

Refocus, Reimagine and Reassure

KYLE KORNEGAY, *Hydrocarbon Processing*

The 2016 AFPM 2016 Q&A and Technology Forum is centered around three ideas: *Refocus*, *Reimagine* and *Reassure*. During these difficult and challenging years for the hydrocarbon processing and petrochemical industries, these ideas are more than just window dressing. They illuminate the needs of the industry and the way forward in difficult times.

Jim Mahoney, a board member for Koch Industries Inc., addressed a crowded room concerning these central ideas in his Monday morning keynote address, *Managing through tough times*. With almost 30 years of



Koch Industries' **JIM MAHONEY** delivers the keynote address to open the 2016 AFPM Q&A and Technology Forum.

industry experience in varying roles within Koch Industries, Mr. Mahoney tackled each idea with practical advice gained throughout his career.

Mr. Mahoney entered the industry in the late 1980s, at a time when the market was strong and jobs were plentiful. A degree in chemical engineering afforded him ample opportunities in several industries, but he chose the oil and gas industry for three reasons—he found the refineries he visited fascinating; he loved the idea that the oil industry was tied to world events; and *Dallas* was one of the most popular shows on television at the time. All in all, the oil industry seemed like a wonderful place to work.

Throughout his long career, Mr. Mahoney said that he learned several lessons that would provide a backbone for the rest of his keynote address. One of the first things he learned in the industry was that the quality of life we experience today is tied directly to the hydrocarbon industry.

“Affordable, abundant energy plays a key role in all aspects of our lives today,” he said. “I have seen how adaptive and innovative our industry is. The petrochemical industry is constantly adapting to the needs of the consumers and constantly innovating to meet economic challenges.”

Mr. Mahoney also emphasized the friendliness of the people at every level of the industry. “The petrochemical industry encompasses people from every part of the globe, in all levels of business,” he said, commenting that he has found everyone he has met to be “salt of the earth.” He next spoke of the economic downturn of the 90s, which he referred to as the “dog days” of the refining industry.

“I constantly heard the phrase, ‘Refining is dead.’ However, in the next decade, people were proclaiming the early 2000s to be the golden age of refining.” The lesson learned here was, as he put it, “Nobody sees it coming and nobody sees it going. The petrochemical industry follows an unpredictable boom/bust cycle, and it likely always will.”

Mr. Mahoney discussed the very nature of the industry. “The business is always challenging. The industry faces a new obstacle every day from government regulations, economic downturns, global events or other woes. These challenges will never stop, and neither will our resolve to overcome them.”

The industry must take advantage of even the worst situations. During the

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Emerging Leaders tackle work-life integration

MIKE RHODES, *Hydrocarbon Processing*

One of Monday morning's liveliest discussions took place in the Principles & Practices: Emerging Leaders Town Hall, where “new” and more-experienced industry leaders tackled issues facing today's workforce. Topics included work-life balance, communication with managers, role models and parallel path actions.

The pressures of today's challenging market and its effect on the increased workload that personnel face was a key component of the work-life balance discussion. Most of the audience agreed that their work-life balance was in the 70/30 to 80/20 range, whether in time, focus or effort. Many agreed that this was undesirable but often necessary.

One of the attendees said that the ratio changed as their career progressed and their personal life evolved, particularly as they began families and their priorities shifted. Some of the more-experienced attendees commented that when they



The pressures of today's challenging market and its effect on personnel was a key component of the work-life balance discussion.

were coming up, this is what was expected of them in their early careers.

“You have to keep in mind, especially if you want to have a reasonable lifestyle and support a family, you have to put in the time,” one of the audience asserted. “The ratio crosses over a bit, and the family has to understand that. If you don't make the cash, you can't pay for weddings, college, cars or any of those things.”

Another attendee stated that we should do something for our bosses and something for ourselves each day. He wasn't referring to “goofing off,” but instead was focused on the need to better ourselves so that we can get where we want to go professionally. “If you spend each day only on the task at hand, you will never progress. Even 15 minutes can make the difference over a long period of time.”

A 35-year veteran said that sometimes we get so focused on the results and what our efforts will lead to, that we forget the “now.” Is it a generational change? One of the leaders said that she noticed that the more-experienced personnel are passing down the importance of work-life balance, and perhaps this was because of the lessons they have learned throughout their careers. Tying into the mentorship discussion that followed, she commented about how her mentor would tell her to stay off her emails during the weekends. “The work will still be there on Monday.” Several members agreed that it seemed like the younger generation was more focused on finding that balance.

Another key point was made about the importance of job satisfaction, “If you don't like what you do, you aren't going to be happy at home.” One of the veterans quipped that he doesn't ever recall the term work-life balance,

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Cybersecurity Day

As Day 2 begins, our focus turns to one of our industry's greatest challenges—the protection of our assets.

Owner-operators have chosen their framework for industrial cybersecurity control systems, but many struggle to implement effective programs, make strategic decisions to ensure the cybersecurity of critical assets, justify investment decisions, and move forward with the development of appropriate personnel, process and technology strategies.

The Industrial Internet of Things (IIoT) promises great opportunity, but it must be secure to fully realize its potential. We are seeing a dramatic rise in attacks—nearly 70% of critical infrastructure companies have suffered a security breach.

Frameworks merely provide guidance and context for organizing a security program. Cybersecurity must not be limited to IT-specific discussions, but should be considered a risk management priority.

The value of an organization's intellectual property is often unaccounted for. The financial threat and the risk of exposure of client or personnel information can destroy a business, so all employees must grasp that cybersecurity is a 24/7 responsibility. No single piece of software or other technology provides a fail-safe protection.

Each organization should consider:

- **Identification.** Conduct an asset evaluation that includes intellectual property, personnel information and technologies.
- **Protection.** Key information should be protected. Not all information is created equal.
- **Detection.** Catch the attack as (or before) it is happening.
- **Response.** A practiced response plan requires a change in organizational culture.
- **Recovery.** Include backup drives and cloud-based storage systems at work and home. ●

SCHEDULE OF SESSIONS

TUESDAY, SEPT. 27 2016

- 7 a.m.–5 p.m. **Registration**
- 8–10 a.m. **Cybersecurity Day: General Session**
Keynote: [Eric Cornelius](#), Director of Critical Infrastructure and Industrial Control Systems (ICS), Cylance Inc.
CISA Panel
Panelists: [Michael Echols](#), International Association of Certified ISAOs (IACI); [Evan Wolff](#), Crowell & Moring; [Kimberly Denbow](#), American Gas Association
- 8 a.m.–12 p.m. **Principles & Practices: Hydroprocessing**
 Topics TBA
Q&A: Crude/Vacuum Distillation & Coking
 This session will be split into two sections. The first half will be the traditional Q&A session, and the second half will be a town hall-type discussion.
Panelists: [Rainer Bass](#), HollyFrontier Corp.; [Ram Mallik](#), Fluor Corp.; [Pete Sharpe](#), Emerson Process Management; [Maji Shyama](#), Essar Oil Ltd.; [Jay Steiner](#), MERRICK & Company; [Bruce Wright](#), Baker Hughes Inc.
- 10–10:15 a.m. **Coffee break**
- 10:15 a.m.–12 p.m. **Cybersecurity Day: General Session**
 • Legal Risks from Cyber-Threats in the Energy and Transportation Sectors:
[Lily Chinn](#) and [Karl Heisler](#), Katten Muchin Rosenman LLP
 • Leveraging Security Insights and Techniques Across Communities:
[Philip Quade](#), National Security Agency
- 12–2 p.m. **Lunch in Exhibit Hall**
- 2–3:30 p.m. **Cybersecurity Day: General Session**
 • Operational Blindspots: Why Securing Critical Infrastructure Starts with Improved Visibility:
[Mille Gandelsman](#), Indegy
 • How to Know if Your Control Systems Are Secure:
[Mark Littlejohn](#), Honeywell Process Solutions
 • ICS Cybersecurity: You Cannot Secure What You Cannot See:
[David Zahn](#), PAS Inc.
- 2–5:15 p.m. **Principles & Practices: Crude/Vacuum Distillation & Coking**
 Topics TBA
Q&A: FCC
Panelists: [Zach Bezon](#), United Refining Company; [Luis Bougrat](#), UOP LLC—A Honeywell Company; [Phillip Niccum](#), KP Engineering LP; [Eric Thraen](#), Flint Hills Resources LP; [W. Lee Wells](#), Houston Refining LP; [George Yaluris](#), Albemarle Corp.
- 3:30–3:45 p.m. **Refreshment break**
- 3:45–5:15 p.m. **Cybersecurity Day: General Session**
 Integrating Process Safety with Cybersecurity
[John Cusimano](#), aeSolutions
- 5:30–6:30 p.m. **Women in Refining Reception**
 (Reception open to registered women only)
 Join us for this opportunity to both share and learn professional development strategies and build a network of women leading our industry, as you relax after two days of intense learning.
 Reception Sponsored by LyondellBasell

WEDNESDAY, SEPT. 28, 2016

- 7:30–10 a.m. **Registration**
- 8–11:15 a.m. **Principles & Practices: FCC**
 Topics TBA
Principles & Practices: Fostering Profitability—Part 1
 • Catalyst Selection:
[Vern Mallett](#) and [Chris Anderle](#), UOP LLC—A Honeywell Company
 • No and Low Capital Project Triage through Implementation Process:
[Chris Bodolus](#), CVR Energy Inc.
Principles & Practices: Fostering Profitability—Part 2
 • Crude Selection and Crude Margins:
[James Kleiss](#), Valero Energy Corp.
 • Inside Refinery Optimization:
[Steve Perry](#), Motiva Enterprises LLC
 • Lessons Learned from the Past
- 8–11:30 a.m. **Cybersecurity: Cyber Attack! All Hands on Deck!**
 A hands-on cybersecurity “Capture the Flag” team training exercise
- 9:30–9:45 a.m. **Coffee break**

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Published by *Hydrocarbon Processing* as three daily editions, September 25/26, September 27 and as an electronic edition on September 28. If you wish to submit a press release, please contact the editor via email at Mike.Rhodes@GulfPub.com.

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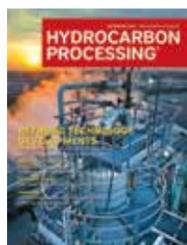
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Another step change in NiMo performance

HENRIK W. RASMUSSEN, Haldor Topsoe Inc.

Haldor Topsoe has launched its latest NiMo innovation, TK-611 HyBRIM, which is part of the second generation HyBRIM technology. This catalyst is being introduced only three and a half years after TK-609 HyBRIM, which has been successfully installed in more than 100 hydroprocessing units (FIG. 1).

What are BRIM and HyBRIM? In the early 2000s, Haldor Topsoe discovered new activity sites in both CoMo and NiMo catalysts by STM microscopy and in situ TEM electron microscopy. These activity sites, or “brim sites,” were located one atom layer from the edge of the metals slab (i.e., not on the edge/rim of a hat, but a little further in on the brim of the hat). Naming aside, it was discovered that these newly active sites were responsible for the nitrogen removal (HDN) and the aromatics saturation (HDA) activity of the catalyst. Very difficult sulfur species, such as 4,6-Dimethyldibenzothiophene, will be captured on the brim site, which will saturate one of the aromatics rings and open up the molecule, making it easier for the type-2 sulfur vacancies on the edge of the metal slab to perform the final sulfur extraction. The brim site will not only help pre-convert the difficult sulfur species, but will also increase the likelihood of these sulfur species making contact with the type-2 sites, resulting in increased catalyst activity.

Topsoe succeeded in producing a catalyst with brim sites and type-2 sites without stacking the metals slabs. In other words, the interaction length with the alumina surface area was reduced without stacking the metals slabs on top of each other. This breakthrough in catalyst production technology provides improved metals dispersion and, therefore, better utilization of the active metals, which results in higher activity for the same metals content. This improvement is due to an improved metals impregnation and decomposition technology. Of equal importance are the improved carrier preparation technology and design of the alumina crystallites.

The HyBRIM technology is a refinement of the BRIM technology, which increases the amount and activity of brim sites by further reducing the interaction of the alumina surface area. An added benefit is an increase of the number of type-2 sites (sulfur vacancies) on the edge of the metals slab, resulting in improved HDS, HDN and HDA activity of the HyBRIM catalysts compared to the first and second generation BRIM catalysts.

Performance comparison. Like TK-609 HyBRIM, Topsoe’s TK-611 HyBRIM catalyst is designed for hydrocracker pretreat and high-pressure ultra-low sulfur diesel (ULSD) service. Pilot plant testing has shown

a substantial performance improvement of 10°F to 12°F in both services (FIG. 2). In most units, this equates to six to eight months of additional cycle length at otherwise unchanged processing conditions. Alternatively, the refiner can utilize this additional activity to process more barrels of feed or a more difficult feedstock, providing improvement in unit profitability.

When comparing the two catalysts in hydrocracker pretreat service at the same temperature, TK-611 HyBRIM will reduce the nitrogen to 26 wtppm, compared to 62 wtppm for TK-609 HyBRIM, as shown in FIG. 3. Keeping nitrogen levels in the feed to the hydrocracking catalyst lower for a longer time results in better yields, cycle length and profitability.

Higher hydrogenation activity. In today’s lower-margin refining environment, it is important to take advantage of low-cost hydrogen (a result of low-cost natural gas) to increase profitability. This is best achieved by increasing hydrogen consumption to maximize the volume swell. The increased activity of the BRIM sites on TK-611 HyBRIM provides additional hydrogenation functionality. The additional volume swell for TK-611 HyBRIM is approximately 0.4 vol% compared to TK-609 HyBRIM. **Note:** This is not the total swell, but only the incremental increase between the two catalysts. A number of ULSD units

achieve as much as 6 vol%–8 vol% volume swell.

The profitability advantage of the additional volume swell is easy to estimate: for a 40-Mbpd ULSD unit, the additional swell will equal approximately 160 bpd, which is an additional profit of about \$35/bbl after subtracting the hydrogen costs. This adds up to \$1.9 MM/yr and, in many units, will pay for the entire catalyst load. As mentioned, this value only represents the delta swell between the two catalysts and not the total swell value, which may be five to 20 times higher, depending on feed compositions and the unit pressure.

Catalyst stability. Higher catalyst activity is only valuable if stability is as good or better than the predecessor. FIG. 4 shows that the stability of TK-611 HyBRIM is equal to TK-609 HyBRIM, resulting in extra cycle length at unchanged conditions, or the increased profitability of processing more feed or more difficult feedstocks.

TK-611 HyBRIM is available from Haldor Topsoe production plants in Texas and Denmark, and has already been adopted by a number of clients within weeks of being released to the market place.

For additional information about Haldor Topsoe’s offerings, visit their hospitality suite in Grand Ballrooms 7/8 on Monday and Tuesday evenings. ●

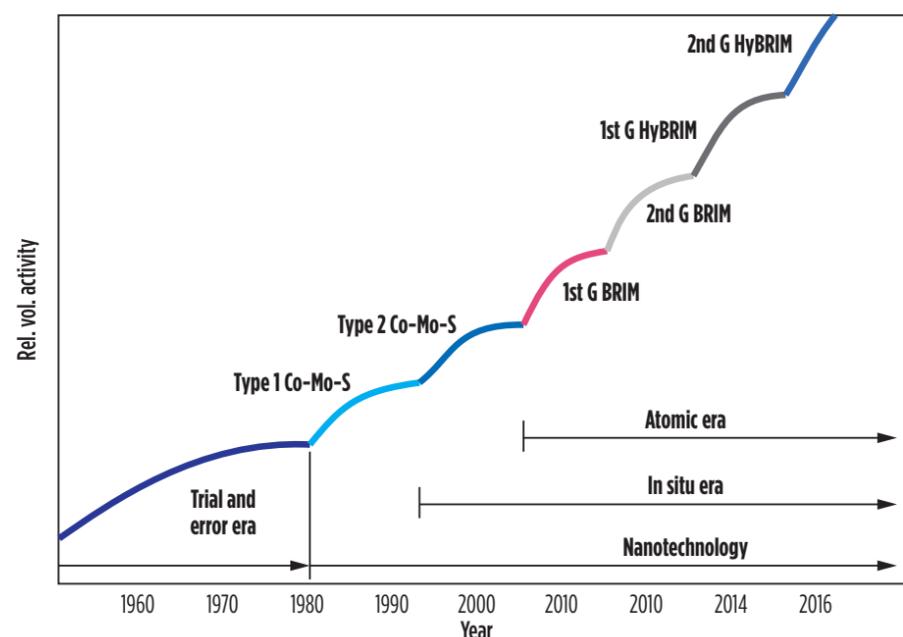


FIG. 1. The development of Haldor Topsoe hydroprocessing catalysts.

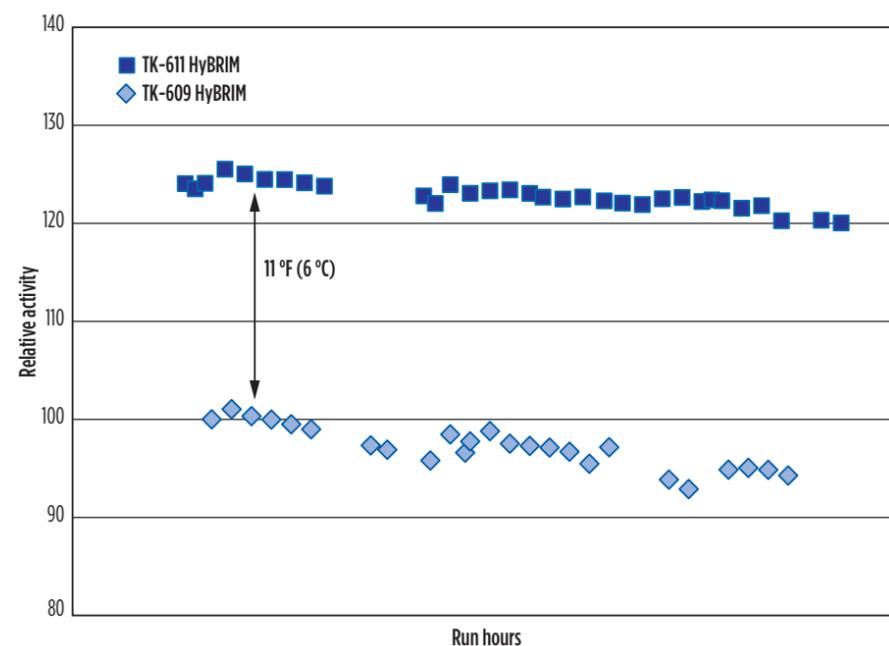


FIG. 4. Comparison of catalyst stability.

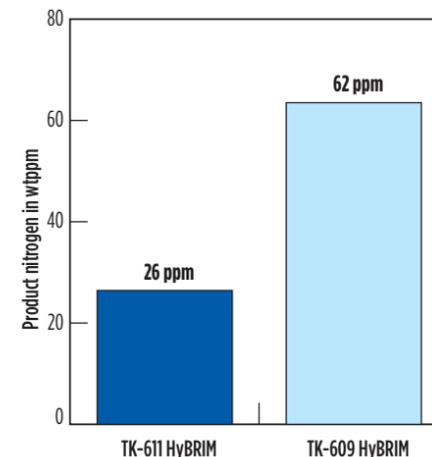
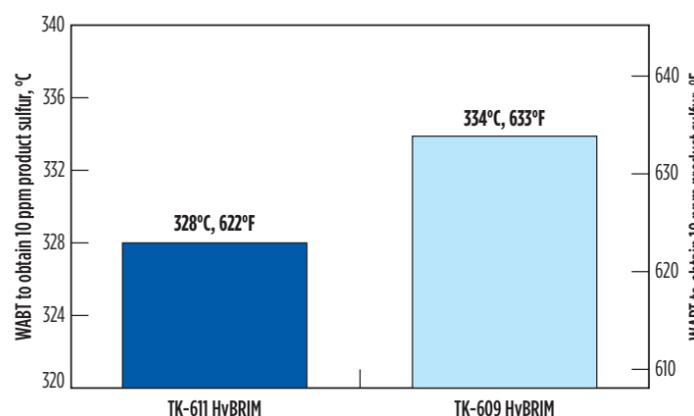
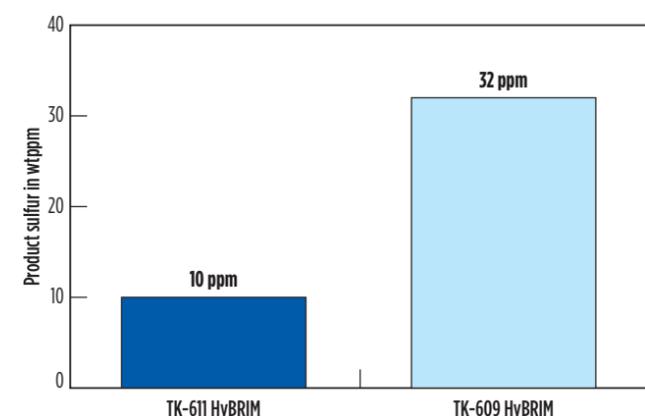


FIG. 2. Comparison of TK-609 HyBRIM with TK-611 HyBRIM in ULSD service. At the same processing conditions, it is possible to reach a 10 wtppm sulfur specification at 11°F lower operating temperature. If the two catalysts are operated at the same operating temperature, the product sulfur will be 22 wtppm lower for TK 611 HyBRIM.

FIG. 3. TK-609 HyBRIM vs. TK-611 HyBRIM in hydrocracker pretreat service.

KEYNOTE, continued from page 1

downturn of the 90s, he said, it was necessary for his company to alter every aspect of its day-to-day operations to adapt to the changing economic conditions. He stressed the importance of the people involved and the vast amount of communication that was necessary to inform employees of the difficult and turbulent times ahead. “Communication should inform the company and its personnel of the necessary changes that will lead them back to prosperity and sustainability,” he said. “Because the industry cannot control the market and other factors, we instead needed to focus on what we could control, and our own actions and choices.”

This inward focus led to the formation of a company-wide improvement plan, something that Mr. Mahoney believes helped see them through a difficult decade. His company focused on several various ways in which performance could be improved.

The first was a re-examination of their safety compliance. They stressed the need to go beyond government mandates in their improvement plan. Another portion of the improvement plan involved cutting costs. Mr. Mahoney said that there is often an over-reaction when cuts need to be made, and this leads to poor spending habits.

“While cost-cutting is important,” he stated, “it is more important to ensure that capital is being spent for the right reasons.”

The final component of the improvement plan was the development of a “scorecard” that would track the progress of their improvement plan and would be shared throughout the organization. “These steps helped our company weather the economic downturn, and improved profitability and sustainability when the market improved.”

Mr. Mahoney’s final thoughts on the industry encouraged the audience to become a champion of the industry itself. In a climate where every aspect of the petroleum industry is viewed negatively, he confirmed that it is vital to change that perception. “So many aspects of the petrochemical industry affect our lives in a positive way, and often they are taken for granted,” he said. “I see a dire need for everyone in our industry to take pride in what we do and become a champion for our industry. The industry is constantly innovating, becoming more efficient and developing new products that enhance our lives. It is time that we remind the world of the important contributions of our industry.” ●

EMERGING LEADERS, continued from page 1

and questioned whether we are just paying it lip service or really striving for a solution. “As leaders, it’s on us to manage our people. Enable your people to take their vacation, but don’t just tell them—find a way to backfill so when they come back they are not facing a mountain of work.”

An experienced operator and new supervisor said that we must remain flexible. “Particularly in a plant environment, the plant is going to dictate your schedule. There will be times that we work 16-hour days to make sure it operates efficiently. This year we’ve faced some significant challenges, so striking that balance is especially difficult. You have to find those times when the plant allows you to get away, and you have to take advantage of that downtime and walk away, get some perspective and leave work behind. We need that time to recharge so we can go back to work with the right attitude and energy. I try to keep that in mind with my people, too.”

“The technological innovations we have now are a blessing and a curse,” said panelist Abigail Sup from Johnson Matthey Process Technologies. “It’s possible that the work-life balance discussion came up when cell phones and emails became standard. Just because we can take our work home, doesn’t mean we should. We need to take advantage of these technologies without letting them control us.”

Integration vs. balance. “We should take advantage of technology to integrate our work and our lives more seamlessly, but this makes it more difficult for managers,” an attendee said, which moved the discussion to how managers can best facilitate work-life integration for their team.

There is a fine line between wanting work-life balance (or integration) and the perceived need to compete with co-workers for career advancement, an industry veteran said. “Will management only promote those that put in the 70-hour week?” he asked. “We have to temper that and not set up a competition between our staff, and that requires a manager that sets an example.”

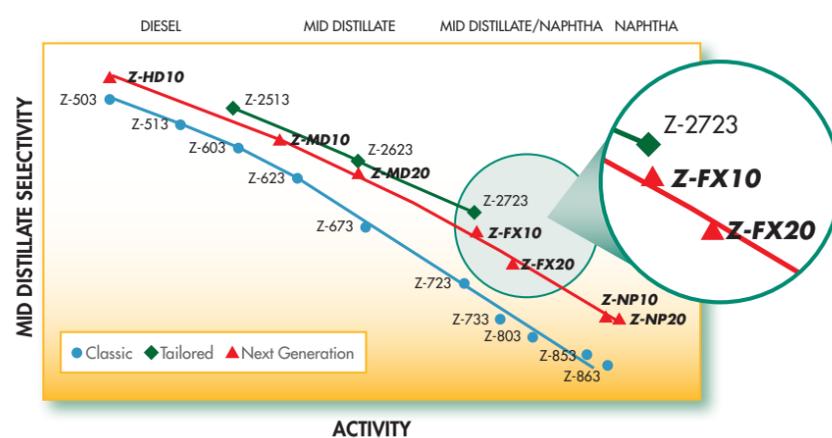
“I think what we’re talking about is flexibility, and the use of time and efficiency,” an experienced engineer stated. “More and more managers are focusing on the result instead of the actual time spent doing the work. At the end of the day, the job needs to be done properly and safely. If that means working from home sometimes, then that helps provide the balance.”

A good relationship and open communication with managers is vital, as well, so that they can know whether their team needs their help or requires tools to complete the job. Mentors and role models provide guidance and training to the next generation, and take advantage of knowledge transfer.

One of the final points was made by a recent college graduate, who asked the group for the best way to go to his bosses and tell them that he felt he could do more and wanted to be challenged. “Be careful what you wish for,” Richard Schultheis from LyondellBassell Industries said. “Don’t leave it open-ended. That’s a great trait to want to expand your skills, but make sure you are specific about your goals and things you are interested in, and what you can bring to the table.”

The group agreed that emerging leaders need to be the drivers for their careers, and to expand their box so they can always be learning and increasing their value to the organization. ●

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Integrate scaffolding into construction project designs

JIM TAYLOR, Fluor

In today's large-scale refinery and petrochemical projects, every aspect of design and construction must be examined to find ways to improve capital efficiency, project safety and schedule certainty. One critical indirect construction cost area that has enormous potential for improvement over traditional methods is scaffolding. On many large-scale industrial projects, scaffolding costs have risen as high as 20% to 40% of direct field

labor costs using the traditional "design as you build" approach.

Integrating scaffolding into the front-end constructability and workface planning, and leveraging 3D design, logistics, distribution and field execution expertise, can significantly improve project execution. In this approach, scaffolds are identified and designed in the 3D model during the project's detailed design phase, rather than during construc-

tion in the field, as is traditionally done. While this requires additional upfront planning and design work, significant benefits and returns in the field include improved productivity, reduced congestion, increased safety and schedule predictability.

The approach uses highly efficient assembly sequencing as a key design driver, including the attachment and support connections for scaffolding that are integral to the structural steel design and fabrication. This early design supports visualization of where the scaffolding will be placed on a module, vessel or elsewhere on the site, as well as the ability to build the scaffolding system in a way to accommodate construction elements, such as electrical trays or piping. This helps to eliminate scaffolding modifications and rework, which are key drivers in the cost overruns for scaffold efforts.

The use of engineered scaffold systems allows for pre-assembly at grade, which improves safety. The engineered systems also provide the ability to build within a model or structure with no ground support, crane-able scaffolding for access and egress, and significantly less scaffolding material required at site. The pre-

fabricated components lock together to support efficiency and safety.

For this solution to be successful, early project alignment is critical, as details of the overall facility assembly strategy must be established early in the design to optimize scaffolding and overall assembly efficiency.

On the Northwest Redwater Partnership's Sturgeon Refinery Project (FIG. 1), the team closely integrated scaffolding as part of the engineering development plan, with two scaffolding designers working closely in the home office during design with the engineering and design team.

Over a 20-month period, the team modeled 2,000 scaffolds, ranging from modules and compressor buildings to vessels and reactor towers. This pre-planning prior to construction enabled the team to know specific scaffold quantities, the construction schedule and hours per scaffold, with nearly 80% of scaffolds planned and modeled prior to construction.

The innovation behind this approach has been recognized by the capital projects industry, with Fiatech naming this solution a Celebration of Engineering and Technology Innovation (CETI) Award winner in 2015. ●



FIG. 1. The North West Redwater Sturgeon Refinery Project in Canada utilizes the integrated scaffolding solution. Scaffolding is placed around the vessel for insulation, painting and fireproofing activities.

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Reduced Plot Space

The higher capacity and efficiency of FFC Plus translates into reduced equipment sizes and plot space. This reduces project capital and lowers plant operating costs.

Existing Merichem or other treating units can be easily retrofitted with FFC Plus, providing up to 150% additional capacity. This capacity increase will not affect the existing turndown range of Merichem units and will improve the turndown of other units. The new contactor is a direct "drop-in" replacement that can be added or switched with minimal modifications within a short shutdown period.



Reactor cooling solution shortens turnaround

As with most major process plants, refineries and petrochemical facilities must periodically shut down entirely, or significant portions of the plant, for major maintenance activities. These turnarounds cause periods of intense activity.

A plant shutdown causes considerable expense without revenue generation, as well as immense pressure to work as efficiently as possible to get back onstream as quickly as possible. Shortening events on the critical path will decrease turnaround duration and get the plant back onstream and generating revenue faster.

Many refinery and petrochemical processes, such as hydrotreaters, hydrocrackers and reformers, contain

catalytic materials in their reaction beds. This could be just one bed in one vessel; multiple beds in one vessel, as shown in the hydrocracker reactor process flow diagram (FIG. 1); or multiple beds in multiple reactors.

Operating temperatures in these processes can be very high. Once a plant begins an initial maintenance shutdown, all catalyst (often hundreds of thousands or millions of pounds) must be cooled from these high operating temperatures to near ambient temperatures. Given the amount of catalyst and reactor metal mass, this takes time and is often the bottleneck, or is on the critical path, for the entire turnaround. Refineries and petrochemical plants are open to ideas to reduce or eliminate this bottleneck.

Power generation and HVAC specialty rental company, Aggreko, developed a solution designed to reduce catalyst cooling time during the initial stage of a planned or unplanned maintenance turnaround for hydroprocessing and reformer units within the petrochemical and refining industry. The patented solution, developed by the Aggreko Process Services (APS) team, focuses on last-phase catalyst cooling and uses a combination of heat exchangers, chillers and pumps

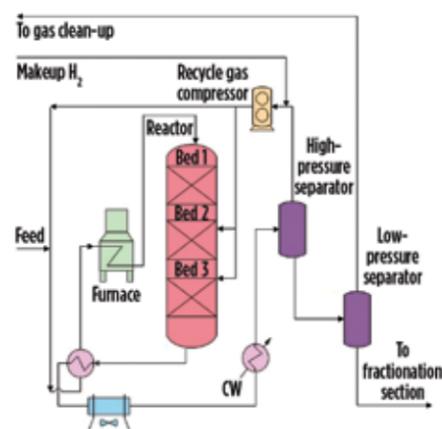
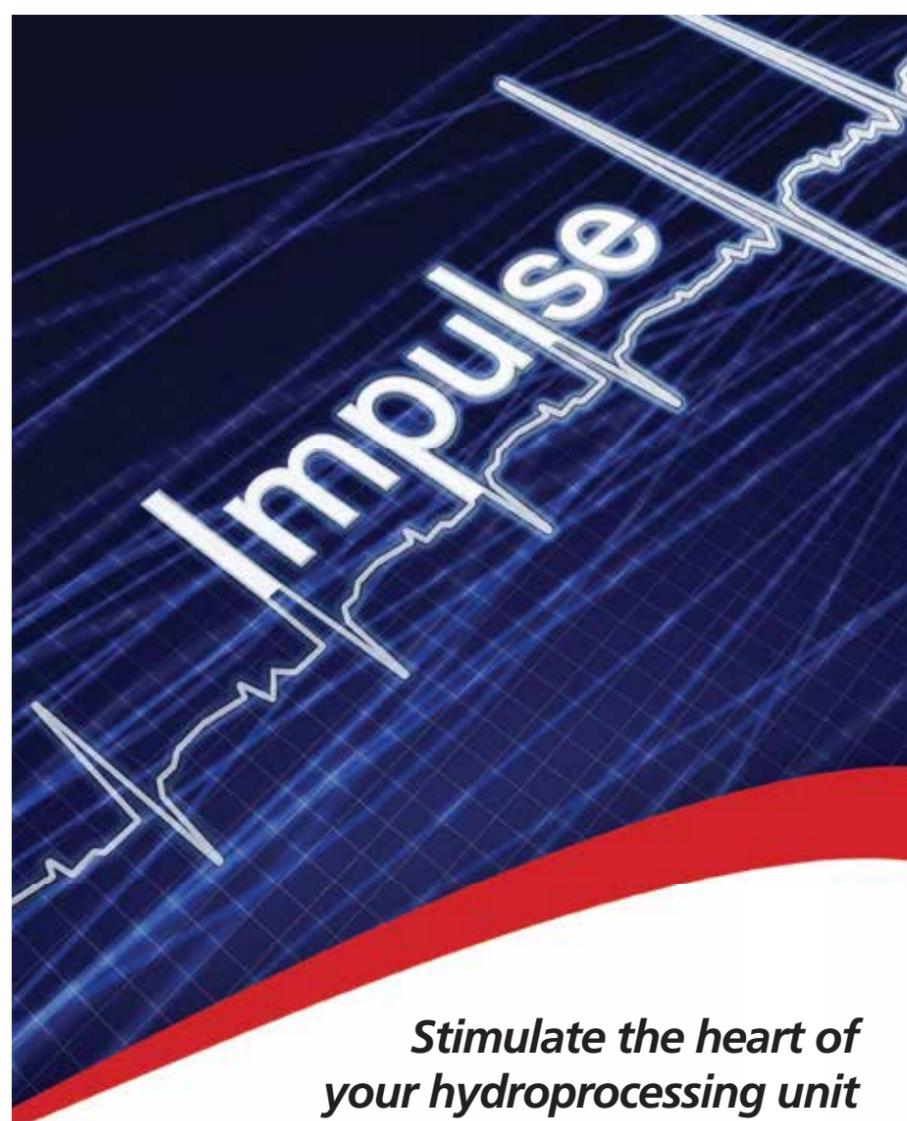


FIG. 1. A flow diagram of a typical hydrocracker reactor process.



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(FIG. 2). Based on a correlation model specific to an oil refiner's turnaround operations and timeline for cooling, APS demonstrated that the process can cool reactor catalyst between 12 hr–24 hr faster than liquid nitrogen.

By utilizing this new process, refiners can move catalyst cooling off the critical path and permit more work while the unit is down. Refiners can also avoid the cost of nitrogen and the potential accompanying safety issues, and extra logistical and human activity of transportation, handling and disposal. Aggreko's process can produce a combined savings between \$250 M to more than \$5 MM, depending on whether the catalyst is on the critical path and the number of refinery units affected.

Real-world results. Hydrotreater reactor vessels, which are used to remove impurities and meet product quality specifications, are crucial for processing distillate products within stringent allowable limits. After two to five years of operation, the typical hydrotreater catalyst is "spent" and must be replaced.

One US Gulf Coast refiner needed to replace its catalyst inventory. To perform a turnaround, the hydrotreater had to be cooled down from more than 500°F to approximately 80°F, a necessary step to safely unload the catalyst and allow vessel entry for maintenance.

The traditional cool-down approach, the injection of purchased

liquid nitrogen, is costly and takes several days to accomplish due to the large size of the reactor vessel and catalyst inventory. The owner sought increased reactor cooling speed to reduce turnaround duration and avoid excessive economic loss.

The owner needed an effective, rapid cooldown method rather than using cold nitrogen. Safety was also a concern, as the reactor vessel weighed more than 2 MMlb and contained almost 1 MMlb of catalyst. To improve operations and address environmental concerns, Aggreko provided a complete hydrotreater reactor-cooling process design package that included all required documentation. The company also installed temporary heat exchangers and chillers to cool the reactor more rapidly than previously achieved. A major advantage was the cost-benefit ratio when compared to the traditional method of nitrogen injection.

Aggreko tested all equipment prior to shipping and ensured all onsite assemblies were leak-free. In addition to providing round-the-clock staffing to operate the equipment, Aggreko trained the customer's personnel on the coordination of operations.

The rate of cooling exceeded the client's expectations, and the temperature was reduced from approximately 200°F to 80°F within 11 hours, which proved to be superior to previous experience with nitrogen cooling on this unit. The job was performed safely and without incident. ●

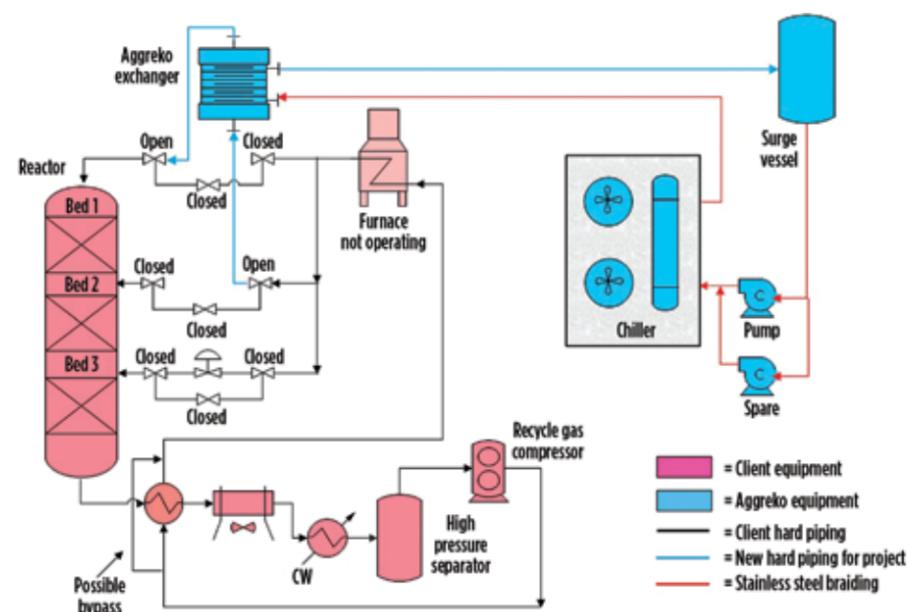


FIG. 2. Aggreko Process Services' solution is designed to reduce catalyst cooling time during the initial stage of a planned or unplanned maintenance turnaround for hydroprocessing and reformer units.

BILFINGER TO PROVIDE SERVICES TO BEAUMONT METHANOL PLANT

Orascom Engineering & Construction, the EPC contractor for turnkey construction of the Natgasoline methanol plant in Beaumont, Texas, has contracted Bilfinger to provide \$100 MM in services.

Services comprise complete mechanical assembly, including piping construction and steel construction, as well as insulation, painting, scaffolding, corrosion and fire protection, and turnover of complete mechanical systems.

Production at the 1.75-MMtpy plant, which will be the largest in the US market and help cover a significant portion of the country's methanol needs, is expected to begin in the second half of 2017. ●

Getting the most from shell-and-tube heat exchangers

BYRON BLACK, Koch Heat Transfer Co.

Driven by competitive market forces and stricter environmental compliance, efforts to reduce energy consumption in petrochemical plants are receiving renewed attention, with an eye toward process changes through the use of innovative heat transfer technologies, improved heat recovery and pinch technology, accurate fouling prediction and reduction, and an increase in plant throughput.

The basic equation of heat transfer is defined as

$$Q = U \times A \times \Delta T$$

where:

Q = Heat load (Btu/hr, or kW, or kcal/hr)

U_o = Heat transfer rate (Btu/hr ft² °F, or W/m² K, or kcal/hr m² °C)

A = Surface area (ft² or m²)

ΔT = Log mean temperature difference (°F or °C)

When designing for increased duty from existing installations, one or more of the variables to have the greatest impact on the heat load (Q) are maximized.

Retrofitting with a TWISTED TUBE™ heat exchanger tube bundle can affect each variable of the equation to increase shell-and-tube heat exchanger performance.

Optimizing the heat transfer rate. The overall heat transfer rate, U_o , is affected by the condition and properties of the hot fluid, the condition and properties of the cold fluid, and the wall that separates the fluids. Specifically, $U_o = U$ inside fluid to inside fouling, + U through inside fouling to tube wall, + U through tube wall, + U through outside fouling and + U through outside fouling to outside fluid.

Since the physical properties of the hot and cold fluids are fixed, the two factors affecting the heat transfer rate are the flow characteristics of the tube-side and shell-side fluids, and applied fouling factors.

Koch's technology significantly increases the tube-side heat transfer coefficient (FIG. 1), and provides excellent mixing of the shell-side fluid while minimizing pressure losses.

For high-fouling services, a square tube pitch is often employed to aid in cleaning, thus the tube count suffers. In the TWISTED TUBE bundle technology, a triangular tube pitch is utilized and still provides a cleanable design with six access lanes.

For example, in a 35-in. inner diameter (ID) bonnet-type channel cover (BEM) shell-and-tube exchanger using ¾-in. outer diameter (OD) round tubes on a 1½-in. rotated square tube pitch, the tube count is 1020 tubes. Using TWISTED TUBE bundle technology, the tube count is 1285, an increase of 26%. This difference is more pronounced when the ¾-in. OD round tubes are on a 1-in. rotated square tube pitch.

This significant increase in tube count makes TWISTED TUBE bundle technology a viable option for bundle replacement, or replacement in kind as a solution to increase capacity without the need to modify piping or foundations for a larger heat exchanger.

Maximizing temperature difference with true counter-current flow. True counter-current flow is the most effective means to maximize temperature difference, reduce the size of a heat exchanger, efficiently obtain closer temperature approaches and introduce a temperature cross in the process.

When the outlet temperature of the cold fluid is higher than the outlet temperature of the hot fluid, this is called a temperature cross. A very common application is the feed-to-effluent heat exchanger, where effluent is used to preheat feed to reduce energy costs.

The equation for duty of each fluid is $Q = \text{specific heat} \times \text{temperature difference} \times \text{flowrate}$. When the process

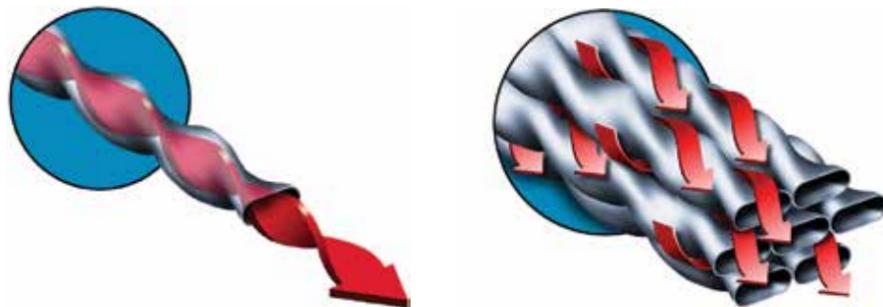


FIG. 1. A TWISTED TUBE™ heat exchanger tube bundle increases shell-and-tube heat exchanger performance.

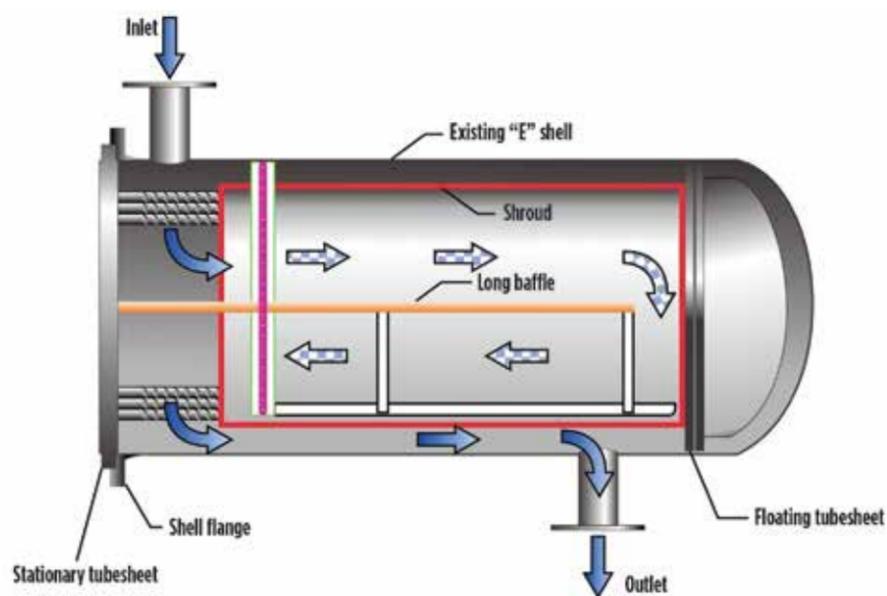


FIG. 2. TWISTED TUBE™ “F” bundle in an “E” shell.

engineer thinks in terms of conventional shell-and-tube configurations, multiple shells must be used in series to handle a temperature cross, thus increasing capital costs. To avoid this, the temperature difference is reduced to avoid a temperature cross requiring an increase in flowrate of the utility fluid (i.e. cooling water, hot oil, etc.) to achieve the desired duty.

True counter-current flow can also be achieved with single-pass shell-and-tube designs, or with “F” shell designs. Both options present reliability concerns, with the single-pass design often requiring an expansion joint, and the conventional “F” bundle design incorporating the use of “leaf” seals that are easily damaged

during bundle installation or removal.

For existing “E” shell design shell-and-tube applications, tube bundles can be replaced with an “F”-type TWISTED TUBE bundle configuration to obtain a closer temperature approach and/or temperature cross without the use of conventional “leaf” seals (FIG. 2).

A Koch TWISTED TUBE heat exchanger tube bundle can increase the duty of an existing shell-and-tube heat exchanger by increasing the heat transfer rate, the surface area and the mean temperature difference. This duty increase can improve heat recovery and allow for higher flowrate while reducing pressure drop with a cleanable design. ●

A NEW ERA IN ALKYLATION



FCCU in the refinery. These olefin feed streams can then be converted into alkylate and sold for a lucrative profit.

However, depending on the alkylation technology employed, a full-range of olefins may not be an option. Customers with the most unusual and chal-

lenging feedstocks turn to the DuPont STRATCO sulfuric acid alkylation technology for successful project deployment. STRATCO projects include:

- License pending for 85%–100% isobutylene feedstock alkylation unit (fed from an isobutane dehydrogenation unit) at a US customer site, expected in 2016
- License pending for 100% propylene feedstock alkylation unit (fed from an upstream propane dehydrogenation unit) unit at a US customer site, expected in 2016–2017
- License pending for 100% amylene feedstock alkylation unit (fed from an upstream FCCU) at a US customer site, expected in 2017
- Conversion of an existing butylene alkylation unit to 100% amylene alkylation unit in progress at US customer site, revamp startup anticipated in 2019
- DuPont licensed a 100% isobutylene feedstock alkylation unit (fed from an upstream isobutane dehydrogenation unit) at Hengli Petrochemical Co. in Dalian City, China.

These unique projects indicate a paradigm shift in the way alkylation has been viewed in the past. ●

Incorporate ICS cybersecurity risk assessments into process risk management

JOHN CUSIMANO and KRISH SRIDHAR, aeSolutions

Numerous cybersecurity incidents, especially those targeting the energy sector, have raised concerns among oil, gas and petrochemical corporations. Such a cyber breach could compromise industrial control and safety systems, leading to health, safety or environmental incidents or financial loss.

“Are our plant controls systems secure?”; “Do we have adequate protection measures in place?”; “Would we know if our control systems were

compromised?”; “Are we prepared to respond to a control system cybersecurity incident?”; and “How do our programs compare to industry standards and best practices?” are typical questions that senior management will look to the CIO and the IT organization for answers.

What senior management wants to know is if the company is managing the risks associated with the threat and vulnerabilities facing modern in-

dustrial control systems (ICS). However, unless a mature control system cybersecurity management program is in place, including the performance of periodic control system cybersecurity risk assessments, those questions cannot be answered.

While IT organizations understand cybersecurity, they cannot possibly understand the corporation’s ICS or the risks associated with system compromise. Simply applying security controls recommended by an IT security auditor, consultant or training institution is insufficient. Accurate answers require cybersecurity risk assessments that are performed by a multi-disciplinary team comprised of IT, plant engineering, automation and operations personnel. In fact, this is exactly what is required by the US Department of Commerce’s National Institute of Standards and Technology (NIST) Cybersecurity Framework and the associated ISA 62443 standard for ICS cybersecurity.

Both the NIST framework (FIG. 1) and ISA 62443 require the identification of critical cyber systems, followed by a detailed vulnerability and risk assessment. Additionally, the forthcoming 2nd edition of ISA 84/IEC 61511 has a new clause that states, “A security risk assessment shall be carried out to identify the security vulnerabilities of the safety instrumented system (SIS).”

Conformance and risk reduction. Performing an assessment of the process hazards and risk associated with cyber compromise of control systems is no longer an option. Many believe that the NIST Cybersecurity Framework, while voluntary, established a “duty of care,” a legal obligation requiring adherence to a standard of reasonable care while performing any acts that could foreseeably harm others. If an industrial cyber security incident occurs where someone is injured or killed, and the company blatantly ignored the NIST Framework, the company may possibly be sued for negligence.

Conformance with the NIST Cybersecurity Framework is certainly not the only reason for an assessment. Conducting assessments can:

- Prioritize cybersecurity enhancements and countermeasures based on what will provide the greatest risk reduction per dollar spent
- Document for management, investors and regulators that a systematic study was performed
- Provide justification as to why certain actions were or were not taken
- Intelligently design and apply countermeasures to reduce risk.

The process. An organized and systematic assessment can identify and qualify threats, vulnerabilities and consequences. The process has successfully assisted operators of oil fields, pipelines, and petrochemical, chemical and gas plants in understanding areas of highest risk and developing cost-effective risk mitigation programs.

The process is based upon a process hazard analysis (PHA), which analyzes how deviations in the process equipment (e.g., pipes, valves, pumps, vessels, etc.) can lead to a hazard. A PHA does not investigate how cyber threats to the ICS can cause these deviations by manipulating devices under control of the ICS and, potentially, the SIS. The ICS cybersecurity risk assessment can fill this gap and provide the linkage between a cyber event and a true process hazard.

While the ICS cybersecurity risk assessment requirement first appeared in 2009 in ANSI/ISA 99.02.01, there has been little guidance on how to actually perform one. However, a new draft standard, ISA 62443-3-2, “Security risk assessment and system design,” has defined a process that involves partitioning the system into zones and conduits, and then assessing the risks associated with each zone. This systematic approach ensures that all access points into the system are evaluated, and unravels the complexity of assessing a large integrated system by breaking the analysis into smaller, more manageable pieces (FIG. 2).

Key learnings. Recent cybersecurity incidents targeting the energy sector and guidelines set forth by NIST and ISA 84/IEC 61511 standards have prompted a renewed focus to approach ICS cybersecurity as a risk-based analysis. Performing a cyber PHA to link vulnerabilities and threats to consequences and likelihood should take into account existing cybersecurity countermeasures. The result is a risk register and risk profile, providing management with a roadmap highlighting ranked set of risks, prioritized recommendations and a mitigation plan. ●

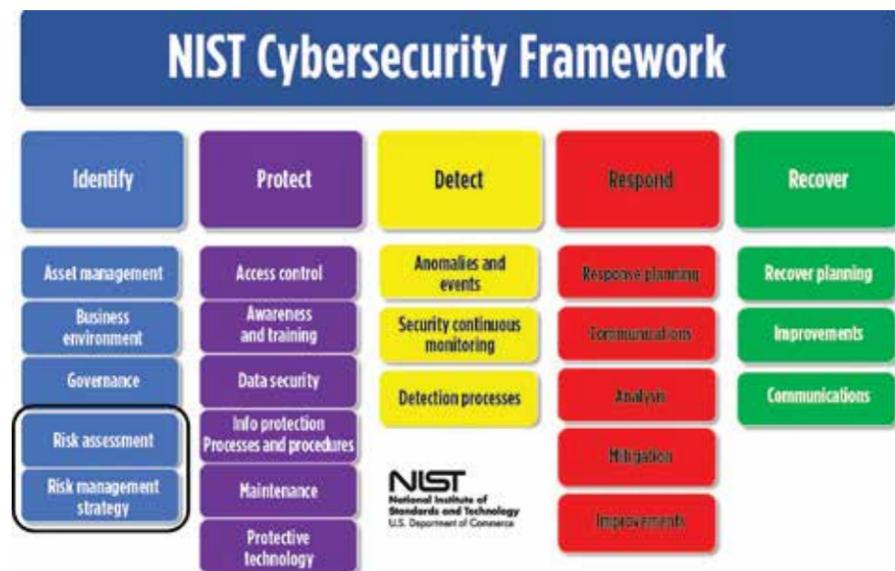


FIG. 1. The NIST Cybersecurity Framework requires risk assessment and risk management.

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- Positive Pressure
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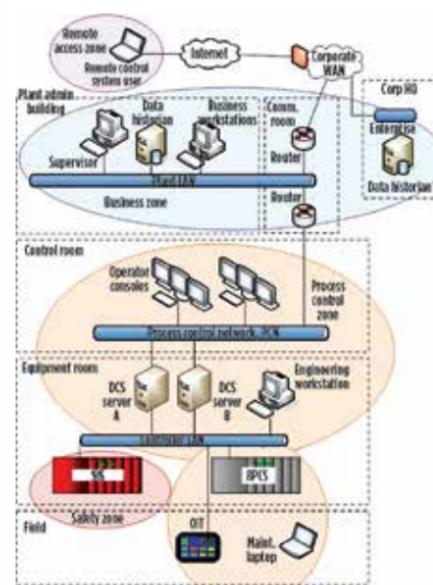


FIG. 2. Example of an ICS partitioned into zones.

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REFINING SOLUTIONS

Not all buildings are created equal

CRYSTAL CEDRO, Hunter Buildings

In the refining and petrochemical industries, blast-resistant modular buildings are more than a luxury—they are a necessity that can safeguard the lives of personnel and protect valuable technical equipment. While modular buildings may look similar in

size and function, it can be difficult to truly understand what separates them.

With the US Occupational Safety and Hazard Administration's (OSHA) enforcement of 29 CFR 1910.119, "Process safety management of highly hazardous chemicals,"

in 1992, industry was discouraged from using portable buildings within plant process areas. The American Petroleum Institute (API) and the American Chemistry Council jointly developed API-recommended practice API RP 752/753 in response to OSHA's stance and specific incidents of wood-framed trailer collapses and resulting injuries/deaths.

Hunter Buildings was conceived with the singular goal of designing and constructing modular buildings to replace wood-frame construction. The company's bolted designs and traditional welded design for multi-module complexes provide more options while maintaining high safety standards and remaining API RP 752/753 compliant.

Hunter structures are custom-designed, engineered and manufactured to meet the client's requirements of site safety, project needs and current American Society of Chemical Engineers (ASCE) recommendations. The engineering, modular fabrication and assembly techniques are compliant with petrochemical and refinery operations safety standards (FIG. 1).

All Hunter analysis calculations are performed by third-party professional structural blast engineers, ensuring accuracy and calculation integrity. The blast design has also been validated by third-party physical tests. Unlike wood-frame construction, Hunter buildings carry a blast rating and arrive ready to achieve site-specific requirements.

Hunter's global manufacturing capabilities include US State Department-certified forced entry, ballistic-resistant (FEBR) modular buildings and complexes, disaster response solutions, and specialty doors and windows.

Installation when and where it is needed. From foundation design to building/setting/assembly to operating facility integration of single to multi-complex, blast-resistant units, Hunter Site Services provides the full spec-

trum of components for an efficient, cost-effective onsite construction.

Hunter's comprehensive services include:

- Site preparation, foundation design and installation
- Total project execution, timeline, cost control, assembly and finish out
- Process and/or utility connections
- Extended warranty, and available agreements after expiration
- Ongoing service and maintenance
- Commissioning prior to turn over to client.

Permanent or temporary applications.

The company's standard buildings are rated for 8.0 psi free field, and can be custom engineered at higher psi ratings to meet unique building requirements. Hunter provides custom interior finishes and sizes ranging up to and above 12,000 ft² for entire building complexes, including two-story structures. Permanent applications include control rooms, operator shelters, zone shops, offices, labs, remote instrument enclosures and motor control center buildings.

While a standard size and interior is provided, these buildings can be creatively combined and positioned to meet a variety of needs, such as turn-around and construction projects, temporary offices, severe weather protection and housing for critical personnel.

Hunter offers tailor-made options such as multi-module complexes; welded or bolted complex mateline connections; varying blast overpressure and duration levels; low-, medium- or high-response blast designs; Class I Division 2 electrical; positive pressure and NFPA 496 compliance; special exterior coatings; gas detection; HVAC (pad mount/end, mount/split system); data and communications wiring; and fire detection/protection/suppression. ●



FIG. 1. Hunter Site Services provides the full spectrum of components and services for an efficient, cost-effective onsite construction.

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GE TECHNOLOGY ENABLES 100% WATER REUSE FOR CANADA REFINERY

Federated Co-Operatives Ltd.'s refinery complex in Regina, Saskatchewan, Canada is installing GE's advanced water recycling technology for a wastewater improvement project that will enable the refinery to clean 100% of its wastewater onsite. Once fully operationally, the Co-op Refinery Complex will be the only refinery in North America to recycle all of its wastewater for steam production, which is used for heating, hydrogen production, power equipment and cooling towers.

Several years ago, the refinery expanded its operations to increase production from 100 Mbpd to 130 Mbpd, which increased its water usage. The refinery's water source is a blend of well water and city water, and restrictions on water use mandated a new source of water. GE offered a solution combining ZeeWeed membrane bioreactor (MBR) technology and a high-efficiency reverse osmosis (HERO) system to recycle and reuse 2 MM gal/day of wastewater. GE will also provide the refinery with wastewater specialty chemicals and monitoring solutions to provide system optimization.

After commissioning, the refinery will reduce its annual use of freshwater by 28%, which is the equivalent of approximately 3,100 households. By recycling 100% of its wastewater onsite, the complex will significantly decrease volatile organic compound (VOC) emissions from its wastewater ponds and reduce the associated nuisance odors. The wastewater improvement project is expected to be fully operational in the coming months. ●

Protect the future of your workforce now

SANJAY SATHÉ, RiseSmart

With job cuts numbering in the hundreds of thousands, the oil and gas industry has been hit hard by the drop in prices. Despite this, signs that prices (and hiring) may pick up again are emerging. A need exists to discover and retain new talent, transfer knowledge from veteran workers to up-and-comers, and fortify employer brand amidst restructuring and layoffs.

Knowledge transfer. The Great Crew Change will indelibly redefine workforce demographics, but that should not mean that the retirement of one employee hampers the continued growth in workforce expertise. Cross-functional job shadowing and leave coverage are two ways to encourage knowledge transfer.

Offering employees the opportunity to shadow jobs that they find interesting encourages them to explore skills and roles beyond their current responsibilities.

Facilitating job shadowing allows older and/or more-experienced employees to breathe new life into their roles as they take on the challenge of mentorship. This can result in increased retention, engagement and productivity, and empowers less-experienced employees to pursue career growth within your organization.

Creating a culture of mentorship also helps protect against future workforce fluctuations. Proactively encouraging employees to learn and grow can keep them engaged and prevent events like the Great Crew Change from creating “brain drain” in the future.

“Leave coverage” should also be considered: instead of hiring a contract worker, offer the opportunity to an internal employee or group of employees who have indicated interest. While this will require you to also cover those jobs, the professional development needs of several of your existing employees can be met.

Adjacent careers and redeployment. Job shadowing and leave coverage protect short-term knowledge transfer, but long-term knowledge transfer, engagement and retention can be bolstered by introducing adjacent careers.

Employees who have been performing one job for an extended period may feel that this is all they are capable of. Considering adjacent careers provides mobility and flexibility within the organization, even while they continue in their current roles.

Restructuring and redeployment. Adjacent careers and long-term skills building can actually help prepare a workforce for restructuring. Rather

than laying employees off outright, working with an outplacement provider to establish a “redeployment” program allows employees to prepare their resumes and discover networking opportunities for open jobs within your organization.

Redeployment reduces the potential cost- and time-per-hire, and ensures that top talent who already understand your company culture and values find their way back into the talent pool and get back to work quickly.

Outplacement. The loss of jobs over the last year has been devastating, for both the employees and for the organizations that will require their talent again once hiring picks up. Outplacement is an option for protecting the future of your workforce, and it helps employees land new jobs quickly once they have been laid off. Coaching and resume assistance can be invaluable to skilled workers who don’t have experience in creating and selling a compelling personal brand.

Helping your employees land quickly preserves the brand by reducing negative sentiment they may have felt upon being laid off. Retention and productivity are improved by showing remaining personnel that you have an interest in taking care of their former colleagues. Opportunities can be cre-

ated for rehiring when economic and business circumstances change.

Proactively investing in an outplacement program can help your employees continue their careers (thereby keeping skilled workers in the industry), pivot to new careers that capitalize on transferrable skills and land quickly without too much interruption in their earning power.

However you choose to support your employees during these times of transition, know that you have options. A proactive approach and a healthy mix of short-term and long-term skills transfer and outplacement support can go a long way toward ensuring your organization’s workforce success. ●



SANJAY SATHÉ is the founder of RiseSmart, a Randstad company, and a provider of contemporary career transition services.

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SCENES FROM THE 2016 AFPM Q&A AND TECHNOLOGY FORUM



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3



4



6



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7



8

- 1 Sunday evening's traditional kickoff reception always draws a full house for food, drinks and good conversation.
- 2 AFPM President **Chet Thompson** presented the Lifetime Achievement Award to **Sam Lordo** at the opening session Monday morning.
- 3 **Dominic Varraveto** from Burns & McDonnell and first-time AFPM attendee **Andrew Nathan** from Virtual Materials Group exchange ideas.
- 4, 5 **Chris Hymel, Scott Walker** and **Dale Champion** from Solenis and PGA Tour golf pro **Billy Hurley** welcomed guests to the golf-themed hospitality suite Sunday evening.
- 6 The AFPM Q&A and Technology Forum presents an opportunity for friends and colleagues to reconnect.
- 7 Monday morning featured a Gasoline Processes Q&A/Discussion where **Matthew Hutchinson** from Axens North America; **James Kleiss** from Valero Energy Corp.; **Stephen Philoon** from UOP LLC—A Honeywell Company; and **Ken Rhodes** from Marathon Petroleum shared their expertise.
- 8 **Honeywell UOP's** suite featured a game theme, complete with a foosball table and Sunday night football.

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2017 AFPM MEETINGS



Annual Meeting
March 19-21, San Antonio, TX

International Petrochemical Conference
March 26-28, San Antonio, TX

International Base Oils &
Waxes Conference
March 27, San Antonio, TX

Security Conference
April 24-26, San Antonio, TX

Labor Relations /
Human Resources Conference
April 27-28, San Antonio, TX

National Occupational &
Process Safety Conference
May 16-17, New Orleans, LA

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

Q&A and Technology Forum
October 2-4, Austin, TX

Environmental Conference
October 15-17, Denver, CO

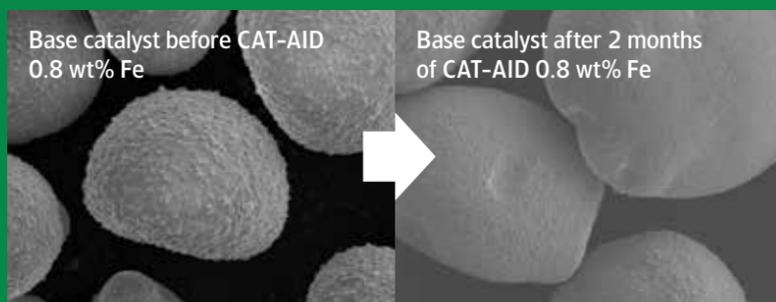
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