, enabling improved plant productivity and worker safety.

Wireless 1410S Gateway features:

- Class I, Div. 2 certification
- flexible connectivity with three power-over-Ethernet (PoE) and one small-form-factor-pluggable (SPF) port
- ac/dc and PoE for power redundancy
- fiber capability
- lightweight, compact design for simpler deployment in extreme temperature ranges
- up to 200 devices on WirelessHART, and up to 100 devices on ISA100
- resilient mesh-architecture support based on 802.11 AC Wave 2
- improved temperature range of -50 °C to 75 °C.

Apps and sensing on tap

Back on the software side, Emerson has released two new Plantweb infrastructure analytics apps, which are part of the overall Plantweb Insight analytics portfolio that already has seven other apps.

- Power Module Management provides calculated insights about power-module status, estimated remaining life and estimated total lifespan. Its benefits include access to power-module status from multiple Emerson gateways, effective maintenance planning to replace power modules and awareness of short-lifespan power modules.
- Network Management provides calculated insights about network status, network best practices and gateway load. Its added features include network diagram, consolidated syslog alerts, and IP address, network ID and firmware version lookup.

In addition, Bass added that Emerson has released three more technologies to its 21-member Pervasive Sensing portfolio. Its new solutions include:

- location tags and anchors that can digitally transform facility safety with a WirelessHART-based location awareness system
- expanded toxic-gas monitoring capabilities for H2S, CO and O2—similar to the H2S sensor, the CO and O2 depletion sensors are smart sensors that store calibration data on the sensor itself
- AMS wireless vibration monitoring to provide triaxial vibration and temperature monitoring with embedded PeakVue analytics to predict bearing issues.

"All of these capabilities demonstrate why investing in an appropriate wireless infrastructure is part of the foundation for digital transformation success," concluded Bass.

CLOUD MIGRATIONS AND IT-OT COLLABORATION JUST GOT EASIER

By Mike Bacidore

Emerson's consultancy expertise in designing and implementing data-management solutions has expanded since the 2018 acquisition of Canada-based iSolutions. "The data-management team has both project-delivery and lifecycle components. It's part of the systems and data business functions, and it's a key component to digital management functions," said Anil Datoo, vice president, data management with Emerson's Automation Solutions business, explaining the scope of a new consulting team's capabilities at Emerson Global Users Exchange in Nashville, Tennessee. The consultancy specializes in IT/OT data management, solution architecture, design and implementation.

The recently acquired services and capabilities extend Emerson's existing abilities to integrate and expose data. Four key areas of expertise include data-historian platforms, cloud migrations from on-premise to the cloud using the Magnotix tool to stream data, business intelligence reporting, and an industrial data-management toolbox.

Solid data-management and integration strategies enable better data strategies and stronger IT-OT collaboration. Opportunity vetting and ROI-based proof of concept are executed in a vendor-agnostic environment, while IoT modernization and cloud migrations can be completed more smoothly with the Emerson consulting team's assistance.

The team supplements Emerson's operational-analytics portfolio to enable self-serve intelligent organizations. "We encounter users interested in increased visibility," said Datoo. "The key benefits we provide include improved work prioritization from timely awareness of impacts; improved communication between field and office personnel; contextualized source data sets for deeper analytics; and reduced load and improved security for control infrastructure."

One use case Datoo identified revolved around IT-OT collaboration at a chemicals plant, which managed polyethylene product quality excursions by allowing subject-matter experts (SMEs) to analyze correlations between product qualities.

Using Aspen IP.21, Magnotix, operator logs, a laboratory information-management system (LIMS) and Microsoft Azure, the plant was able to reduce polyethylene production excursions by understanding interactions between catalysts and feedstocks more effectively.

"We believe data management is a key enabler of digital transformation solutions. We try to stay vendor-agnostic, so our platforms are able to connect to any device or control systems. If the data-management layer is built properly, that layer is where you would centralize the analytics and the visualization," said Datoo.

"Digital transformation is largely brownfield," explained Peter Zornio, chief technology officer with Emerson's Automation Solutions business. "Anil's team is the part that does the data integration. It's a business process. We see the need for a consulting group to tackle that."

"We believe data management is a key enabler of digital transformation solutions." Emerson's Anil Datoo explains the need for consulting expertise at organizations.

LYONDELLBASELL ELIMINATES SIS TRIPS WITH DIFFERENTIAL PRESSURE FLOW SOLUTION

By Jim Montague

It takes a lot of petrochemical production capacity to make the building blocks for the world's clothing, packaging, construction materials, auto parts, furniture and bedding. And at 3,900 acres and about 2,000 employees, LyondellBasell's Equistar Chemicals complex in Channelview, Texas, is one of the biggest on the U.S. Gulf Coast.

The complex has two world-scale olefins units that manufacture ethylene, propylene, butadiene and benzene, and in 2015 two new cracking furnaces were added that were three times the size of the older units. Within each furnace, gas to be cracked passes through eight tubes instrumented with eight pressure transmitters per tube—four for the feed and four for dilution steam. Each tube also has two orifice plates, one each to measure the hydrocarbon feed rate and the other to measure the dilution steam flow rate. Each of the orifice plates has four differential pressure (D/P) transmitters installed across it, including one for the basic process control system (BPCS) and three for the safety instrumented system (SIS).

"Each of the eight tubes runs hydrocarbons through it for cracking into other products, but failure to control the flow could cause a fire and burn the furnace down," said Wes Nance, senior I&E and IEA reliability engineer, LyondellBasell, who presented "Run and don't trip: LyondellBasell improves SIS on cracking furnace feed and dilution steam flows" at the 2019 Emerson Global Users Exchange in Nashville, Tennessee.

Overcoming some flaws

To operate the furnaces safely and reliably, LyondellBasell had to compensate for some design and engineering flaws, Nance said. "The EPC firm we bought the license from built the furnaces to their specifications, not ours, so important details concerning the process were either not known or not considered," he explained. "These included excessive impulse line lengths greater than 50 feet in distance and more than 30 feet in elevation, as well as poor choice for scaling upper range value (URV) that was originally set at 25 inches of H_2O."

"This poor design and engineering resulted in massive problems with furnace reliability. We had multiple furnace trips due to inaccurate measurements and excessive variability from both feed and dilution steam meters. Startups required calling out a technician to blow down transmitters and readjust the zero. And we had recurring Priority 1 work orders to correct problems, which interrupted maintenance schedules and was detrimental to productivity."

Nance added that early corrective actions included changing the initial orifice place to create larger differential pressure, re-ranging transmitters to 0-100 inches of H_2O. "These early measures reduced frequency of failures and deviations, but not to an acceptable level," said Nance. "We were concerned that these errors could threaten the reliability of our whole furnace expansion project.

Nance reported that he and his colleagues also found several other root causes of poor furnace performance.

"In all, less sweat, less stress and more money." LyondellBasell's Wes Nance discussed the successful installation of a Rosemount D/P flow measurement solution that has eliminated cracking furnace trips due to feed or dilution steam flow-metering errors.

For example, in the dilution steam meters, taps were fouling due to sludge in the dilution steam, and blow downs of the meters would blow particulates into their diaphragms causing premature failure. The orifice plates also had inadequate diameters of upstream straight pipe run, and the long impulse lines allowed large variations in the static head.

"The 15 diameters we had weren't enough," said Nance. "We also had two elbows in the line, and needed closer to 45-50 diameters." Also, condensate was collecting unevenly in the impulse lines because they were too long.

A better alternative

Nance added his team considered several flowmeter alternatives to address its furnace performance issues:

- Strap-on ultrasonic flowmeters would increase costs, but weren't widely used or proven in this application;
- Coriolis flowmeters were known to be quite accurate, but this most expensive option would require piping modifications and incur excessive pressure drop;
- Vortex flowmeters also would require piping modifications, but importantly only were available in dual-transmitter configurations insufficient to meet necessary safety integrity level (SIL) requirements;
- Meanwhile, revamping the original D/P approach promised to be the least expensive option as well as simplest to maintain, even though it wasn't the most accurate.

In the end, they chose to stick with a revamped D/P solution. "D/P was accurate enough for our application, even though it wasn't as accurate as the other options," Nance said. "Plus, they were the easiest to maintain and least costly, and we could maintain three out of four (3oo4) voting. Our other design goals were to eliminate the fouling due to the sludge in the dilution steam; eliminate the head errors from the impulse lines; improve ease of maintenance; and increase our flow measurement accuracy and reliability."

Because the straight-run piping associated with the original orifice plates was too short, Nance and his team selected Emerson's Rosemount D/P solution with a 1595 four-bore conditioning orifice place (COP) that combines a flow conditioner with an appropriate orifice plate. This approach works to create a uniform flow profile in a relatively short pipe run, improving flow measurement accuracy.

"Four holes give the best possible flow profile in 2-in. to 24-in. or larger lines," said John Scott, executive account manager, Emerson. "Rosemount 1595 conditioning orifice plate only requires two diameters upstream and downstream of any flow disturbance, while up to 50 diameters are required for conventional orifice plates."

The Rosemount D/P solution adopted by Lyondell-Basell also used a remote-seal assembly with 1199FFW flush-flanged seals, and Duplex 2507 SST diaphragms that are durable in slurry applications where 316L steel can be damaged. It also included 2-meter (6.6-ft) capillary lengths, and Tri-Therm 300 fill fluid that can handle -40 °F to 572 °F temperature extremes, and met specs without heat tracing for Houston's relatively mild ambient temperatures.

A plan comes together

"Using remote seals on the transmitters eliminated damage from the sludge, while the 2-meter capillaries got the transmitters far enough away from the heat, but still kept them close to the process," Nance said.

Meanwhile, the feed transmitters used a design that inverted the typical pipe mount. "We also learned it was best to mount the tap for a transmitter at an angle that positioned it between the holes in the orifice plate. If we hadn't done this, it would have made a big difference in our readings and we wouldn't have known why. Partnering with Emerson really helped prevent this issue."

Thanks to its improved flow designs, conditioned flows, and other measurement improvements, Nance reported the dilution steam meters variability was reduced from about 22.5% to about 3.75%, while the feed meters variability improved from 23.8% to about 1.25%.

"Since installation of our Rosemount D/P solution in 2018, we've had no ethylene furnace trips due to feed or dilution steam metering errors," added Nance. "We've also had significant reductions in I&E maintenance to check and repair meters, and increased furnace availability and profitability. In all, less sweat, less stress and more money."

LISTEN FOR TUBE-BUNDLE LEAKS TO CUT HRSG DOWN-TIME

By Dave Perkon

The varied availability of alternative energy sources, such as a solar and wind power, has contributed to combined-cycle power plants operating intermittently, sometimes many times a day. This cycling operation of gas turbines, for example, increases thermal stress to many components, specifically tube bundles within the associated heat recovery steam generators (HRSGs). Tube failures in HRSGs are among the most prevalent causes of unplanned outages at combined-cycle facilities.

A new, non-invasive technology to help eliminate these outages was discussed at the 2019 Emerson Global Users Exchange in Nashville, Tennessee. A large western utility worked with Emerson as well as Nooter/Eriksen in St. Louis, to deploy Rosemount 708 wireless acoustic transmitters to detect leaks in the HRSG tube bundles of the combined-cycle power plant.

"This is a classic example of pervasive sensing used in a new application," said Shane Hale, Emerson's global director of business development for wireless, at Emerson. "This is a new application for wireless technology. It wouldn't make sense installing it in the traditional wired way. Because we don't have wires, we can install it in days, and, in many cases, less than a day."

With a legacy dating back more than 100 years, Nooter/Eriksen has long been a manufacturer and OEM for HRSGs. "They have supplied over 1,000 HRSGs each on the back end of a gas turbine as part of a combined-cycle facility," said Chris Short, executive field sales for Emerson's measurement and analytical business. "The HRSG creates steam from the hot exhaust of the gas turbine that is then fed to a generator. It also feeds high-pressure steam back to the turbine to generate additional power by helping with regeneration. These systems generate anywhere from 2 MW to 300 MW of power."

Frequent cycling stresses tubes

The root cause of the tube-leakage problem is the variable availability of the alternative energy sources that were not around when these facilities were built. Today, intermittent production of wind and solar electricity requires these combined-cycle facilities frequently ramp up and down.

"The facilities were not designed for the thermal cycling they're now seeing on a regular basis," explained Short. "They were designed to run 90% of the time and not to be turning on when the wind stops or a large cloud passes overhead. The thermal shocks are stressing the system, and we have heard from our customers that tube leaks are the number-one failure leading to an unplanned outage in a combined-cycle facility. Typically, that means $100,000 to $200,000 of lost profit per day. And these unplanned outages can last anywhere from three to five days, depending on workforce and material availability."

The current way that most tube-bundle steam leaks are detected is by the presence of condensate in the exhaust gas found during manual inspection rounds. "A second way is by looking at the flow of steam makeup water, but small changes make small leaks very difficult to detect," said Short. "A final way is to test for leaks when the turbine is down by pressurizing the tubes and listening for

"These facilities were not designed for the thermal cycling they're now seeing on a regular basis." Emerson's Chris Short, together with colleague Shane Hale explained the financial benefits of HRSG early-steam-leak detection at the 2019 Emerson Global Users Exchange.

air leaks. But at that point, it is almost too late as it could take days to receive materials for repairs. All of these methods are very reactive."

A more proactive way is to use the acoustic sensor technology of the Rosemount 708 to detect steam leaks. "This wireless transmitter listens for ultrasonic acoustic signals, and it also has a temperature sensor," said Hale. "It was originally designed to detect failed steam traps, but, with the proven ability to listen, we looked for other applications. It turned out this is a really good application that otherwise took a manual check."

The sensor itself detects ultrasonic frequency sound in the 35 kHz to 45 kHz range. "It's beyond the audible range for humans, and beyond range for pump noise, for example, but right in the range of a steam leak," said Hale. "It talks wirelessly via a WirelessHART network, which makes installation quick and easy."

Essentially this sensor listens for the ultrasonic whistle of a steam leak inside of an HRSG. "Two issues are how to detect a leak inside and where to mount the sensors," said Hale. "Fortunately, there are many places temperature is measured in an HRSG, and the thermocouple is a large metal tube, a thermowell, that extends into the HRSG. It turns out the thermowell is a good amplifier or microphone for an ultrasonic signal—an acoustic antenna. We simply strap the acoustic sensors to the thermocouples that already exist. It's a non-invasive installation that takes just minutes to install."

Dramatic project ROI

The acoustic transmitter does not provide a waveform or frequency of the sound detected because that would quickly drain the sensor's battery, explained Hale. "Instead, the sensor outputs acoustic counts between 0 and 255," he said. "The WirelessHART in the sensor is designed to give you as much information as you need, but it also needs to conserve battery. In this application, the battery will last five to 10 years depending on the configured update rate. If the actual waveform was transmitted, the battery would only last about a year."

Over time, when the monitored acoustic count goes up, there is a leak. "When the leak is detected, it doesn't mean the system needs to be shut down immediately; the increasing acoustic count indicates maintenance needs to plan to fix the leak during an upcoming shutdown. In the past, repairs of a leak found during a scheduled pressure test could take days."

"If you can detect the leak early, you can likely patch it to fix it quickly," said Hale. "If not, the repair can be a major project, keeping the system down for several days instead of an eight-hour shift," he said. "It's a huge business advantage to know of the leak early."

WIRELESS ILLUMINATES PERFORMANCE AT TVA

By Jim Montague

The Tennessee Valley Authority (TVA) delivers electricity to about 10 million residents in parts of seven states, and part of this mission is carried out by 24 units at eight combined-cycle plants that need continuous condition monitoring to improve performance.

To update, improve and expand its condition monitoring, TVA sought to implement Etapro performance monitoring and predictive maintenance software about 18 months ago to create physical models that could continuously monitor heat rates and steam flows to increase overall operating efficiencies, improve reliability, recognize abnormalities and reduce downtime, according to Susan Hobbie, PE, senior I&C engineer, Merrick & Co., an engineering services firm that collaborated with TVA on the project. However, the cost and complexity of bringing in all these parameters quickly turned into an obstacle.

"We originally considered using wired 4-20 mA, serial, analog HART or Foundation fieldbus, but the quantity of instruments involved and networking costs quickly increased to $2-3 million. To minimize these expenses, we settled on using WirelessHART to monitor the 40-60 new instruments we added at each plant," said Hobbie, who presented "TVA uses wireless as backbone for performance monitoring" at the 2019 Emerson Global Users Exchange in Nashville, Tennessee. "These plants also had all different layouts, with two or three units each and control rooms in different locations, so that was another challenge in designing wireless solutions for them."

Hobbie reported that digital modernization with WirelessHART would let it serve as the combined-cycle plants' measurement backbone, and create the physical models that TVA wanted to measure applications, including wireless heat recovery steam generator (HRSG) monitoring, wireless circulation water monitoring, wireless leak valve detection, and wireless weather monitoring.

"We estimate that wireless saved more than $580,000 over the eight plants, which was 15-20% of the total project's material and construction costs, No wire or conduit was needed, minimal downtime was required, and there were no new or extended outages," added Hobbie. "These savings were achieved even though the different control room locations and other unique features required custom WirelessHART designs for each facility.

"Even though we used our existing DCS infrastructure wherever possible, we realized we couldn't design all of these wireless networks ourselves. It was a big help that Emerson came to every site and helped us select the right antennas, such determining when extended-range was needed."

Major wireless players

John Hillencamp, senior sales engineer, Emerson, added that the wireless networks at TVA's eight combined-cycle plants are using Emerson's 1410 gateways with antennas

"By implementing wireless, TVA now has a digital infrastructure that can be expanded with minimal cost, and with just a 1.5% increase in efficiency at one unit, we could save millions of dollars, and achieve project payback in one year." Merrick and Co.'s Susan Hobbie discussed a money-saving wireless infrastructure project at the Tennessee Valley Authority.

that can be 600 feet away from the transmitters and devices trying connect with them to deliver their data.

"There's a lot of steel in these plants, so it can sometimes be hard to get a signal from a HRSG transmitter to the gateway, but we can use regular or extended-range antennas as needed," said Hillencamp. "We didn't really have ay communication problems at TVA's eight plants because the software they're using only needs to be updated about once per minute. This also enables their batteries to last 8-10 years. We also used the AMS Wireless Snap-On application for managing the wireless networks."

Hillencamp reported that one of the most prevalent components employed at TVA's combined-cycle facilities was Emerson's Wireless 248 temperature transmitter. The 248s worked well for steam drain valves because they have a magnetic temperature sensor that can determine valve position and detect drain valve leaks. Many of these transmitters were installed with Type K thermocouple probes. "They were too costly to put on each transmitter, but they went on 20-30 prioritized valves per plant," added Hillencamp. "Some of these valves were losing $1,782 per month, but using these sensors could pay back their cost twice in one month, so TVA is planning to use more of them."

Similarly, HRGC monitoring was needed because flue gas was fouling, corroding and plugging its tube bundles. Rosemount 3051 S CD2 pressure transmitters were used on the HRSGs because they could maintain designed flow paths, preserve HRGC efficiency, and detect plugged impulse lines.

To monitor ambient weather conditions, Hillencamp added that TVA also implemented Rotronic temperature and humidity sensors along with its Wireless 248 transmitters. "This lets operators know when to chill inlet air a bit more, which can help make the HRGCs more efficient," he added.

Continuous is comprehensive

Beyond implementing tailored wireless designs at TVA's combined-cycle plants, Hobbie and Hillencamp reported they and their colleagues also needed to account for the different DCSs at each facility, so they could achieve continuous monitoring.

"The plants had standardized on Emerson's Ovation, but some also had DeltaV or a DCS from Siemens or ABB," said Hillencamp. "However, the flexible gateways and protocols we chose could be used with Ovation, DeltaV, Modbus and AMS at all eight plants."

Hobbie reported this flexibility was important because it helped TVA achieve its goal of adopting continuous monitoring instead of periodic monitoring. "Periodic field testing only provides a snapshot of a specific moment in time, which means users have to make assumptions," explained Hobbie. "By monitoring real-time continuous data, we can improve reliability, recognize abnormalities and decrease downtime."

Hillencamp added, "This is the first big wireless project for TVA, so its methods and benefits are likely going to spread to other areas, such as its fossil plants."

Hobbie concluded, "TVA can now create physical performance models as ambient conditions change, which will affect how much steam and power can be produced. By implementing these wireless technologies, TVA now has a digital infrastructure that can be expanded with minimal cost. And, with just a 1.5% increase in efficiency at one unit, we could save millions of dollars, and achieve project payback in one year."

DENKA STARTS SMALL FOR BIGGER EFFICIENCIES

B Mike Bacidore

Because most digital-transformation initiatives are brownfield projects, there's a lot to be said for starting small and then scaling up to a larger implementation, whether it's regionally or corporate-wide.

Many organizations fail to achieve digital transformation because they invest heavily to make a big bang and then wind up in pilot purgatory, explained Jonas Berge, senior director of applied technology, Emerson. He and Ng Hock Cheong, head of maintenance at Denka's styrenic resins plant in Seraya, Singapore, explained during a 2019 Emerson Global Users Exchange session how the 23-year-old chemical plant avoided the pitfalls of purgatory by reducing equipment downtime and steam consumption in small pilot projects.

The Denka plant faced many challenges with manual operation and equipment failure. The affected machinery that was identified for the projects included steam traps, cooling towers and centrifugal pumps. And field-personnel safety was also marked for improvement.

Previously, steam traps were monitored in a yearly manual survey using a portable tester. Steam-trap failures went undetected, which affected energy consumption and product heating. This would lead to product-quality issues and ultimately a time-consuming cleanout.

The cooling towers posed a different type of challenge. Plant maintenance technicians were unable to measure vibration on the gearboxes because they resided inside protective shrouds. Surprise failures would occur, and the damage required difficult and expensive repairs, which resulted in lost cooling capacity.

A monthly manual survey of centrifugal pumps was being done using the portable vibration tester, too. Sometimes serious damage would occur, and expensive repairs were needed due to extreme operating conditions.

Finally, a man-down situation at another site had gone undetected, so it was decided to use the Seraya site to pilot a real-time locating system (RTLS) to assess its feasibility, as well.

Phase 1 of the project included a seven-month IIoT steam-trap proof of concept, which began in August 2015. It's now been in full operation since March 2016. In Phase 2, the plant increased the number of steam traps monitored and then added cooling-tower monitoring and centrifugal-pump monitoring, as well as the commencement of RTLS testing.

"The plant was moving from manual processes to automation-software-based and data-driven ways of working," explained Berge. "They have an existing DCS, which we had to protect. That was one of the criteria for creating the open architecture. We created and added a digital operational infrastructure (DOI), which is independent of the DCS." The additional DOI includes pervasive sensing at the base, with pervasive networking. Analytics and reporting are built on top of that.

"It started with the IoT sensors, and the data was aggregated into software," explained Berge. "Then it takes in data from the DCS. The last step is integration with the

"Steam consumption was reduced by 7%, and the assured product heating improved product quality and yield." Denka's Ng Hock Cheong explained how starting small can yield big results at the 2019 Emerson Global Users Exchange.

ERP. Digitalization was executed in phases, not a big-bang approach."

One step at a time

Reducing steam loss is critical in any facility. The Denka plant began by adding two-in-one sensors to 148 steam traps for acoustic and temperature monitoring. Samples were taken every minute. "The analytics and reporting are done across the cloud using industrial protocols," explained Berge. "This model was very revolutionary in its time." The AMS 9420 wireless vibration transmitters belong to Emerson, and they are included as part of the subscription-based service. The sensors are WirelessHART. Data goes to a cellular router and then into a Microsoft Azure cloud instance that is managed by Emerson. A periodic report, identifying which steam traps need to be replaced, is generated from the cloud analytics. The project was then expanded to 214 steam traps, covering the majority of steam traps in the plant.

The cooling-tower solution was implemented on the cooling-tower gearboxes. "They were instrumented with vibration sensors to predict bearing issues," explained Berge. The data could be analyzed in the cloud via IIoT-based connected service or analyzed "on-prem" at the edge using the Plantweb dashboard. "The data drives maintenance activity, such as an oil change," said Berge. Like the cooling-tower gearboxes, the centrifugal pumps were instrumented with vibration sensors for monitoring, using an hourly sample.

The new man-down solution was targeted at warehouse personnel, who were issued location tags. On-prem software offers man-down alarming, rescue locating, evacuation-mustering headcount and geofencing. With the proof of concept now successful, it is being considered to scale to the main plant eventually.

The proof is in the pilots

"Steam consumption was reduced by 7%, and the assured product heating improved product quality and yield," explained Ng. "The cooling-tower monitoring reduced maintenance cost and downtime. Time between cooling-tower fan overhauls went from three years to five years."

The same result occurred for the centrifugal pumps, extending time between overhauls from three years to five. And the condition-based monitoring helped to reduce downtime.

The man-down system promises faster detection of safety situations. "We have faster response time for the rescue team," said Ng.

"Overall, we wanted to reduce manual operation," explained Ng. "With the digital transformation of these pilots, we were able to improve the plant operation, maintenance and reliability. We will include many more in the future."

SELF-TESTING LEVEL SWITCHES SAVE $600K AT MARATHON

By Paul Studebaker

The Marathon (formerly Andeavor Logistics) natural gas and natural gas liquids (NGL) process facilities in the Uinta Basin, centered in Red Wash, Utah, can throughput more than 2,900 MMCF/day with natural gas inlet processing capacity more than 1,500 MMCF/day. It has 16 compressor stations distributed over 4,000 square miles in Utah, and 88 compressor stations in Wyoming and North Dakota.

"We have four I&E technicians doing a lot of drive time—some of the stations are four hours out," said David Van Leuven, I&E supervisor, Marathon, in a presentation at the 2019 Emerson Global Users Exchange in Nashville, Tennessee.

"The vessels we focused on here are the scrubber bottles, two to four per compressor," Van Leuven said. "The existing float level switches in the scrubber bottles were unreliable--gas coming back in from the first-stage scrubber would have liquid that would shut the compressor down."

To guard against failed level switches, "We thought we wanted a probe in the gas stream to the compressor that would detect high liquid level," Van Leuven said. "We tried adding a tuning-fork switch in the compressor inlet, but it always thought it detected liquid, and tuning it didn't work." On a suggestion from the vendor, they moved it back in the nozzle, which seemed to work, but they were still concerned.

"Around that time, Karl came in and suggested we try a Rosemount 2140 level switch in the scrubber bottles," Van Leuven said. Karl White, senior sales representative, Emerson, co-presented with Van Leuven and Derek Hanni, senior I&E technician, Marathon.

The Rosemount 2140 is a vibrating-fork level switch that is virtually unaffected by foam, turbulence, vibration, solids content, coating products or liquid properties. As a HART device, it integrates into existing wired HART loops.

"The design of the switch resists fouling, and you can tune out splashing and false switching," said White. "They can be partial-proof-tested locally or remotely."

The scrubber bottle is the last stage of protection before gas enters the compressor. "It removes any residual fluid from the gas stream," said Hanni, "So, we need a way to shut off the compressor if there's too much liquid in the scrubber bottle."

The existing float-style switches had parts that could be sucked into the compressor, which was a safety risk to personnel and the equipment. The float switches also are complicated to disassemble, clean and test. "It's very time-consuming," Hanni said.

Technicians were able to put the 2140 in the exact position same as the float switch, which saved a lot of installation time, lockout and tagout. "Before the 2140, the hardest test during maintenance was the float switches," Hanni said. "Now, the 2140 partial-proof test takes less than a minute. You press a few buttons, the device performs a self-test, and the display shows the status during the test and the test results. The 2140s freed up a lot of time because we didn't have to pull them out to check them." That also reduced technician's PPE requirements, and exposure to the process.

"The 2140s freed up a lot of time because we didn't have to pull them out to check them." Derek Hanni of Marathon (left), co-presented with Karl White of Emerson (center) and David Van Leuven, Marathon.

The trial led to the purchase of 220 instruments. That investment is paying off in increased revenue by avoiding maintenance shutdowns and avoided cost of manual testing. Marathon calculates ROI as 34% with payback at 124 days.

The Rosemount 2140 level switch local/remote proof test allows Marathon technicians to confirm their high-level alarm is working properly without having to shut-in and drain the vessel, remove the float switch and place it in a bucket to verify operation. It takes up to two hours to shut-in the vessel and test a float switch.

As a result, using the 2140 freed up approximately 500 hours of maintenance time per year.

MOBILE APP BOOSTS PRODUCTIVITY AT BAYER

By Mike Bacidore

Bayer's Muscatine, Iowa, plant produces 70% of North America's Roundup herbicide, as well as 100% of acetanilide selective chemical products and 100% of Bayer's dicamba formulation. The facility sits on a 150-acre campus with more than 450 employees and eight operating units, including four DeltaV control systems.

Kurt Schlawin, manufacturing technologist, process control engineer, Bayer, was looking for the ability to get process information to a cell phone and eliminate unnecessary alarm notifications to personnel.

"Our facility runs 24/7, but engineers and leadership are only there during the day," said Schlawin. "We wanted to minimize the time in front of a laptop and push that information to cell phones." The answer was the DeltaV Mobile app.

"Smartphones have changed the way we access data," said Ben Jackman, global sales manager, mobility, Emerson, who jointly presented with Schlawin at the 2019 Emerson Global Users Exchange in Nashville, Tennessee. "We're finally seeing some of the positive effects, such as access to real-time data and alarms, in the industrial space."

Some positive effects of mobile technology, specifically DeltaV Mobile, include reduction of the reliance on fixed consoles for accessing process information; enabling more timely engineering responses to abnormal conditions; reducing the number of DeltaV system alarms to which process operators can't respond; and targeting alarms and alerts to the appropriate people.

"The DeltaV Mobile app allows you to have access to process data and your graphics," said Jackman. "It allows you to see trends and alarms and set notifications. DeltaV Mobile is a read-only native extension of DeltaV, featuring four capabilities: notifications, including email, text or push; alarm lists organized by preference; watch lists, including any parameter from DeltaV or OPC; and trends."

The Muscatine facility currently has four DeltaV systems and one PLC connected into the mobile server. Off-site employees can connect via VPN. The DeltaV Mobile system is managed by IT. "I had to have a lot of conversations with our IT department and conduct a Bayer ISO risk assessment," explained Schlawin. "They approved our risk assessment. I learned you need web certificates set up internally for DeltaV Mobile. The software installation was easy, and the documentation was straightforward."

Mobility use cases

"The first use case was the monitoring of production status when people were off-shift or on call," explained Schlawin. "They want to watch specific steps, but not the entire batch. With DeltaV Mobile, they can choose two ways to get the information. They can see the batch steps, or they can get a push notification—for example, wake me up when it gets to Step 6, so I can watch that."

Another use case is to track process-safety updates and quality. "Any time we have a safety integrity level (SIL)

"If anything fails, we can send a notification to our engineers, so they can take action more quickly." Bayer's Kurt Schlawin praised the virtues of mobility at the 2019 Emerson Global Users Exchange.

activate, we treat that as a near miss," said Schlawin. "Previously, I had to create custom scripting for each one of these interlocks. With DeltaV Mobile, that's built-in. It's also more robust. If we add a new interlock, the notifications will be automatic."

The third use case is relaying the right information to the right personnel. "If communication goes down, operations receives an alarm, and they have to call the process-control group," explained Schlawin. "With DeltaV Mobile, we can target the right individual. Or, if it goes to multiple people, someone can claim the alarm, so multiple people aren't responding to the same issue."

For the facility's cross-contamination tests on the first batch of product, taking samples had sometimes been forgotten. "We can send notifications to engineers and help remind them to contact the area and be sure the sample is taken," said Schlawin.

The fourth use case is tracking hardware device alerts and health. "As we put more devices in our controllers, the index number drops. Custom control modules are used to monitor DeltaV diagnostics, and a custom graphic was created with custom scripting. The operator has to call the process-control engineer when he gets the alarm."

The last use case is the tracking of KPIs. "A lot of our leaders don't have access to DeltaV," said Schlawin. "With DeltaV Mobile, the production leader can log in. He has direct read-only access to KPIs and production status with his own personalized watch lists."

Benefits and capabilities

Many of the positive effects have been evident already at Bayer. The DeltaV Mobile system is quicker, better and faster than remote access through laptop for read-only access, said Schlawin. "It's reduced nuisance DeltaV alarms from the console. More data is in the hands of key personnel, and access is faster for troubleshooting and monitoring."

The app also reduces engineering response times and the potential for lost production time. Employees' work-life balance is improved because of VPN access. The app has simplified operator displays and eliminated the need for custom scripting. It also enables faster engineering response to off-hour process-related issues.

"With DeltaV Mobile, if anything fails, we can send a notification to our engineers, so they can take action more quickly," summarized Schlawin.

CHARMs LOWER COSTS, IMPROVE SAFETY FOR CARGILL

By Mike Bacidore

The corn-processing plant in Fort Dodge, Iowa, has been part of Cargill's food and agriculture business since the facility was purchased from Tate & Lyle in 2011. It produces ethanol and feed stock, but also pioneered a digital transformation for Cargill that lowered costs and improved safety.

The corn-refining process involves inspecting, cleaning, steeping and separation. Steeping is a very important continuous-batch process. "We soak it in a water-and-chemical solution," explained John Krueger, instrumentation, process control and automation lead, North America, Cargill, who spoke at the 2019 Emerson Global Users Exchange in Nashville, Tennessee. "If you don't soak it long enough, the corn is brittle. If you soak it too long, it becomes mush. This hurts our value stream."

The problem Cargill needed to address involved the screens at the bottom of the tanks that would plug up with corn periodically, making it difficult to read levels. The manual process necessary to clean the screens once they were plugged was time-consuming and dangerous.

"There's a ring header on the bottom of the tank to flush the screens," said Krueger, "but plugging of the screens by corn particles presented a challenge. They would create a mat layer, and that would overflow the steeps, creating a problem with our level reader. It was a manual process to unplug the screens."

Because the steeping process didn't take place close to the control room, someone would have to take a five-minute walk to get there and then use a ladder to get in there and try to break up what was on the nozzle.

"It was overall not a very good design for a manual process," said Krueger, "and the valves were being left open."

The facility's leadership challenged engineers to automate the 30 ring-header valves and set up a control scheme. This required a solution for applying water at the correct intervals to keep screens clean, reducing line plugging, optimizing water flows throughout the steep and reducing the need for manual intervention. "And they challenged us to do it in two weeks," said Krueger.

Works like a CHARM

The traditional scheme for this implementation would have called for individual solenoids, but the control system was point-limited. "We only had 10% spare capacity for I/O," explained Krueger. "And wiring hardware, locations and timing all added to costs. The plant already had DeltaV hardware, and we had been looking at the ASCO 580 with CHARMs. We received drawings and were able to modify the existing cabinet for the 32-valve bank easily."

Each CHARM I/O card (CIOC) can accommodate up to 96 I/O channels. In this case, 32 solenoids and 64 characterization modules (CHARMs) were connected via the manifold to DeltaV using two cables. "Once the cabinets were modified, we were ready to commission," said Krueger.

"One advantage the module gives us is diagnostics because it's tied to the DeltaV," explained Mike Unterreiner, business development manager, process-hydrocarbon, fluid & motion control, Emerson. "If a coil has a short circuit, it

"They challenged us to do it in two weeks." Cargill's John Krueger explained how they lowered costs and improved safety using CHARMs at the company's Iowa corn-processing plant.

will show up as an error message in DeltaV. Another diagnostic is for the bus cables. Each manifold is connected to the CHARMs baseplate."

But the big advantage of the ASCO CHARMs approach was the cost. It was 30-40% lower than the traditional approach, and completely eliminated the need for a third-party Profibus network. Installation was simplified because of the DIN-rail mounting in cabinet. "It took very little time to commission once it was installed," said Unterreiner. "DeltaV automatically senses that is it connected to the solenoid bank and auto-configures. The solenoid valves are labeled on the solenoid ports, and, when commissioning, a light on the solenoid comes on to show it's being signaled." Water flow management was improved, and the new system reduced the need for manual screen-cleaning intervention, so workers weren't being sprayed with steep or running the risk of falling off of a ladder. And, best of all, the project was completed within the two-week period set by management.

Standard bearer

The system was modified slightly and then standardized regionally for Cargill. "Fort Dodge found it so helpful, they took it to the region for a standard consideration," explained Krueger. It was standardized using ASCO 503s, replacing the existing solenoid-bank design. "We also standardized on the four-way valve, instead of the three-way," said Krueger. "When we look at our new design, there was a cost savings. It wasn't as great as the Fort Dodge plant, but not all of our plants are DeltaV, so we have a solution that will meet those needs, as well."

UP-FRONT ATTENTION EASES INTEGRATION TASKS FOR SHELL

By Mike Bacidore

Construction is underway for the Shell Pennsylvania Chemicals Project near Pittsburgh. The polyethylene plant is expected to be operational in 2021, but only because of an organized approach for the integration of third-party communications with the plant's DeltaV control system architecture.

"There are four different engineering contractors. To be successful, we had to ensure that we provided some consistent standards on how to communicate," said Bob Sherven, principal control and automation engineer, projects and technology, at Shell. "We have an ethane cracker engineered by one engineering contractor and two gas-phase polyethylene plants by another. The third polyethylene plant has a different contractor, and the fourth contractor basically did everything else."

Roughly 25,000 packages—digitally communicating devices or systems—were readily networked to the DeltaV system. However, 6,000 additional packages needed to be connected using other protocols.

"First, we created a spreadsheet to track the many different packages," explained Sharath Anthanahalli, senior control systems engineer at Bechtel. "We wanted to centrally manage and coordinate." The spreadsheet included IP addresses and Modbus addresses, as well as information on how far a package was from the control room. "We captured everything and tracked the changes during the engineering phase," said Anthanahalli.

What's the protocol, Kenneth?

Protocol options for soft interfaces were identified early in the project:

- Modbus TCP/IP for PLCs and analyzers;
- OPC DA to handle the large volume of data used for monitoring; and,
- Profibus for low-voltage motor controls.

"We did not want a bunch of distributed PLCs throughout the site," explained Sherven. "We wanted a network for configuration management from a central location for all packages. We networked for software patch upgrades and antivirus updates."

The typical Modbus network included DeltaV Ethernet I/O cards (EIOCs) in redundant configuration for Modbus TCP/IP communications together with Cisco switches and Fortigate firewalls/routers. "We eliminated 99% of the cybersecurity issues with a managed switch," explained Anthanahalli.

"We had a different design for OPC," said Sherven. "There's a Kepware intermediary server for translation from OPC UA to OPC DA for DeltaV."

It wasn't always easy to get the information for each third-party package from the vendor. "If the engineering contractor was bidding out a compressor package with a PLC, after the purchase-order (PO) award, we had to get the information," said Sherven. "It was not a requirement

"If the engineering contractor was bidding out a compressor package with a PLC, we had to get that information after the purchase-order (PO) award." Shell's Bob Sherven explained how they tracked and managed information on 6,000 digitally communicating devices and systems that needed to be connected to a new plant's DeltaV control system using a range of protocols.

for them to supply the information. The PO might go to the compressor manufacturer, but they might have subbed out the controls."

The information was then entered into SmartPlant Instrumentation (SPI), a database tool.

Testing occurred all over the globe, and the testing-schedule spreadsheet showed where and when the testing for each package was going to happen. "Most of the time, a Shell person or an Emerson person would be there," explained Sherven. "We had two DeltaV suitcases, one in Europe and one in North America, for factory acceptance testing."

Challenge accepted

Particular challenges came from vibration monitors, an analyzer management and data acquisition system (AMADAS), substations, steam-turbine generators, optical analyzers, a tunable diode laser (TDL) analyzer and a pressure swing absorber (PSA).

"We went three separate times to Munich for the PSA," said Sherven. "There was a high latency for getting into the DeltaV."

The system was seeing an 8-second latency from the Siemens PLC, causing considerable back-and-forth finger-pointing. "As it turned out, firmware was the issue," explained Anthanahalli.

Two opposing package strategies exist, according to Sherven. The first is to dedicate substantial engineering time up front during the design phase, while the second focuses little on packages during the design phase and defers to the site, so the packages can be dealt with during commissioning.

"We consciously chose the first strategy," said Sherven. "The second is one you're more forced into."

DELTAV UPGRADE RELIEVES PRESSURES AT QATARGAS

By Paul Studebaker

Construction of the world's largest liquefied natural gas (LNG) facility was started in 2002. The facility was commissioned in 2007, and by 2015 Qatargas management recognized that it needed upgrades. The facility's aging control system was breaking down and had limited hotfix support. And as the facility continued to expand, it ran up against control system capacity constraints.

Al-Shammali presented "Operational Certainty at Qatargas through a DeltaV system upgrade" with Ahmad Hassan Al-Sulaiti, projects management manager and projects execution division manager, Qatargas, and Harish Govindan, engineering manager, Emerson, at the 2019 Emerson Global Users Exchange in Nashville, Tennessee.

Qatargas is the world's largest liquefied natural gas (LNG) producer and a leading exporter, with 183 offshore wells producing 16.5 billion SCF/day. The natural gas is liquefied in 14 LNG trains, including six "mega-trains," each processing 14 megatons per year (MTPA). The facility also has two helium refineries and produces sulphur, natural gas liquids, ethane and field condensate along with LNG and helium.

Innovation leads to virtualization

Qatargas is always striving to be in the top quartile in efficiency, reliability and customer satisfaction, and measures itself against the rest of the industry. "Where the current industry 'Efficient and Reliable Operations' average score is 94.9, Qatargas is currently at 95.95, and is targeting 98," Al-Shammali said.

To achieve those goals, "We started in 2015 on an upgrade project with the understanding that, for operational excellence, we need system integrity. Our effort was built around that," said Emerson's Govindan.

The LNG trains were reaching the current system's capacity of 120 nodes, and with continuing expansion and debottlenecking, the facility needed more capacity. "So, we split the system into two zones, but kept it in the same cabinet space as we were space-constrained," Govindan said. "We adopted virtualization—the way to go today—for all assets, both off- and onshore." They also upgraded the controls and added new cybersecurity to meet the new policies; new backup and recovery systems; and health monitoring for widely dispersed assets, including wellheads.

The two zones each use four domain controllers and 12 host blade servers. In all, 144 controllers were replaced and upgraded, 149 workstations were replaced, and 326 switches and eight firewalls were installed and configured. The upgrade involved about 37,000 hours of project execution.

The project was completed during a 7-½-day shutdown in 2017. To accommodate other shutdown activities, the control system upgrade was completed in 3-½ days. "We did all those changes and trained the operators in 3-½ days, with no safety incidents and no loss of visibility," Govindan said, adding, "Many people contributed to making this project a success," including Emerson engineers,

"Virtualization is a preferred innovation. We now have plenty of room for expansion, and increased availability through monitoring and a more reliable system." Jassim Al-Shammali of Qatargas described the successful control system modernization project at the world's largest LNG facility.

equipment OEMs, local vendors and contractors, as well as employees of Qatargas.

"It was a big leap for Qatargas people to go from what they had to what they have. It had to be seamless, with no culture shock," Govindan said. "It took us two years to get ready, to run the simulations and go through all the what-ifs, FAT, etc."

Upgrades raise the bar

Since then, then number of machines has gone up in the same footprint. The two zones eliminate single-point failures and provide redundancy. The offshore wellheads are equipped with virtualized DeltaV, and run unmanned.

"Virtualization eases backups," said Al-Shammali. Patch management helps the facility meet industry cybersecurity requirements, as does system hardening: separating business from plant systems with one-way communication through data diodes, etc.

"Virtualization is a preferred innovation," said Al-Shammali. "We now have plenty of room for expansion, and increased availability through monitoring and a more reliable system."

DELTAV SUCCESS ON A SHOE-STRING BUDGET

By Mike Bacidore

Volatile markets can make it difficult to plan for product lifecycles, especially when it comes to commodity resources such as potash. A roller-coaster price fluctuation can cause havoc in business plans and investment strategies.

Such was the case for potash producer Mosaic, a Fortune 500 company formed 15 years ago through a merger of IMC Global and Cargill's crop nutrition division. It employs 15,000 people in eight countries. Despite its deep pockets and global resources, Mosaic tightened the belt of its Canadian operation in Colonsay, Saskatchewan, when the market seized and collapsed.

"Prices for potash soared in 2008 and 2009," explained Allan Blakely, account manager at Spartan Controls, a western Canadian distributor, integrator and Emerson Impact Partner that worked with Mosaic at the height of the booming potash economy. "Expansions were greenlit, but, as they came on-line, they were hit with a plummeting market, with prices dropping from almost $900 per ton to just over $200. The appetite for capital investment was and remains very low for potash mines."

This market fall prompted a period of capital constraints that motivated Matthew Gillespie, control systems engineer at Mosaic, to work with Blakely to devise creative strategies to improve mine operations without busting the budget. The two of them shared their story at the 2019 Emerson Global Users Exchange in Nashville, Tennessee.

The buck stops here

Mosaic was challenged with several aging and obsolete control systems, all of which are tagged with high-dollar value for replacement. Mosaic has been able to upgrade all of these projects, despite this period of capital constraints, by making smart decisions technically and financially.

Many organizations rally around chasing the buck when times are good, but, when the loonie flies south, financial decisions become more difficult. "Successful projects are built on mantras," said Gillespie, who referenced Benjamin Franklin's advice: "The bitterness of poor quality remains long after the sweetness of low price is forgotten."

At Mosaic's loadout facility in Colonsay, the control system had been installed, commissioned and forgotten in the 1990s. It included a Wonderware HMI and a complex database system for billing. The non-networked GE 90-70 PLC was programmed with LM90, which is essentially text-based ladder logic. "Downtime was caused by equipment failure and database overflow," said Gillespie. "It's a loadout, so it's a high-traffic area, and there's not a lot of time to play around with things. There was a computer in the cable space that was running a macro for the billing. The system was convoluted because it was backlogged with billing functions still running from the '90s."

A capital request for full replacement in 2014 was rejected because of the cost, timeline and need for management education. A similar capital request in 2015 was

"Doing nothing was not a good answer, and waiting wasn't an option." Mosaic's Matthew Gillespie explained how to upgrade controls on a budget.

engineering-approved, but the project was rejected because of cost and design.

In 2016, Mosaic sat down with Spartan Controls and made a plan, which was accepted. "I designed the system for a fraction of the cost," explained Gillespie. "Management approved it because it was so little money and not much of a risk."

The I/O costs were out of scope. "We could wait on the I/O, which dropped the costs 75%," said Gillespie. The Modbus TCP Virtual I/O Module (VIM) was used to interface with a GE RX3i PLC as an I/O server. Data was stored in the site historian, eliminating the need for an additional database. The I/O was not touched, but Mosaic invested heavily in the network.

Thanks for letting me vent

In a second project, Mosaic and Spartan looked at the mine-ventilation system, one of the most critical pieces of equipment on-site. The mine area is surrounded by an underground lake, and a metal ring holds back 900 psi of water pressure.

The control system was installed, commissioned and forgotten in the year 2000. The facility includes a four-burner management system (BMS) with an un-networked 90-30 PLC and an un-networked HMI panel.

A 2015 capital request was accepted. The burners were modernized in 2016, but the controls were pushed due to budget. However, a control-system update was scheduled in 2018 with replacement in kind, looking at the RX3i to replace the 90-30 PLC. "But replacement-in-kind was not the right solution," said Gillespie. "We had to find something better, but the budget was set."

As it turned out, the right solution was to integrate with DeltaV for the same price as a PLC, explained Gillespie. A custom CHARMs cabinet was built. It utilized the existing SX controller in the mill and preserved the new workstation by using a fiberoptic keyboard, video and mouse (KVM) extender. To save money, in-house programming, also known as Gillespie, was utilized.

Ten years after

DeltaV servers were installed 10 years ago in the same rack that once housed Provox servers, explained Blakely. The protection was poor. "Brine leaked in from the roof. There was intense heat and frigid cold. But, as long as they kept running, management was OK with it," he said.

"Five years ago, we embarked on what I like to call the 'virtualization boxing match,'" said Blakely. "We started to investigate the age and state of the servers. Virtualization in a salty environment is a clear winner. The capital request was written but denied based on cost. We went through 10 full rounds of revisions and four years of disappointment. In 2018, we divided the project into three phases."

Phase 1, replacing the servers, was approved and completed this month. Phase 2 includes building the thin-client network and replacing the workstations. Phase 3 will add a redundant virtual real-time operating system, VRTX, in a different geographic location.

"Spreading the project over three years doesn't give us redundancy until the third year," said Blakely. "We still have to be careful until this project is complete. And the project overall cost is slightly higher."

Tuppence for control

"Doing nothing was not a good answer, and waiting wasn't an option," explained Gillespie, so actions were taken, and the results have been encouraging.

"The loadout has had less than one hour of downtime since commissioning," he said. "Truck-loading efficiencies increased 180%, and billing has functioned flawlessly. Also, the process engineering group has identified several cost-saving projects."

The mine-ventilation system was integrated into DeltaV for the same cost as a replacement-in-kind PLC system. Powerhouse operators are now able to troubleshoot the system properly, making efficiencies in natural-gas usage and carbon-monoxide production. It's also opened up new opportunities for advanced control and integration.

The virtualization project is now in progress after five years of attempting to get funding. Mosaic will finally able to retire the old servers, not to mention benefitting from the reliability that comes with a virtualized system.

"Three projects were denied for several years until measures were taken to ensure funding," said Gillespie. "We achieved this by splitting up projects into smaller pieces, leveraging existing infrastructure, salvaging parts, integrating our islands of control and using in-house labor for commissioning and programming."

HOW DELTAV DOES SIS SECURITY

By Jim Montague

While cybersecurity of process control and automation systems is essential, cybersecurity of safety instrumented systems (SIS) is even more crucial. They are the last line of defense—and potentially the difference between safe operations and equipment damage, injury or fatalities. Fortunately, Emerson's DeltaV distributed control system (DCS) and DeltaV SIS and their supporting software include many capabilities that can protect users, applications and facilities against cyber threats and attacks.

"Sometimes cybersecurity presentations are good about creating awareness, but fail to provide practical information about what to do, so we try to provide very specific examples about how to achieve a more defendable SIS," said Sergio Diaz, product marketing manager, DeltaV SIS, Emerson, who presented "Best practices for a cyber secure SIS" with Alexandre Peixoto, DeltaV product marketing manager, cybersecurity and network products, Emerson, at the 2019 Emerson Global Users Exchange in Nashville, Tennessee. "DeltaV has many built-in features that can prevent unauthorized changes in safety logic configuration as well as unauthorized downloads, bypasses and field device changes."

Security in context

Before addressing SIS security, Diaz reported stressed the importance of first understanding the overall context in which cybersecurity happens. Probably the most notable of these is "defense in depth," which is simply the concept of establishing multiple protection layers to reduce the odds of cyber probes or intrusions succeeding.

Common cybersecurity mechanisms in DeltaV and DeltaV SIS include:

- Security information and event management (SIEM) for DeltaV;
- Network security monitor;
- Automated patch management;
- Emerson Smart Firewall;
- Backup and recovery;
- Application whitelisting;
- Endpoint security;
- DeltaV Firewall-IPD (intrusion protection device);
- Multi-factor authentication;
- GPS time server;
- Symantec ICS (industrial control system) protection; and.
- Industrial network firewall.
- On the other side of the cybersecurity equation, five common threats to a SIS include:
- Changes to its offline configuration in the database;
- Unauthorized downloads;
- Online changes that could impact safety logic, such as to a trip limit;
- Unauthorized bypasses; and,
- Unauthorized device configuration changes.

"If there's a probe of an SIS like this, it's more than likely malicious, and it can shut down systems and/or cause major consequences," said Diaz.

"It helps to remember that what makes sense for safety usually makes sense for cybersecurity." Emerson's Sergio Diaz discussed specific threats and appropriate counter measures available in the DeltaV and DeltaV SIS environment.

Counter measures for secure logic

To use defense-in-depth principles to protect an SIS, Diaz provided a series of recommendations:

- To prevent offline modifications in safety logic, give users just enough privileges to perform their tasks, and use DeltaV keys to define the scope of each user. Next, prevent remote attacks by enforcing physical presence, and requiring users to have a smart card and a PIN to log into the system.
- To prevent unauthorized downloads, Diaz advises requiring additional approvers, who must authorize software modules before they can be downloaded. DeltaV can accommodate up to five approvers. Following modification, modules become unauthorized again, and can't be downloaded again until re-approved.
- DeltaV also has a physical presence method for preventing downloads which requires that the CHARMs Smart Logic Solver (CSLS) be physically unlocked to allow any downloads. Locking the CSLS key switch prevents downloads, decommissioning, debug mode and HART write commands. In DeltaV, Version 14, CSLS is timed-unlocked and also prevents certain online changes. Version 14 can also be locked by an SZ controller switch.

"A lot of mechanisms come together to give DeltaV robust cybersecurity," says Diaz. "User privileges, two-factor authentication, additional approvers, locking CSLS and physical presence are the defense-in-depth layers that protect DeltaV's safety logic and prevent unauthorized changes."

Peixoto added, "We usually ask 'what if' before adding a new defense-in-depth layer. If one ring is removed, our protections are weaker."

Disabling unauthorized bypasses

Sometimes it's necessary to bypass inputs in an SIS for updates and maintenance, but Diaz cautioned that allowing multiple bypasses in the same SIF isn't good practice because it disables the SIF. He added that preventing multiple bypasses at the control system isn't good practice, and that the best method is to handle bypasses at the logic solver level.

Preventing multiple bypasses in DeltaV begin with an initial secure design countermeasure of unchecking the "multiple bypasses are allowed" and 'bypass permit not required to bypass" boxes in the software's Bypass Opts sections. This means changing Bypass Opts requires either an authorized download or unlocking of the logic solver.

Preventing bypasses in DeltaV can also be done by enforcing physical presence, in this case, with a physical switch connected to an input. This switch must in the right position before allowing a bypass, which remote hackers can't do. Meanwhile, operators can remove bypass permits that remove bypasses, even if there is no human-machine interface.

Authentication can prevent bypasses by requiring proper privileges and the entry of physical credentials to set a bypass. For added security, it's also possible to use two-factor authentication to enforce physical presence.

While one user can move a key switch and have enough privileges to set a bypass, an additional approver can also be required to prevent multiple bypasses. This second approver doesn't need SIS privileges, and only needs to be given approving privileges.

Enabling notifications in DeltaV is another way to prevent bypasses, and many types of alerts and alarms are available in its SIF Alerts section, which can tell users, for example, if equipment has been left in a less than secure state. These read-only alerts can also be sent to smart phones and tablet PCs via DeltaV Mobile.

Finally, setting a timer, allowing bypasses to time out, and enabling automatic bypass removal are ways to prevent bypasses from inadvertently being left active. For example, a certain bypass may only be allowed during a proof test, and while it doesn't need a switch, the user must unlock the logic solver before setting the bypass permit for the proof test, which should last less than one minute.

In summary, physical presence, two-factor authentication, additional approver, notifications and automatic removal are the defense-in-depth layers in DeltaV that prevent unauthorized bypasses.

Preventing field device changes

Another important SIS cybersecurity procedure is preventing changes in field devices. This is crucial because intruders and cyber attacks can change device configurations to disable device operations; make device signals constant, so they mask real process readings; and impact mA signals by placing a ground to also mask real readings.

"Most field devices are only monitoring processes and sending data to be managed," said Diaz. "However, if they allow ranges to be changed in processes, then changes in readouts and current are possible, and devices can be disabled to create hazards."

Diaz added that some of the most useful countermeasures for preventing field device changes include:

- Lock cabinets where DeltaV components are located;
- Lock HART devices. HART 7 supports locking secondary masters. This lock can be set from DeltaV Explorer, but it doesn't prevent primary master from making changes;
- Alert when a fixed signal occurs, but first consider the affect on logic and maintenance work practices;
- Alert when a disparity happens, such as in loop current, but again, think through the impact on logic and work practices;
- Alert when a line fault occurs. While a common safety measure, such faults affect security, too;
- Configuration changes need to be monitored, and alerts must be made when changes are detected; and,
- Lock logic solvers, such as those handling HART write commands.
- In short, physical presence, lock logic solver, alerts, locking devices and physical security are the defense-in-depth layers in DeltaV that protect field devices.

Protecing the system

Once individual sets of defense-in-depth layers are established for logic solvers, bypasses and field devices. Diaz reported that each group can be further protected from malicious probes, intrusion and attacks within layers for their overall system and network. These include the usual cybersecurity measures of:

- Segmenting networks with managed Ethernet switches used as firewalls;
- Establishing whitelisting for authorized devices and users;
- Enabling and updating antivirus software; and,
- Maintaining firewalls between operations and enterprise areas.

"Safety instrumented systems are typically isolated, but defense-in-depth layers can be added on top as part of the cybersecurity for the larger system," added Diaz. "It also helps to remember that what makes sense for safety usually makes sense for cybersecurity. Also, using built-in features, such as those in DeltaV, leads to a more defendable SIS."

KPIs HELP GAUGE CYBERSECURITY AT SAUDI ARAMCO

By Jim Montague

Just like other parameters and processes in control and automation, cybersecurity can also be measured to determine correct and effective action.

"We implement a lot of controls in our plant, and cybersecurity is very new in comparison, but we still have to consider it," said Khalid Al-Ghamdi, engineering consultant, Process Automation Systems division, Process Control and Systems department, Saudi Arabian Oil Co. (Saudi Aramco). "Management mainly asks, 'Are we safe?' So we buy some cybersecurity software, but we still scratch our head because we're not completely certain."

Al-Ghamdi presented "Measuring effectiveness of operations technology (OT) cybersecurity controls" at the 2019 Emerson Global Users Exchange in Nashville, Tenn.

Why and what?

To develop a successful cybersecurity program and protections, Al-Ghamdi reported that several questions must be answered, namely: Why measure? What to measure? How to measure? And who needs to do what?

"Cybersecurity has to by justified by some increase in revenue, and we're in a world of key performance indicators (KPI), so we have to measure to manage and evaluate the effectiveness of cybersecurity control implementations," explained Al-Ghamdi. "We also have to measure cybersecurity because it helps transform technical jargon into business-friendly terms, keeps management involved, turns good data into good decisions, justifies investments if needed, and builds a foundation for KPIs about cybersecurity."

Al-Ghamdi added that cybersecurity metrics should be focused on things users want to measure, and deciding where to focus should be based on previous assessments of gaps and regulatory requirements or policies. "If you don't know where to focus, then start simple, capitalize on available expertise, go for some quick wins, and use an iterative model," said Al-Ghamdi. Some of these regulatory requirements and guides include:

- IEC 62443, Industrial Network and System Security;
- NIST SP 800-53, Security Controls;
- NIST SP 800-55, Performance Measurement Guide for Information Security; and,
- NIST SP 800-82, Guide to Industrial Control Systems Security.

Individual applications, facilities and organizations decide what cybersecurity metrics to measure based on technical, procedural and/or environmental controls, such as number of incidents, incident response procedure (IRP), door access controls, etc. "They also decide what to measure based on business impacts," added Al-Ghamdi. "These can include industrial control system/operations technology (ICS/OT) group vs. enterprise metrics, and compliance vs. gaps."

How to measure

Al-Ghamdi reported there are at least five basic steps needed to develop and implement an effective cybersecurity program. They include:

"Once applicable KPIs are established and their data is gathered, they can be aggregated to come up with one number that's easy to understand, such as a percentage level of cybersecurity that can be compared." Khalid Al-Ghamdi, engineering consultant, Saudi Aramco

- Identifying metrics by deciding on business goals; knowing your audience; starting small and building as you evolve; choosing scalable metrics that are understandable to non-technical audience; and, making sure any given metric answers a question for decision-makers.
- Identifying required data sources to populate metrics; building a baseline of existing resources, such as number of servers, printers, workstations, network devices, etc.; and, using the baseline for all metrics.
- Implementing metrics by automating collection of data wherever possible; building an Excel sheet for constituent parameters and formulas, such as number of backups and total supported systems; and, preserving collected information for each metric.
- Presenting results by consolidating all relevant information into a report; presenting information in a graphical format; making metrics clear to the intended audience; and, ensuring sustainability of the collected data.
- Adjusting and updating metrics by gauging progress after one year (at most); seeking audience feedback for improvements; adjusting underlying formulas to scale—and recognizing that 100% cybersecurity isn't the primary objective.

"Complete cybersecurity can't be the goal because it can't achieved—potential probes, intrusions and attacks are always evolving," said Al-Gahmdi. "This means cybersecurity must be always evolving, too, and KPIs must be measured month to month."

In addition, Al-Ghamdi recommended using the following eight KPIs and matrices for OT cybersecurity in a given environment:

- How many cybersecurity incidents occur during one year?
- What percentage of the setting has backups available?
- What percentage of the environment is in compliance with patching policy?
- How well is the endpoint protected by antivirus software, an intrusion protection system (IPS), etc?
- What percentage complies with international best practices, such as firewalls or network configuration hardening?
- How many cybersecurity awareness sessions were conducted in one year?
- How many disaster recovery and cybersecurity drills were conducted during one year?
- How many active system administrators are there?

"Once these and other applicable KPIs are established and their data is gathered, they can be aggregated to come up with one number that's easy to understand, such as a percentage level of cybersecurity that can be compared," added Al-Ghamdi. "For instance, if you're 88% cybersecure one month and 86% cybersecure the next month, you can drill down to find out what needs to be addressed. However, because people tend to relax over time, each facility also needs cybersecurity awareness sessions and drills. Plus, they also need to have enough plant administrators for cybersecurity, so one is always around when needed."

Al-Ghamdi also suggested using a simple formula for network security, which he defined as: Network security = (# of network devices with hardened configurations / total # of network devices) x 70% + (# of certified firewall policies / total # of firewall policies) x 30%

Once the results of these KPIs and other statistical indicators for cybersecurity are collected, Al-Ghamdi advised assigning tasks for addressing them to several primary job descriptions and departments that can be established, including:

- Chief information security officer/governor of risk compliance (CISO/GRC);
- Plant administrators;
- Network management systems (NMS) administrator;
- Security operations center (SOC)/security information event management (SIEM); and,
- Responsible, accountable, consulted, informed (RACI) model.

"It's also essential to keep going with cybersecurity," concluded Al-Ghamdi. "Once we populate our KPIs and other tables, we can see where problems are happening and manage them. However, because this is a learning curve, we also have to go back every six months, and see what else we have to do. It helps to remember that it took process safety about 140 years to push into the process industries and become mature, and cybersecurity is still at an early stage."

JXTG BOOSTS VALVE RELIABILITY WITH CONNECTED SERVICES

By Paul Studebaker

It's well established that predictive maintenance is the best way to keep equipment online and minimize breakdown with their accompanying unplanned outages, collateral damage and safety issues. But it's not always practical to do it yourself.

"We know that a valve alert monitoring program is important to avoid sudden failure by earlier identification of potential failures. Tracking the valve condition over time with predictive analytics lets us take action before it fails," said Kazuya Koizumi, instrumentation and reliability engineer, JXTG Nippon Oil & Energy Corp. Koizumi presented with Clinton Schneider, director, valve reliability solutions, Emerson, and Sumitaka Ichiki, manager, Plantweb marketing, Emerson Japan, at the 2019 Emerson Global Users Exchange in Nashville, Tennessee.

JXTG operates 13 refineries and chemical plants. Its refinery in the petrochemical complex in Chiba, near Tokyo, is Japan's largest at 139 KBD crude distillation unit (CDU) capacity, and has been operating since 1968.

In 2008, AMS ValveLink was installed on 144 critical valves. "These are not block or bypass valves, but severe service valves where reliability must be high," Koizumi said. The valves were diagnosed annually, with Emerson reviewing the performance diagnostic tests. Offline diagnostics were performed during turnarounds.

"Our utilization of valve condition monitoring was limited to annually for several reasons," Koizumi said. The reasons were lack of internal resources, lack of expertise in valve diagnostics interpretation, and having more than 1,000 nuisance alerts per month. As a result, be said, "Unfortunately, it was impractical to sustain a monitoring program using only JXTG resources."

The solution is valve condition monitoring through Emerson's Connected Services offering. Recently added at Chiba, an online ValveLink monitoring system sends valve condition and alert information through the cloud to Emerson, where experts and expert systems perform analyses. Recommended actions are sent back to our site via email, where they are performed by JXTG technicians, if necessary in collaboration with the local Emerson representative.

The Connected Services program was executed in three steps. "First, we met with Emerson to share issues and align roadmaps. Second were the actions needed to optimize the alert threshold values," Koizumi said. Emerson representatives visited the site and collected data weekly. They performed alert analyses on the five valves with the most alerts, and optimized the valve alert settings.

"Before optimization, we had more than 1,674 valve alerts per month and afterward, 39 alerts per month for a reduction of 98%," Koizumi said.

The third step was a trial of connected services—a remote proof-of-concept to check the feasibility of the hardware and software by executing the monitoring and reporting process remotely. Doing this required a minor modification of the AMS network by adding a VPN router and setting up an AMS client on the Microsoft Azure cloud environment. Emerson service staff accessed the data remotely to

"Before optimization, we had more than 1,674 valve alerts per month and afterward, 39 alerts per month for a reduction of 98%." Kazuya Koizumi of JXTG Nippon Oil & Energy Corp. on the company's successful use of Emerson Connected Services to remotely monitor valve performance.

review AMS alerts, and recommended actions from the analyses were reported to JXTG weekly by email.

The connection included a firewall, and Emerson accessed with read-only permission.

One early finding was an air leak on a sequential valve of a hydrogenization unit with frequently-operated valves. The alert was for mass air flow, but valve response was normal. The recommendation was to check for system leakage. "We found a leak before it affected unit operation," Koizumi said.

A second finding was on a heat exchanger bypass three-way valve. The alert was for travel deviation: the valve was travelling 9% for a full-close signal. The recommendation was to test actual travel in the field and if verified, a valve overhaul. "We verified the problem but determined it was not affecting operations, so we deferred the overhaul to the next outage," Koizumi said.

Today, by increasing AMS utilization from yearly to weekly with minimum additional workload, JXTG Chiba has achieved $500,000 in loss avoidance by finding problems early, and 98% reduction in nuisance alerts.

"We see an opportunity to improve the results by time-series analysis of valve condition to detect gradual changes—degradation—of valves and make better estimates of when it will noticeably impact control, reliability or safety," Koizumi said. "We plan to further secure the system with a data diode to physically restrict it to one-way communication, and we would like to expand the monitoring system to include operational-critical valves and machinery vibration."

ATCO CUTS GATE-STATION NOISE WITH BOOTLESS REGULATORS

By Dave Perkon

ATCO, a gas distribution company that supplies more than 1.1 million customers across Alberta, Canada, through a network of transmission and distribution systems, was having noise, reliability and maintenance issues at its high-pressure natural-gas letdown sites. At its Whitemud Gate Station, for example, the existing installation of booted regulators produced an unacceptable amount of noise for nearby condominium complexes' residents.

This user-case-study presentation of the solution to these problems, utilizing Fisher EZH and FL bootless regulators, won best-in-conference accolades at the 2019 Emerson Global Users Exchange in Nashville, Tennessee.

The solution that ATCO created with the help of Spartan Controls in Alberta, Canada, resulted in extremely safe, reliable and quiet operation at numerous distribution stations, while reducing maintenance costs.

Chris Yin, facilities engineer at ATCO, designs natural-gas regulating stations that reduce high-pressure gas from outside the city to low-pressure gas inside the city. This ensures the customers have safe and reliable gas delivered to their homes. Yin is in charge of capital-improvement projects under the Urban Pipeline Replacement (UPR) program. The goal of the UPR program is to reduce the high-pressure gas that is currently inside the city to low-pressure gas. This includes installing new equipment to ensure the system is adequate for the future.

To boot or not to boot

"Much of our work at ATCO revolved around changing from boot to bootless regulators," said Eric Kaert, gas utilities specialist at Spartan Controls. "A boot-style regulator works by adjusting the loading pressure and adding force on top of the boot (diaphragm) pushing it down to block the port, stopping gas flow. As the pressure is relieved downstream, the pressure on the diaphragm is reduced, allowing it to raise the supply gas flow downstream, increasing pressure.

One of the draws of a boot-style regulator is that the boot is in the main flow of the gas stream. "All of the main flow is through and around the diaphragm, which causes the pressure drop," said Kaert. "So you have a piece of rubber, the seal, in the gas stream handling the pressure drop. At some point, the diaphragm will wear and ultimately fail. Typically it fails open, allowing full pressure downstream, requiring over-pressure devices to operate. The key point is that the throttling-and-control element is a piece of rubber."

On the other hand, a bootless regulator is more like a control valve. "A plug and a seat in the regulator do the throttling with the diaphragm above, outside the flow of gas—it doesn't see any of the main flow of gas—it just sees the loading pressure," said Kaert. "It's more like a valve and actuator. The pressure occurs across the plug and elastomer seat, and, even if that wears away, there is still a metal backing that can control the pressure."

"Of all the design considerations, noise gave us the biggest issue." ATCO's Chris Yin (right) together with Eric Kaert of Spartan Controls explained how the Canadian natural gas distribution company successfully mitigated auditory emissions at the Whitemud Gate Station at the 2019 Emerson Global Users Exchange.

The bootless regulator is also more accurate and requires less differential pressure to operate. "The diaphragm area is much larger on a bootless regulator," said Kaert. "With the same change in pressure affecting a much larger area, it has much greater accuracy."

The boot-style regulator is lower in cost and weighs less than the bootless-style, and the bootless-style has a higher initial capital cost, is heavier and appears to be more complex," explained Kaert. "However, when we show maintenance and operators the valve and they get to take it apart, they are no longer concerned with complexity," he said.

Designing for low noise

When the team designed the UPR stations, there were design considerations that had to be addressed. "Of all the design considerations, noise gave us the biggest issue," said Yin. "Whitemud Gate Station is a success story about how bootless regulators helped us eliminate noise issues at a station near customers."

The government picked out the Whitemud Gate Station location within a transportation utilities corridor. "Usually we can pick locations that are far away from residences," said Yin. "Unfortunately, in this case we were given the Whitemud location and had to work with it. A condominium complex was located immediately to the north of the site. It was extremely close, and we foresaw noise issues but were asked to do our best."

In 2017, ATCO designed the station with a gas inlet pressure of 290 psig to 580 psig. The gas moves through the station, that includes a line heater to preheat the gas and is regulated down to an outlet pressure of 80 psig with a peak load of 1.7 million standard cubic feet per hour (scfh).

"The station components consist of two parallel piping runs," explained Yin. "The top one is the main run, and the bottom run is the alternate run. Each run has a monitor and a worker regulator. The wide-open monitor regulators are acting as a safety guard. Downstream are the workers that cut the pressure down to 80 psig."

Originally, Yin chose 6-inch boot regulators. "We finished the design and installed the system just before winter," he said. "We monitored for a few weeks without any concerns, and then winter hit. As the temperature dropped, gas demand ramped up causing a lot of gas flow. A few weeks later we received noise complaints from the residents. We took measurements at the site and found readings as high as 117 A-weighted decibels (dBA)—very loud. It was a huge safety concern and a big nuisance for the customers."

We reached out to Spartan Controls, and it determined the noise was coming from the boot regulators, continued Yin. "The design of the boot-regulator flow path caused the gas to be more turbulent and therefore noisy. That, combined with the noise of the boot movement itself, caused a lot of noise," he said.

Spartan Controls specified a Fisher Class 600 RF 6-by-12-inch FL SRSII bootless regulator because of its straight-through design that reduced the turbulence and related noise. The solution required piping modifications and a downstream spacer for ease of maintenance.

"With the new bootless regulator installed, there was a huge reduction in the sound level," said Yin. "We had the noise level checked again, and the new regulator brought the sound level down to about 85 dBA from 117 dBA. To this day, we have had no further complaints of noise from the station. Replacing the regulators was enough."

Before the bootless regulators were installed, ATCO planned to install noise curtains and pipe lagging for noise attenuation in the next four stations, just in case. However, since the bootless regulators solved the noise problem, it scrapped that idea, which actually saved $90,000 CAD per site.

"Overall, Whitemud was a huge success story, and we have plans to use the Fisher FLs at our next four big UPR stations," said Yin. "Not only do the FLs attenuate the noise, these bootless regulators are more reliable and require little maintenance, compared to boot regulators. The long-term/lifetime costs must be considered. Considering boot replacement cost per year to the much-longer-life bootless regulator replacement cost per year, the bootless solution provided an estimated savings of $650,000 to $1,300,000 CAD per year at ATCO."

HIGH PERFORMANCE VALVE SOLUTION ENSURES SAFETY FOR KOCH AG

By Jim Montague

Manufacturing urea for fertilizer is a severe process, requiring extreme heat and pressure, specialized, heavy-duty equipment—and constant attention to process safety.

Koch Ag and Energy Solutions, a wholly owned subsidiary of Koch Industries Inc., operates five production facilities in North America, as well as a terminal and distribution system for fertilizer and natural gas. The company's plant in Fort Dodge, Iowa, was built in the 1960s and makes urea-ammonium nitrate and ammonia, and uses many of Emerson's Fisher control valves, Fieldvue valve controllers and ValveLink PLUG-IN for the company's PRM, or Plant Resource Manager, software.

In the course of urea manufacture, hot carbon dioxide and ammonia are combined at 4,000 psig, and a recent process hazards analysis (PHA) identified several new safety requirements, according to Nick Hunter, reliability engineer, Koch Ag and Energy, who presented "Koch Ag and Energy Solutions gains added safety protection with Fisher" at the 2019 Emerson Global Users Exchange in Nashville, Tennessee.

"We found some operating requirements that had to be added," said Hunter. These included:

- Five-second stroke speeds for fast isolation, which necessitated an instrument error system and volume tank;
- Bi-directional shutoff to prevent backflow and carbamate formation; and,
- Special, urea-compatible metallurgy, which is difficult to machine, and requires super-long lead times.

"We also had tight footprint constraints to fit existing process piping, and two parallel valve assemblies weighing 4,000 pounds each."

Big-time ball valve and actuator

To meet the Fort Dodge plant's safety requirements, Koch Ag and Emerson developed a solution that consisted of a Fisher Z500 severe service ball valve with bi-directional shutoff, chrome carbide ball and seat coating, and a Bettis G5024-SR4 actuator for high-torque output and fast-stroke speed. The assembly was factory acceptance tested at the Emerson Innovation Center flow lab.

"To serve in severe on/off applications, the Z500 for has a floating, metal-seated ball, which enables it to withstand extremely high pressures," explained Jeff Van Arb, product engineer, Emerson. "The Z500 can achieve bubble shut-off to 25,000-psi."

Meanwhile, large and heavy enough to be shipped on its own semi-trailer truck, the Bettis G5024-SR4 is a G-series, Scotch-yoke actuator with quarter-turn valve actuation, compact/modular design, pneumatic or hydraulic actuation, spring-return or double-acting,

"There are additional opportunities for Fisher Z500s at this site and across Koch, but the best part was collaborating with Emerson and Impact Partner Stover Controls: they really helped us achieve a safer plant." Nick Hunter of Koch Ag and Energy Solutions discussed how a new high pressure, high performance valve solution addressed the company's increased safety standards.

symmetric or canted yoke, multiple manual override options, and torque ratings up to 6-million inch-pounds.

Passing the test

The new valve and actuator were installed in August 2018. The Z500 valve and Bettis G5024-SR4 immediately enabled Koch Ag to achieve the safety integrity level (SIL) targets it was seeking, and the new valve and actuator also passed their leak test after one year of service. Because the Fort Dodge plant shuts down every 90 days to change out the platinum gauze used in its nitric acid process, the new valve and actuator can do a full-stroke valve test at that time, which means partial-stroke testing isn't needed.

Notes from the test stated, "The valve was put in the tester, and the actuator mounting foot was removed, so the valve could be opened and closed manually. A seat leak test was performed, and a video was made. No seat leakage. Packing and gaskets were also checked for leakage, and none was found. Actuator mounting foot was reattached as found. Inlet and outlet were cleaned, and pictures were taken."

Hunter added, "There are additional opportunities for Z500s at this site and across Koch, but the best part was collaborating with Emerson and Impact Partner Stover Controls because they really helped us achieve a safer plant."

GAIN DELTAV CONTROL OF MIXPROOF VALVES

By Paul Studebaker

Working with valve arrays for fluid transfer has always been an issue, inv xolving complex panels of valves and safety problems due to errors and poor labeling. Mixproof valves can simplify panels, increase safety and ensure product integrity.

Mixproof valves each allow two isolated flows, or mix two flows together. "In general, they're safer than using conventional valves, and more flexible as they can control flows from any source to any destination," said Anders Kao, process automation engineer, Emerson, in a presentation at the 2019 Emerson Global User Exchange in Nashville, Tennessee.

Kao said, "With mixproof valve arrays replacing the conventional transfer panels, we will need some implementation ideas on how to make its DeltaV design compatible with the PCSD," the Project Management Office Configuration Standard. His presentation focused on mixproof valves and their valve states, the logic behind the mixproof valve array control module, and how a mixproof valve array equipment module is designed to match PCSD standards as much as possible.

How mixproof valves work

Each mixproof valve has a top path and a bottom path. Their states are: both closed; mix top and bottom; upper lifting (drains top); and lower lifting (drains bottom). They are equipped with multiple limit switches to verify their state.

In a typical flow control panel, the valves are used in an array of rows and columns. One source connects to all the top paths, and one destination connects to all the bottom paths.

"There is no standard library in DeltaV for a mixproof valve or array," Kao said. "There is also not an independent control module—each valve has two possible flows so they can have more than one ownership and not just one owner ID." The valves can be used by multiple phases, two units and/or two products. Further, the status of one valve in an array depends on the status of the array as a whole, and an array can be used by multiple operations.

"We need to deal with mixproof valves in a way that's consistent with the rest of the project to meet PCSD standards," Kao said.

For example, an array of three rows and five columns would handle three sources (one per row) and five destinations (one per column). A source is connected in series to the top path of all the valves in its row. A destination is connected in series to all the bottom paths in its column.

In its DeltaV representation, a source will own all the top paths in its row. A destination will own all the bottom paths in its column. A flow is defined by its source and its destination. A source equipment module (EM) may always own its top path, and a destination EM may always own its bottom path.

To prevent cross-contamination, no two (or more) flows may share a common source or a common destination, therefore, do not open (mix) a mixproof valve unless both the top path and the bottom path are used for the

"We need to deal with mixproof valves in a way that's consistent with the rest of the project to meet PCSD standards." Emerson's Anders Kao discussed how to represent arrays of mixproof valves in the DeltaV control system.

same flow. However, the same array can simultaneously feed two separate destinations from two separate sources.

As a result, for N sources there will be N source EMs that own the common source (top path). These EMs have a destination assignment that determine their ownership of the destination path (bottom path). A manager control module (CM) is needed to ensure no flows may share a common destination or a common source.

Definitions for DeltaV

The definition of a mixproof valve is: Valve contains a top path, a bottom path, and a drain path. It allows paths that are separated by a device that: Opens (mixes); Upper Lifts (top-drain); Lower Lifts (bottom-drain); Closes (isolates).

The DeltaV mixproof valve CM has a top path Owner and a bottom path Owner. The DeltaV mixproof valve CM will have the following EDC states:

1. Open (mix)
2. Upper lift (top drain)
3. Lower lift (bottom drain)
4. Close (isolate)

The DeltaV mixproof valve CM has two additional commands:

1. Upper pulse (pulse between close and upper lift)
2. Lower pulse (pulse between close and lower lift)

"Remember to have enough limit switches to know if your valves are in the status they're supposed to be in to avoid mixing," cautioned Kao.

For a given EM with source Y and destination X, if the EM is owned, it will acquire the appropriate valve tops and bottoms to complete the needed path using the appropriate CMs. For example, CMij is the mixproof valve CM for source i and destination j.

The rule for the EM end command for an open mixproof valve (top is owned and bottom is owned) is "close when done." "Remember that the top path is always owned by the source EM and the bottom by the destination EM."

For an upper lift mixproof valve (top is owned, bottom is not), the rule for the end command is "only if top is owned." Similarly, for a bottom lift (bottom is owned, top is not), the rule is "only if bottom is owned."

The sequence is:

1. A phase acquires the source EM via an alias and sets its owner ID and destination.
2. The mixproof array EM sends its destination to the CM manager.
3. The CM manager approves (or disapproves) given the source EM and its destination:
   a. No two or more flows may share a common destination or a common source
   b. No two or more EMs may execute their logic at the same time (queue)
4. The phase may fail if the CM manager disapproves. Otherwise, it will continue executing its logic.

SH: Advantages and an idea

"The benefits of this approach are that you can generally reuse the PCSD logic with minimal change at higher-level entities," Kao said. The acquisition can be edited to account for the assigned destination, and a source EM alias can be used to specify the source unit. It also requires minimal graphic changes, as you can reuse most of the dynamo functions (CM), reuse the faceplate (CM), and reuse the faceplate and dynamo (EM).

"However, since no two or more flows may share a common source or destination, clean-in-place (CIP) flows can't go to multiple sources at the same time. And, since a source is always owned by an EM, you can't have multiple sources for a flow," Kao said.

A potential improvement would be to use one EM for the array. "The manager would rest in the EM, and each path would be truly defined by sources and destinations, not constrained by the source unit or destination unit used," Kao said. "It would involve fewer modules (and points of failure), but might require some uncommon practices to handle."

IIoT IN OIL AND GAS? USERS MAKE GAINS—CAREFULLY

By Jim Montague

Connecting oil and gas wells and their supporting sites and equipment with Industrial Internet of Things (IIoT) technologies can increase production, reduce downtime, improve safety and reduce emissions. It provides these advantages by enabling remote monitoring, automated workflows, machine learning, augmented reality and other advanced technologies. Because of these potential benefits, many users are investigating digitalized devices and software, and trying them in non-critical sections of their applications and facilities.

This is where IIoT and its fans meet reality—and lose momentum.

Legacy assets, connectivity issues, worker attrition, cybersecurity, possible governmental concerns and other pesky snags contribute to slowing IIoT and digitalization down, according to the five panelists in the Upstream Oil and Gas Forum at the 2019 Emerson Global Users Exchange in Nashville, Tennessee. However, they reported that careful, common-sense approaches can solve many of these issues, and deliver on many of the promises of the IIoT and digitalization.

The good news

"We had 300 wells we couldn't monitor remotely before, so when there was a drop in production, we had to send someone out in a helicopter. Last year, it took 37 helicopter trips and two weeks worth of time to check those wells, and find and resolve problems—and we lost 2,000 barrels of oil," said Todd Anslinger, control systems engineer, IIoT Center of Excellence, Chevron. "Since we added Emerson transmitters and Digi gateways that transfer 4-20 mA signals to the cloud via LTE cellular wireless networking, we can monitor when they go below a certain output pressure, for example, and determine if they really need a visit or not. We estimate we can save about $25,000 per event."

Tim White, asset management director for offshore drilling contractor Valaris plc, added that, "When events happen offshore, managers onshore want to know what's happening. However, it can be risky to have calls coming in every hour, so we've been trying to correlate our data to better inform our rig managers, so they don't have to call as much. Plus, more readily available data helps us look like rock stars to our VPs."

Likewise, natural gas producer EQT Corp. recently implemented IBM Maximo asset management software to help its supervisors and managers by showing production data on their PCs and smart phones, according to Gary Baxter, former production operations director, EQT. "This solution got us involved with IIoT, but we soon found that we needed 78 database revisions," said Baxter. "We couldn't do all of them, so we had to revise, and implement Emerson's ROC800 remote operations controller, which let us do more analytics."

Similar to his fellow panelists, Jim Sage, IT principal for emerging technology, Occidental Petroleum (OXY), reported, "We implemented IoT starting last year, and began by proving its viability and value, researching available IoT platforms, determining device connections, and validating how we'd create software containers and analytics. We also asked our business side what kind of real-time drilling and gas lift data they'd need. We learned it's important to determine the IoT-readiness of the larger organization, so over the last year and a half, we got ready with a cloud-computing that we could plug our IoT solution into. Now, we can connect edge-computing devices to help control shutdown devices."

Is ROI there yet?

Because funding for innovations is often scarce, the oil and gas panelists reported that IIoT and associated new technologies must demonstrate their value quickly to gain acceptance.

"We look to see financial benefits within one year because if it's two or three years, then it won't get funded because everyone assumes the technology is going to change anyway," said Anslinger. "Behavior changes with familiarity and training, so it's crucial to show people what the IIoT can do for them, what dollars and cents they can gain, and that it's cost-effective to implement."

Beyond fast payback, White reported IIoT must also show it can ease user workloads. "The first response to many networking projects is 'Big Brother is watching' and that we're spying on them. So we try to show the benefits of IIoT to the guys on the front lines and how it can make their jobs easier. For example, IIoT can automate many of the tasks they don't like, such as collecting some scheduled readings, which helps them start to like IIoT and support it."

Baxter added, "It also helps to keep an IIoT solution in front of everyone and train them. They also appreciate it more if the solution comes from other field and operations users, rather than some ivory tower in Houston."

Sage explained that any effort to get potential users acclimated to the IIoT can be helpful because disruptive changes have been coming so fast. "Most changes in process control and automation have been incremental, but what's happening now is a reallocation of people to learn the new skills needed as we transition from previous methods to those based on the IIoT. And, once we connect to our edge devices, the benefits of their data will start to come in."

More timely data, more gains

One of the main advantages of the IIoT and digitalization in general is that users can not only collect more signals and data, but they get them much more often. "With our wireless devices, we can check process or equipment status every hour," said Chevron's Anslinger. "For instance, when we inject CO2 and water into wells, we can see the downhole pressure more frequently, and make better decisions."

White reported that Valaris will use its increased data volume and speed to improve maintenance, as well as optimize operations. "One of our big goals is condition-based maintenance, and we know the IIoT will help accomplish it, as well as reduce staff and deploy 'tiger teams' that can manage multiple rigs," explained White.

OXY's Sage added that some job descriptions have to change to allow many IIoT-related benefits to happen. "Field technicians and IT used to work in very different areas, and used to be subject to many of the information technology (IT) vs. operations technology (OT) conflicts and assertions that 'this is mine,' " said Sage. "However, digital transformation is merging these areas, and at the same time, expanding many data science departments that are needed to move digital transformation forward. Our own data science group has grown astronomically."

Jorge Tavaras, manager at Petrobras, added that, "Our OT and IT personnel and tasks have become very mixed in recent years. Sometimes we find ourselves doing each other's jobs, and sometimes we no longer know if we're in the IT or OT groups."

Simpler, faster, secure communications

Anslinger reported that another virtue of the IIoT is it allows people and their devices to communicate more quickly and get more done. "When we used to add a non-control instrument to a process, we'd typically have to submit a management of change request (MOC), and it could take 30 days to run conduit to the DCS, add a PLC if needed, and complete about eight total steps to reach the cloud and get data to it," said Anslinger. "Now, if we're just adding an IIoT-based analytics device, we can get it done by lunchtime."

Sage added that OXY requires its IIoT devices to be LTE wireless/cellular, which lets his staff tell their field colleagues that they're taking devices off the operations network and freeing capacity. To maintain cybersecurity, he explained that OXY usually has many field and business firewalls, and avoids opening IoT connections to field devices, but also extends its LTE devices from a DMZ and automated private network (APN) to the cloud.

Recipe for success

Because about 70% of IIoT projects reportedly fail, the panelists agreed there are several primary elements needed for digital transformation and IIoT success.

"Oil and gas users are good at developing and running pilot projects, but not as good at scaling them up," said Chevron's Anslinger. "This is where C-suite approval and support is really crucial, and where useful innovations like the IIoT can get the traction they need. However, IIoT projects are also likely to fail if they require a lot of added infrastructure work. If an ultra-wideband device is installed under other equipment, and needs conduit

and fiber run to it, then it's tough for users to swallow if they're only going to get, for example, just 10 centimeters of added accuracy."

Sage added, "Many legacy devices were installed in the field and forgotten. What's needed now is more consciously managing operating systems and their field devices. The IIoT is mainly just adding an ARM microprocessor, but they need updates and a system to manage them, which we're exploring."

Beyond internal support, Sage and Anslinger added it's vital to have knowledgeable partners and vendors for IIoT and digital transformation projects.

"A year and a half ago, we still had vendors that were proposing closed systems and networks, and they're either no longer in business or trying to adopt open-system standards," said Sage. "There are also vendors that propose doing IIoT as an open service, but we're also not going to put an unknown black box or software in our processes. Of the many startups trying to do IIoT, most don't understand how to interact with existing plant systems."

Anslinger added that, "Suppliers can help users with high-level IIoT strategies, evaluating which assets could benefit from the IIoT, and what device management is needed."

CHEMICAL-MAKERS EMBRACING DIGITAL TRANSFORMATION

By Mike Bacidore

Digital transformation is spreading throughout the chemical industry. At 2019 Emerson Global Users Exchange in Nashville, Tennessee, signs of that shift were evident from the comments of panelists speaking at the Industry Forum for Chemicals.

"We have wireless infrastructure on 60-70% of our sites," said Greg Aguilar, global reliability engineer at Celanese. "We're piloting two projects using KNet [Emerson's recently acquired data analytics solution], and we are using AMS at some of our larger sites."

3M is keeping pace, too. "In many areas, we are well on the way," said Lendon Haggard, manufacturing technology manager at 3M. "Our corporate PACESetter initiative is something most companies don't have." 3M's corporate initiative gives its stakeholders a set of standards, a way to think about innovation. "Our division has specific things that are different, but we have to share those responsibilities."

San Jacinto College in Houston has built custom laboratories with industry members that went live in August. "They were looking forward to electronic logs and procedures, as well as maintenance work orders on mobile devices," said Jim Griffin, vice president of petrochemical, energy and technology at the college. "We incorporated that into our curriculum."

Petrochemical company Braskem Idesa has an expert team that looks for new ventures. "It's a good way to do it," said Stephany Villarreal, automation and digital transformation engineer. They look for suppliers whose offerings fit company needs."

This search for transformative ideas means newer technologies abound at companies on the digital-transformation journey. "We are using remote monitoring, and we use drones," said Aguilar. "We recently piloted some analytics and machine learning."

3M also uses drones and monitoring technologies for predictive maintenance (PdM). "We do everything, but less in augmented reality and wearables," said Haggard. "We have tried them, and they're very neat, but we have other things we have to work on."

Safety, especially eliminating confined-space entry, is a number-one driver, according to Griffin. Light detection and ranging (LiDAR) remote-sensing technology is important for environmental detection and repair. "We have performance-learning platforms, and we're looking to add some augmented reality," said Griffin. "We teach data analytics, but I teach process technology and instrumentation, too."

Perceived success

Perception is everything when it comes to new initiatives, especially at companies looking to justify investments in digital transformations. "Several of our initiatives have been successful," said Aguilar. "We're including some machine-learning models. We've been able to identify equipment issues that have gone under the radar for months or years. We try to define what the success criteria are up front, and we look at proof of concept and return on investment. How are we impacting our business? How can we increase productivity? Or how can we avoid lost production?"

3M has been successful in several areas, said Haggard. "Our reliability program is part of the factory of the future,"

he explained. "We're at the point now where no one is questioning whether it will work. We're now asking how much it will cost and where the funding is coming from. We measure success in terms of productivity."

At 3M, IT makes the rules, Haggard admitted, but the collaboration has improved, largely because of the success of new initiatives. "In the past few years, we've made great strides," he said. "Now we're at the point where, when we call corporate IT, they're being told by executives to help us."

Having successful cases to show goes a long way, added Aguilar. "It's getting the sites to request the new technology." he said. "It helps to build that trust."

IT-OT convergence

Collaboration between IT and OT has often been accelerated by digital-transformation implementations. Some have even changed reporting structures in organizations.

"This year we have a new structure globally," explained Villarreal. "IT and OT belong to the same vice president."

It's also affected protocols. "We're seeing new ways of getting data to the cloud," said Ted Masters, president and CEO, FieldComm Group. "We're trying to integrate a collection of different technologies, bring them all together and integrate them in a common model. Advanced physical layer (APL) means adding Ethernet to field devices. The next-generation field device will be faster and more powerful."

Both Aguilar and Haggard agreed that using an APL-standard field device sounds promising, but that might still be a few years away.

Accepting a non-analog field device would be fine for regulatory and supervisory control, but not safety, said Haggard. "In chemical plants, EHS is involved," he said. "We are making decisions differently with other people involved. When we say, 'safety,' we're at a different level. We're storing and working with chemicals that are dangerous."

And wireless technology is being used primarily for monitoring, but both 3M and Celanese are using it for some control in certain conditions.

Lessons learned

Embarking on a digital transformation comes with stumbling blocks, but organizations need to overcome them and learn from those hurdles.

Aguilar quipped, "If you'd asked me IT's job two years ago, I would have said it was to make it harder for me to work. As part of our digital-transformation journey, bringing IT in early and treating them like a partner has really been helpful. Now people think I work for IT. Now we understand each other."

Buy-in is also the biggest lesson learned at 3M. "Right now, we have a lot of need for buy-in at the operator level because we're changing the way someone does a job," said Haggard. "We're using a highly skilled hourly individual to do higher-level tuning, just under what our controls engineers would do."

In the end, it's a transformation of the business process, said Masters. "You've got to have collaboration and executive backing. Otherwise, you may have all the transformation in the world, but you could end up doing things the same way you were before."

REFINERS BOIL DOWN TODAY'S CHALLENGES

By Paul Studebaker

"Today's refineries are dealing with many challenges including operational agility, higher margins, different crudes, corrosion and reliability, as well as how to use the Industrial Internet of Things," said Ed Schodowski, refining director, Emerson, to attendees of the Refining and Petrochemical Industry Forum at the 2019 Emerson Global Users Exchange in Nashville, Tennessee.

With the guidance of live audience polls, Schadowski moderated a panel of four industry experts who discussed six topics that brought out a range of views and useful insights for automation engineers at refining and petrochemical companies. They dove in by asking the audience what types of operational excellence programs they've used to improve Solomon benchmarks, and how automation was involved. The audience chose mechanical availability (73%), turnaround index (35%), net cash margin, USD/bbl net input (19%), energy intensity index (15%), and personnel efficiency index (13%).

"Solomon is a double-edged sword," said panelist Bruce Taylor, director, digital transformation, Sinclair Oil Co. "It can lead management to slash and cut budgets and head counts, so you have to produce information that explains maintenance efficiencies—for example, sometimes it's less expensive to just replace a relief valve than to remove it, test it and put it back." Taylor recommended that managers make the Solomon criteria more granular, so plant personnel could recognize their influence. He said, "We gave them metrics directly related to them so they know their contribution."

Panelist Michael Barham, principal engineer and control systems technologist, Marathon, said, "Looking at the metrics, our mechanical availability is high, but we haven't done much using automation. We could do much more to increase that number, but how can we quantify it? We measure things falling apart, not holding together." Barham emphasized that turnarounds are a quick way for plants to lose money. "They're often 20% over budget," he said. "Good turnarounds equal good maintenance. Do turnarounds well, and the rest will fall out."

Panelist Richard Marcantel, instrument engineering manager, Citgo, said, "We're an old plant with analog signals and few smart devices. We need to have as much availability as possible. We're trying to leverage HART and get information to people who can use it."

Panelist Dustin Beebe, vice president, control and operator performance, Emerson, pointed out that "Procedural automation can transform the way people work. Don't just deploy technology, lift and shift operators. Automation is one way to do it."

Improve equipment reliability

Attendees were then asked where they were on the journey toward best practices in Integrity Operating Windows (IOW) as described in API 584, and improving fixed equipment reliability. The poll showed 48% "have started and are on the journey," while 28% are "talking about it and creating plans," 21% have "only discussed it," and 3% have programs that are "fully developed and comprehensive."

Emerson's Beebe observed that, "With millennials coming in, most people are on the journey."

Marcantel at Citgo said, "We started, and are early in the journey, asking how to get data—information—to the

computers on their desks to make better decisions." It's important because, "We make measurements on rounds, but what happens between rounds?" he said.

"The bottom line is money," said Marathon's Barham. "We look at the IOWs when it's important, but mostly pull data before meetings, and that's shortening downtime."

Taylor at Sinclair warned that, "Many people don't know what an IOW is versus a limit or target, so we usually give information in terms operators can appreciate," such as dollar signs or value symbols. Further, "When we see step changes from shift to shift, we try to learn from those anomalies and get everyone on the same page," he said.

Upskill for more data

Asked, "What have been the best upskilling methods and procedures to utilize additional information about the process and assets?" the audience poll showed attendees use formal onsite training (69%), formal vendor offsite classroom training (48%), lunch-and-learns (52%), webinars (16%) and universities/technical schools (8%).

Training is good, but "It's hard to get change into the operator rhythm, to continually reinforce training so it becomes part of the operating norm," Taylor said. "Training is valuable, but it has to be followed up."

At Marathon, "A chemical company customer requires our operators to have four-year technical degrees, so we sponsor and follow that," said Barham. He says the problem with formal training is that it's a one-time thing. "Webinars are very valuable because they're always coming up," he said. Repetition is important because, "Our models that we train them on don't replace the models in their heads—they compete with them."

Marcantel at Citgo said, "We do all of these. We have a really good technical school in our area, and companies in the area require a degree from that school." He prefers off-site training because people tend to get pulled out of on-site training for emergencies. But the most important thing is to put training to use immediately, he says. "If you don't use it, you lose it."

Beebe agreed. "We can't do enough formal training, so we use more online webinars," he said. "Operators can see a webinar on, for instance, alarm management or an instrument procedure, then they can go do it."

Justify wireless

Asked to comment on lessons they're learned about wireless justification, implementation, maintenance, etc., the audience poll revealed that 51% need a better vision for use cases, 44% need better financial justification, 28% need management buy-in, 23% need a total wireless IT plan, and 21% have had trouble tackling cybersecurity issues.

"We put in a comprehensive Wireless HART and Wi-Fi system," said Taylor at Sinclair. "The infrastructure was five times the cost of the devices for a single application, so we canvassed for all the applications and created a vision—no one use case justifies the cost, but together, the return was huge. We cut two to three days out of a turnaround." But he cautioned, "When you build it, who owns it? Who changes the batteries? What about monitoring and cyber? And you must understand the protocols—Wi-Fi is not industrial."

Marcantel at Citgo pointed out that, "Management doesn't understand all the terminology. Dumb it down so they can understand." He agreed that it's important to make decisions about ownership and maintenance upfront.

"We designed a wireless temperature sensor innovation program with great Emerson sensors, but it's not moving forward due to cost priorities," lamented Barham.

Beebe replied, "Think about what the project means to your company. Then challenge the vendors on cybersecurity and understanding your use case."

Get a grip on mass balance

Asked about their successes and best practices in improving mass balances, the audience poll found that 80% have improved data quality for unit or plantwide optimization/modeling, 13% have improved losses, 5% have reduced financial risk, and 3% have reduced theft.

"Our biggest challenge is people," said Barham. "It's so basic, it's not sexy, and people don't care." There are great automated tools that use statistics to pinpoint where the problems are, "But then you have to get the fix done," he said, adding, "You must have mass balance for advanced process control (APC) projects and model-based control."

Beebe noted that available systems "can pinpoint the instruments causing loss, tell you where to put instruments, where to improve accuracy. A refinery runs on barrels, which equal mass, and you really need to understand where it's going."

Marcantel said, "We have a lot of orifice plates, not mass flowmeters. New processes and new crews change things up all the time, and when you start with bad data, you end up with bad results."

Taylor observed, "It has the same problems as APC. Who keeps it evergreen? A new engineer gets the job for their first 18 months, then what? It's a great application for artificial intelligence (AI)."

Connect islands of automation

Finally, the audience was asked to fill in a blank: "Where has your plant removed islands of automation, such as stranded PLCs?" Responses were many and varied.

"First, what's the value? It's a capital cost, it has to have ROI," said Barham.

Marcantel replied, "The costs include maintenance of stranded PLCs, doing maintenance and diagnostics out in the plant. Technicians could be doing something else more productive. We've integrated a lot of PLCs to our DCS—a DeltaV can integrate them very easily. Or run a Modbus TCP connection and bring it back. Use an OPC connection if there's no DCS to get it to operators," adding, "It really helps you on the maintenance side."

Beebe said, "It's also for optimization, by bringing data together and into the cloud. It helps you coordinate cybersecurity, deploy patches, control attack surfaces."

Taylor pointed out that, "When islands are not integrated, they run on their own for functionality as well as data. It's hard to know what's going on." Furthermore, "AI is coming, and AI totally depends on cross-functional views. For example, a pump's usage, history, environment—we need all that to optimize it."

DRUGMAKERS LOOK TO A MORE FLEXIBLE PHARMA 4.0

By Dave Perkon

A forum of industry veterans explored current challenges and possibilities, as well as future opportunities in the life sciences and pharmaceuticals manufacturing industries at the 2019 Emerson Global Users Exchange in Nashville, Tennessee.

"The automation industry is going through a big transformation process," said Bob Lenich, life sciences marketing director at Emerson. "Industry 4.0 is an example. Life sciences manufacturing is transforming in a similar way with Pharma 4.0."

Market trends and business drivers such as cost pressures, uncertainty, market growth and more product classes feed the cost, feasibility, speed and quality of the products. The life-sciences industry also has embarked upon a digital transformation that is having an impact on flexible and continuous manufacturing.

Enabling technologies and capabilities are changing how life-sciences products are being manufactured. There are many opportunities and ways to accelerate the pipeline, and there are things that can be done to make it go more quickly from development to actual full-blown manufacturing.

Historically, the life-sciences industry has produced two things: product and paper. "Over the past few years, data is the new currency," said Lenich. "Now, they produce product, paper and data. Now, you need to take the data and do something with it, such as analytics. This is a growing activity that is exploding across the industry."

Global alignment of manufacturing standards

Derek Englert, lead of global automation at AveXis, provides development, implementation and deployment of a global automation solution across AveXis manufacturing network. "AveXis is a small-molecule manufacturer, and all our equipment is single-use," he said.

"From a DCS standpoint, we looked at our equipment and decided what could be standard across our five facilities. Most equipment is standard, but there are differences. We had control-module classes that we keep as global and maintain those across all of our sites. Phases and recipes will also be maintained across all of our sites. If the equipment modules are the same, we keep them as global but will use different equipment modules in each plant to account for differences in the equipment, but they must maintain the same interface to the phases. That means our control-module classes, phases and recipes are global."

Rex Polley, principal global automation engineer at Lonza, also commented on global alignment. "Lonza is a 122-year-old company with about 60 different plants, and it's important to note that we are a contract manufacturer. We do specialty chemicals up through large-molecule, small-molecule and cell and gene therapy. There is a lot of variety."

One of Lonza's large sites literally has a dozen plants in a campus with 55 DeltaV systems installed. "This one site is done with a single, global library, but a new plant has learnings that are fed back to the library where they can be maintained and fed back down," said Polley. "It's basically a single site acting as a global site."

"A perfect standard is only perfect for one person, but good enough can be good enough for everyone," said Polley. "Sometimes it takes a lot of pushing to get people to understand that." Even though it's not how one person would have done it, it will work and has worked.

Englert discussed the difficulties with decisions by consensus. "When you try to say, 'Here is how I'm going to

approach this,' and then try to get all your stake holders at all your sites to agree, it goes nowhere. You do get conflicts as everyone has different backgrounds and has seen different ways that work. Again, you don't have to come up with something that is perfect; it just needs to work as well as possible," he said.

How AveXis approaches it is with a center of excellence where it has a team that takes in information from all the stakeholders, so people know their voices are being heard, continued Englert. "However, the team has the final decision on how it will be implemented," he said.

Automation enabling flexibility

In Englert's experience, he has often seen people who think automation reduces flexibility. "But automation can add quality and reduce paper," said Englert. "It really depends on how you automate the system, but paper can be very easy to change."

The executive leadership should clearly lay out what flexibility is needed, said Englert. "However, you cannot demand all the flexibility without any of the constraints," he said. "Meeting the business objectives is possible with automated systems."

Polley noted that as a contract manufacturer that has to fit a customer's process into its facilities, Lonza's flexibility is inherent. "It's hard not to be flexible," he said.

"To non-automation people, it is necessary to explain the concept of templating, classes, instances of classes and aliasing in automation. Breaking these concepts down and putting them in non-automation terms for people allows them to quickly realize that automation can give them quite a bit of flexibility while still having structure."

AveXis has been unhappy with how some of their skids have been functioning, explained Englert. "They often have their own proprietary software system that we cannot touch," he said. "We can only interface to them through recipes. It limits what can be added and how to validate the system because you don't have full visibility."

Because of that, AveXis is pulling some of its skids, removing the proprietary software and installing a DCS implementation. "These are currently lab-scale skids," said Englert. "When it grows in scale, you need the flexibility in the process. The only way to do that is with a DCS."

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