Welcome to the American Fuel & Petrochemical Manufacturers 117th Annual Meeting! We are thrilled to be back in San Antonio and pleased you could join us.

AFPM and its members have accomplished a lot in the last year. We have continued to safely and reliably meet increasing consumer demands for our life-enhancing products. US refining and petrochemicals saw record-high production and utilization rates, matched by strong US exports abroad. We engaged on more public policy issues than ever before, including trade and tariffs, IMO 2020, chemical regulations, product bans, the Renewable Fuel Standard, CAFE standards, carbon tax and electric vehicle (EV) subsidies. We testified several times before Congress on behalf of our industries, and our narrative on key public debates was included in dozens of outlets, including the Wall Street Journal, Financial Times, Forbes, The Hill and the Houston Chronicle, to name just a few. As a result of our efforts, last year we saw the net favorability of the fuel and petrochemical industries rise by more than 10%.

The new year brought with it a new Congress and a new set of opportunities and challenges, with some policymakers calling for a so-called “green new deal” that ultimately seeks to eliminate our industries. While we face many challenges, we are excited about the future of our industries and the many opportunities that lie ahead.

The fuel and petrochemical industries are well-positioned to keep growing and thriving. We continue to innovate and find cleaner, cheaper and more efficient ways to deliver our products to meet increasing consumer demand globally. Petrochemical demand is at a historic peak and looks to remain high for the foreseeable future as the middle class grows worldwide. While some say that the growth of the internal combustion engine has peaked, consumers continue to demonstrate that they prefer the ever-greater horsepower, performance and efficiency offered by new internal combustion engine vehicles.

We are also enhancing our operations and performance with advanced technologies that are having a positive impact on safety, security and emissions. Our production processes and fuels are cleaner than ever and, despite all the progress we have made together, we are just beginning to scratch the surface of how our industries can be part of a more sustainable future. Ultimately, our goal is to change the narrative about our products and industries by sharing stories that bring to life the many ways we are driving progress and propelling the world forward.

Changing the narrative and innovating toward a more sustainable future

CHET THOMPSON, President and CEO, American Fuel & Petrochemical Manufacturers

See WELCOME, page 3
Ultra-light crudes and condensates are here to stay. These streams have flooded the market in recent years, and many of them are deeply discounted against reference crudes. Refiners have been processing increasing percentages of this light material through their Crude Distillation Units (CDUs) up against unit naptha handling limits. On the surface, processing condensate and other ultra-light crudes with high API gravity and low sulfur should be easy. In reality, many refiners have experienced significant challenges, some of which are unique to ultra-light crudes and condensates.

Although their bulk properties signal that these crudes should be easy to process, new recovery techniques tend to leave undesirable compounds in the crudes that can adversely affect refinery CDUs or Condensate Splitters. Some of the bad actors are:

- High melt point waxes / high paraffin content
- Tramp amines from production H₂S scavengers
- Filterable solids
- Tramp phosphorous compounds

These undesirable compounds are the source of operating and reliability problems in CDUs and Condensate Splitters worldwide, and the onset and severity of certain problems can often be traced back to the introduction of new ultra-light crudes and condensates.

These supposedly “easy” crudes have been linked to the following problems:

- Fouling in the cold preheat train
- Poor desalter performance
- Fouling in the warm and hot preheat trains
- Crude heater fouling and hot spots
- Accelerated overhead system corrosion
- Salting in the top of the crude column
- Plugging of kerosene section trays and exchangers
- Plugging of stripping trains

Despite the impression that new ultra-light crudes and condensates should be easy to process, they are not. Condensates and ultra-light crudes are crudes, meaning that many of them can be difficult to process and can present unique refining challenges.

Process Consulting Services, Inc. has experience with these crudes and has addressed all of the problems above through process and equipment design features. Contacts today to maximize profitability and minimize headaches while processing these discounted crudes.
Optimizing DP flow applications in refineries

DAN CYCHOSZ, Emerson Automation Solutions

Differential pressure (DP) flow meters are common in many process plants and particularly in refineries thanks to their versatility, accuracy and scalability. How they work and how they can be configured to optimize operations in refineries are discussed here.

The basic measurement concept requires creating a pressure drop in the line. Traditional wisdom used to be that getting the maximum accuracy and turn-down range meant creating the largest pressure drop. Fortunately, the accuracy of today’s DP transmitters is better than in the past, making it possible to get good flow readings with less pressure loss.

Best practices call for relatively long, straight and smooth pipe sections upstream and downstream from the primary element. Standards specify that as much as 4 to 5 pipe diameters upstream and five diameters downstream are required to achieve maximum accuracy. This can make mounting a DP flow meter in complex and congested piping a challenge. On new installations, additional costs can be incurred when piping runs longer than otherwise needed must be specified to ensure accurate measurement. Using multiple holes rather than just one for the orifice plate primary element can alleviate the problem by significantly reducing the straight pipe requirement, while maintaining high measurement accuracy and repeatability.

DP flow meters usually have impulse lines between the transmitter and both sides of the primary element. The design and construction of the impulse lines have a major influence on the success of the installation. If poorly executed, they can be prone to many problems including clogging, freezing and slugs of gas or liquid. In refineries, they are governed by strict piping requirements that specify welding techniques, isolation valves, etc.

In critical applications, impulse lines are normally all welded and include gate valves on the high and low sides to isolate the transmitter. These allow the transmitter to be removed without shutting down the process. Bleeding ports are also included to clear gas slugs trapped in the lines.

Combining design developments. With these points in mind, what should a DP flow meter designed to thrive in an unforgiving refinery application look like? Shown in FIG. 1, Emerson’s Rosemount™ 9295 process flow meter is a case in point. Key features include:

• It is supported by a Rosemount 3051S MultiVariable™ transmitter on a pre-assembled spool section ready for mounting.
• The impulse lines are kept short to minimize plugging.
• A four-hole conditioning orifice plate primary element reduces overall length, making it easier to fit into existing piping.
• Overall construction is welded stainless steel in keeping with today’s technologies, they can do a better job than ever. •

DAN CYCHOSZ is a global DP flow product manager for Emerson Automation Solutions in Boulder, Colorado and is responsible for Rosemount DP flow meters. He earned a BS degree in chemical engineering from Iowa State University. Prior to joining Emerson, he spent time in the chemical industry in a technical sales role.

FIG. 1. Emerson’s Rosemount 9295 process flowmeter is designed for difficult refinery operations while providing a high degree of precision and reliability.

SENATOR TED CRUZ TO RECEIVE AFPM LEADERSHIP AWARD

At Monday morning’s General Session, Senator Ted Cruz (R-Texas) will be awarded the 2019 AFPM Leadership Award.

Throughout his life, Senator Cruz has proven to be a passionate and effective fighter for limited government, economic growth and the Constitution. His calling to public service has been inspired by his firsthand observation of the pursuit of freedom and opportunity in America. Senator Cruz’s mother Eleanor was born to an Irish-Italian working-class family. The first in her family to go to college, she graduated from Rice University with a degree in mathematics and became a pioneering computer programmer in the 1950s. After being tortured and imprisoned in Cuba, his father, Rafael, fled to the US in 1957, then started a small business in the oil and gas industry. Senator Cruz has been a tireless fighter for liberty because his family knows what it is like to lose it.

As Solicitor General for the State of Texas and in private practice, he authored more than 80 US Supreme Court briefs and argued 43 oral arguments, including nine before the US Supreme Court. He also won an unprecedented series of landmark national victories that include his defense of US sovereignty against the UN and the World Court in Medellin vs. Texas, our Second Amendment right to keep and bear arms, and the constitutionality of the Ten Commandments monument at the Texas State Capitol and the words “under God” in the Pledge of Allegiance.

In the US Senate, he has led the fight to repeal Obamacare, to secure the border and to confirm Justice Neil Gorsuch to the Supreme Court. He has also led the fight to defend life, marriage, the First Amendment, the Second Amendment and our Bill of Rights.

AFPM is proud to recognize Senator Cruz for his contributions to the US and the petrochemicals and refining industries. •
THREE LEGACIES
ONE FUTURE

For years, the energy and petrochemical industries have counted on the catalysts, technology licensing, and services provided by the companies that comprise Criterion, CRI, and Shell Global Solutions. Today, these companies have come together under the Shell Catalysts & Technologies brand, working together as a more integrated partner to solve the industry’s most complex challenges. As Shell Catalysts & Technologies, we channel years of experience providing value-adding solutions, technologies, and services that drive the industry — and the world — forward.

That’s the promise of Shell Catalysts & Technologies.
A career with the US Army took Russell Dell to all over the US and abroad. Whether he was working as an operations officer in Fort Drum, New York or as a battalion commander in Afghanistan, a particularly memorable adage was applicable no matter the job at hand.

“There is one thing we say about a soldier,” Lewis said. “If you can save me from danger, save me from danger.”

Lewis has carried that philosophy to his position as the Corporate, Western Regional Security Supervisor for Marathon Petroleum Corp. From his office in San Antonio, Lewis plays an integral role in ensuring the safety of the integrated downstream company’s employees. The need for “persistent surveillance” in this industry is not so different from what Lewis was responsible for while he served in the military.

While the potential for accidents at a refinery pale in comparison to those of a battlefield, an employee may still face some precarious positions in areas that are very open. There is a lot of terrain out there.

Marathon Petroleum, which recently acquired refining company Andeavor, is exploring the most effective ways to deploy the technology. Some Marathon Petroleum facilities are using drones to perform flare and tower inspections, eliminating the need for scaffolding and human risk. Additionally, the company is using drones for pipeline right-of-way work and for surveillance during different types of emergencies. It is also partnering with the University of North Dakota to cultivate its aviation program as a training ground for drone pilots at refineries.

If a model refinery exists for drone deployment in the US, it is the Shell Deer Park Manufacturing complex in suburban Houston, Texas (FIG. 1). The 1,500-acre facility is located 20 miles east of downtown and has operated since 1929. It is the company’s largest manufacturing hub in the world—some 5,000 people pass through the front doors daily, with up to 17,000 entries and exits to and from the facility.

The sheer size of Deer Park made it a logical choice for the early adoption of drones, and so became the pilot program for all UAV programs at Shell.

“Everything we do is about protecting personnel in the field,” said Gary Scheibe, a longtime Houston police officer and Homeland Security veteran who has been at Shell for eight years. After working with contractors using drones and seeing the benefits of the technology first-hand, Scheibe made a strong case to develop UAV capabilities in-house. “I requested some funding for a drone program, and they gave it to me. We bought some initial birds (drones) and trained ten pilots. A year-and-a-half into our program, we have $100,000 invested in it.”

Efficiencies and improvements. Shell Deer Park’s Drone Aerial Response Team (DART) was begun in early 2017. In addition to Scheibe, DART’s members also include a former Marine who specializes in logistics and a former Army infantry veteran, Sheriffs’ deputy and EMT who performs inspections and manages the CCTV and access control. One team member, a former Marine who has since moved to a refinery in Louisiana, wrote Deer Park’s policies for drone use and training.

DART has provided the refinery a much quicker response time. Live video footage monitored by the DART team allows for action within 15 min. - 20 min. In the first year of the program, the team logged 477 flights, with each flight eliminating the need for personnel to work at heights, and resulting in an estimated cost savings of $1.2 MM.

Perhaps the most notable use of UAVs at Shell Deer Park was in the aftermath of Hurricane Harvey, when the DART team worked with Drone Systems Intl. and deployed two drone teams to scan the property. The one can fly a mission and identify issues with images and video, enabling engineers and maintenance crews to make repairs quickly while the other drone scans other areas for trouble.

“Large-area inspections previously took two weeks to complete; the drone can do them in two hours,” said John McClain, the Shell Deer Park DART Chief Pilot who manages inspections and the CCTV. “We are saving people from working at heights, saving rental costs, and saving man hours and time on tools.”

These efficiencies and improvements are welcome early results of Shell’s innovative approach to using drones, and evidences that similar capabilities could benefit from adopting UAS. However, the use of UAS remains a delicate proposition.

“Pioneering a new technology at a facility that already observes extensive safety and security measures,” said Tom Owen, Senior Director of enterprise sales and business development at San Francisco, California-based KittyHawk, a drone operations management platform.

“Operators of major industrial facilities and critical infrastructure often will not incorporate a new technology like UAS until they fully evaluate it and establish a firm understanding of exactly how it is going to work—and rightly so,” Owen partnered with the Shell Deer Park team in the earliest days of the DART program.

Close collaboration. The KittyHawk platform and team help organizations develop and integrate essential elements of a UAV program, from pilot training and -log -keeping, to mission planning and in-field situational awareness, to data management and sophisticated reporting. They also help pilots (FIG. 2) stay informed of regulations issued by the Federal Aviation Administration (FAA), which classifies drones used for business purposes as commercial aircraft.

Recently, Shell Deer Park hosted a group of safety experts from refineries and petrochemical plants across the country. The DART crew gave equipment demonstrations, walked through drone -use scenarios, and answered questions about the obstacles they faced getting the drone program up and running.

“Safety among our members is a non -negotiable,” said Amanda Smith, Senior Director of health and safety programs for AFPM, which facilitates industry collaboration and the proliferation of good safety practices. “Ensuring the safety of people is of primary importance. If one company has a safety approach that is more effective than others, they are eager to share that knowledge, and others are eager to apply it.”

Drones are making refineries and petrochemical plants safer, more efficient

FIG. 1. The sheer size of the Shell Deer Park Manufacturing complex in suburban Houston, Texas made it a logical choice for the pilot program for all UAV programs at Shell. Source: Shell Deer Park.

FIG. 2. Following Hurricane Harvey, the DART team worked with Drone Systems Intl. and deployed two drone teams to scan the property. One can fly a mission and identify issues with images and video, enabling engineers and maintenance crews to make repairs quickly while the other drone scans other areas for trouble. Source: Shell Deer Park.
Monday’s General session: Featured guests

In Monday afternoon’s General Session, Sustaining the future: Leadership perspectives, CHET THOMPSON, President and CEO of AFPM, will moderate a panel of industry leaders as they look ahead to the future of the refining and petrochemical industries. The panel includes MICHAEL COYLE, President, Manufacturing, Chevron U.S.A. Inc.; TODD W. FREDIN, Executive VP Supply, Trading and Logistics, Motiva Enterprises LLC; JOE GORDER, Chairman, President and CEO, Valero Energy Corp.; DANIEL LAMP, President and CEO, CVR Energy Inc.; MARK LASHIER, President and CEO, Devon Phillips Chemical Co. LP; and LOIC VIVIER, Senior Vice President, Fuels, ExxonMobil Fuels & Lubricants Co.

MICHAEL COYLE has been President of Chevron’s manufacturing organization since July 2016. He previously served as VP of manufacturing, where his responsibilities included overseeing the safe and reliable operations of Chevron’s four niche refineries located in Salt Lake City, Utah; Cape Town, South Africa; KaoPei, Taiwan; and Bunbury, British Columbia. In this role, he also served as VP of downstream strategy. Prior to his career with Chevron, he was an engineer in the Perth Amboy refinery. He went on to serve in a variety of engineering and operating positions of increasing responsibility at Chevron’s Salt Lake, Philadelphia and Petrobrás refineries, ultimately returning to the Perth Amboy refinery, where he served as Operations Manager prior to assuming the role of Refinery Manager.

Prior to joining the refinery, Fredin was with ConocoPhillips, where he last served as President of Europe, Africa, Middle East and Central. He joined Conoco in 1975 and held various positions in the Middle East, Europe, the Middle East and Asia, with diverse assignments in refining, upstream, business development and trading.

JOE GORDER became Chairman, President and CEO of Valero Energy Corp. in 2014. He previously served as VP of manufacturing, where he was responsible for refining operations and commercial operations in marketing, supply and transportation. He has also served as Chief Commercial Officer and President of Valero Europe. In this role, Gorder oversaw all commercial trading and related activity for the company, including crude and feedstock supply and trading, trades marketing, logistics operations, commercial business development, transportation and specialty products marketing. Additionally, he was responsible for all business development and trading of Valero’s assets in the UK and Ireland.

Gorder served as Valero’s Executive VP of marketing and supply, following a tenure as Senior VP for corporate development and strategic planning. DAVID LAMP serves as CEO, President and a Director of CVR Energy Inc., as well as CEO and President and a Director of the general partner of CVR Refining LP, and Executive Chairman of the general partner of CVR Partners LP. Lamp has more than 37 years of technical, commercial and operational experience in the refining and chemical industries. Prior to his role as President and COO of Western Refining Co., he was President and CEO of Northern Tier Energy Corp., which merged with Western Refining; Lamp previously served as COO and Executive VP of HollyFrontier Corp.—in 2011, Holly Corp. and Frontier Oil completed a merger of equals and changed their name to HollyFrontier Corp. Mr. Lamp joined Holly in 2004 and held various roles, including EVP of refining operations, Executive VP of refining and marketing, and President.

MARK LASHIER is President and CEO of Chevron Phillips Chemical Company LLC. Throughout nearly three decades with Chevron Phillips Chemical and its owner company Phillips Petroleum, now Phillips 66, Lashier has held several leadership roles. Before his August 2017 appointment to the company, he served as Executive VP of commercial businesses. LOIC VIVIER is the Senior Vice President of Fuels for ExxonMobil Fuels & Lubricants in Spring, Texas. In his current role, Vivier oversees the global fuels value chain, from crude to customers, and is accountable for its financial performance. Prior to his current position, he served as VP of wholesale and specialties, GBU of ExxonMobil Fuels, Lubricants & Specialties. He was responsible for the global wholesale fuels products, asphalt, basestocks and specialties product lines.

The second session, Sustaining the future: Meeting the challenges, will be moderated by JARED HAWES, Director of state and local outreach for AFPM. Featured panelists include JIM BECKER, VP, Polymers & Sustainability, Chevron Phillips Chemical; JENNIFER FLEETLEY, Corporate Program Portfolio Manager, EMERE R & D, Corporate Strategic Research; STACEY POTHAM, Senior Project Director, INEOS Olefins & Polymers USA; JULIA REINHART, VP, HR and Administration, Valero Energy Corp.; and KIRK TOBERSON, Technology Director, Motiva Enterprises LLC.
THE REFINERY OF THE FUTURE IS FLEXIBLE, INTEGRATED AND CONNECTED

Targeting 50–70% petrochemical products

Today's integrated refining and petrochemical mega-projects are targeting 50–70 percent petrochemicals products. This is also achievable for existing refineries through strategic, step-wise investments in new process technology with advanced molecular management. Honeywell UOP can help refiners develop an integration strategy that profitably unlocks additional value by utilizing the latest bottom-of-the-barrel technology, high-conversion hydrocracking and today's energy-efficient aromatics complexes. Integrating these technologies enables traditional refiners to diversify into petrochemicals and create their own Refinery of the Future.

Unlock new value from every barrel

Honeywell UOP can develop a step-wise approach to increase value capture of every barrel of oil, targeting the lowest value stream for conversion first. A configuration study for a 500kBD refinery with existing VGO Hydrocracking to diesel and Delayed Coking unit demonstrated a potential pathway that would allow a refiner to profitably maximize bottom-of-the-barrel conversion through Uniflex™ MC Technology and integrate into petrochemicals with VGO and diesel Hydrocracking to naphtha. (Table 1 below)

Join Stan Carp, Senior Manager of Configurations at Honeywell UOP, on Tuesday, March 19, for more details on this valuable case study.

Table 1: Improve Economic Performance with Uniflex™ MC Technology and Hydrocracking to Naphtha

<table>
<thead>
<tr>
<th>CASE</th>
<th>BASE</th>
<th>1</th>
<th>2</th>
</tr>
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<tbody>
<tr>
<td>Vacuum Residue Upgrading</td>
<td>Delayed Coker</td>
<td>Uniflex MC Unit</td>
<td>Uniflex MC Unit</td>
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<td>Naphtha</td>
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<td>Naphtha</td>
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<tr>
<td>Aromatics Complex</td>
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UNIT YIELD IMPROVEMENTS VS. BASE CASE

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<th>BASE</th>
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<th>+ 30</th>
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<tbody>
<tr>
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<td>Base</td>
<td></td>
<td></td>
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<tr>
<td>Coke Yield, %</td>
<td>Base</td>
<td>- 30</td>
<td>- 30</td>
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REFINERY ECONOMIC PERFORMANCE IMPROVEMENTS VS. PREVIOUS CASE

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<th>BASE</th>
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<td>Incremental IRR, %t</td>
<td>Base</td>
<td>+ 23</td>
<td>+ 16</td>
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<tr>
<td>Incremental NPV, %</td>
<td>Base</td>
<td>+ 32</td>
<td>+ 16</td>
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95 RON with ETBE: A panacea for the RFS?

ARA BARSAAMIAN and ELISEO CURIOJO, Refinery Automation Institute

Since the US Congress mandated the Renewable Fuels Standard (RFS), the refining industry and renewable fuel producers, mainly US ethanol producers, have been at odds with each other: refiners have resented paying significant capital for renewable identification numbers (RINs) to meet their renewable volume obligations (RVOs); ethanol producers have been clamoring to increase the renewable volume obligation (RVO) to meet their renewable volume obligation (RVO) to address the challenges of today’s competitive refining environment.

Blending gasoline with ETBE. In addition to the advantages mentioned here, ETBE uses cheap naphtha that is inexpensive and abundant thanks to shale crude production, in addition to also using cheap butane.

Successful blending tests runs were conducted with 22 vol% ETBE, equivalent to using 10 vol% ethanol, shown in FIG. 1; 33 vol% ETBE, equivalent to using 15 vol% ethanol, shown in FIG. 2; and 44 vol% ETBE, equivalent to using 20 vol% ethanol, shown in FIG. 3.

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Getting the US Congress, the oil refining industry and ethanol lobbies to agree on using more ethanol (in the form of bio-ETBE) and moving to a 95 RON standard is the next step. ARA BARSAAMIAN is the President and CEO of Refinery Automation Institute LLC (RAI) and has more than 40 years of experience in gasoline, diesel and butane blending operations and technology.

Recently, he has been involved in the IMO 2020 bunker blend, regulations and IMO 2027 spec. Earlier in his career, he was a Group Head with Exxon Research & Engineering Co., President of 30 Corp. and Vice President of ABB Simon, all in the area of fuels blending. Mr. Barsamian holds BS and ME degrees in electrical engineering from City University of New York.

LEE ELISEO CURIOJO is a chemical engineer and STO at ARA. For the past five years, he has worked in the areas of gasoline, diesel, bunker blending, ethanol non-linear property correlations and octane booster; and naphtha and sulfer blending. He also teaches the gasoline, diesel and bunker blending optimization section of RAI’s blending public course. He previously worked at Catholic University of Louvain in advanced modeling and optimization. He holds BS and MS degrees in chemical engineering with honors from the University of Calabria in Italy.

Hot surfaces and autoignition temperatures in petrochemical facilities

EDDIE GUIDRY, Fluor Enterprises Inc.

For many years, electrical hazardous area classification (EAC) has been developed for hazardous (classified) areas in petrochemical facilities. The original intent for these plans was to indicate areas where either flammable materials were present under normal conditions, and/or where flammable materials may be present under abnormal conditions in such quantities that may produce an ignitable mixture. Hazard plans have always considered sparking parts and hot surface temperatures of electrical equipment. Some electrical equipment with hot surfaces are marked with temperature codes (T-Codes), and some are not.

The latest industry trends, both nationally and internationally, are leaning towards using HAC plans to consider autoignition temperatures (AIT) of any equipment with exposed hot surface temperatures found in classified areas (FIG. 1). ISO standards 80079-36 and 80079-37 were recently issued to address hot surface ignition temperatures for equipment other than electrical, although compliance with these documents may prove difficult. US standards do not clearly address the issue of hot surface temperatures associated with non-electrical equipment in classified areas.

Codes and practices. Papers related to electrical installations in the petrochemical industry are presented each year in global conferences, and leading engineers and plant companies are represented. In 2016, Paper No. PCIC-2016-04, Hot surface ignition temperatures and the impact on electrical area classification plans, presented an alternative to the ISO approach by offering a risk-based approach for the consideration of hot equipment surfaces for non-electrical equipment located in classified areas in the US market.

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A new look at integration opportunities

MARION BURLAK, STAN CARP, KEITH COUCH and MATT GIFFRITHS, Honeywell UOP

Changing factors driving the fuels and petrochemicals markets present both challenges and opportunities for refiners. The refinery of the future will be an integrated fuels and petrochemicals producer that consumes less energy, eliminates waste and connects the enterprise for optimal operations. Refiners can begin by making well-planned investments that have immediate benefits to profitability.

US gasoline demand in 2035 is expected to be 13% lower than in 2018, and diesel demand is expected to be 6% lower. At the same time, export of higher sulfur or otherwise lower-quality fuel from the US to those locations.

The rise of petrochemical demand driven by the emerging and rapidly growing middle class around the world, is a phenomenon that will continue through the coming decades and provide rich opportunities for US refiners.

1. Natural gas is one of the world’s cleanest and most flexible fuels, providing an energy cost advantage. The current oversupply of LPG (propylene and butane) in the US, due to expanding natural gas field developments, is projected to increase by 40% from 2018 to 2023. These factors favor propylene production via propane dehydrogenation (PDH), and independent producers are already operating 20 PDH facilities, with more projects in development. Similarly, paraxylene and benzene can be readily produced with profitable from naphtha.

Initiating an integration strategy. For a US refiner to realize these significant increases in value, the development of a well-planned integration strategy is the starting point. Optimum use of each stream and molecule, technology selection, specific gasoline and diesel specifications, and other factors must be considered for each unique case.

In one case study, a five-step petrochemicals integration plan was developed that included a fluid catalytic cracking unit (FCCU) revamp to increase propylene production, the addition of a world-scale PDH unit for further propylene production, the addition of a world-scale aromatics complex to convert naphtha to aromatics, and a new distillate hydrogenation/dry reforming unit.

This series of investments moves the refinery’s fuels production and cost advantage out of existing capital. For example, DCP Midstream has publicly discussed how it invested $20–$25 MM in transformations and recovered $20–$25 MM within one year through lower downtime and other factors.

Embracing transformation. Expect to see a version of this story played out over the next several years. Heavy industry has embraced digital transformation and Internet of Things (IoT) technologies to date largely to reduce costs, such as process energy and maintenance, or to increase productivity out of existing capital.

FIG. 1. Heavy industry has embraced digital transformation and Internet of Things (IoT) technologies to date largely to reduce costs, such as process energy and maintenance, or to increase productivity out of existing capital.

A new frontier for energy companies: Selling software

MICHAEL KANELLOS, OSIsoft

Saudi Aramco is one of the most successful energy companies in the world, and its success lies, in part, in its ability to create and exploit new technologies. The company plans to create an independent subsidiary that will license software applications and other technology developed through its ITB (integrated manufacturing operations management) program to third parties, said Eyad Buhumuza, Manufacturing Operations Management Project Management Specialist and Solutions Architect at Aramco. The company will license judiciously—you will not able to build exact replicas of their plants or processes through the software and service they will make available.

Instead, the subsidiary will license solutions for predictive maintenance, pump optimization, i.e., the problems every petrochemical plant and refinery faces (FIG. 1). The new subsidiary will possibly even license technology to other heavy industries.

High-octane reformate is re-tasked for aromatics production and the gaso-
Turning an IMO 2020 problem into a high-profit solution

BOB RILEY, W. R. Grace & Co.

Few refining industry issues have been as ubiquitous as compliance by refiners over the last several years as the upcoming International Maritime Organization (IMO) regulations on marine fuel sulfur. Nearly every conference, summit and meeting, the refining industry has a healthy connection to this issue, and the projected impacts have been estimated to be billions of dollars to refiners and to their customers near the deadline for the implementation of IMO 2020.

W. R. Grace, along with our partners at ART Hydroprocessing, have been working for some time to understand the impact of IMO 2020 on refiners, and to identify the most profitable solutions to help refiners adapt to the new environment. With desulfurization via hydrocracking and hydro treating are major components of many refineries, the impact on the industry as a whole remains significant. Many refiners have not yet made multiple options. At the same time, the value of middle distillates, including FCC light cycle oil (LCO), which is still a powerful option to address this need in hundreds of refineries. Our newest innovations, including our MIDAS® technology, allow for the inclusion of a high degree of our signature mesoporosity, as well as an increased amount of macroporosity to extend the range of benefits that can be delivered by our MIDAS catalysts.

FIGS. 1 and 2 show the results of one such application, where the use of MIDAS increased FCC LCO by destroying FCC bottoms. In this case, the refinery’s primary target was to upgrade FCC bottoms into LCO, and the catalyst employed was designed for this specific purpose. The baseline catalyst was a high Z/M formulation from Grace, which had been used to maximize gasoline + liquefied petroleum gas (LPG) make.

Based on typical FCC yield profiles, a reduction in FCC bottoms of 1 vol% of fresh feed (as an example) can reduce the amount of FCC bottoms produced by 20%-30% overall, significantly reducing the issues associated with blending this difficult stream. Coupled with an increase in FCC LCO production (while managing to ensure volume swell is maintained), the refinery can realize significant value today. In addition, this value could be significantly magnified in the future as the IMO 2020 rule is implemented.

For more information, or to meet a member of our team, visit the W. R. Grace & Co. ART Hydroprocessing hospitality suite on Sunday and Monday evenings in the Marriott Rivercenter.

The road to successful plant modernization

HYONSOOK KANG, Yokogawa

Anyone working in a refinery or heavy petrochemical plant with “vintage” automation equipment is painfully aware of the effects a distributed control system (DCS) from the 1990s, 1980s or even earlier can have on operations. These old control platforms are built on long-obsolete technology, which means that replacement parts and people who understand how they work are in short supply.

Unscheduled outages caused by failures of old components threaten plant efficiency and even operational viability, yet plants are still pursuing upgrades to current platforms. Those that do launch projects often do not go nearly far enough with the kinds of improvements possible, with huge opportunities lost as a result. Why is this the case, and what can be done to alleviate the situation?

Process manufacturing plants have little incentive to replace something that is operating well. Age alone is rarely a primary consideration, which is why so many plants have such old automation equipment and infrastructures. However, the two main arguments for migration—reliability problems caused by obsolescence and functional limitations—are insurmountable.

The new DCS should be considered a platform to improve production and efficiency by removing the impediments caused by the old, unreliable platform, while providing new tools to achieve better performance. Improved performance might be defined as higher production volumes, lower production costs, reduced energy consumption, improved regulatory compliance, greater feedstock handling flexibility or some combination of these. One way or another, it is about profitability for the plant driven by operational excellence. Safety also enters the discussion because incidents cause production disruptions.

The capabilities of modernized automation technologies are designed around three factors (FIG. 1):

• Improved advanced process control (APC) concepts
• Engagement with the changing workforce
• Operation in a secure environment with minimal cyber risks

In refineries, production gains of 2%, 3% and even 5% have been routinely realized after APC implementation as processes are optimized.

Embracing modern technology. Clearly, nobody needs to be convinced of the value of APC considering these points, but achieving these gains can be challenging. Often, initiatives like this can founder. During the 1990s and 2000s, Intel spent billions trying to move into hot markets like data center management, consumer electronics and communications technologies, and failed almost every single time. After a while, the mothership would simply lose interest.

Still, energy companies should at least examine ways to monetize their technology. They invariably will have to increase their investments in digital technologies over the next decade to improve their existing operations anyway. Trying to produce these same breakthroughs will represent a low-risk way to explore a new, potentially high-return opportunity.

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FIG. 1. Realizing operational excellence requires dealing with the three major challenges of a modernization project.
A solution for FCC propylene production and purification

CARL KEELEY, LOTHAR KARRER AND MODESTO MIRANDA, BASF

Demand is strong for propylene, which is used to produce a large variety of petrochemicals. Over the last five years, propylene production has doubled, and growth rate was sustained at about 4% per year. Traditionally, secondary fluid catalytic cracking (FCC) is the second-largest producer of propylene, but use of FCC-lyle propylene can improve a unit’s flexibility to produce a range of feedstocks to maximize propylene selectivity. Purification adobsents are used to upgrade the raw propylene to chemical-grade quality. The chemical-grade propylene is combined with benzene to make cumene (isopropyl benzene), an important building block for the synthesis of other organic compounds, such as phenol, aceton, bisphenol-A, phenolic resins and monomers.

**TABLE 1.** Results of the first trial of BASF’s FCC propylene production.
The propylene yield exceeded 10 wt%.

<table>
<thead>
<tr>
<th>Reactor Temperature, °F</th>
<th>1,000</th>
<th>1,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>C/O ratio</td>
<td>10.46</td>
<td>10.36</td>
</tr>
<tr>
<td>Propane, wt%</td>
<td>2.91</td>
<td>2.81</td>
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<tr>
<td>Propylene, wt%</td>
<td>9.61</td>
<td>9.61</td>
</tr>
<tr>
<td>Butane, wt%</td>
<td>8.47</td>
<td>8.37</td>
</tr>
<tr>
<td>Butylene, wt%</td>
<td>9.14</td>
<td>9.14</td>
</tr>
<tr>
<td>Total LPG, wt%</td>
<td>29.81</td>
<td>29.61</td>
</tr>
<tr>
<td>C5 + C6, wt%</td>
<td>32.54</td>
<td>32.54</td>
</tr>
<tr>
<td>RON, octane</td>
<td>8.21</td>
<td>8.21</td>
</tr>
<tr>
<td>MON, motor octane</td>
<td>13.98</td>
<td>13.98</td>
</tr>
<tr>
<td>Snurly, wt%</td>
<td>6.77</td>
<td>6.77</td>
</tr>
<tr>
<td>Coke, wt%</td>
<td>4.81</td>
<td>4.78</td>
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</tbody>
</table>

**FLUOR,** continued from page 15

trical equipment surface temperatures have been addressed, other process equipment, such as exchangers, is still an ongoing concern. For instance, it is very typical to have an exposed reactor temperature that exceeds 480°F (250°C). This can mean a significant over-temp condition, which can carry a potential T-Code of T3 (a maximum surface temperature not to exceed 392°F [200°C]). Logically, this does not make sense, as neither gas nor vapor desicn between electrical equipment and mechanical equipment.

American Petroleum Industry Recommended Practice API RP 2216 acknowledges the risk of hydocarbon liquids and vapors by hot surfaces in the open air, discusses issues with hot surface temperaturs of non-electrical equipment, but does not offer a definitive approach for assessing the associated risks. The conclusions reached in API RP 2216 may erroneously lead one to believe that any criteria for the classification of electrical equipment in classi- fication and ignition classifications is conclusive. This can lead to the conclusion that the classification of electrical equipment, industrial engineering, working as an Engineer/Manager for major UGK, ethylene, polyethylene and refinery projects. Ms. Kang worked for Shell for the bulk of her career before joining YOKOGAWA, and she holds an MBA in Chemical Engineering from The University of Illinois at Urbana-Champaign.

As an Industry Consultant for YOKOGAWA, she helps companies to make the voice of the customer to YOKOGAWA’s internal personnel. She has more than 35 years of experience in petrochemicals, process instrumentation, and automation. She regularly present at the conferences and technical committees. She is also a member of the Executive Committee of the Japan National Association of Electrician of Japan (JNEC), and she is the current chairperson of the JNEC Panel 11 since 1999.

**EDDIE GUEVARA** is a Senior Fellow in electrical engineering, specializing in codes and standards for Flare Crowns. He is very active in the development of many US national (ANS) and international codes and standards and is a past chairman of the principal member of the NEC Panel 11 since 1999.

**YOKOGAWA,** continued from page 19

**HOSPITALITY SUITES**

<table>
<thead>
<tr>
<th>Marriott Rivercenter Floor PLAN</th>
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</thead>
<tbody>
<tr>
<td><strong>HOSPITALITY SUITES</strong></td>
</tr>
<tr>
<td>March 17-18, 2019</td>
</tr>
<tr>
<td>American Fuel &amp; Petrochemicals</td>
</tr>
<tr>
<td>American Fuel &amp; Petrochemicals</td>
</tr>
</tbody>
</table>
Deep in the heart of Texas

Welcome to San Antonio! The city’s independent spirit and varied culture make it an ideal gateway to the region’s scenic beauty, outdoor retreats and historic legacy. First settled as a colony of Spain, the city has grown up as a territory of Mexico, part of the independent Republic of Texas, and finally as a key city in the greatest of the United States (well, that’s what we Texans think).

The Old World charm of San Antonio is represented everywhere you look. The influence of Spanish, Mexican and German cultures, among others, is apparent in culturally significant art, museums, architecture, cuisine and music. Even some of the street signs are written in three languages. With such a variety of attractions, it is little wonder why San Antonio is the most popular tourist destination in Texas.

The Texas Hill Country. Settled by Germans and Eastern Europeans, the Hill Country has a culture all its own. Storybook farms and ranches dot the countryside, and you may still hear long-time residents speaking German in Fredericksburg. Boerne and New Braunfels. You’ll also find quaint B&Bs, antique shops on old-fashioned main streets and celebrations with roots in the Old World, like Wurstfest (a sausage festival) and Weihnachten (a Christmas festival). Floating down cool rivers, strolling quaint main streets in search of unique bargains, playing a round at one of many championship-quality golf courses, or hiking and biking through rolling, scenic terrain are all within driving distance. Outside of Boerne, the Cascade Caverns offer a 48’ break from the Texas heat, including a 100°F underground waterfall. The Missions and the Alamo. In the 18th century, Franciscan priests from Spain established five Catholic missions along the San Antonio River, primarily to extend Spain’s dominion northward from Mexico, but also to convert and educate the native populace. Today, the five missions (San Antonio de Valero, Mission San José, Mission Concepción, Mission San Juan and Mission Espada) represent the largest concentration of Spanish colonial missions in North America, and they have been nominated for World Heritage status.

The Alamo (Mission San Antonio de Valero) was founded in 1718 as the first mission in San Antonio, serving as a way station between east Texas and Mexico. In 1836, decades after the mission had closed, the Alamo was the site of one of the most notorious battles in American history, becoming an inspirational symbol for liberty during the Texas Revolution. For 13 days, 150 “Texians” died defending the Alamo against more than 1,000 of Mexican General Santa Anna’s troops, including state folk heroes William Travis, Jim Bowie and Davy Crockett. The Alamo is open daily, and the most accurate depiction of the Battle of the Alamo can be seen at the IMAX movie theater.

Attractions. The San Antonio Zoo is one of the largest in the nation, housing over 3,500 animals. Take the Zoo Train for a relaxing tour of the grounds and nearly a dozen naturalistic exhibits. Marine life shows and displays, adventure camps, exciting rides and one of the coolest water parks anywhere await you at SeaWorld San Antonio. Sample one of over 100 rides, including the only “floorless” roller coaster in the southwest, at San Antonio’s Six Flags Fiesta Texas. Since it was opened during the 1968 World’s Fair, the 15-acre HemisFair Park has remained one of the city’s top draws, anchored by the 750-ft. Tower of the Americas. Hit a two-for-one special under one roof: the Plaza Wax Museum and Ripley’s Believe It or Not! Museum are fun for visitors of all ages. Shop at Market Square, known as the largest Mexican market north of the Rio Grande, and find unique local and imported pieces of art, pottery, jewelry and textiles. Visit the lavish homes of the historic King William District; immerse yourself in local art at the McNay Art Museum; shop in the Travis’ Village; cruise throughout town on a Seagull; get your “cultured cowboy” on at the Briscoe Western Art Museum; experience the Natural Bridge Wildlife Ranch; stroll through the Botanical Gardens; and visit La Villita, one of the original neighborhoods in old San Antonio, to see the artisan studios, shops and restaurants. Are you getting the drift? The list goes on and on.

The River Walk. No visit to Texas is complete without strolling or riding a boat along the San Antonio River Walk, a vibrant oasis of cypress-lined paved paths, através stone bridges and lush landscapes. Steps away from the MRC and MRW hotels, it gently winds through the city center, providing millions of visitors each year with easy access to the city’s cultural hot spots, authentic restaurants, local shops, nightclubs and historic sites. Visitors and locals dive aboard river cruisers while the sounds of mariachis echo from above. This is the river that first inspired the settlement of San Antonio, and it still flows like today as the city’s center.

Dining. Perhaps nowhere is the city’s diverse culture more evident than in its cuisine. San Antonio’s culinary palette and cooking styles reflect the heritage and innovation of European and Mexican influence. The variety of options, including the famed Tex-Mex with its aromas of spices and fresh cilantro, are unmatched in the state and accompanied perfectly by local wines, beers and tequilas. Many of our acclaimed chefs who studied elsewhere bring their world-class training back to our culinary landscape. And the barbeque? This is Texas, partner. Enough said.

Music flourishes here: country-western, mariachi, rock, blues and folk can be heard throughout the city. Art comes alive in outdoor murals, gardens, parks and sculptures. The confluence of cultures is everywhere and in everything, especially the open, friendly faces of the people who call San Antonio home. Our city has deep roots in its past, but we are forever mindful of its future. Thank you for visiting San Antonio, and we hope you enjoy it as much as we do. •
Let’s do
the math.

Grace custom catalyst solutions, co-developed with you, are about more than performance—and more than chemistry. They’re designed to add to your bottom line.

In some cases, the difference between our refinery customers’ financial return on Grace technologies versus the alternative has reached into eight figures.

If you’re ready to put Grace chemistry to work to strengthen your business, we’re ready to show you how we can help. Call us to get started with the calculations.


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