AFPM

115th American Fuel & Petrochemical Manufacturers

ANNUAL MEETING

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DAY TWO | #AM17
Tuesday | March 21, 2017

Changing the narrative about our products and our industries

MIKE RHODES, *Hydrocarbon Processing*

At the Monday-morning general session of the AFPM Annual Meeting, attendees were eager to kick off their day with new insights into the refining and petrochemical industries. This year's opening remarks, given by Gregory J. Goff, Chairman of the Board for AFPM, and Chairman, President and CEO of Tesoro Corp.; and AFPM President Chet Thompson, did not disappoint.

Mr. Goff opened the meeting by welcoming the attendees and thanking them for their collective efforts on behalf of the organization and the industry as a whole.

"I am grateful for the opportunity to have helped lead our efforts, humbled by the intelligence our association brings to the table, and excited to meet the challenges ahead," Mr. Goff said. "It's always an easy thing to poke fun at the dysfunction in Washington D.C., but all this does is give us an excuse not to be actively involved. That's a mistake none of us can afford."

Mr. Goff commented that while the election encouraged some to take a defensive posture when considering the future, it could be possible that the country, the government and the industry are at the tipping point of a real opportunity.

"Over the next several months, we will have the opportunity to make some important choices on truly monumental issues: tax reform, healthcare reform, international trade and, finally, the potential integration of energy and environmental policies," Mr. Goff said.

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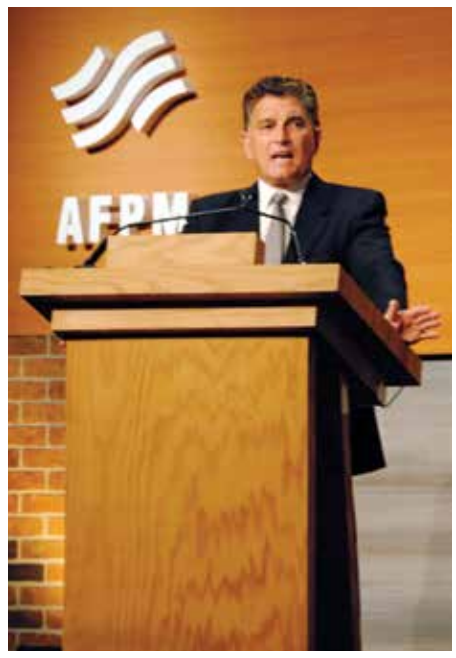

Gregory J. Goff, Chairman of the Board, AFPM; and Chairman, President and CEO of Tesoro Corp.

US poised to become energy superpower as it enters "great transition"

ASHLEY SMITH, *Hydrocarbon Processing*

During the latter part of Monday's general session, Peter Zeihan, geopolitical strategist and author of *The Accidental Superpower* and *The Absent Superpower,* spoke about the geopolitical state of the world and its relationship to global energy.

Peter Zeihan, geopolitical strategist and author, impressed Monday's general session with his insights into geopolitical and energy transitions.

"We are in the midst of the greatest shift in the global system of the last 70 years, perhaps the last 500," Mr. Zeihan said. "And it will all be concluded in less than a decade. Your world is turning inside out. Let's talk about the end of the world."

During his speech, Mr. Zeihan explained why the US is the global superpower, and why the country will continue on this path for generations to come.

"Not only is our chunk of North America the most economically viable chunk of territory on the planet, it's the most secure," Mr. Zeihan said. "We cannot mess this up."

US energy security stems from the country's geography, with mountains in the west, forests and lakes to the north, and ocean moats on either side. The most important geographical asset, the Mississippi River, enhances the country's economic viability.

"Moving things from point A to point B by floating is one-twelfth the cost of any other transportation," Mr. Zeihan said. "The greater Mississippi, by itself, is 13,000 mi of eternally navigable water, which is more than the combined total of the rest of the planet."

After World War 2, trade systems came crashing down, Mr. Zeihan explained, leaving the US to figure out what

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INSIDE THIS ISSUE

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Honeywell UOP makes a move to revolutionize the HPI

LEE NICHOLS, *Hydrocarbon Processing*

As AFPM's Annual Meeting kicked off with a well-attended opening reception, one of the highlights on Sunday night was Honeywell UOP's customer appreciation dinner. The invitation-only event featured more than 160 oil and gas professionals from some of the most notable and well-respected companies in the hydrocarbon processing industry (HPI).

The company's customer appreciation event was held in the historic Sunset Station at St. Paul Square in east San Antonio. Originally named the Southern Pacific Depot, this historic location was one of the main stopping points along the famous Sunset Limited Route to California. The opening of the depot was a catalyst for industrialization and commercialization in the area.

Guests were greeted by the festive sounds of mariachi as they walked into the venue. An opening reception allowed business associates and old friends to mingle before taking their seats for dinner. Rebecca Liebert, President and CEO of Honeywell UOP, provided opening remarks. She cordially thanked UOP's customers for the opportunity to participate in their projects and operations, as well as Chet Thompson, who was in attendance, for his hard work over the past two years as President of AFPM.

Ms. Liebert's talk focused on the range of technical solutions Honeywell UOP can provide to the industry, as well as a view of the oil and gas industry as a whole. "A lot has happened in our industry since we met last year [at AFPM Annual Meeting 2016]. In fact, when we met in San Francisco, the price for WTI was approximately $38/bbl, and we thought *that* was a recovery!" Ms. Liebert said.

"The US is emerging as the swing producer for crude and natural gas liquids (NGL). Ethane and other NGL are being produced at as low a cost as anywhere in the world. This is feeding a renaissance in the US petrochemicals market," Ms. Liebert said. "And of course, we offer solutions for the recovery of NGL and for the efficient utilization of these feedstocks."

Ms. Liebert acknowledged and thanked her colleagues from Honeywell Process Solutions (HPS) that were in attendance, and showcased how their technologies can aide operators. "We have shown the benefits to our customers when HPS enters projects early. The use of Experion Solution Suites for licensed units, or integrated solutions on our modular offerings, bring significant value to our clients," Ms. Liebert asserted.

Rebecca Liebert, President and CEO of Honeywell UOP, addressed top industry professionals at the company's customer appreciation reception and dinner.

"In 2016, together with HPS, we introduced the Honeywell Connected Plant (HCP), which incorporates UOP's extensive process knowledge in a cloud-based digital solution that makes plants run more profitably. HCP is off to a great start, bringing to the industry a level of process reliability, efficiency and optimization that has been impossible before."

Ms. Liebert provided further details on new technologies the company has launched in the past year. These milestones included the introduction of ionic liquids alkylation and a new line of hydroprocessing catalysts. Working in conjunction with Chevron, the

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SCHEDULE OF SESSIONS AND SPECIAL EVENTS

TUESDAY, MARCH 21, 2017

7 a.m.–12 p.m.	**Registration**
7:30–9 a.m.	**Industry Leadership Breakfast featuring:** Greg C. Garland, Chairman and CEO, Phillips 66 Mr. Garland will share his insights from more than 30 years of industry experience in technical and executive leadership positions within the oil, natural gas and chemicals industries.
9–11:30 a.m.	**Breakout sessions:** Reliability, Hydrocracking, Distillation, FCC, Plant Automation/Cybersecurity, Process Safety
12–2 p.m.	**Annual Luncheon featuring*:** Peyton Manning, legendary NFL quarterback Peyton Manning has earned his place among the greatest quarterbacks in NFL history. As a leader in nearly every statistical passing category, Mr. Manning is the NFL's only five-time Most Valuable Player, 14-time Pro Bowl selection, and the first starting quarterback in NFL history to win a Super Bowl with two different teams. *Open to registered member attendees only
2–4:30 p.m.	**Breakout sessions:** Environmental, Hydrocracking II, Refinery Operations, FCC II, Gasoline

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AFPM

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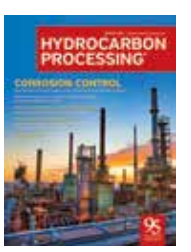

OPENING REMARKS, continued from page 1

Chet Thompson, President of AFPM, addresses Monday morning's general session.

"We have a responsibility to rise up and meet these challenges willingly, with a sense of duty and purpose, and with the problem-solving acumen that the refining and petrochemical sectors have consistently demonstrated."

A comparison was made between the limiting government of the last eight years and the "business-friendly, if not slightly chaotic, White House." Mr. Goff stated that the industry is no longer viewed with open hostility and disdain, but industry leaders must still step up and do their part, and not deviate from the industry's founding principles.

"If we are honest with ourselves, let's state that government regulations are not inherently bad," Mr. Goff said. "If they are done smartly, fairly and with transparency, regulations need not stifle innovations that support the investment of capital. Rational regulations require a government that regards the business community as a partner, rather than as a threat to social well-being."

Mr. Goff outlined the AFPM mission and his pride in the organization's steady transformation over the years, as well as its stable transition from the last administration to the present one. He stressed the importance of allowing core principles to guide the organization's actions. He also complimented the increased strength, visibility and gravitas that AFPM now has in Washington D.C.

"These improvements have not come easily or cheaply, but they will continue to pay dividends for the industry," he concluded.

AFPM President Chet Thompson opened by thanking Mr. Goff for his service to AFPM over the last two years. "His commitment to AFPM and the industry has been tireless. Our organization has taken on a much greater profile under his direction, and he leaves his role having expanded our capabilities and solidifying our organization's standing and future strength," Mr. Thompson stated. His sentiments were echoed by the warm round of applause that followed.

"The bad news is that Greg's tenure as AFPM Chairman is over, but we are thrilled to have Larry Ziemba from Philips 66 as our incoming Chairman, and Joe Gorder of Valero as our new Vice-Chairman."

Refining. Mr. Thompson provided a review of the last year, stating that 2016 was a good—but not great—year for the petroleum and petrochemical industries. US refining capacity reached an all-time high of 18.4 MMbpd, and crude runs were at a record 16.5 MMbpd. US gasoline demand exceeded 143 Bgal (another record), and distillate demand remained strong at 59 Bgal.

In 2016, exports of refined petroleum products were robust, totaling more than 3.3 MMbpd, or more than double what they were a decade ago. "Even more promising is that the US Energy Information Administration (EIA) projects that product demand will remain strong this year, and for many decades to come," he stated.

As far out as 2040, the EIA projects that refined products will continue to supply more than one-third of US energy consumption and more than 40% of global demand. "The US is the world's refiner, and will be for the foreseeable future," Mr. Thompson said. "Domestically, US refiners continue to be huge part of our economy. Last year, refiners supported 2 MM jobs and paid more than $100 B in wages." The audience was pleased to hear that refiners contributed approximately $365 B to the US economy.

Petrochemical. The petrochemical industry had another good year, as well. "The US remains the preferred location for the global petrochemical industry, due to our abundant domestic resources," Mr. Thompson said.

He cited that, by 2020, product demand is forecast to rise 6%/yr, and exports are anticipated to expand by 60% over 2015 volumes. To keep up with demand, more than $150 B in capital projects are in queue. The US petrochemical industry also supported 2 MM jobs last year and contributed more than $322 B to the US economy.

Safety. Mr. Thompson stressed the industry's focus on protecting its workforce, communities and the environment. "Last year, the US refining and petrochemical industries, once again, had a rate of injury and illness well below other major industrial sectors. This is a testament to the level of importance our industry places on safety.

"Our members also continued to make substantial investments in the environment, reducing our emissions and discharges, and installing the equipment needed to meet the stringent Tier 3 standards that took effect in January," he said. "As a former member of the EPA, I'm proud of our environmental record."

Last year was a productive one for AFPM, as significant progress was made on some of its key legislative and regulatory priorities. The organization successfully petitioned the Supreme Court to stay the Clean Power Plan, a decision that could be one of the most important ever for environmental law and the energy sector.

AFPM also helped secure passage of the long-awaited legislative reforms to the Toxic Substances Control Act, the first time in 40 years that US chemical laws have been changed. Efforts to address the Renewable Fuel Standard (RFS) were made, in particular by introducing bipartisan legislation to amend the RFS by prohibiting the EPA from setting ethanol mandates that exceed the E10 blend wall. This legislation received more than 100 cosponsors, and has built momentum for action by Congress. These are only a few examples of AFPM's activities.

"No doubt, more than anything else, 2016 will be remembered for the seismic political shift that occurred," he said. "We now have President Trump, Republicans controlling both chambers of Congress, Rick Perry as Secretary of Energy, Rex Tillerson as Secretary of State, and Scott Pruitt as EPA Administrator! What a remarkable turn of events for our country and our industry! We now have an administration that does not want to wage war against us, but rather wants us to prosper."

AFPM is targeting policies that will help it achieve its vision, including tax reform, regulatory reform ("We do not seek regulatory reform to shirk our responsibilities, but they must be reasonable, cost-effective and transparent"), embracing free-market principles and improving infrastructure.

"Now is not the time to be quiet, to idly sit by, or to assume that the change envisioned by the new administration will happen without our active involvement," he said. "We need to be more engaged than ever to change the narrative and educate the public about the products we make and how they make people's lives better in every aspect." ●

HONEYWELL UOP, continued from page 3

launch of the ionic liquids alkylation technology was the first successful liquids alkylation technology to arrive on the market in 75 years. After a hiatus of 10 years, Honeywell UOP re-entered the hydrotreating sector with the launch of its Unity™ line of hydroprocessing catalysts. These advanced hydrotreating catalysts provide multiple benefits, such as allowing operators to take advantage of heavier and "opportunity" crudes, meet stricter environmental regulations on fuel quality, and allow extended lifecycle while processing heavier and contaminated feedstocks.

Ms. Liebert concluded her remarks by reinforcing what Honeywell UOP has been hearing from its customers, and how this has guided the company's investments in research and technology development to respond to these issues in the industry.

"At the top of the list is technology flexibility—to move quickly between gasoline and diesel production, and to have alternatives for naphtha to produce petrochemicals," Ms. Liebert said. "We need new ways to leverage low-cost methane and new technologies for petrochemical processing, and this is much of what we intend to develop through open innovation.

"In clean fuels technologies, we need more efficient methods to remove sulfur while raising octane, as well as new ways to leverage hydrogen for competitive advantage. We must reduce the carbon footprint, energy consumption and downtime of facilities. We must design for greater operability, with an even more sophisticated understanding of operating units. With the 'great crew change,' we must improve operator skills and knowledge transfer. Throughout an entire project lifecycle, we deliver solutions for *all* of these issues."

Finally, Honeywell UOP is embarking on a new wave of delivering technology support and service based on digitization. "This [digitization trend] will change the way all of us will be working with each other in the future—with more efficient business processes that are faster, more accurate and generate greater value," Ms. Liebert said.

"This goes *way* beyond automating existing processes. We are talking about using the Industrial Internet of Things to manage information on demand, with simple interfaces and tools that put us firmly in control of our operations. This technology will provide faster project execution, on-demand access, predictable delivery and complete control over information."

Just as the Southern Pacific Depot was a catalyst for industrial development, Honeywell UOP intends to revolutionize the oil and gas market with its technological solutions portfolio. ●

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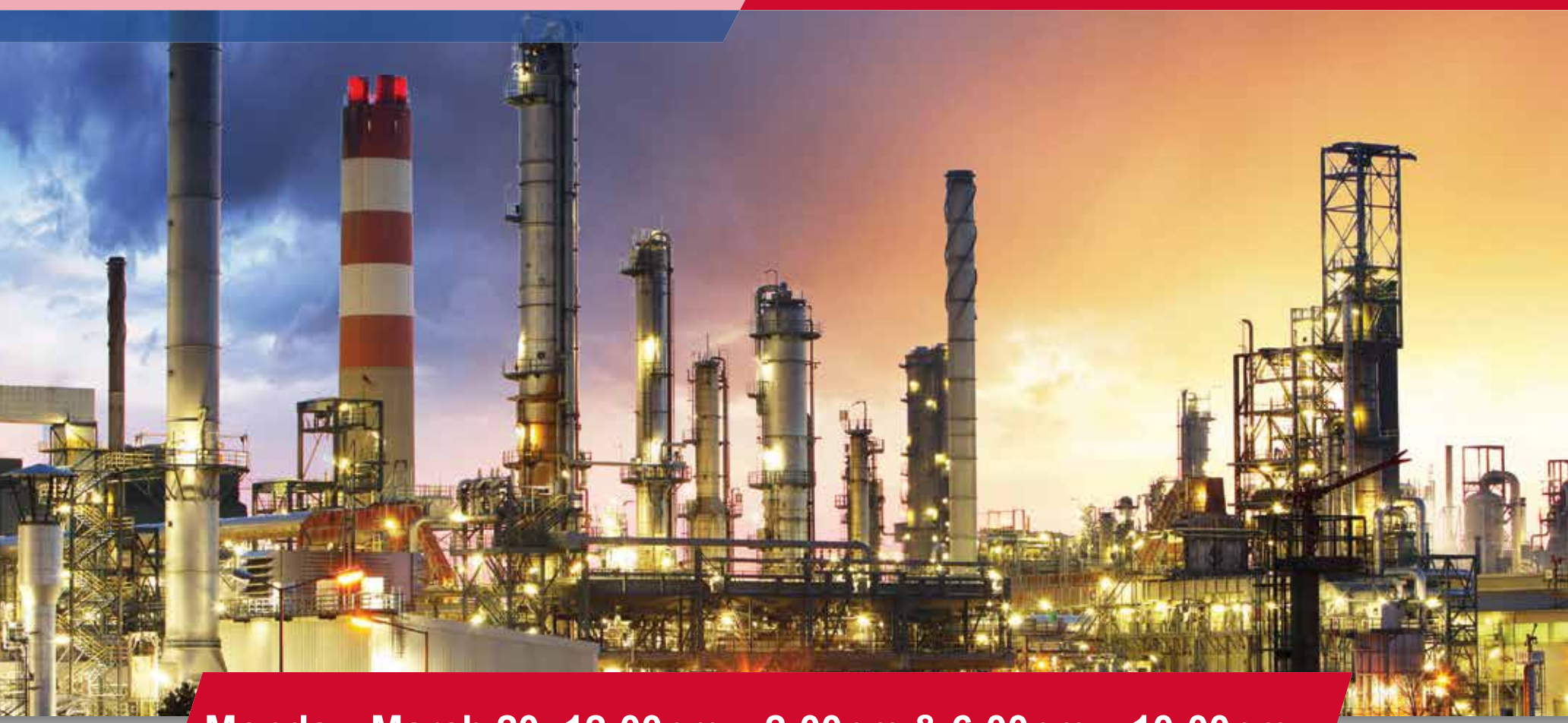

Monday, March 20: 12:00pm – 2:00pm & 6:00pm – 10:00pm

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Overcoming clean fuels production challenges

GEORGE ANDERSON, Albemarle

By exploiting fluid catalytic cracking pretreatment (FCC-PT) technology improvements, refiners can overcome the increasingly challenging production of ultra-low-sulfur gasoline (ULSG) while complying with regulations.

FCC-PT units are more important than ever, and require high-activity catalyst systems with good stability to achieve operating goals. FCC-PT units span a wide range of operating conditions and process many types of heavy feedstocks with differing compositions and contaminants. Refinery operating objectives can also vary greatly.

Pretreating objectives. Unlike processes that produce clean fuels directly, the economic value of FCC-PT is largely derived from how well it improves FCC product yields, product qualities and operations. Depending on the refinery, key objectives include:

- Maintain low product sulfur level to enable environmental compliance on gasoline sulfur and FCC SO_x emissions
- Maximize HDN and HDA to improve FCC yields and operations
- Increase vacuum gasoil (VGO) conversion.

Controlling catalyst fill costs and achieving target cycle lengths are also high priorities for most refiners.

FCC-PT units can generally be characterized by operating objectives and hydrogen partial pressure (ppH_2). "Low"-pressure units operate with an inlet ppH_2 < 800 psi; "moderate"-pressure units operate with an inlet ppH_2 between 800 psi and 1,300 psi; and "high"-pressure units operate at a ppH_2 > 1,300 psi.

North American units fall primarily in the moderate- to high-pressure range. While many of these units focus on deep HDS, maximizing HDN/HDA is also a major focus. With implementation of Tier 3 ULSG regulations, many FCC-PT units must operate at even deeper HDS, particularly those units in refineries without FCC naphtha post-treat capabilities.

Coping with wide variations. CoMo and NiCoMo catalysts are particularly effective in low- to moderate-pressure FCC-PT applications with low product sulfur targets. As product sulfur targets decline further, the need for more active and stable catalysts increases. Even for moderate- to high-pressure units targeting deeper HDN and HDA, the need for higher HDS activity has increased.

It is nearly impossible for a single catalyst to attain every objective. VGO STAX–FCC-PT technology enables the design of tailored catalyst systems to achieve unit objectives within operating conditions and constraints. This technology accounts for the chemical reactions in different reactor zones, and matches the catalyst benefits with each zone to optimize overall performance. FCC-PT typically involves only two reaction zones. FIG. 1 illustrates the basic concepts by showing the types of reactions in each zone and the inhibitors slowing these reactions.

In Zone 1, direct desulfurization (DDS) predominates, and NiCoMo catalysts are ideal for boosting HDS reaction rates. HDN and HDA reaction rates are limited by lower pressure, and nitrogen (N) inhibition further slows HDN/HDA rates in Zone 1 at all pressure levels. When intermediate product sulfur and N fall below certain levels, Zone 2 is reached. HDS reactions occur via a combination of DDS and hydrogenation (HYD) reactions at a slower rate than in Zone 1. HDN and HDA reactions will be faster than in Zone 1, but are still relatively slow. Thus, NiCoMo catalysts with balanced HDS and HDN activities can be very beneficial in this zone, especially at moderate ppH_2.

For high-pressure operations, deep HDN/HDA is often highest priority. Achieving deep HDN/HDA generally requires the use of NiMo catalyst in Zone 2, and possibly in Zone 1, as well. However, for units that are HDS activity-limited in any way, NiCoMo catalysts are beneficial in Zone 1 and often in the upper portion of Zone 2, even for high-pressure units.

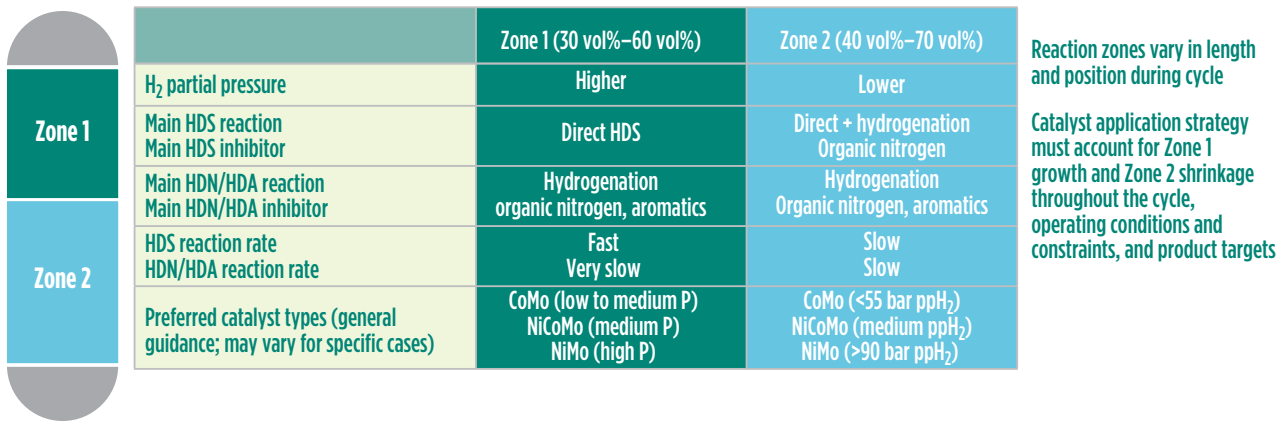

FIG. 1. Relating FCC-PT reaction zones to preferred applications.

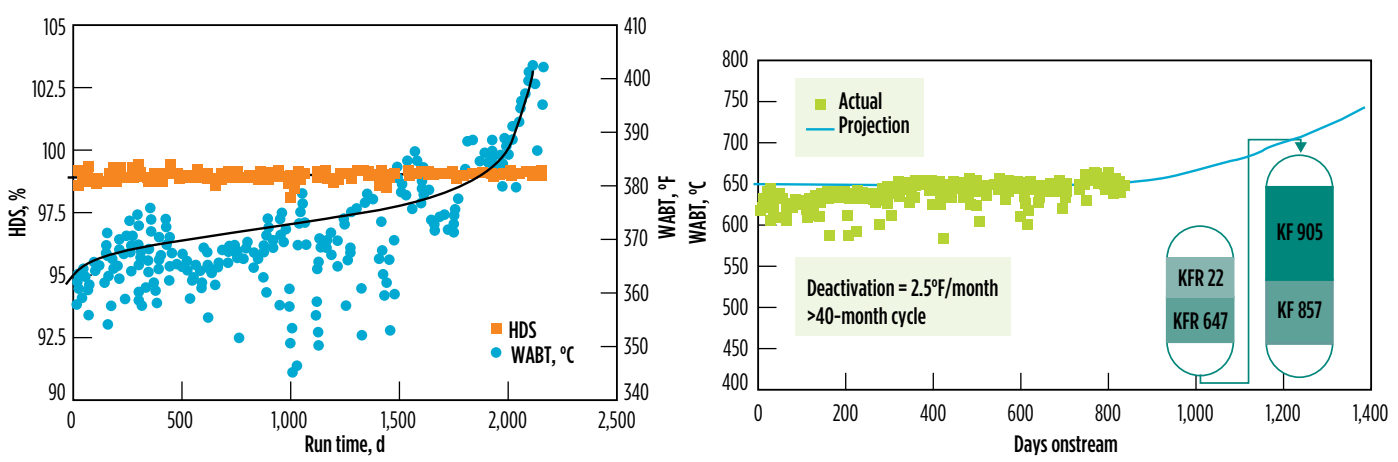

FIG. 2. Temperature profiles for two different commercial application examples.

TABLE 1. FCC-PT catalysts commercialized since 2014

Catalyst	Sizes	Type	Process objective	Pressure range	Units loaded
KF 780	1.3Q, 3Q	CoMo STARS	HDS	Low to moderate	11
KF 861	1.3Q, 2Q	NiMo STARS	HDN /HDA	Moderate to high	5
KF 907	1.3Q, 2Q; 1.5E	NiCoMo Type I	HDS	Low to moderate	6

Optimized applications. VGO STAX-FCC-PT technology solutions have had numerous successful applications worldwide. The first example (FIG. 2) is a low-pressure unit that processes VGO with 2 wt% sulfur and 1,600 ppm nitrogen. This unit targets 200 ppm FCC feed sulfur to produce FCC gasoline with 10 ppm sulfur. Its STAX catalyst system is designed with CoMo and NiCoMo STARS catalysts and achieves nearly six-year cycles.

The second example is a high-pressure unit processing a blend of heavy VGO and heavy coker gasoil containing 3 wt% sulfur, 1,500 ppm nitrogen and 2 ppm nickel plus vanadium. The objectives are to produce FCC feed with 1,500 ppm sulfur and < 600 ppm nitrogen over a four-year cycle. A guard catalyst system removes nickel, vanadium and silicon, and protects against reactions causing pressure drop buildup. A NiCoMo/NiMo STARS active catalyst system was applied. As shown, this STAX system is approaching three years on oil, and its performance matches process model projections.

Drop-in improvement options. Given the increasingly challenging process objectives they face, refiners need catalyst systems with superior activity and stability.

The FCC-PT catalysts listed in TABLE 1 provide technology solutions to customers spanning the broad range of FCC-PT applications. When used in STAX systems, the individual catalyst benefits can be leveraged to satisfy multiple objectives and constraints.

KF 780 has high HDS and HDN activity, with low loading density and fill cost. It is excellent for use in Zone 1 at low to high pressures, and also for Zone 2 at low to moderate pressures.

KF 907 also has high HDS and HDN activities, and its activity benefits increase as operating severity increases. This Type 1 catalyst shows strong performance benefits in Zone 2 of moderate- to high-pressure units, especially for units with startup constraints and/or activity stability challenges.

For moderate- to high-pressure applications, NiMo catalyst use in Zone 2 is usually preferred, especially if HDN and HDA are key objectives. KF 861 STARS is a high-activity NiMo catalyst with relatively low loading density that provides attractive fill cost.

Stiffer challenges, more robust systems. As refiners face tougher FCC-PT operations challenges, they need more reliable and robust catalyst systems that deliver high activity and good stability. The performance benefits of Albemarle's new catalysts are enhanced in STAX systems, ensuring that all operating objectives are achieved. ●

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Overcoming the challenges of facility operational cyber security

RANDY KIRKENDOLL, Redi Technologies LLC

In recent years, we have seen incursions into US operating facilities in pipelines where system operational and configuration data was exfiltrated. We have also seen Trojan malware in nuclear facilities in Germany that embedded itself into the facility control system (entering through an infected jump drive) and was awaiting instructions from the attacker outside of the system. In late 2015, a major, coordinated attack in Ukraine took down half of the nation's power grid. This Trojan malware gave the attackers complete remote control of major facilities across the country, leaving operators unable to retake control from their HMI screens and shutting down power for the better part of a day.

One of the key challenges facing today's control systems (including HMI servers, SCADA systems and historians) is that many controller platforms were developed long before cyber security was an issue—this is also true for DCSs, PLCs, RTUs and SISs. As a result, cyber security solutions in place must be "bolted on," which is the technical equivalent of continuously carrying a shield to protect oneself from an attack.

A new design for built-in cyber security. The oil and gas industry is increasingly recognizing the need for cyber security to be built into control systems rather than added on. For example, the RFP for a "next-generation" control system that Lockheed Martin recently issued on behalf of ExxonMobil called for "defense-in-depth intrinsic security, including message encryption, secure boot, cryptographic signatures chain of trust and a security model that allows asset owners to protect against known risks, detect abnormal situations and evolve with emerging threats." Control system developer Bedrock Automation has been working closely with ExxonMobil to advance such a platform. The company is marketing a new control platform that was designed from the ground up with the most advanced performance control technologies and built-in cyber security.

The Bedrock™ control platform has incorporated security into the base product from the beginning. Since the custom chips are manufactured by Bedrock Automation parent Maxim Integrated Products, security extends to its supply chain, as well. During initial designs, Bedrock's Cybershield 1.0 firmware enabled the first intrinsic cyber security for an industrial control system that was supported by a pinless I/O backplane, which prevents cyber intrusion into the I/O; metal-wrapped construction on all I/O modules and backplanes; and extreme performance on the controller, communications modules and I/O modules. The system features the simplest I/O scheme that, among other unique features, includes a universal I/O module that allows for configuration of any I/O type on all channels. This is accomplished in a secure manufacturing environment that removes the human element using built-in, automated, cyber secure module fabrication.

With the inclusion of more than 40 intrinsic technologies, the Bedrock Open Secure Automation™ (OSA™) platform initially delivered on two fundamentals of cyber defense: a secure control platform, and a secure component supply chain. The resulting endpoint root of trust leverages hardware-based secret root keys and certificates for advanced cryptographic authentication of Bedrock hardware and software components, which are further fortified with layers of anti-tamper protection.

Bedrock Automation recently announced newly upgraded control system firmware that extends its intrinsic cyber security protection to networks, the IIoT and third-party applications (FIG. 1). Bedrock Cybershield 2.0 firmware not only enables authentication and encryption of I/O networks and field devices; it now protects compliant networks and user applications, such as controller configuration, engineering and SCADA. This is achieved with the world's first industrial control system (ICS) certification authority (CA), drawing on the power and flexibility of public key infrastructure (PKI) and transport layer security (TLS).

Attempting a similar level of protection with conventional, bolt-on technologies increases operational cost and complexity, with little certainty of protection against inside-out or outside-in attacks, such as Stuxnet or stolen credentials. Since cyber security hardening is a standard feature of all Bedrock system components, the cost of obtaining this protection is negligible.

The Bedrock OSA was created as both an open and a secure platform for hardware, networks and software. Software developers who want to take advantage of this opportunity can now receive certificates of authorization (CAs) to incorporate Bedrock encryption keys into their software, giving their programs secure access to Bedrock controllers. Several leading software providers are releasing or testing this secure integration. The first cyber secure software partners include: 3S of Germany—its IEC61131 configuration and runtime engines are running over TLS with authentication to the Bedrock system root of trust; and a field device tool (FDT) frame application by M&M Software for HART configuration. This will be followed closely with Inductive Automation's Ignition™ SCADA, and other SCADA partners later this year. Bedrock Automation also offers a controller that enables end-users to obtain customized, company-specific root keys and certificates, adding yet another layer of security.

Looking forward. Increasingly complex cyber threats will continue to be developed, with ever more impactful risks. These increasing threat levels require equally aggressive solutions in the operating control systems within our facilities, and demand creative solutions with intrinsically embedded cyber security in controllers that implement authentication tools such as biometrics, smart cards and role-based access; built-in network and communications security implementing self-managed certification authority; public key infrastructure; and transport layer security. These next-generation tools now allow refiners, critical infrastructure assets and government agencies—such as the DHS ICS CERT and ICSJWG members—to move forward and protect intellectual property, processes and facilities to the safest possible levels. ●

FIG. 1. A new firmware upgrade for the Bedrock control system extends its intrinsic cybersecurity protection to the operations domain.

VERACITY TAPPED TO DEVELOP CRITICAL INFRASTRUCTURE NETWORK SECURITY

Veracity Industrial Networks, a leading developer of next-generation operational technology (OT) network cyber security for the industrial internet, is part of a three-company team tapped by the US Department of Energy (DOE) to develop a secure networking solution that reduces cyber attacks against US industrial and utility networks.

The team, which includes engineers from Veracity, Schweitzer Engineering Laboratories Inc. (SEL) and Sempra Renewables, will focus on developing technology to reduce cyber attacks aimed at energy delivery systems. The companies will use new Ethernet communications technology designed to keep systems operational when under cyber attack. The project includes automating the identification of unwanted network behavior and outside intrusion, the containment of network areas and the rerouting of critical information.

Building on the already successful completion of the DOE's Watchdog and SDN projects, which were sponsored by the DOE's Cybersecurity for Energy Delivery Systems (CEDS) program, the team will deliver:

- A security state policy enforcer application that runs on the northbound interface of a flow controller
- A DIN rail mount software-defined networking (SDN) Ethernet switch
- An industrial control system extension to the open-source SDN specification using the OpenFlow® specification
- The ability to apply an action to encrypt/decrypt packets on a per-flow basis and automate key management. ●

People problems: Addressing operator competency

MARTIN ROSS, Honeywell Process Solutions

The first step in solving any problem is admitting that you have one. People are the process industry's greatest asset, but they can also be the weakest link without the support they need. Problems with operator competency impact process performance and can pose serious safety consequences. Weaknesses can only be addressed if they are first identified.

Fortunately, both leading and lagging indicators can reveal operator competency challenges before more serious consequences occur.

Look in, look out. The most obvious leading indicators are operator performance and knowledge, which are best assessed through a review. Can operators explain the process, the important process variables and how they are controlled? What are typical disturbances and standard procedures? Are they consistently completing tasks, making good use of the control systems and effectively managing upset conditions?

The work environment is a less direct measure, but can provide a powerful indicator of problems (FIG. 1). Symptoms of high stress or low morale among operators, or high staff turnover and absenteeism, can be indicative of concerns over competency. If operators are not confident that they are able to run the plant well, the chances are that they will not.

However, it is not enough just to listen to operators. Listen to what others are saying: Are safety and environmental authorities giving poor reviews and identifying operator performance? Are underwriters' concerns about increased upsets or environmental emissions pushing up premiums? Is customer satisfaction suffering due to difficulties meeting schedules, or quality and specification requirements?

Listen to what the data is saying, as well. Trends in production performance can reveal competency problems: rising operating costs due to lower yields; higher energy and chemicals costs or falling catalyst activity; increased re-runs of off-spec products; and rising numbers of incidents. Competency may not be the root cause in each case, but it often is a contributing factor.

Take action. Any operator competency gap must be closed, and this requires a framework for evaluation and intervention. This framework is best based on continuous performance evaluation, both for new hires after training to identify weaknesses in specific competencies, and after an operator is "certified." Continuous monitoring identifies any drift from expected performance.

Deviations from expected norms must be identified, mapped to a competency gap, closed by refresher training, and continuously monitored to prevent future issues. Therefore, an ability to identify specific competency gaps and suggest training is essential.

One method is to examine an operator's roles and responsibilities and identify the required competencies and proficiencies. For console and field operators, for example, a key responsibility is to operate under normal conditions. This, in turn, requires a set of competencies: operating unit controls, interacting with other units and executing a shift handover. These are linked to behaviors: explaining unit control schemes, manipulating controls without adversely affecting the unit, troubleshooting control loops, and so on.

Finally, each competency can be assigned a proficiency level, from "aware" to "knowledgeable," "skilled" and "master." In this way, the competency model not only identifies gaps, but also specifies the training needed to close them and meet the needs of both the staff and the business.

To learn more about new technology and online operator training, attend John Roffel's presentation, "New Technology Addresses Operator Training Challenges" on Tuesday at 2:30 p.m. ●

FIG. 1. One method to increase operator competency is to examine the operator's roles and responsibilities and identify the required competencies and proficiencies.

IN THE NEWS

APC PERFORMANCE EARNS PATENT FOR ADAPTIVE CONTROL ALGORITHM AND MULTIVARIABLE CONTROL METHOD

APC Performance LLC has been granted its patent application for its Rate-Predictive Control (RPC™) and Model-less Multivariable Control (XMC™).

RPC is a new model-less and inherently adaptive, or "naturally self-tuning," process control algorithm. It deploys as a reusable distributed control system (DCS) software function block, or it can be directly built into commercial control system products as one of the user-selectable control algorithm options. In many applications, RPC provides a more reliable alternative to industry-standard "PID" control.

XMC, the model-less multivariable control technology, embeds RPC as its internal control method. The products represent important and far-reaching breakthroughs in industrial process control technology because they solve fundamental limitations that have historically undermined process control performance in the past. RPC does not depend on detailed process models for either single-loop or multivariable process control, eliminating more than 90% of plant testing and model-related activities, costs and maintenance; and is inherently adaptive to changes in process gain, which is especially important in an industry that has struggled to find a reliable self-tuning controller in the past, and where dynamically changing process gains have been a particular problem of model-based multivariable control.

Process industries, such as refining, chemicals and power generation, rely heavily on process control technology for safe, stable and reliable operation. RPC and XMC help process industry sectors to realize large gains in overall real-time process control and optimization performance. APC Performance's RPC has the potential to streamline advanced control practice and reduce costs, while increasing process automation performance and agility.

SIGHTLINE SYSTEMS' EDM PROVIDES ADVANCED, REAL-TIME ANALYTICS

Sightline Systems has released its Enterprise Data Management (EDM) for Manufacturing, a predictive analytics software that is designed specifically to help manufacturers take advantage of IIoT system and device data streams, enabling them to proactively address costly challenges that can develop throughout the production process.

EDM for Manufacturing assists process and quality engineers by correlating thousands of data points collected in real time from sensors, SCADA systems, historians, PLCs and more. The information is displayed on a highly visualized dashboard, providing an accurate picture of the entire manufacturing operation, enabling floor personnel to more accurately and efficiently identify trends and patterns that affect output quality. Manufacturers can also leverage data to better forecast demand, automate manual processes and perform preventive maintenance.

The software uses advanced machine learning techniques to significantly simplify the prediction of future operational performance. By reviewing collected historical data, EDM for Manufacturing determines the best statistical model to provide a reliable forecast of future behavior. Forecasts are automatically generated on easy-to-understand dashboards. Alerts can also be created, providing early warning of problems. Behavioral alerts can also be generated if real-time data does not conform to predictions, adding another layer of alerts.

EDM for Manufacturing eliminates manual copying and the manipulation of industrial data by hand or in spreadsheets. EDM correlates vast amounts of data in microsecond intervals, and the actionable intelligence it provides enables manufacturers to quickly remedy issues, reducing cost, eliminating waste, diminishing production flaws, managing risk and ensuring safety and compliance.

EDM for Manufacturing also recognizes anomalies that could indicate if a machine is likely to break down in the near future, giving manufacturers the opportunity to perform needed maintenance in non-emergency conditions without shutting down production. EDM looks at the history of machine failures and compares those instances to the sensor data the machine is sending to identify trends and patterns that could signal a problem before the breakdown.

Sightline Systems' EDM for Manufacturing equips quality and process engineers with advanced, real-time analytics to proactively address potentially costly challenges.

CH2M, SHELL SIGN FRAMEWORK AGREEMENT PROVIDING GLOBAL ENGINEERING SERVICES

CH2M has signed a framework agreement with Shell to provide engineering, procurement, construction and project management services across upstream, integrated gas and downstream projects globally.

As an engineering, procurement and construction services provider, CH2M will focus on delivering projects for Shell's operating sites and business units. This collaboration will allow Shell's business units to access CH2M's global technical and management expertise. ●

Zachry Group brings a unique ability to create significant value for our customers. With enhanced capabilities and services—including **our recent acquisition of Chicago-based Ambitech Engineering Corporation**—Zachry Group is now uniquely positioned to support the current and emerging needs of our customers. We are better equipped than ever to provide a fully integrated, seamless package of services, from concept to commissioning—and everything in between. Plus, after we've designed it, built it and turned it over, we can keep it running in top condition through our maintenance and specialty services.

To all AFPM attendees, we welcome you to San Antonio! Enjoy the colorful, vibrant Alamo City, which has been Zachry's home base for 65 years.

Be sure to stop by our AFPM hospitality suite in the Travis meeting room to hear more about our enhanced capabilities and our exciting acquisition of Ambitech Engineering, a global provider of engineering, design, project management, procurement and construction management services.

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EIA: Planned outages not expected to constrain fuels availability

The US Energy Information Administration's (EIA) latest analysis of planned refinery outages during the first half of 2017 states that such outages are not expected to cause a shortfall in the supply of petroleum products, including gasoline (despite record demand), jet fuel and distillate fuel, relative to expected demand.

National supply and demand balances have limited implications regionally because pipeline infrastructure, geography and marine shipping regulations constrain product flow between regions.

The EIA's national and regional conclusions are the result of simulating regional supply on a monthly basis based on a set of refinery operations assumptions. The report considers planned shutdowns of refinery units as reported by Industrial Info Resources (IIR), and provides the EIA's analysis of the implications of outages affecting atmospheric crude distillation units, fluidized catalytic cracking units (FCCUs), catalytic reforming units, hydrocracking units and coking units. Barring unusually high unplanned outages, planned outages that extend beyond schedule or higher-than-expected demand, the supply of gasoline, jet fuel and distillate fuel is expected to be adequate in all regions through June 2017.

Gulf Coast (GC) region (PADD 3). Planned outages for the first half of 2017 are higher than average, but regional inventories appear to be sufficient to offset lost production from planned outages. PADD 3 contains more than half of the US refining capacity, so it produces far more petroleum products than it consumes. The region's surplus production supplies other US regions, most notably the East Coast and the Midwest, as well as international markets. The EIA's calculations indicate above-average PADD 3 production reductions due to planned capacity outages, with gasoline reductions from full capacity production of roughly 344 Mbpd (thousands of barrels per day) in both February and March, and 311 Mbpd of distillate fuel in February and 246 Mbpd in March. In total, over the first half of 2017, gasoline reductions represent 27% of inventory, jet fuel decreases represent 28% of inventory, and distillate reductions represent 26% of existing inventory. With GC gasoline and jet fuel inventories at their highest level in 10 years, distillate inventories close to the 10-year average, and high levels of gasoline and distillate exports that could be diverted to domestic markets to offset reductions in refinery production, several options exist to make up for production losses due to planned GC refinery outages.

Midwest region (PADD 2). Planned outages for the first half of 2017 are at lower-than-average levels for all types of refinery units, so supply of petroleum products is likely to be adequate to meet domestic demand. Production losses from planned outages are expected to reach their highest level in April, with slightly lower losses in May. Total estimated production losses for gasoline, jet fuel and distillate fuel over the first half of 2017 are equivalent to 7%, 16% and 6%, respectively, of existing inventories in the region, as of January 20. PADD 2 contains 21% of the nation's refining capacity and represents 25% of total US demand for petroleum products. As a result, Midwest refineries produce most of the gasoline and distillate fuel consumed in the region, particularly during the winter, when consumption is lower. Additional supply is available from inventories and from the GC, if needed.

West Coast region (PADD 5). Planned outages for the first half of 2017 are close to average, and regional inventories appear to be sufficient to offset lost production from brief periods of higher planned outages. PADD 5 has 16% of the nation's refining capacity and represents 15% of total US demand for petroleum products. Planned outages, which are expected to peak in March, will produce cumulative reductions in petroleum product production over the first half of 2017 equivalent to 19% of existing gasoline inventory, 32% of jet fuel inventory and 45% of distillate fuel inventory.

East Coast region (PADD 1). Planned outages for the first half of 2017 are lower than average, so supply of petroleum products is likely to be adequate to meet domestic demand. PADD 1 contains 7% of the nation's refinery capacity and represents 29% of total US demand for petroleum products. Consequently, supplies are transferred into PADD 1 from other regions, primarily from the GC and from imports out of the Atlantic Basin market.

Rocky Mountain region (PADD 4). Planned outages for the first quarter of 2017 are lower than average, with some higher outages in 2Q. Regional product inventories, which are at or above average levels for this time of year, appear sufficient to offset lost production from planned outages. The PADD 4 region has 4% of the nation's refining capacity and represents 4% of total US demand for petroleum products.

While unanticipated events could result in some issues, the EIA's detailed review found no region in which planned refinery outages are likely to lead to inadequate gasoline, distillate or jet fuel supplies during the first half of 2017.

See the full EIA report at: https://www.eia.gov/petroleum/refinery/outage/pdf/refinery_outage.pdf

POLE POSITION

ANNOUNCING

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Criterion announces the newest catalyst generation in performance… our scientists have used our R&D expertise to secure the pole position to launch the CENTERA GT™ high performance catalyst! We continue to innovate to increase performance and quality, and CENTERA GT takes another leap forward. This next generation, along with the SENTRY™, ASCENT™ and ZEOLYST™ catalysts, will help refiners keep on winning. Our advanced portfolio of products protects and performs, adding value with customized solutions for the complex needs of refineries.

SENTRY™: Ultimate protection from feed poisons and pressure drop
Hydrotreating: Performance in quality meeting strict fuel standards and maximizing advantaged feeds
Hydrocracking: Increasing the quality and yields for high value products processing heavier feeds

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A novel approach to FCC catalyst withdrawals

RICK FISHER, Johnson Matthey Process Technologies

Almost all FCC units withdraw catalyst manually, usually once every few days. Today's designs are limited by poor control of withdrawal rate due to manual adjustments of catalyst and carrier air flows; operator safety and withdrawal piping integrity due to high temperatures and poor velocity control, which can result in hot catalyst spills and frequent maintenance requirements; a lack of cooling of the withdrawn catalyst prior to removal from the refinery; and the significant impact of the batch withdrawal process on unit operation and flue gas emissions.

Johnson Matthey's novel approach overcomes all major drawbacks of existing designs.

- Pressure balance design eliminates erosion of the throttling device normally used to control withdrawal rate.
- Pipe erosion is minimized as withdrawal line velocity is tightly controlled.
- Continuous withdrawal eliminates large changes in the regenerator or reactor bed level seen with batch withdrawals. A constant bed level can be maintained at all times.
- Withdrawn catalyst is cooled sufficiently to prevent damage to storage vessels.

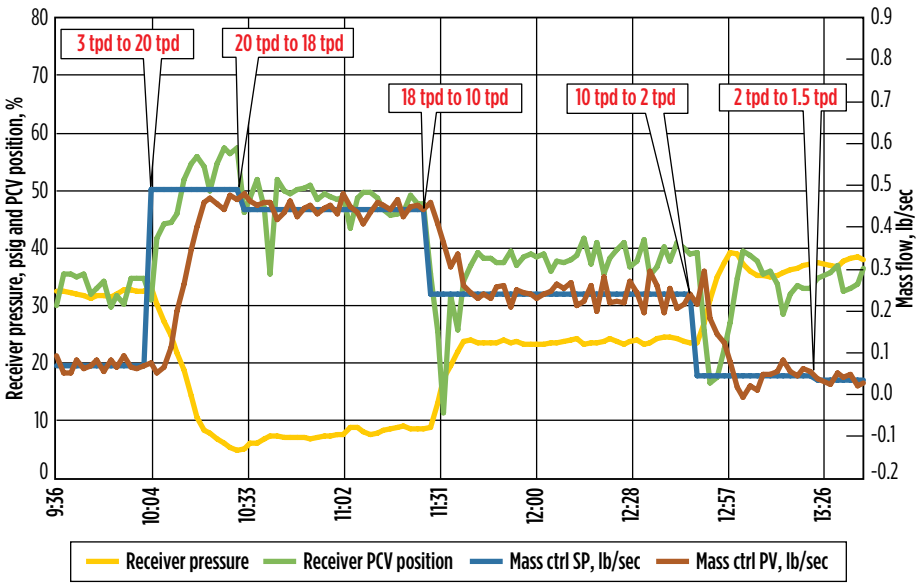


FIG. 1. CWS test period, withdrawal rate variation.

The first Johnson Matthey INTERCAT$_{JM}$™ continuous catalyst withdrawal system (CWS), which was installed at Marathon Petroleum Co.'s Garyville, Louisiana refinery, is comprised of an everlasting isolation valve, a positive displacement fan, three finned pipe-in-pipe heat exchangers to cool the catalyst, and a collection vessel to receive the cooled catalyst. The CWS uses a sophisticated control logic to carefully control the withdrawal velocities by using pressure balance between the regenerator and the collection vessel, which is mounted on load cells so the exact quantity of catalyst withdrawn is known. This improves the accuracy of the FCCU catalyst balance, and enables easier catalyst loss troubleshooting. The cooled catalyst is transferred to the equilibrium catalyst (E-Cat) storage hopper prior to removal.

The CWS can be carefully monitored and controlled through the refinery DCS, or operated through the standalone controller provided with the system.

The CWS can be operated over a wide range of withdrawal rates, with smooth transitions when the desired withdrawal rate changes. This system control is dictated by the pressure balance between the collection vessel and the regenerator. **FIG. 1** provides an overview of the varying withdrawal rates achieved by the CWS during testing.

The CWS design capacity can be tailored to particular needs and can achieve sustainable continuous withdrawals in excess of 40 tpd.

The conventional method of batchwise catalyst withdrawals not only presents potential safety concerns, it additionally upsets regenerator stability and affects combustion kinetics. This unsteady period of operation can upset the heat balance and cause a degradation of yields, resulting in economic loss and a change in regenerator flue gas composition as combustion kinetics are altered. Johnson Matthey's INTERCAT CWS$_{JM}$™ is a fresh approach to regulate catalyst withdrawals, which is one of the least controlled aspects of FCC operation. The improved control of the catalyst withdrawals will reduce costs associated with maintenance repairs, safety incidents and operational swings in the FCC from sudden catalyst inventory reduction.

To learn more about Johnson Matthey's latest products, visit the Tuesday morning session led by Martin Evans, VP of Equipment Technology, Johnson Matthey Process Technologies. ●

Turnaround best practice strategies

MATTHEW POPOVACKI, T.A. Cook Consultants Inc.

Turnarounds (TA) are significant undertakings, but their planning and execution are often seen as part of a short-term facilitation process, distinct from the long-term perspective of corporate and asset strategy.

Such a separation of strategy from planning and execution means that the potential gains from aligning and managing initiatives between functional disciplines (such as HSE, asset integrity, operations, procurement, shutdowns, capital projects, maintenance and reliability) are either ignored or not fully exploited.

However, with the help of a shutdown, turnaround and outage (STO) strategy, the gap between strategic vision and the tactical planning and execution of TA activities can be bridged.

Integrated strategic management (ISM) model. An effective and structured approach to an STO strategy is essential. To make that process clearer and more effective, an ISM model (FIG. 1) can be used to define the steps that managers can take to overcome divisions between corporate goals and optimal asset performance.

Once the ISM model has been used to align initiatives across the different functions, a best practice STO strategy can be fully developed. However, misconceptions exist regarding the frequency and size of major events that can hinder this development. As TAs require sites to go offline for extended periods of time, the impact on production can be serious. To reduce that impact, organizations are impelled to decrease the frequency of major events, thus reducing the time that an asset is not producing.

Unfortunately, taking this approach actually increases the complexity of individual events and does not take into account safety, quality and productivity. These key influencers must be considered, as they enable assets to be maintained and perform optimally.

Implementation. To successfully deliver an STO strategy, most organizations create a temporary or core TA team to prepare and deliver on major events, while drawing on resources from different functional areas. Some viewpoints or assumptions can impede the effective use of this approach.

These common misconceptions often lead organizations to continue to work in silos, which in turn creates gaps between processes within various functional areas. To mitigate these issues, companies must look beyond focusing on individual processes to improve overall asset performance. All functional areas must be fully engaged, coordinated and integrated with the STO processes so that the TA team can fully rely on them. Implementing an STO strategy is a good example of company-wide cooperation: success will depend on how well processes are integrated with the multiple functional areas, while continuing to perform primary duties.

Integration is crucial. Successful strategies are not executed by themselves. To deliver on their strategies, organizations must increase visibility across multiple functional areas and effectively integrate processes. To be effective, they must adopt a more holistic, tactical and structured approach. Integrated planning should be a heavy focus to minimize the large gaps typically found between long-term strategic vision and actual performance.

Incorporating a structured approach such as the ISM model allows organizations to engage all functional area processes and eliminate silos or gaps that exist between departments. It also enables companies to take advantage of the synergies within different functional areas, and to deliver on strategies that will represent more profitable and optimal performance.

To learn more about implementing best practice STO strategies with the help of integrated planning, do not miss Matthew Popovacki's presentation on Tuesday at 3:30 p.m. in Salon K/L. ●

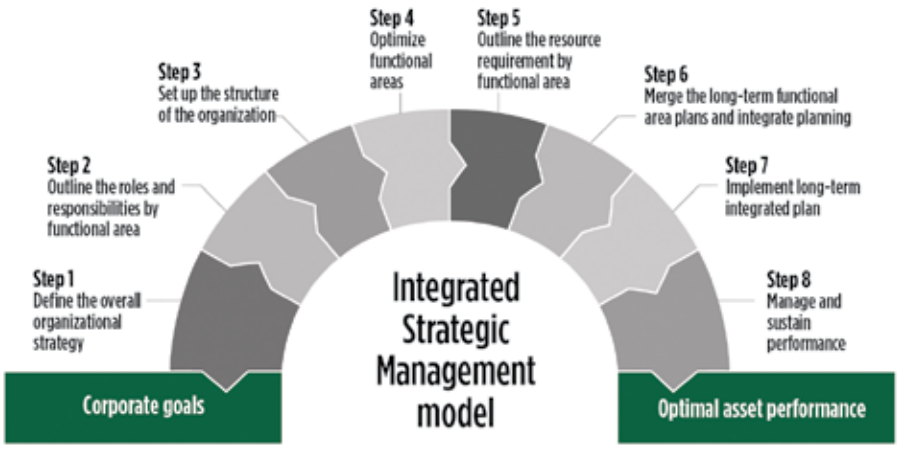
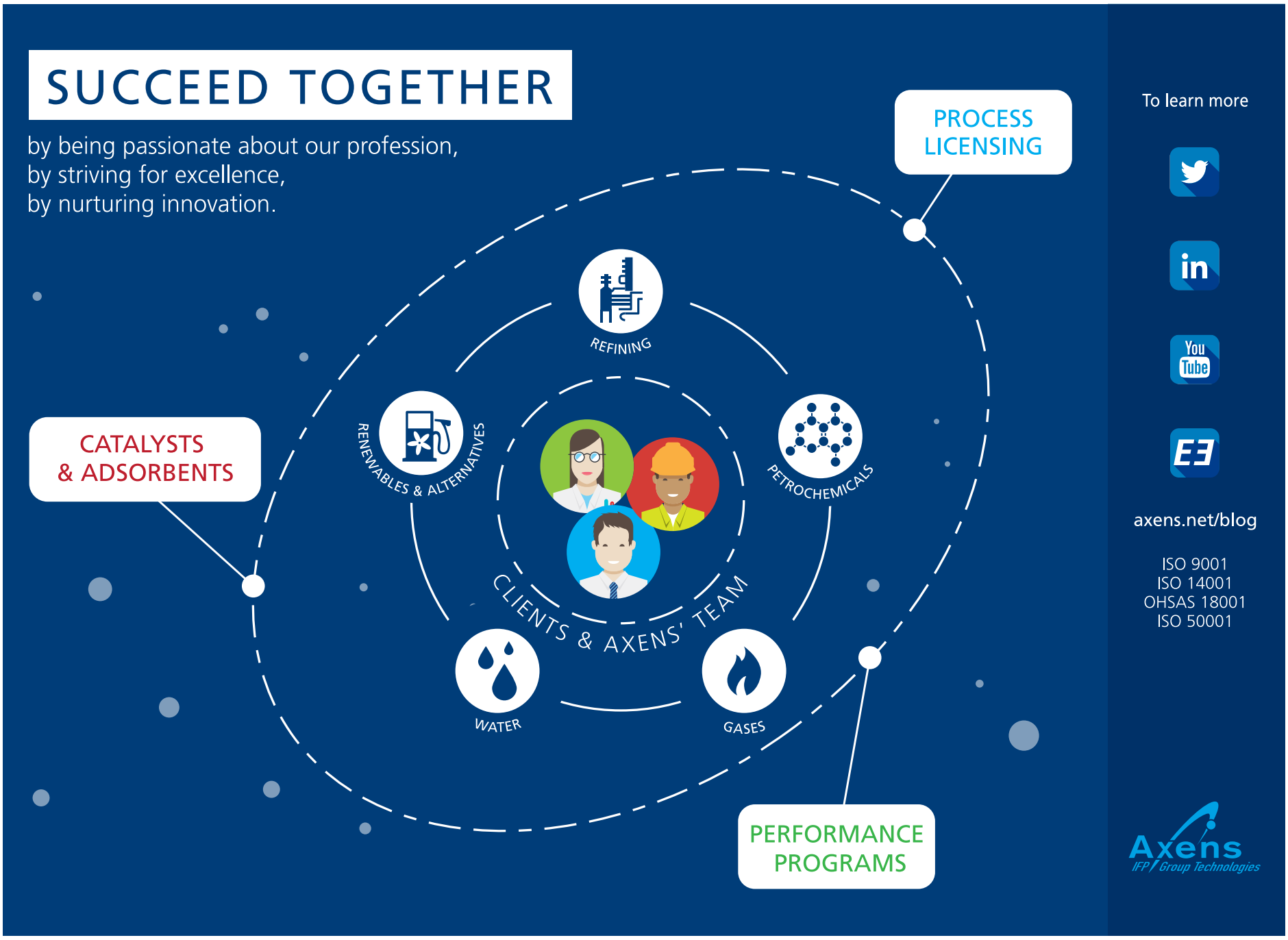


FIG. 1. T.A. Cook Consultants' ISM model provides an effective and structured approach toward an STO strategy.



BMS upgrade challenges, opportunities in brownfield installations

MIKE SCOTT and **PAUL GRUHN,** aeSolutions

Various types of fired equipment in the process industries use burner management systems (BMS). Some brownfield installations may date back 40 years or more, and most of these installations were originally designed according to prescriptive standards. However, most systems have required and undergone a variety of changes and upgrades over time. Applicable standards have changed considerably over that time period, and this can result in a variety of challenges.

As more and more of these fired devices become obsolete, many organizations are considering upgrades. Potential challenges—as well as opportunities—exist when attempting to apply the ISA 84 standard safety lifecycle to a BMS. Prior to 2010, the prescriptive BMS industry standards had neither embraced nor invoked the safety lifecycle. As of 2015, the National Fire Protection Association (NFPA) BMS series of standards have *all* invoked the safety lifecycle in some capacity. For a brownfield installation, this represents a significant opportunity for potential cost savings.

A problem-solving methodology. A two-pronged approach is necessary to solve these challenges for brownfield BMS upgrade projects. Step 1 is to conduct a process hazards analysis and review the existing design vs. the required safety integrity level (SIL) targets. The existing safety instrumented functions (SIF) can then be reviewed for acceptability. If these existing acceptable SIF designs deviate from the prescriptive "cookbook" requirements mandated by the latest governing codes or standards, an "equivalent design" justification can be developed to support a deviation from the prescriptive requirements. Governing codes and standards have documented that this methodology is acceptable. Step 2 is to use "templatization" to further reduce the costs of implementing the safety lifecycle on multiple similar units.

FIG. 1. An intelligent drawing package and a database approach that will handle all engineering deliverables are required for the safety lifecycle.

Example case. Consider the application of the 2015 Ed. of NFPA 85 on a multiple burner boiler/incinerator with multiple fuel streams. The NFPA 85 standard mandates that the boiler has a double block and bleed valve arrangement for *each* individual fuel line to *each* burner. Considering that this application has multiple burners, each with multiple fuel lines, the cost of putting blinders on, and prescriptively applying the requirements of the standard, would be very high. In retrospect, is such a design really providing the level of risk reduction needed compared to the cost of implementing the change?

Based on actual experience, the accepted design was accomplished using only single valves on the header and fuel lines. Considering that multiple boiler installations were all using the same design, this represented a significant cost savings associated with the installation of hundreds of extra valves. An equivalent alternate design that is risk-based is now possible. This ensures that an organization is meeting its corporate risk criteria, as well as managing risks with a "right-sized" design.

Templatization. Consider an NFPA 85 boiler with a single burner and single fuel that is used at multiple sites, which is quite common for most companies. The sites will be very similar. After engineering the first design, a significant reduction in cost and schedule can be achieved if it is possible to then "copy and paste" all other instances. This can be expanded to instrumentation and controls design, as well.

The suggested approach, shown in FIG. 1, will require a database approach to the safety lifecycle that will handle all engineering deliverables. An intelligent drawing package will also be needed. If these two things can be synchronized, then be templates for deliverables can exist. Using templates and accomplishing this process can reduce the cost of engineering, as well as improve quality and consistency.

Achieving cost savings. Actual experience on multiple BMS projects indicates that the level of overall savings can be as high as 75% on the safety lifecycle, 70% on control system design and integration, and 35% on operation and maintenance activities. The combined overall savings are approximately 60%.

A global oil, gas and chemical company conducted a field survey of more than 80 fired devices. The company decided on an upgrade project to meet new corporate safety standards, ensure code compliance and replace obsolete BMS-related controls. An eight-year program was launched to design templates and complete detailed design, commissioning and construction plans that would take advantage of scheduled outages. To achieve savings in both cost and schedule, the company mandated the use of templatization. The first several BMS upgrades are expected to yield a savings of $70,000 each. As the program progresses, continuous improvement sessions are planned to brainstorm additional ways to reduce costs and shorten the schedule even further. Overall, the user is expected to save at least $6.5 MM over the entire course of the program. ●

SPRAGUE ACQUIRES TWO NY REFINED PRODUCT TERMINALS

Sprague Operating Resources LLC, the operating subsidiary of Sprague Resources LP (SRLP), has signed a definitive agreement to purchase the Lawrence and Inwood, New York refined product terminal assets of Carbo Industries Inc. and Carbo Realty LLC.

Sprague will pay a total consideration of approximately $70 MM, plus payments for inventory and other customary items. The consideration comprises approximately $30 MM of SRLP units to be issued at closing, $10 MM in cash paid at closing and the balance in cash, paid ratably over ten years.

The Carbo terminals are located in Inwood and Lawrence, New York, and have a combined gasoline, ethanol and distillate storage capacity of 157 Mbbl (thousands of barrels). The terminals are supplied primarily by pipeline, and can also accept product deliveries by barge and truck. Located adjacent to the region's major transportation networks, Carbo provides the storage, blending and additive injection capabilities to serve major branded gasoline marketers, as well as unbranded gasoline/distillate marketers focused on the New York City and Long Island markets. ●

Maintain profitable plant operations

JASON MALLETT, Aggreko Process Services

The heating and cooling of process streams is probably the most common operation in refinery or petrochemical plants—most refineries contain between 200 and 300 heat exchangers, many of which are in relatively clean service with only a small probability of failure. However, when failures or excessive fouling occurs, the usual result is either a reduction in unit throughput or a complete unit shutdown.

Temporary heat exchangers (**FIG. 1**) can alleviate these issues and are used for emergencies, process improvement, debottlenecking or turnaround purposes.

Emergencies and seasonal cooling limitations. Leaks represent a common emergency situation. For example, when an exchanger experiences a leak from the process side to cooling water, the material will potentially vent hazardous or flammable material into the atmosphere from the cooling tower. Strict environmental limitations mandate that the exchanger be immediately replaced, or the facility will have to shut down operations.

Heat exchangers can also limit a process unit's operation during hot summer months. Process units may experience cooling limitations due to warmer cooling tower water or, in the case of air-cooled heat exchangers, because fin fans have become less effective. Good examples are the overhead of a distillation tower or a separator inter-stage drum. Here, the temporary exchanger remains in place only during summer months, and can be reused.

Process enhancement/optimization. To maximize production capacity, a temporary exchanger can often be used to alleviate a bottleneck, for example. By adding an exchanger to the crude preheat train, heat recovery can be maximized to the extent that the crude furnace inlet temperature increases. If the crude furnace was the bottleneck, then raising the crude furnace inlet temperature allows more crude to be processed. A supplemental exchanger might remain in place until a more permanent solution can be installed.

Turnarounds. Most heat exchangers are a fixed and normal part of plant operations, but temporary exchangers are often needed during turnarounds for vessel steam-outs or for cooling catalyst. During a turnaround, refiners must cool the catalyst in hydrotreaters, hydrocrackers and reformers from the unit's normal high operating temperatures to near ambient temperatures in two separate steps. In the first step, the feed is blocked in and the furnace is shut down. A recycle gas compressor is typically used to circulate hydrogen-rich gas through the feed/effluent exchanger, through the furnace and then into the reaction vessel, where the gas picks up heat from the catalyst bed. The heated gas is then cooled in fin fans and a cold-water exchanger before entering a high-pressure, low-temperature separator. The loop is then repeated until the catalyst temperature reaches approximately 150°F–200°F.

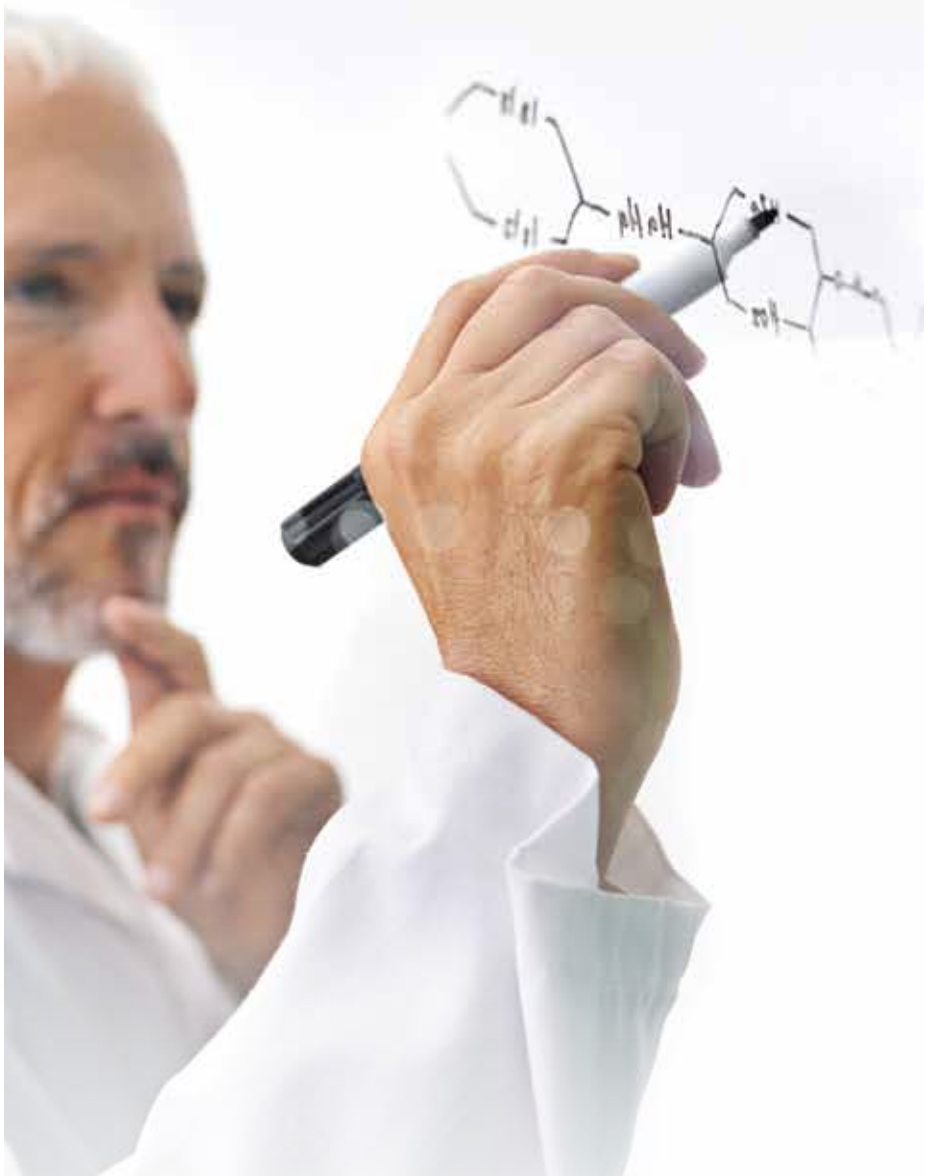
The second step typically requires purchasing liquid nitrogen and injecting it once through into the reactor system to cool the catalyst further. This process presents several disadvantages, including the multiple days required to completely cool the catalyst and allow entrance into the unit. The large volumes of liquid nitrogen required add both significant costs and logistics challenges in the form of a steady stream of tanker trucks moving in and out of the refinery. The used nitrogen is typically relieved via the flare system, which may snuff out if too much nitrogen is present in the flare gas stream. Another potential strike against liquid nitrogen arises in situations where the system's metallurgy is sensitive to the extremely cold temperatures introduced when the nitrogen enters the vessel.

Fortunately, a new, patented process from Aggreko now exists for this second phase that can typically accelerate catalyst cooling from 200°F to under 100°F within 12 hr–24 hr, and without the need for liquefied nitrogen. Accelerating catalyst cooldown allows for faster entry to the reactor vessel, permitting the operator to move this vessel off the "critical path" and allowing the plant to restart its units faster.

Given the range of problems that can quickly hinder the operation of their process-critical heat exchangers, refiners and petrochemical plant operators are increasingly turning to the short-term solutions afforded by temporary heat exchangers. While they offer a means to keep processes running at optimal rates during emergencies, hot summers, process enhancements and turnarounds, temporary exchangers can deliver on this promise only through careful planning, design and installation. Partnering with a service provider with the right experience, expertise and equipment is critical to ensuring that temporary heating and cooling solutions protect a plant's profitability, while minimizing environmental impact. ●

FIG. 1. The use of temporary heat exchangers is helping process plants to maximize production capacity.

Let's do the math.



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Building the case for a progressive handover approach

AMISH SABHARWAL, AVEVA

Ensuring that an asset is delivered on time and to specification is a top priority for project managers of major energy and process plants (FIG. 1). Operators expect to receive a fully operational asset so they can begin generating revenue as quickly as possible.

Delays to startups are costly, but they do happen for various reasons. One of the most consistent, yet easily avoidable, reasons comes from a poor approach to information handover.

When constructing an asset, the engineering, procurement and construction company (EPC) generates vast amounts of engineering information—3D models, electrical information, component specification, and piping and instrumentation diagrams—that potentially span several million records. This information plays a key part in preparing the asset for startup and operational readiness, underpinning processes such as risk assessment, failure mode, effect and cause analysis, permitting, spares strategy management and preventive maintenance planning.

This essential information must be delivered with the physical asset. However, in many cases, the handover of this information is an afterthought that introduces unnecessary risks, costs and delays. The result is that refineries are completed, but it may take weeks or months before startup and operations can be fully planned, leading to lost revenue.

AVEVA recently interviewed 50 North American senior decision-makers that are involved in oil and gas infrastructure projects about this issue. The results highlighted the true extent of inefficient handovers: 98% experienced at least some delays, and 100% experienced unexpected costs as a result of poor information management and handover processes.

FIG. 1. A poor approach to information handover is one of the most consistent, yet easily avoidable, reasons for costly startup delays.

Reasons for information-related delays. Causes for the delays in being fully operational included the unexpected time required to sift through poorly filed operational information (98%), additional data requirements from EPCs for asset operation (90%), and data not being delivered in the structure and format that their systems required (80%). Reasons for unexpected costs included converting data into their own format (84%), requests to EPCs for additional information (76%) and litigation as a result of substandard delivery (68%).

These were not just minor annoyances: 92% of respondents had at least one information issue that led to severe or significant delays, and 34% said that it took one to four months after the information had been delivered before they had it in a structure and format that allowed their asset to be fully operational.

By analyzing the research, we identified three clear reasons why information handover was causing such unexpected problems:

1. A failure to properly specify upfront what information was required: 18% admitted that they had not done this at all, and a further 50% said that the information had been agreed upon, but still fell short.
2. The inadequate use of information management technologies: 52% were not using an information management system, and a clear tendency existed toward using off-the-shelf document storage systems.
3. Handover is still seen as an activity to be "bolted on" to the end of a project: 22% said that handover came as a surprise cost, and 28% said that, while they had budgeted for it, they did not give it much more thought until the end of the project.

A better way forward. It is clear that handover in its current form is wasteful, inefficient and can often impact an asset's profitability. However, by taking a progressive and planned approach, these problems can be addressed.

The positive impacts of changing the process can already be seen throughout the industry. Of those surveyed, 82% said that making handover an incremental process, built into every stage of their project, would reduce costs.

A progressive approach begins with clearly defining what is expected in the contract. Project managers should work with operational teams to understand how the information will ultimately be used, define engineering standards, confirm format delivery and outline timing.

With the support of all parties, technology should also be utilized to support this process, define engineering standards and enforce the schedule. The correct and most effective tool should be sophisticated enough to share engineering information, and offer more functional and efficient approaches to information management.

Finally, project teams tasked with ensuring that project delivery milestones are met should have their responsibilities extended to confirm that information handover milestones are met, as well. This includes confirming that the correct information has been handed over according to the schedule, in the correct structure and data format.

For those who apply best practices, a progressive handover should mean that the data is accurate, provides clear visibility and can be easily managed, reducing the risk of delays and additional costs.

A change in mindset. The industry is calling for a handover approach that supports both the EPC and the owner-operator, and results in real cost savings and efficiency improvements. However, both parties require a change in mindset to ensure that handover is part of the conversation and plan from the beginning. Equally important is the technology that will help control handover and data verification.

Long-held inefficiencies need to be addressed, and the pattern of late-stage handovers must be changed into a progressive and planned approach. •

EXXON TO INVEST $20 B ON USGC REFINING PROJECTS

ExxonMobil Corp. plans to invest $20 B through 2022 to expand its chemical and oil refining plants on the USGC. The investments across Texas and Louisiana will take advantage of cheap shale gas to produce plastics and other chemicals for export. The strategy builds on prior steps that Exxon and peers, including Dow Chemical Co., have taken in the wake of the American shale expansion, which sharply cut production costs. The bulk of the expansion will take place in Beaumont, Texas, with plans to expand polyethylene production, oil refining capacity and LNG exports. Exxon also will increase its lubricant manufacturing capacity and potentially build a new refinery to produce ethane, a key building block for chemical production. •

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SUPERPOWER, continued from page 1

to do next. This led to the July 1944 Bretton Woods conference that was attended by 730 delegates from 44 allied nations.

"At Bretton Woods, the US explained that the rules of the global system would be different from now on," Mr. Zeihan said. "Instead of everybody having their separate trading network, everything would be pooled and the US military would patrol the seas, making it safe for everyone."

The agreement at Bretton Woods worked, according to Mr. Zeihan. Global GDP expanded by a factor of 10 while the global population tripled. "This has been the greatest period of peace and prosperity in human history," he opined.

Since then, the world has changed: China is taking its place as a global leader in manufacturing; Brazil is competing with the US in agriculture; and Russia is throwing its weight around on the global stage, Mr. Zeihan said. However, the systems that shaped these countries are falling apart, and this "transition" will force them to change in unforeseen ways.

"You have to remember a few things," Mr. Zeihan said. "What enables these countries to be what they are is Bretton Woods and free trade. What is China without global market access? What is China without international energy markets? What is Brazil without imported credit?"

Mr. Zeihan asserted that the US remains the least involved economy in the world when it comes to trade and exports. Last year, US manufacturing exports accounted for only 8% of its GDP, he said.

"We are a domestic economy, not a global economy," Mr. Zeihan said. "We merely have global reach."

The demography in the US is also different from other countries, according to Mr. Zeihan. He focused on three sets of age groups: Baby Boomers, Generation X and Millennials.

- **Baby Boomers.** This generation is the largest, as a percentage of the population, in human history. The population within this age bracket makes the US capital rich. By 2022, the majority of the Boomers will have retired, and their investments will be liquidated. The velocity of money will slow, which could cause capital costs to quadruple.
- **Generation X.** As the smallest generation, the problem comes from relative size, Mr. Zeihan said, because there are a greater number of Boomers and more Millennials. When Boomers retire and Generation X is providing relatively small amounts of capital, taxes could increase by 50% to pay for that retirement.
- **Millennials (Generation Y).** This generation, through its consumption, has kept the US out of recession for the last three years, according to Mr. Zeihan. That consumption boom will likely last another 10 years. This generation will also be able to fill out the tax-paying class in a way that Generation X could not.

"Today, courtesy of the Millennials, we are the top consuming power; and courtesy of the Boomers, we are the top investment power," Mr. Zeihan said. "But by 2030, the US will be the only consuming power and the only financial power. We are in the midst of the great transition."

After trade and demography, shale energy is the third major factor that is shifting the world, according to Mr. Zeihan. With the advancement of technology, shale drilling has become more efficient and cost-effective.

"We don't drill dry wells anymore, and we haven't for years," Mr. Zeihan said. "We haven't drilled low-productivity wells in three years because we know exactly where to go."

The production cost of shale is around $38/bbl, and Mr. Zeihan predicts that costs will continue to decline. After new technologies are fully integrated, production costs for shale fields will fall below $25/bbl, making shale energy cost-competitive with every energy play in the world, including Saudi Arabia.

"As a unit, North America becomes a net energy exporter in 3Q 2017," Mr. Zeihan said.

This is causing the US to change how it views the world, Mr. Zeihan said. "The country has begun to withdraw, and will continue to withdraw. With the election of President Trump, the speed at which the country withdraws will increase.

"Under a President Hillary Clinton, this change would have been sign-posted, methodical and gradual over four to eight years. Under President Trump, it's happening over four to eight tweets," he quipped.

With the exit of the US from the global economy, Mr. Zeihan said, "all bets are off."

Mr. Zeihan specializes in global energy, demographic and security, analyzing the realities of geography and populations.

In 2012, Mr. Zeihan founded his consulting firm, Zeihan on Geopolitics, which provides clients with direct, custom analytical products. Clients include energy companies, financial institutions, universities and the US military. Before going independent, Mr. Zeihan worked for geopolitical analysis firm Stratfor for 12 years.

Mr. Zeihan's second book, *The Absent Superpower,* was released in 2016. It focuses on the growth of US shale and how global changes may be causing issues in other countries, such as terrorism spilling out of the Middle East and into Europe. Due to its geographic wealth, US energy security is rapidly emerging as the most critical piece of the global picture. ●

SCENES FROM THE 2017 AFPM ANNUAL MEETING


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1 AFPM President **Chet Thompson** met with members of the press and others Sunday afternoon to discuss AFPM's direction and goals in the coming years.

2 The capable **AFPM team** welcomed its members to another successful event.

3 At the kickoff reception, **Gene Michelini** of Burns & McDonnell (left); and **Bob Ludolph** and **Aristides Macris** of Shell Global Solutions reminisced about how they worked together 25 years ago.

4 Attendees packed the reception hall at Sunday night's reception.

5 The team from **Essar Energy** traveled from India to attend this year's AFPM Annual Meeting.

6 **Erik Moy,** Badger Licensing LLC; **Asit Pandya,** Technip USA; **Brent Schier** and **Amanda McWhorter,** Technip Stone & Webster; and **Tiffany Chism,** TechnipFMC Process Tech enjoy Texas whisky from Garrison Brothers Distillery at TechnipFMC's hospitality suite Sunday night.

7 **Martin** and **Marguerite Turk,** and **Curtis Kelly** of Schneider Electric renewed old friendships.

8 **Roy** and **Amy Sager** from Kiewit Energy showed their Texas spirit at Sunday evening's welcome reception.

9 **DuPont** featured bourbon and the blues in their soulful suite.

10 **Julianne Trahan** from The Weitz Company concentrates on her card as magician **Bo Gerard** shuffles the deck and **Bryan Trahan,** also from The Weitz Company, looks on, trying to figure out the trick.

11 Cheers! **Mickey** and **Agnes Reeves** from CH2M, **Kjell Wold** from Emerson Automation Solutions and **Terry Malone** from Lloyd's Register Energy raised their glasses to a successful kickoff event.

12 **Malcolm Sharpe** from Merichem Company was a big winner at Chevron Lummus Global's casino-themed hospitality suite.

What's missing in this picture?

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Human Resources Conference
April 27-28, San Antonio, TX

National Occupational &
Process Safety Conference
May 17-18, New Orleans, LA

Reliability & Maintenance Conference
May 23-26, New Orleans, LA

Operations & Process Technology Summit
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