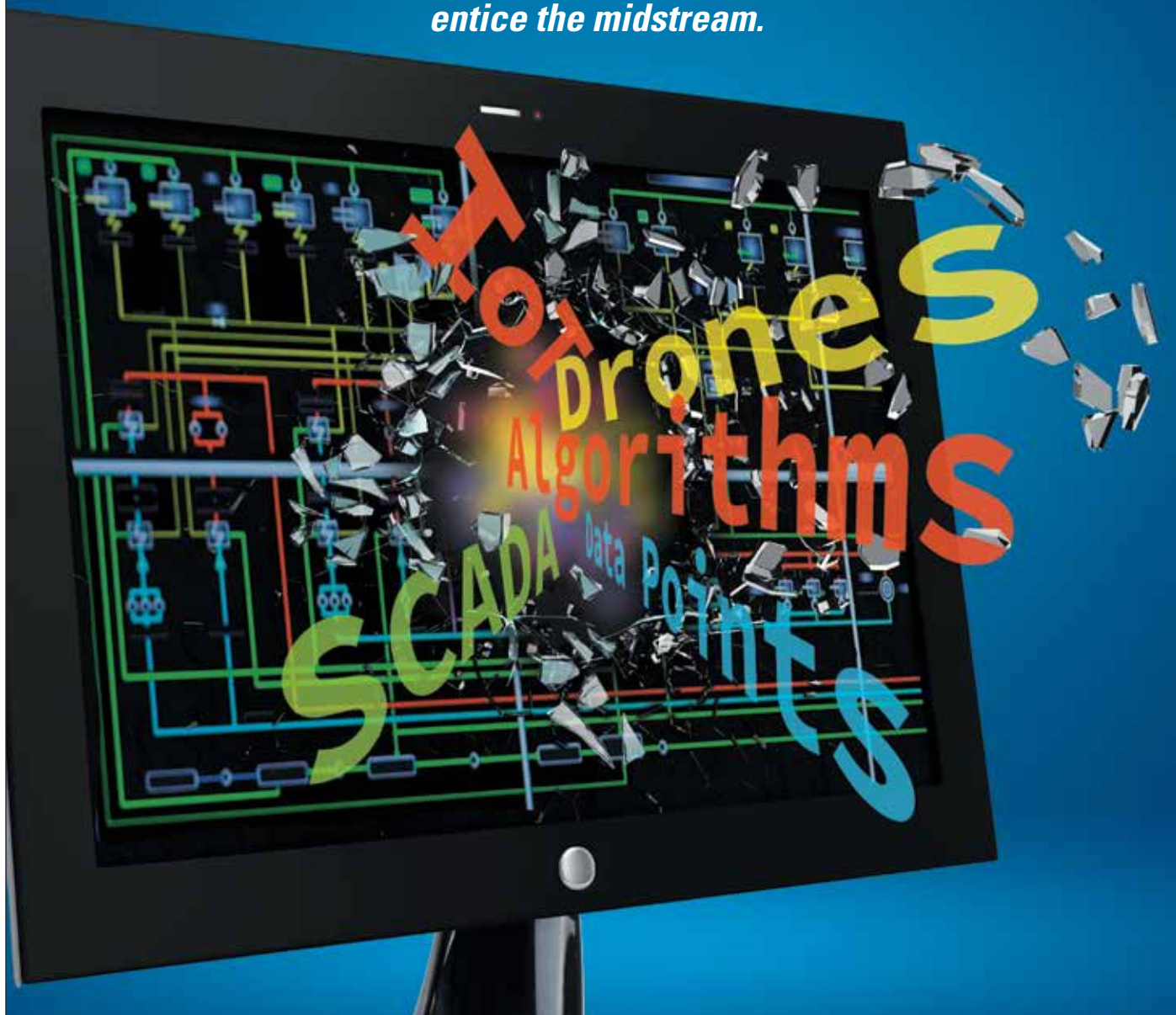


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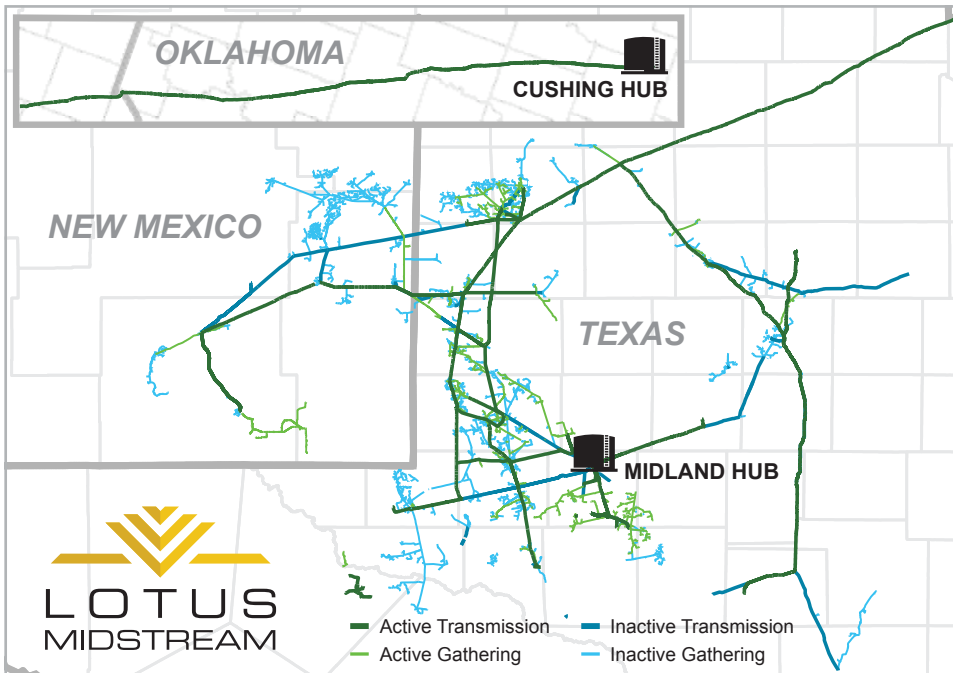
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**On the cover:** Behind an explosion in software and techniques—and accompanying jargon and acronyms—lies new technology the promises to increase midstream efficiency and profitability.

# From the Wellhead to the Water

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## Tech Savvy

By Paul Hart, Midstream Editor-At-Large

I have an elderly relative who may be the least tech-savvy person I know. I recently received a handwritten letter from him (remember when everyone did that?) apologizing that he had not sent out expected emails because his Windows XP-fired desktop computer had once-and-for-all crashed.

For the record, Microsoft released XP in 2001—centuries ago in the computer business.

He purchased a replacement laptop and brought it home, only to discover there was no way to hardwire it to his Internet service, complaining in his note that “I’ve wasted hundreds of dollars.” I called (he has one of those early-model cell phones about the size of a corn cob) and explained he needs to get Wi-Fi in his house.

You know the response: “What’s that?”

It all sounds humorous, and I guess it is to everyone but him, but the episode is a reminder that doing business nowadays—personal or otherwise—requires adopting rapidly evolving technology. This elderly relative is long-since retired, so technological hiccups are a mere inconvenience for him. That’s not the case for a billion-dollar enterprise.

Businesses, like people, sometimes get behind the technology curve. I recall touring an offshore production platform’s control room not too many years ago that still had dial telephones. For the record, AT&T released its Touch-Tone push-button phone technology in 1963.

Unfortunately, the energy business has not been a particularly quick technology adopter. Even the legendary perfection of hydraulic fracturing came despite considerable “we’ve never done it that way” in-house pushback.

A good friend told me of a consulting assignment in recent years for a Texas-based trucking company with a big crude-hauling business. Accounting still used ledger books and pencils. Desktop computers sat in boxes in a storeroom; never got around to setting ’em up.

Can we do better? Yes we can, and we should. No one wants change for change’s sake, but if there are better ways to do things, then companies must adapt or die. Investors and customers demand it. My friend Robert Bryce’s great book, “Smaller, Faster, Lighter, Denser, Cheaper,” plots the course of human development and makes the case that the trend will continue.

Are there risks? Or course there are. There are malicious people out there who exploit technology for their own gain, but that has been true of Fallen Man since the Garden of Eden. Take precautions.

And not all risks are human. Author William R. Forstchen’s new thriller, “48 Hours,” revolves around a solar coronal ejection that threatens to destroy all telecommunications, power plants—and civilization.

That is not total fiction. The September 1859 Carrington Event really did fry telegraph networks, while metal fences and railroad tracks threw sparks. The Aurora Borealis glowed as far south as Cuba. What would it have done 160 years later?

Again: take precautions, then move ahead.

Some of the authors who contributed to this issue make excellent cases for what some call “data mining,” the interpretation and manipulation of data to determine what will go wrong—and fix it now—before something bad happens. We have the opportunity through impressive computer power to turn vast amounts of random and meaningless information into actionable, and profitable, knowledge.

We focus on midstream-related technology advancements in this issue as a way to highlight what’s out there and what it can do for segment operators. Let’s do more to take the midstream to greater

success, reliability and profitability.

With technology our topic, I’m pleased to welcome to these pages Jeffrey Share, who has joined Hart Energy as a contributing editor. Jeff has excellent expertise on the operations and technology of the sector. Midstream veterans know his name from his award-winning work at *Pipeline & Gas Journal*, *Oil Daily* and the *Houston Post*. He will be contributing to Hart publications, as well as Hart Energy’s new, unified website. (Be sure to check it out soon if you haven’t already.) I’m pleased that he authored the lead story for this issue.

Welcome aboard, Jeff. ■

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# Permitting Pace Quickens

**FERC's streamlining process is accelerating the construction of terminals to handle burgeoning natural gas flows.**

*By Joseph Markman*

**T**he pace of midstream projects slowed as 2018 came to a close, and the federal government shutdown that continued into the new year did little to lift spirits. However, the Federal Energy Regulatory Commission (FERC), unaffected by the budget battle, continued to operate and accelerated its approval process for LNG terminal permits.

“Speeding up of the approval process would provide relief for the terminal operators, the gas producers and the gas buyers who are waiting for infrastructure to export the domestic production internationally,” analysts for Stratas Advisors wrote. “Many companies announced [in the fourth] quarter that FERC has provided them with approvals necessary to move to the next stage of the regulatory process.”

## Permian Basin

Phillips 66 Partners, ranked No. 20 on Hart Energy's Midstream 50 list, held an open season that began in November for the expansion of its 850-mile Gray Oak Pipeline, which will move crude from the Permian Basin to Corpus Christi, Sweeny and Freeport, Texas. The pipeline could expand to 900,000 barrels per day (Mbb/d) depending on the outcome of the open season.

The pipeline is expected to be in service by the end of 2019, and the expansion, in service by fourth-quarter 2020.

Wolf Midstream Partners LLC pursued producer commitments for its proposed Red Wolf Crude Connector,



The Belgian-flagged Very Large Crude Carrier *Aral* takes on a load at the Moda Ingleside Energy Center on Texas' Corpus Christi Bay. Moda Midstream commissioned the new terminal and dock as 2019 began to help handle the nation's swelling volumes of exported crude. *Source: Hart Energy*

a new crude oil pipeline to serve the Midland Basin, in late in 2018. Before the year was out, the company was doing the same for a pipe of a different color, the Gray Wolf Crude Connector.

The pipelines connect at the origination point near Big Spring, Texas, in Howard County and offer capacities of 120 Mbb/d. When built, they will connect to Wolf's crude oil terminal and downstream connections near Colorado City, Texas. Gray Wolf will provide multiple joint tariff options to access the Corpus Christi/Ingleside export market.

## Gulf Coast

Cheniere Energy Inc. celebrated the long-awaited opening of its Corpus Christi LNG export facility, then

celebrated again about a month later when the Liberian-flagged *Maria Energy* departed with the first cargo of LNG to ever be shipped from Texas. A second train received the go-ahead from FERC in first-quarter 2019 to begin commissioning and the company made a final investment decision on Train 3 in 2018.

The ACE Pipeline System partners—Phillips 66 Partners, Harvest Midstream and PPF Logistics—launched a binding expansion open season in January for a 400 Mbb/d project in Louisiana. ACE will provide move oil from the St. James, La., market hub to refineries in Belle Chasse, Meraux and Chalmette, La.

The system will include a newbuild segment to St. James to connect with

## Projects

Harvest's existing CAM pipeline. Depending on interest, the partners are considering adding a delivery destination in Clovelly, La., as well. ACE is expected to go into service in second-half 2020.

### Marcellus-Utica

Energy Transfer LP, No. 2 on the Midstream 50 list, made good on its promise to put its Mariner East 2 NGL pipeline into service by the end of 2018, beating its deadline by two days. The 350-mile pipe—beset

by delays—began moving ethane, propane and butane from Ohio to the Marcus Hook Industrial Complex outside Philadelphia, where the NGL will be shipped to domestic and international points.

The Dallas-based company added that it expects the pipeline's sister project, Mariner East 2X, to be in service by the end of 2019.

### Scoop/Stack

Canyon Midstream Partners II LLC is expanding its brand-new Redcliff

cryogenic gas processing plant in Woodward County, Okla., increasing capacity from 200 million cubic feet per day (MMcf/d) to 240 MMcf/d. Redcliff is connected to a sprawling pipeline system that includes 180 miles of gathering lines and five field compressor stations in Oklahoma's Woodward, Dewey, Blaine and Canadian counties. ■

*Joseph Markman can be reached at [jmarkman@hartenergy.com](mailto:jmarkman@hartenergy.com) or 713-260-5208.*

## Selected Recent Midstream Construction Projects

Operator/Developer	Project	Location	Added Capacity	Play	Status/Completion
<b>PERMIAN BASIN</b>					
Phillips 66 Partners	Grey Oak Pipeline	West Texas to Corpus Christi, Sweeny/Freeport, Texas	N/A	Permian Basin	Open season began Nov. 12.
Wolf Midstream Partners LLC	Gray Wolf Crude Connector	Big Spring, Texas, to Midland, Texas	120,000 bbl/d	Midland Basin	Open season ended Jan. 21.
Wolf Midstream Partners LLC	Red Wolf Crude Connector	Howard County, Texas, to Colorado City, Texas	120,000 bbl/d	Midland Basin	Open season ended Dec. 14.
San Mateo Midstream LLC	Rustler Breaks Pipeline System	Eddy County, N.M.	N/A	Permian Basin	Crude oil gathering and transportation system went into service in December 2018.
Wood	Pipeline	West Texas	N/A	Permian Basin	Wood was awarded a \$43 million contract to build a 80-mile pipeline.
<b>GULF COAST</b>					
Phillips 66 Partners, Harvest Midstream, PBF Logistics	ACE Pipeline System	St. James, La., to Belle Chasse, Meraux and Chalmette, La.	400,000 bbl/d (initial)	N/A	Open season; expected in-service of second-half 2020.
Energy Transfer Partners LP	NGL fractionation facility	Mont Belvieu, Texas	150,000 bbl/d	Permian Basin	Seventh fractionator is expected to be operational in first-quarter 2020.
Cheniere Energy Inc.	Corpus Christi LNG export facility	Corpus Christi, Texas	N/A	N/A	Facility opened in November 2018.
EnLink NGL Pipeline LP	Cajun-Sibon III NGL expansion project	South Louisiana to Mount Belvieu	N/A	N/A	Open season ended Dec. 10.
Venture Global LNG	Calcasieu Pass LNG export project	Louisiana Gulf Coast	N/A	N/A	Kiewit picked to build facility; construction expected to begin in early 2019.
<b>MARCELLUS-UTICA</b>					
Energy Transfer LP	Mariner East 2 pipeline system	Eastern Ohio to Marcus Hook, Pa.	525,000 bbl/d	Appalachia	System went into service before the end of 2018.
<b>SCOOP/STACK</b>					
Canyon Midstream Partners II LLC	Redcliff processing facility	Woodward County, Okla.	40 MMcf/d	Stack	Plant's 20% capacity expansion is expected to be completed in second-quarter 2019.

Complete listings online

Source: Hart Energy



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# Technology's Role

Research and development organizations agree on major trends in pipeline technology progress.

By Jeffrey Share

**T**he petroleum industry has always run on technology, be it upstream, midstream or downstream. As the main conduit of this vital industry, pipeline operators continually rely on technological advances to ensure the safety and efficiency of their vast systems.

*Midstream Business* asked prominent research and industry associations to discuss the forces at play—regulation, environment or system efficiency—that allow operators to do more with fewer resources.

They discussed government vs. private industry sourcing, what new product types developed from the

latest technologies will make the greatest impact on pipeline operations, and lastly, the issue of proprietary technologies or information sharing.

## GTI

Based in suburban Chicago, GTI—formerly Gas Technology Institute—leverages infrastructure-related industry dollars with significant federal and state government funding for research, development and deployment (RD&D).

Kern River Gas Transmission's Apex expansion added 266 million cubic feet per day of capacity to the Wyoming-to-California system. New technology allows improved fleet and utilization management on pipeline construction projects, saving substantial time and cutting costs. Source: *PipeLine Machinery International*



Government support comes primarily through the U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA), along with state programs, including California, New York, Texas, and Pennsylvania. Operations Technology Development (OTD) is a member-driven consortium of natural gas utilities administered by GTI that was established in 2003 and has 25 members and provides collaborative funding.

“As technology plays a larger part in our daily activities, it is increasingly important to invest in research, development and deployment,” Tony Lindsay, GTI managing director, energy delivery, told *Midstream Business*.

He noted that technology advances in recent years have helped to improve materials used to construct the

U.S. pipeline network, methods for emissions detection and mitigation, prevention of third-party damage, and use of the growing amount of data available about existing infrastructure—just to mention a few. All have an underlying focus on safety and the integrity of the pipeline systems.

Several key factors are involved in the increasing need for RD&D, he added.

“There has been a stronger push for research to develop materials, installation equipment and methods to help control costs while efficiently repairing and replacing an aging infrastructure in the U.S.,” Lindsay said.

“Understanding demands on the distribution system from new energy sources is another new area being addressed. The introduction of renewable natural gas (RNG) into pipelines has also created a need to apply new technologies to ensure that safe and reliable operations continue.”

Pipeline executives insist that safety is always the No. 1 priority and a primary driver for spending research money. Reliability also comes into play as the increased use of natural gas in power

generation and the integration of renewables creates new opportunities as well as challenges for operators.

“Improving efficiency in operations, controlling cost and minimizing environmental impact are very important as well. These efforts are driven by operators and owners being responsive to the customers and territories they serve by providing the greatest value possible while maintaining the integrity and safety of their systems,” Lindsay added.

At the local distribution company level, regulators support infrastructure-replacement programs, ensuring that aging systems are replaced with modern materials that technology helps provide cost-effectively.

Stricter regulations increasingly influence technology advancements by formalizing prudent inspections and practices by operators, and requiring evaluation of risk in their operations. Another step toward improving safety is reducing the primary cause of incidents that compromise pipeline systems, namely damage from third-party construction activities.





“The pipeline industry has been increasingly focused on developing and implementing low-impact, highly reliable solutions for non-invasive assessments of pipeline conditions.”

— Tony Straquadine, executive director, INGAA Foundation

This brings the market new tools capable of providing advanced warning and improved accuracy to locate and identify potential conflicts, he said.

Today, a growing awareness about what can be done to minimize the release of emissions into the environment has brought about advancements in methane-detection technologies and the use of advanced monitoring techniques.

Moving forward, Lindsay suggested that sensors, data collection and communications will have a beneficial impact on pipeline operations. The industry now takes greater advantage of building established communication networks for remote monitoring of system pressures, alarms and shutdowns tied to leak detection, weather-related events, excavation activities or third-party damage.

“Gas-quality monitoring and assurance technologies will be necessary as more RNG is fed into pipeline systems. Also, expect that risk modeling and cybersecurity protection will see meaningful changes. Research will emphasize predictive analytics, the reduction of risk and diminishing cyberattack threat exposure, intellectual property theft, and system operations disruption or damage,” he said.

Tracking and traceability of assets being installed is a growing issue, so a standardized approach for capturing pipe, appurtenances welding and coating

data is under development. The plan is to enable system operators to more effectively manage data and improve the decision-making process.

Operators are asking for alternatives for inspection and test methods when evaluating pipeline assets. Several technologies are being validated that can provide inspections equivalent or superior to a hydrotest, and can obtain regulatory acceptance, Lindsay said.

**Pipeline Research Council International**

“Whether it’s looking for ways to safely increase production, enhancing the integrity of the pipeline network, greater understanding of right-of-way intrusion, or reducing the environmental impact of transportation, technology has always been a key part of the oil and gas industry,” Cliff Johnson, president and CEO of the Pipeline Research Council International (PRCI), told *Midstream Business*.

Everything is predicated on the industry’s long-avowed mission of zero-tolerance incidents.

“As we move into the future, the industry is stepping up to do even more because any release is too much. The industry, years ago, established the goal of zero incidents. There is a greater acknowledgment that if any operator fails, we all fail,” Johnson said, agreeing with GTI’s Lindsay that “safety is the No. 1 driver for the oil and gas industry to invest in research and development [R&D].”

Based in suburban Washington, D.C., PRCI was founded in 1952 by several pipeline operators to address a specific integrity problem. It has evolved into one of the most influential collaborative venues in tackling industry challenges.

What role should government play in sponsoring R&D?

“That’s an interesting question,” Johnson said, noting that the U.S. falls short of other countries, such as Canada, Australia and some European nations, in funding research for the oil and gas industry.

“The success of pipeline infrastructure should be a better partnership between industry and government—with industry the lead funder—not only to address current challenges but as we shift to emerging energy sources and explore new ways to use existing infrastructure or look to new systems,” he added.

Johnson said an effort is underway within the U.S. Department of Energy, through the National Petroleum Council, to develop a research portfolio for all modes of oil and gas transportation. Funding for the PHMSA Research & Development Program is a continuous concern, he added, with a recent funding cut affecting its ability to be part of the technology development cycle.

Looking ahead, Johnson suggested the next big step will be the development of the Pipeline Data Hub (PDH).

The PDH will provide information for better tool selection, integrity, safety processes, and development of personnel. For example, the database will enable users to understand the capabilities and limitations of inline inspection tools and non-destructive evaluation (NDE) tools in order to design an integrity program for their pipeline systems.

**Maguire Energy Institute**

Bruce Bullock, executive director of the Maguire Energy Institute at Southern Methodist University’s Cox School of Business in Dallas, feels today’s strengthened emphasis on R&D is largely focused on productivity, cost savings, automation—and less on frontier technologies.

“From 2008-2016, the U.S. had perhaps the most anti-hydrocarbon administration in our history. While

the Trump administration has made great strides in reversing many of these policies, the industry now is focused on stricter regulations, environmental issues and public opinion as a way of life,” he told *Midstream Business*.

“Much of the anti-hydrocarbon agenda has moved downward to the state and local level. At the same time, we are in an economic environment with very volatile crude prices, impacting midstream customers. So, cost savings is paramount as well,” Bullock said.

An improved disciplinary approach could be a real difference maker, Bullock predicted.

“Predictive analytics offers a huge upside for the pipeline industry. The type and extent of data that can now be collected from pipeline operations both today and historically can help prioritize maintenance, inspections, prediction of future failures, etc.

“This benefits the environment through fewer accidents and lower costs by staying ahead of future failures or problems, and it does so in real times as opposed to just inspections,” he added. “Further, it provides a crystal ball to site new pipelines, so infrastructure doesn’t trail the E&P sector as much in the cycle as it now does.”



Improved monitors help pipelines spot potential leaks. Methane emissions are an important priority for operators with today’s emphasis on greenhouse gases. *Source: GTI*



Critical crack/wall-loss models help inspectors detect flaws that could fail a pressure/hydro test. A new GTI model enables operators to use Engineering Critical Assessment techniques in lieu of costly hydrotests that require shutdown and water injection. *Source: GTI*

### Battelle

Andrew Duguid, senior research scientist for Columbus, Ohio-based Battelle Memorial Institute, offered a two-fold reason for the growth of pipeline R&D.

“The push is both from the industry being required by pending regulations, i.e. the updates to [the federal rule] 49 CFR 192, also referred to as the Mega Rule, to be more knowledgeable about the material properties for the pipes that are in the ground, and the need to reduce the cost for obtaining that information through technological advances in non-destructive evaluations,” Duguid told *Midstream Business*. “Or, face the consequence of severe reduction in material property values, i.e. assume low toughness and low strength, if the actual values are not known.”

As well as facing the removal of protective “grandfathered pipeline clauses,” the industry must deal with recategorization of locations to finer definitions of consequence areas, such as adding a medium-consequence area to the low- and high-consequence terminology.

“One cannot separate the effects of regulation, environmental issues and safety on both efficiency and cost. In addition, high-pressure gathering lines, i.e. from deep Marcellus Shale drilling operations, are pending being classified under the same rules as the transmission lines,” Duguid added.

Most pipeline safety technology is developed and deployed using private capital. PHMSA spends about \$10 million annually on R&D and

capitalizes on public-private partnerships to enhance the impact of these federal funds. While both the federal government and industry play a vital role in the early stages of technology development, industry has been the leader in turning the fundamental research into viable tools for use in the field, he says.

Duguid said sensors will make the greatest impact on pipeline operations over the next five years. He identified several areas of ongoing rapid growth:

- NDE using smart pigs (anomaly detection and sizing accuracy);
- NDE using in-the-ditch methods (anomaly sizing using full-field inversion techniques);
- Leak detection in the field (using drones and AUVs); and
- Material characterization using NDE methods.

Along with GTI’s Lindsay, Duguid agreed that more clients are requesting cost-effective methods to maintain material characterization of legacy pipe, which is traceable and verifiable for regulatory compliance.

### American Gas Association

Lori Traweek, chief operating officer for the Washington, D.C.-based American Gas Association (AGA), which represents over 200 local energy companies, can easily vouch that the job of delivering natural gas to over 71 million customers has always been a highly technical process.

“The design, construction, operation and maintenance of our distribution



“Predictive analytics offers a huge upside for the pipeline industry. The type and extent of data that can now be collected from pipeline operations both today and historically can help prioritize maintenance, inspections, prediction of future failures, etc.”

— **Bruce Bullock**, executive director, Maguire Energy Institute, Southern Methodist University

infrastructure benefits greatly from innovation and those benefits are passed directly to natural gas customers,” she told *Midstream Business*.

“The driving force behind technological innovation in the natural gas utility space is safety, reliability and operation excellence. As America’s natural gas utilities continue to enhance the safety and efficiency of their operations and systems, we will work together to develop and deploy new technologies and improve upon existing systems and procedures.”

Traweek credited much of the work being accomplished through research consortiums, such as GTI Operations Technology Development, Utilization Technology Development, and Emerging Technology Program; NYSEARCH, and PRCI. Participating companies are entitled to initial access to the research results, but she said the entire industry benefits from the discoveries as technology that emerges from their research becomes widely available.

Some examples of technologies she said were developed through research and are in use today enhancing safety and operations are:

- Inline Inspection (ILI) inspection of a pipeline from the interior of the pipe using an inline inspection tool. Also called intelligent or smart pigging;

- Detection of natural gas emissions using sensors attached to cars, planes and drones or with handheld devices;
- Improvements made in the strength and longevity of pipeline materials such as steel and plastics;
- Modern pipeline construction techniques such as robotic welding and coating application; and
- Directional drilling to minimize impacts to residences and the environment.

Natural gas utilities and their customers will continue to benefit from these technologies and other technologies under development. Utilities and their research partners are also studying:

- Aerial surveying methods, including the use of Lidar, which measure distance to a target by illuminating the target with pulsed laser light and measuring the reflected pulses with a sensor;
- Earthquake and ground movement detection;
- Technologies to better analyze risk; and
- Residential methane detectors.

**INGAA/INGAA Foundation**

The Interstate Natural Gas Association of America (INGAA) and its sister organization, the INGAA Foundation, represent the interests of the North

American transmissions pipeline industry from their base in Washington, D.C. Their mission is somewhat different from the AGA, but technological advances are equally vital to both.

Tony Straquadine is the new executive director for the foundation, whose members are service providers for pipeline operators.

“The pipeline industry has been increasingly focused on developing and implementing low-impact, highly reliable solutions for noninvasive assessments of pipeline conditions,” Straquadine told *Midstream Business*. “For example, pipeline operators have used inline inspection devices as an important pipeline safety tool for many years. These devices travel inside the pipeline to evaluate its condition.

“ILI technology continues to advance. Improvements in the tools’ ability to travel through pipes now allow many pipeline segments to be internally inspected where it was not possible to do so in the past. ILI providers have begun to combine technologies into single ‘combo’ tools to enable detection of a variety of pipe anomalies in one run,” he explained.

Today’s technological advancements include not only enhanced assessment tools, but also modern methods for analyzing inspection data to identify where remedial actions are needed.

For example, Straquadine said improvements in data storage and computing capability allow sophisticated analyses of ILI data that were not possible in the past. The move is generally toward more detailed, more accurate and more precise data, and better means for processing large amounts of data, leading to the ability to glean more information from inspections.

As do his counterparts, Straquadine added the demand on operators to perform safely, reliably and responsibly is higher than ever. One example is that as the proportion of the country’s electricity generated with natural gas continues to grow, pipeline operators are seeking to utilize inspection methods that do not require pipeline shutdowns. ILI is a great example of noninvasive technology that does not require a pipeline shutdown.

“The same noninvasive technologies that allow operators to conduct safety inspections, while avoiding pipeline shutdowns, enable companies to avoid removing the natural gas from the pipe. Thus, modern inspection technologies, such as ILI, allow companies to avoid ‘blowdowns’ where natural gas is released to the atmosphere. These modern technologies improve safety but also avoid methane emissions, consistent with INGAA’s methane emissions commitments.”

Operators are already deploying the next generation of pipeline safety technology. However, Straquadine said, updates to pipeline safety regulations are necessary for these modern technologies to have the greatest impact. Several new pipeline safety rulemakings related to gas transmission pipelines are now pending before PHMSA.

He added these proposed regulations provide the “rules of the road” for operators to continue to implement 21st century safety technologies that are more effective, more efficient and less disruptive than past methods.

“PHMSA should continue to work to update its older regulations to reflect today’s technological and engineering capabilities.”

### NACE International

The Houston-based National Association of Corrosion Engineers International (NACE) has witnessed tremendous growth in recent years, parallel with the concerns of pipeline operators worldwide regarding the damaging nature of corrosion.

“It seems like today the push for R&D has increased as well as some of the funding methods via consortia and joint ventures,” Jeffrey L. Didas, current NACE International president and senior corrosion engineer at Matcor Inc., told *Midstream Business*. The industry benefits from these consortia and joint ventures as they can pool the research dollars and get a better product or improved technology. This allows this technology to get into the ditch in a timelier manner and benefit the industry.”

“R&D had been done at the vendor level, and still is, and self-funded, which has always been a drawback as the

vendor had to figure the payback of the R&D vs. the developed technology and how long it would take before they would get a return on the investment,” Didas explained. “For example, \$100,000 for research on a new or improved \$1,000 meter may take 10 years before the payback for the improved technology hit the books.”

As expected, aging infrastructure—along with ongoing corrosion and materials degradation—seems to be driving the need for new and improved technology.



“Finding corrosion, finding cracking, finding issues in a timelier and more accurate manner is driving several R&D projects,” Didas said. “Others are data analysis, Big Data, for predictive models and risk models. Software for getting the results from all this Big Data in a usable manner and someday in real time. Waiting costs money.”

And what about the role of government?

“A good question,” he replied. “Industry puts in the larger percentage right now as the government has cut back

over the past few years. Much depends on where and what type of research. For pipeline integrity and corrosion, and control and safety via, say, the traditional research groups and companies, it tends to run 35% government and 65% industry. That fluctuates somewhat with the project types.”

Like the others, Didas pointed to the ILI industry for creating and modifying existing technology, increasing accuracy for corrosion and cracking, and the ability to obtain more data per run.

“This will keep improving and create improved growth rate calculations and improved predictive software. Non-piggable lines will have more tools to use for performing surveys, finding corrosion and cracking. More and more other industry technologies are being adapted for use on pipelines.

“Getting more accurate data quicker will provide the biggest impact by hopefully finding the problems before a

Stronger construction materials, coupled with improved installation equipment and methods, help speed repair-and-replace projects for aging infrastructure—a particular headache for local distribution companies in older cities. *Source: GTI*





“As technology plays a larger part in our daily activities, it is increasingly important to invest in research, development and deployment.”

— Tony Lindsay, GTI managing director, energy delivery

potential incident, allowing the operators to perform the repairs before the failure occurs,” Didas said.

In the world of corrosion prevention, cathodic protection remains the industry’s mantra, and will be well into the future.

“We are always discussing with our customers what they need to make their job easier and more productive or more efficient. We find they want higher-output anodes with a longer life, more efficient installation methods, more use of trenchless technology, more industry standardization and more joint ventures with other pipeline operators to lower costs,” Didas said.

**Southwest Research Institute**

From San Antonio, Southwest Research Institute (SwRI), a leader in flow measurement technology, the story is somewhat different, Terry Grimley, staff engineer at its metering research facility, told *Midstream Business*.

“Your questions seem to be based on the premise that there is substantial and active R&D of new technologies,” Grimley replied. “From the perspective of flow measurement, I don’t feel that’s necessarily the case. In the midstream sector, the technologies are certainly being refined and improved, and research is required to better understand performance and the effects of operating conditions, etc.

“However, I have not seen the introduction of any breakthrough

technologies related to flow measurement for more than 20 years. Of course, the industry is notoriously slow to adapt some of these technologies, so 20-year-old technology may still be new to some,” Grimley said.

One issue this otherwise highly competitive industry has often had to deal with is whether to retain proprietary ownership of its sponsored research, or being willing to share knowledge gained from technological advances.

Opinions differ:

**Battelle’s Duguid**—“In some ways, industry is being driven to share data just based on cost-reduction. The PRCI has a project to maintain a database of material characteristics. The issue is, sometimes the characteristics are very specific to a pipe supplier, such that, long-seam welds have a lot of variability just within a given location on a single pipe, let alone the variability within a heat of pipe or between heats.

“Some historical pipe vendors are known to have supplied pipe with poor properties. This is the easy part to recognize. The harder part is that one poor-property location within 1,000 miles of good pipe. The key to sharing information is trusting the source of the information be kept anonymous, which will lead to trust of the process and more sharing.”

**NACE International’s Didas**—“It depends, mostly on the funding for the R&D. Some funding from private

industry restricts sharing the technology and keeps it proprietary. This is not new, as if you are investing your money in research, you want to get the benefit. However, some companies do allow the technology to be shared and they may or may not get a royalty back to help offset their investment.

“Most of the time, we do seem to share all or part of the technology with the industry, especially from a joint industry project and/or a government-funded project.”

**GTI’s Lindsay**—“GTI has been working in the collaborative space for decades, and the industry has been very willing to work together to develop solutions to address the most important challenges. There is great collaboration and sharing in the industry that is fostered by effectively using private funds to leverage public research programs.

“As a result, findings are made public, and ultimately the technology advances find their way into commercial products, adopted best practices, or become the basis for sound regulatory guidance or requirements.”

**Maguire Energy Institute’s Bullock**—“The entire oil and gas industry shares best practices and innovation better than any other industry in the world. People who switch from tech companies to our industry always marvel at the degree of cooperation that goes on among players. We are one of the few industries where mergers have a high degree of success, thanks to cooperation among the players that goes on every day. I would anticipate this continuing.”

**PRCI’s Johnson**—“I believe there is a greater desire now in all facets of the industry—operators, service providers, research organizations, trade associations and technical societies—to work to develop the needed tools, processes, standards and personnel to ensure that we continue to have the safest and most efficient pipeline infrastructure. As we continue to develop solutions for the pressing challenges we face, it is important that we be willing to share in areas related to safety and integrity. ■

*Jeffrey Share is a Houston-based Hart Energy contributing editor specializing in midstream energy topics.*



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# 2.0

**DCP Midstream moves ahead with an ambitious plan to fully integrate new technology that will fundamentally change the way the company does business.**

*By Paul Hart*

**T**echnology, expressed as a blizzard of software packages, iPad apps and Internet of Things (IoT) connectivity, is the talk of the midstream nowadays. But are the sector's operators making the fullest use of all that technology offers them?

Too often, probably not.

Many times, all that fancy, gee-whiz stuff arrives as bolt-on/duct-taped/jury-rigged additions to existing organizations and technology systems and really don't change all that much. File folders change names, links move on computer screens and graph lines change color.

Rather, too often, differing software actually may impede, rather than improve, operations as employees struggle to adapt.

Instead, "we are fundamentally changing the way our industry approaches people, processes and technology," Wouter van Kempen, chairman, president and CEO of DCP Midstream, told *Midstream Business*. The Denver-based firm, ranked No. 15 on the Midstream 50, is investing millions of dollars and thousands

of staff hours in a ground-up digital transformation it calls DCP 2.0.

### **Different direction**

The goal is to create a tech-savvy midstream firm that operates in a markedly different manner from what it was—and what many of its competitors are.

The CEO said the process began as one of senior management's reactions to the oil and gas industry's crash in 2015 and 2016. DCP, like most other firms in the business, endured a painful pullback that saw costly assets gathering dust and, worse, talented and loyal employees let go.

Van Kempen said having to lay off those people was the most painful part of the retrenchment for him "and I vowed to avoid that at all costs moving forward. We had to change the way we run the company."

The energy business, like all commodity-based industries, will be cyclical forever. The fourth-quarter 2018 oil price collapse was another reminder of that fact. So what needs to happen,

he added, is to build "an organization that is sustainable in any operating environment." Technology can help make that happen, van Kempen emphasized.

"Make no mistake of viewing this as merely implementing slick apps and putting plant screens up in a control room ... this is all about completely disrupting the industry," he added.

In 2015, the CEO presented the basic concept of DCP 2.0 to the firm's board of directors. Some directors expressed their doubts about the idea at first. After all, didn't the firm already enjoy great technology, such as a first-class SCADA system?



What was it missing?  
Wouldn't a broad remake be disruptive?

What could 2.0 add except costs and confusion?

But van Kempen gained board approval by emphasizing the plan was not change for change's sake but a whole new way to operate that would stabilize operations as it offered the potential for increased returns to unit holders.

DCP's Integrated Collaboration Center in Denver is a SCADA control room—and much more. All photos, DCP Midstream



“We have \$13 billion of steel in the ground and we have to make sure that all of it is making money. How can we make sure we’re getting as much as we can out of what we have?” van Kempen added.

### Operations, not IT

So management went to work to implement the plan. Bill Johnson became group vice president and chief transformation officer (CTO) of the

project, having formerly been vice president of DCP’s North Business Unit. Believing that real priorities must receive high-level and focused attention, the new position reported directly to van Kempen. Soon after, a cadre of diverse talent, from design thinkers and app developers to so-called “scrum masters” (group facilitators) and Silicon Valley veterans, was hired to form his team.

Johnson is an operations guy, not an IT executive. He has a mechanical engineering degree from Texas A&M’s engineering school and held senior positions in engineering, operations, reliability and maintenance, turnarounds, corporate engineering and plant management at multiple chemical and refining sites before joining DCP in 2011.

In 2017, the project began in earnest, aiming to be “a transformation to achieve operational excellence through eliminating pain points and setting people up for success,” Johnson told *Midstream Business*. He added that 2.0

represents “a tremendous opportunity to digitize our operations and corporate functions to deliver rapid solutions resulting in higher margins, lower costs, and greater reliability.”

“The oil and gas industry is behind, and midstream is even further behind, in adopting digital technology,” Johnson said. “Producers have made some amazing technology advances downhole, but there has not been a lot of change in the above-ground operations of our assets. Innovation is something we have to do.”

But the process has to involve the entire organization, he added. It can’t be viewed as only something IT does.

“This is not an IT project, it has come out of operations. And in fact, IT now reports to me,” he said. “Similarly, our commercial and back-office functions are developing automation, bots, artificial intelligence and other digital tools that can optimize our work processes ... eliminating lower-valued work and improving job satisfaction. This is about the company as a whole,” Johnson said.

### Idea swaps

Significantly, DCP is looking beyond in-house and in-sector techniques that it can employ.

“We don’t need to invent something here,” van Kempen emphasized. If a given technology works for industries as diverse as, say, banks or airlines, it might have immediate application with minimal tweaks at a gas plant. The CEO noted his own career began outside midstream—he came to DCP from tech-savvy General Electric. He noted that

## Applied Technology

the midstream segment's operators can become inbred and less efficient if they are not open to outside ideas. It's a trend all industries need to avoid, he added.

Johnson agreed.

"We got started by looking outside our industry," he said. "Oil and gas is not a leading adopter of digital technologies. So, we went outside to look at what others are doing. We looked in retail, logistics, banking, airlines and more. We used the learnings from these visits to refine our vision and fully develop our plan."

software Slack and the similar Microsoft Teams chat board to encourage the informal mixing and matching of ideas. It even implemented Facebook's new platform, Workplace, to encourage people across its 17-state footprint to engage and accelerate the transformation.

It's a significant departure from typical corporate, chain-of-command communication procedures, the CTO emphasized.

DCP wants to encourage "a culture of innovation" that can adopt new methods across the organization—



**"Make no mistake of viewing this as merely implementing slick apps and putting plant screens up in a control room ... this is all about completely disrupting the industry."**

**— Wouter van Kempfen, chairman, president and CEO, DCP Midstream**

### A new look and feel

Given that diverse background, it's no surprise that the heart of the 2.0 program looks fundamentally different than a typical, button-downed energy company's cube-farm headquarters.

Consider one floor of DCP's headquarters, 23 stories above the bustling streets of downtown Denver.

Stepping off the elevator, the vibe is Silicon Valley. Bluejean-casual employees work from laptops set out on folding tables. Such groupings can be easily mixed or matched as current work projects require. Sofas and easy chairs provide nooks for impromptu meetings. "Collaboration" is a word used frequently.

It may look disorganized but it works, Johnson said, because the layout offers easy ways to communicate. DCP employed the team communications

department-to-department and plant-to-plant—enabling faster value creation, Johnson said.

In the middle of that Silicon Valley-style floor at Denver headquarters is something that looks very familiar to any midstream operations person: DCP's Integrated Collaboration Center (ICC). At first glance it appears to be just a bigger-than-usual SCADA control room with maybe a little extra NASA space-shot stuff thrown in for good measure.

"I've heard some say, 'we have SCADA,' but SCADA as a singular approach is antiquated. SCADA is a rearview mirror, it tells you what *has* happened, not what *will* happen. We want to take millions of data points, put them together and figure what will happen, or how to do things better," van Kempfen said.



### Usable data

The concept is to convert the mountains of data modern technology provides into usable information that enables real-time management decisions.

The ICC, as its name implies, allows DCP to collect and study data from throughout the organization, then its algorithms crunch that information and projects what lies ahead.

"Our ICC acts like a nucleus of several operating data sources. It is the central nervous system of our operations," van Kempfen said. "In real time we are tying together data from SCADA and engineering, over 8,000 different contracts, financial systems, and all of our real-time market prices for gas, crude and NGL—allowing us to optimize our integrated plant system, driving greater profitability and better reliability," he added.

Ideally, it can project that a given pump at a Permian Basin processing plant is going bad. That pump may be moving



The Mewbourn natural gas processing complex in Weld County, Colo., serves Denver-Julesburg Basin producers.

as much product as ever but it's steadily using more and more power to do it.

Why?

That's a bad sign and worth checking. A busy operator may overlook the power usage data point—but the system won't. The pump can be shut down and replaced or repaired before an incident occurs.

### The payoff

So is 2.0 paying off? Yes, the results have been impressive, according to Johnson. But the full financial return is yet to come.

"From concept to 18 months, DCP 2.0 evolved into a function already delivering a payback equal to the tens of millions we invested in the first year," Johnson said. "We're continuing to build operational and financial models to drive optimization. We have opportunities in the rest of our plants, and we also have opportunities to optimize the gas in our systems, where we have large integrated systems with multiple plants."

"There's huge opportunity there," he added. "It lies in getting the rest of the plants in every system into an optimization model in the ICC and continuing to fully digitize and enable our workforce across every function in the company."

### Mewbourn

Plant control rooms now match the ICC layout, if on a smaller scale, and transmit real-time data between the field and headquarters. An hour's drive northeast of Denver, operations are monitored at the firm's Mewbourn 2 and 3 facility, built to serve Denver-Julesburg producers. Multiple computer monitors show what currently is happening in the complex—a typical SCADA function—but also what will happen, Craig Taylor, plants supervisor, told *Midstream Business*. He noted that much, if not all, of that information can be pulled up on an iPad or cell phone if necessary. The idea is to avoid inconvenient—and

costly—callouts at 2 in the morning on holiday weekends.

The Mewbourn 3 operation is one example of what the DCP 2.0 concept can do. The new plant has a capacity to process 200 million cubic feet per day and went online in third-quarter 2018 after a remarkably short, nine-month construction and commissioning window.

Collaboration is a key to how it works, Johnson added. Separate gas plants and operating districts have a significant amount of freedom via 2.0 to develop new apps and procedures that can be shared elsewhere in the organization.

Will that hack technicians figured out at a Permian plant work at a plant in the Denver-Julesburg Basin? Maybe, maybe not—but let's work together to find out. It's what van Kempen calls "a culture of innovation."

DCP put significant effort into the program throughout 2018. This year, the program is accelerating and Johnson says there has been "rapid



**“The oil and gas industry is behind, and midstream is even further behind, in adopting digital technology. Producers have made some amazing technology advances downhole, but there has not been a lot of change in the above-ground operations of our assets. Innovation is something we have to do.”**

— **Bill Johnson**, *group vice president and chief transformation officer, DCP Midstream*

refinement, integration and extension of transformational solutions conceived, built and delivered.”

### Easy does it

So is all of this change confusing to employees? Ideally, it won't be.

New apps, procedures and techniques should be easy to master, both van Kempen and Johnson said. New Uber customers, for example, don't need to fly to that firm's headquarters in San Francisco for two weeks of training, van Kempen added. Likewise, a bank doesn't require a customer to spend days reading instruction books or watching videos after its app gets downloaded onto a cell phone.

A major 2.0 goal is to make procedures easier, faster and cheaper to operate.

Even small changes can add up quickly, Johnson noted. If DCP can figure how to save \$2,500 per day at each of its 60 gas processing plants—very small potatoes for an organization with annual revenues approaching \$10 billion—that can add up to \$50 million per year that goes straight to the bottom line.

“We're picking up pennies,” he added with chuckle. And all those pennies can add up to serious money. “Ultimately, the ICC gives us the ability to make impactful optimization decisions in real-time—rather than daily, weekly,

or monthly—resulting in immediate improvements in our operations. Not to mention, there's the impact of the incredible arsenal of data we are building as a foundation for predictive analytics.”

The effort already has paid off, van Kempen confirmed. DCP 2.0 provided some \$20 million of incremental EBITDA in 2018, a year Johnson added was a time DCP “was transforming the end-to-end value chain.” And there is significant potential for 2019 and beyond, the executive said.

“We want to know what every plant makes [financially] every day,” van Kempen added.

### 2.0 and more

The technology-based effort of DCP 2.0 is part of a broader effort van Kempen orchestrated to change the firm overall known as DCP 2020.

Company literature describes DCP 2020 as “a framework for ensuring we are sustainable in any market environment. At its core, we are all focused on operational excellence in everything we do, founded on the principles of reliability, risk management and efficiency, and the behaviors of discipline, accountability and managerial courage.”

Johnson added that the 2020 effort “is about creating efficiencies that allow us to continue to reduce our costs while

adding to our asset base. It's about creating higher margins through our ICC and the integration, optimization, and collaboration around all of our data, and it's about creating real outcomes at an unprecedented speed, delivering step changes in our reliability, safety, and customer service.

The goal of DCP 2020 is to broadly increase efficiency, creating higher margins and improved outcomes. Company executives point out that in the program's four years, through 2018, the firm cut operating costs even as DCP's asset base grew by \$5 billion. Higher margins come via 2.0's improved integration and real-time plant optimization.

And the outcomes? DCP gains speed and agility, improved reliability and safety marks and faster paybacks.

And overall, the firm improves profitability as it assures improved operations, whatever the commodity price environment may be.

“We're still on a journey. DCP 2.0 is transforming our business and changing the way we work. We've established a culture of innovation and agility. We're starting to create our workforce of the future and positioning DCP to accelerate or transformation. We have taken costs down, improved margins and reliability, while growing our asset base to \$13 billion.” The key to success is “asset performance,” Johnson said.

“We've been working on this for a while now, but we still have a long way to go and a lot of opportunity in front of us, Johnson added. “We achieved a one-year payback in 2017. That is very rare for an initiative like this, with even more potential upside in the future.” The numbers are still out for 2018 but they look promising.

“Transformational changes will happen in our industry, we've got to jump on this quickly,” he said. “The benefit is that we can lead and be ahead of many other people in oil and gas. DCP will be a leader. This represents a huge opportunity for us, and we will lead the transformation in the midstream space.” ■

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# 5 Ways To Be 'Agile'

What does the frequently used technology buzzword really mean?

By James Boyd

“**W**e want to take an *Agile* approach to delivering...”

It's a phrase heard frequently from organizations as they take on complex digital transformation implementations. “Agile software development” is a popular term that gets project teams excited. There's excitement in the promise of a speedy delivery and return on investment—one that allows flexibility in scope, requirements and discovery.

Unfortunately, all too often that excitement fades quickly and is replaced by the anxiety of promises unfulfilled.

## Why Agile?

According to the *Agile Practice Guide*, developed jointly by PMI and the Agile Alliance, “More mature organizations are increasingly prone to being highly complex and potentially slow to innovate, and lag behind in delivering new solutions to their customers ... Speed of change will continue to drive large organizations to adopt an Agile mindset in order to stay competitive and keep their existing market share.”

When an Agile project fails to deliver on promises, and benefits of the delivery framework are not realized, organization leaders can be quick to characterize Agile as a flawed idea. In many cases, after closer review, the cause of failed Agile projects is not because of the idea, but rather the execution.

In fact, when Agile projects are executed with a solid understanding of Agile principles, the results can be realized—as advertised.

Many organizations have grown familiar with the concept of Agile projects, which is certainly a good starting point for moving in the direction of project delivery. However, in order to take the next step of realizing the promises of successful Agile endeavors, one needs to understand the principles that support this framework.

## 12 principles

The 12 basic Agile principles are commonly understood within the practicing Agile community, five of which are key (see accompanying table). Organizations are well-served to ensure project teams are knowledgeable in these principles and adhere to them when determining how to tailor an Agile approach to meet their projects' business objectives:

1. The highest priority is to satisfy the customer through early delivery of value;
2. Welcome changing requirements;
3. Deliver working software frequently in shorter timescales;
4. Business people and developers must work together;
5. Build a motivated team and trust them to get the job done;

6. Face-to-face conversation is the most efficient and effective;
7. Working software is the measure of success;
8. Promote sustainable development;
9. Continuous attention to technical excellence and good design enhance agility;
10. Practice the art of simplicity by maximizing the amount of work not done;
11. Best solutions emerge from self-organizing teams; and
12. Reflect on how to become a more effective team at regular intervals.

Witnessing trials and triumphs of small- and large-scale Agile projects, the key principles shown here are what organizations should give close consideration to in order to realize the promise of successful Agile execution. Related do's-and-don'ts are offered based on practical experience.

A consultant can assist a project venture. Delivery knowledge, coupled with deep energy industry expertise, can propel an organization to realize the promises of a successful Agile execution. ■

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*James Boyd is a director in the process and technology practice at Opportune LLC.*



## Making The Agile Process Work

Top 5 Principles		How To Apply
1	<b>Highest priority is to satisfy the customer through early delivery of value</b>	<p><b>Do's</b></p> <ul style="list-style-type: none"> <li>• Maintain focus on customer business objectives and what products/features drive value</li> <li>• Prioritize efforts on what can bring the most value the soonest</li> </ul> <p><b>Don'ts</b></p> <ul style="list-style-type: none"> <li>• Devote time to delivering complex project artifacts that could be better spent delivering valued functionality</li> <li>• Back-load delivery of high-value functionality for fear of complexity/risk...take them on early!</li> </ul>
2	<b>Working software is the measure of success</b>	<p><b>Do's</b></p> <ul style="list-style-type: none"> <li>• Measure a project's productivity based on fully functioning products (you know it's done when you see it working)</li> <li>• Focus efforts on activities that demonstrate working software and/or remove roadblocks in the way of its delivery</li> </ul> <p><b>Don'ts</b></p> <ul style="list-style-type: none"> <li>• Spend time and effort measuring partial completion (e.g., % completion of in-progress items)</li> <li>• Hold traditional status meetings. This can lead to the infamous "we're almost complete"</li> </ul>
3	<b>Welcome changing requirements</b>	<p><b>Do's</b></p> <ul style="list-style-type: none"> <li>• Recognize requirements become clearer when solutions are demonstrated against use cases</li> <li>• Understand marketplace developments can be addressed by accepting new requirements</li> <li>• Keep open dialogue between business and delivery teams to trade; accepting new value-add requirements with de-prioritizing previous requirements for sake of time and cost</li> </ul> <p><b>Don'ts</b></p> <ul style="list-style-type: none"> <li>• Reject value-added changes simply because a pre-dated milestone has passed</li> <li>• Introduce unnecessary bureaucracy as a deterrent to change</li> <li>• Accept changes without challenging value proposition (in a simple manner)</li> </ul>
4	<b>Practice the art of simplicity</b>	<p><b>Do's</b></p> <ul style="list-style-type: none"> <li>• Accept simple solutions that satisfy business needs</li> <li>• Place value on what has demonstrated to work well enough</li> <li>• Remember that a simple solution can be enhanced later</li> </ul> <p><b>Don'ts</b></p> <ul style="list-style-type: none"> <li>• Delay demonstrating work functionality for the sake of perfecting it</li> <li>• Fill idle time by gold-plating work functionality. Use additional time to pull-forward efforts that have not started</li> </ul>
5	<b>Build motivated teams and trust them to get the job done</b>	<p><b>Do's</b></p> <ul style="list-style-type: none"> <li>• Create simple status tools (easy to interpret and update) and make them publicly visible. Allow teams to spend more time delivering than report</li> <li>• Empower project team to make delivery decisions based on a trusted understanding of business-valued objectives</li> <li>• Support a self-organized team that knows what it takes to deliver by allowing freedom to make internal decisions</li> </ul> <p><b>Don'ts</b></p> <ul style="list-style-type: none"> <li>• Attempt to micro-manage by adding layers of reporting/approval that detract from time spent delivering</li> <li>• Pull teams from agreed upon delivery cycles to attend management/status meetings</li> <li>• Slow delivery progress due to cumbersome decision processes</li> </ul>

Source: *Opportune LLC*



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# The Interview

## Technology And More

**GPA Midstream has evolved to serve the sector.**

*By Paul Hart*

**O**ne of the energy industry's leading trade groups—GPA Midstream Association—is nearing its centennial. Founded to provide important technical, research and safety services, today the Tulsa, Okla.-based organization does those things and much more.

*Mark Sutton, its president and CEO, joined GPA Midstream more than 30 years ago following a distinguished career at Mid-America Pipeline Co. He visited with Midstream Business to discuss what the organization offers now as the industry continues to evolve.*



**Mark Sutton**

Source: DCP Midstream LLC

## Interview

**MIDSTREAM** We have readers who are new to the sector and may not be familiar with your association. Could you provide some background?

**SUTTON** We are an energy trade association made up of midstream energy companies. We have a sister organization, GPSA, made up of midstream service suppliers to the industry. Our staff supports both organizations.

We were formed back in 1921 specifically to address the chaos around the sector's only product at the time, known then as drip gasoline. This drip gasoline was a wonderful additive to the motor fuel pool of the day—except we couldn't always get it to market safely.

The industry had an issue: This drip gasoline sometimes blew up in railcars while it was being transported across the country to be blended into the gasoline blendstock pool. After a few accidents, the industry realized it had a really valuable product that, as a result, nobody wanted. The association was formed thereafter and it went quickly about getting our technical house in order so we could safely sell this valuable product.

We've undergone four name changes to date, and after some 98 years of work we're still serving this industry. We have evolved over time to meet the needs of our members and the sector. Today, we focus on advocacy, education and training, market information, research and technical issues, and safety.

I've been involved with GPA Midstream's technical and training and educational efforts for most of my career here.

**MIDSTREAM** What would you regard as the top priorities nowadays for the association and the sector it serves?

**SUTTON** The association has changed over the years to meet the industry's needs. Nowadays, that means we're doing much more in the way of advocacy and education.

We have an aging workforce issue. The average age of employees at our member companies is 50 years old. Between 40% and 60% of our aging employees will retire in the next five years. That says something right there: What are we going to do about it?

Since 1981, our industry has lost over 1 million jobs—1 million employees. That's significant. These numbers indicate that we're in the process of a major workforce change in the next few years. In order for us to prepare for this, and in order to keep from learning all of the old Human Resources lessons over again, there are roles that companies need to play and roles that GPA Midstream needs to play.

**“We have evolved over time to meet the needs of our members and the sector. Today, we focus on advocacy, education and training, market information, research and technical issues, and safety.”**

In my mind, the company roles are to hire the best and the brightest employees they can find. It doesn't matter whether they're engineers, business people or technical folks. Just hire the best people you can find because you can train them up.

We need to keep the industry veterans as long as it's feasible to help train these new employees. And lastly, a company needs to keep track of its best practices that were developed by its own veterans on staff and make sure that knowledge is transferred to these employees.

The association's role involves training and recruitment.

**MIDSTREAM** You opened an office in Washington, D.C., several years ago as part of your advocacy outreach. Wasn't that a switch for an association that historically has been focused on research and technical issues?

**SUTTON** Maybe it was but as I said, GPA Midstream has evolved to

respond to the needs of the industry. Our board felt that some of the biggest challenges the industry faces today are in the political and policy arenas. Much of the public and many leaders in Washington and the state capitals are unaware of the midstream's role in sustaining our economy.

We see advocacy as very important in today's political climate. We have to have a seat at the table when it comes to drafting legislation and policies. We provide a lot of basic information to administrators.

There have been situations where government agencies were drafting rules and regulations that would heavily impact our business yet the people working up the policies had zero expertise in what we do. We're here to help them, to explain what goes on and why it's important. Everyone gains from that.

**MIDSTREAM** What is the association doing to keep its vast resource of technical information in order?

**SUTTON** One, we need to continue developing and maintaining technical standards and practices, which are developed by committees made up of industry experts, and make certain they reflect what the industry needs going into the future.

As I said, GPA Midstream's roots are very deep on the technical side of the industry. We need to build on that knowledge.

GPA Midstream needs to continue our cooperative research program and ensure that it continues to obtain and publish the most relevant and needed physical property data. We also need to provide quality educational training opportunities that assist the industry in managing that generational workforce transition over the next five to 10 years.

Our technical committees have developed, and we maintain, 29 industry standards and reference bulletins. We've also published 200-plus research reports. Several more industry standards are in the pipeline now and our technical committees are working on them.

Our standards range from determining the heating value of natural gas—read that as 'the cash register' for our industry—to sampling our products



GPA Midstream's annual convention provides an important hub for exchanging ideas, discussing technical developments and creation of new business contacts. The 2018 conference in Austin, Texas, featured a midstream CEO roundtable that drew a substantial crowd. *Photos courtesy, GPA Midstream*

and determining whether they're on specification or not. I can't stress enough how important these efforts are in keeping the industry's technical house in good order.

Now, I'm prejudiced, but I think all of our technical standards are important. But please allow me to mention two in particular that give a flavor for what these standards do.

First, GPA Standard 2140 sets the specs for fractionation-grade ethane and commercial propane and butane. The standard originally was published in 1940. That's a long time ago, but we have maintained it ever since.

Also, GPA Standard 2145 specifies the physical properties that our products trade upon through the U.S. and the world. This is stuff like relative density and molecular weight, things that you need in all your calculations to determine the value of a product.

**MIDSTREAM** Do you work with other trade associations or research groups?

**SUTTON** Yes, we are actively solving many of the midstream industry's technical challenges through our cooperative research program. This work is directed by two of our subgroups, which are staffed by some of the best technical minds that our industry has to offer.

The budget for this work is modest, it's some \$650,000 for 2019, but it has proved that our program is practical, economic and efficient. We can do this valuable work on such a tight budget because our subgroups are all volunteers. If we had to pay these volunteers what they're worth, our program would easily need to be funded in the millions of dollars on an annual basis. We can't afford that.

This creates tremendous value for the industry. We received a report from the Gas Research Institute that studied our research program. It estimated that, basically, every \$1 invested in our program paid back more than \$10 in a rate of return on investment to the industry.

That's big time, and we've been doing this since 1960.

**MIDSTREAM** Can you discuss the association's research efforts?

**SUTTON** We oversee and direct work to obtain physical property data and publish these thermophysical data to improve the predictive models that our industry uses to design gas processing facilities. In other words, we go out and get a bucket and a thermometer and measure data points, publish them, and we hope that all these process simulation programs, all

these companies that provide them, incorporate them into their models for greater efficiency and profitability.

Our program serves as a highly effective and efficient means of identifying and prioritizing the industry's data needs. It serves to audit, compile and evaluate available data and computational methods. It also serves in designing and supervising experimental measurements. These experiments are done by the investigators that we use and they're from all over the world. Our work also provides the computational tools for accurate and economic design of midstream facilities.

Once again, it's all about publishing the data and getting it to the process simulation folks. Anything that improves design and makes operations safer is a good thing.

**MIDSTREAM** Educational programs are one of your core services.

**SUTTON** Correct, we have our GPA Midstream Convention in April of every year. I don't know how familiar everyone is with our convention but it is one response to the training challenges of the workforce changeover, which I mentioned earlier. This year's convention will be April 14-17 in San Antonio.

Our convention provides an outstanding opportunity to provide

## Interview

education and training to over 2,000 midstream professionals. It offers research paper presentations and roundtable discussions on multiple topics.

We changed our convention program in 2018 to make it more relevant. We now offer three distinct learning tracks. We have a technical track, we have

**MIDSTREAM** That's certainly a creative use of technology. What's changing with the Data Book and how long will it take?

**SUTTON** It really is very creative and I'm excited about it. Future editions of the Data Book will be in the Internet cloud and it will be available on a subscription basis for

the 12th edition that got pulled off a bookshelf, something that is out of date. Once the cloud-based version becomes available, you don't have to worry about whether you have the latest edition on hand because everything will be updated in real time.

First, we're working now to post a simple PDF version of the book this spring. Later, we plan to have a totally interactive version available online that also will feature links to spreadsheets, graphs, video and audio. A subscription to our Data Book will become integral to a GPA Midstream membership.

**MIDSTREAM** Gas chromatography is a basic technical function of natural gas processing and GPA Midstream has provided training for this function for many years. What's changing there?

**SUTTON** You're correct, gas chromatography is used in analytical chemistry to separate and analyze compounds. We use it in the midstream to analyze and determine the various components of natural gas and NGL.



Above: Martin Erne, right, GPA's director of technical services, helps an attendee at one of the organization's training courses. The association has provided the industry with a variety of training programs since its founding nearly a century ago.

a commercial track, and we have an advocacy and compliance track.

Of course, there's also an additional benefit of attending our convention, which is the networking side of the business. Our convention has outstanding networking opportunities and I don't know another meeting like it in the world.

Another educational and training tool that our sister organization publishes for the industry is the GPSA Engineering Data Book. This publication has been referenced by many in the industry as the Bible for the industry. It is the authoritative reference for design and technical information pertaining to the midstream industry.

We were directed by our board of directors at its December 2018 meeting in Dallas to convert the book to a web-based format.



member companies. This will ensure that anybody—looking at an iPad or a laptop, even perhaps a cell phone if you want—has the most recent version of the Data Book.

The 14th edition of the book was published in 2016, but we know some may be looking at the 11th edition or

For over 45 years GPA Midstream has offered the industry training in gas chromatography. This is a full, one-week school and it teaches gas chromatograph operators how to reliably perform GPA Midstream-standard methods of sampling and analyzing natural gas and gas liquids.

Again, we depend on volunteers for this valuable program, and it's considered one of the best available in the world. We have 30-some instructors and typically we have 80 to 100 students in each class, so the ratio of instructor to student is really good.

It's focused on the current operating standards of chromatography. The school is held one time a year on the campus of the University of Tulsa.

**MIDSTREAM What other training programs do you offer?**

**SUTTON** We have a couple of other training courses and we are proud of them. One is an Introduction to Midstream course. It teaches new or inexperienced midstream personnel what actually happens at an operating facility.

Of course, it uses the GPSA Data Book as a reference. It's a three-day course that we hold at least once a year. Also, we have just begun to offer this course to companies for internal employee training. If a company wants, we can bring this course in-house if you have a bunch of new employees who are not experienced in the industry, say accountants or maybe human resources specialists. It's not for engineers necessarily.

Another recent training course that we're extremely proud of is our GPSA Engineering Data Book training. This course trains students in the fundamentals of how best to utilize the Data Book. It's targeted at new or inexperienced engineers and we conduct at least two courses per year.

That's really important because our members have found many young engineers don't use the book. This gets into the employee turnover question. Some new engineers just ask somebody a question about problems that older, experienced employee have handled. Or, newer employees often just search the Internet for answers.

All this means that sometimes they get the right answer and sometimes they don't.

So we're really proud that this school can actually train people on how to use the Data Book. Like the intro-to-midstream course, we have started offering internal training too. For

example, The Williams Cos. has done this at its headquarters in Tulsa.

Another formal training opportunity that we're involved in consists of a partnership with Oklahoma State University's Institute of Technology in Okmulgee, Okla. There are two separate programs offered. One is a gas compression technician training course and the other is a pipeline integrity training course.

These courses are intended for those looking for technical careers and I'm pleased to say that students completing them have an almost 100% employment rate.

**One of the things that GPSA and GPA Midstream have done over the course of many years is to provide funding for scholarships, typically for engineering students.**

**MIDSTREAM Are these courses with OSU the only programs you offer students looking at gas processing as a career?**

**SUTTON** No, not at all.

One of the things that GPSA and GPA Midstream have done over the course of many years is to provide funding for scholarships, typically for engineering students. However, we have found we can't control whether these students will come into our industry when they graduate. For example, they might just as easily take our training, then work at, say, a DuPont or some other chemical company outside the midstream.

Now, we're gearing these two programs essentially to provide 100% of the graduates into our industry, which is really, I think, a good thing.

The graduates earn a two-year technology degree.

Another formal education opportunity that we're involved with is our endorsement of the Energy Management Program of the business school at the University of Tulsa. This program offers a midstream track that our executive committee and our board has endorsed. It provides education and the fundamentals of gas processing, midstream business applications, safety, health and environmental concepts, and many other midstream-specific topics. Companies like ONEOK Inc., Magellan Midstream Partners and Phillips 66 Co. have blessed the curriculum and look to hire future business graduates from this program.

**MIDSTREAM You mentioned the value of networking at your convention. Do you consider that training?**

**SUTTON** Yes, of course. I think it's good to look at some of the informal training that GPA Midstream offers its member companies. It's an overlooked benefit.

I call it "informal leadership training" and what I mean by that is when a company actively gets their volunteers, their employees, engaged in GPA Midstream committees and activities, it provides that organization an informal way to build leaders by participation, whether that be leading a taskforce to revise a standard or maybe leading a committee.

This participation benefits both the company and its employees. We pursue any chance we get to encourage management of our member companies to get their people involved and engaged.

We actually had one company that I won't name here that added to its performance evaluation program an employee's efforts on GPA Midstream committees and leadership of GPA activities.

Obviously, I'm biased—I love that idea—and I'd love to see other companies to do that. This is a somewhat intangible benefit but I think it's important if you get engaged. ■

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SPONSORED CONTENT

# Life's a Beach for Most Shale Players

**D**espite starring roles at the seashore, sand and water seldom take center stage – except in today's shale plays. Thanks to extended lateral drilling and enhanced, multi-stage fracturing, it can seem like well completions are nearly equal parts sand, water and pipe.

Water and sand play, no doubt, major roles in developing shale resources – period. And cost associated with handling, treating and disposing produced water contributes greatly to LOE (lease operating expenses) for nearly every Permian producer.

For all these reasons and more, Hart Energy has added two focused, one-day conferences – dubbed **DUG Sand** and **DUG Water** – to the Monday schedule (set-up day for exhibitors) at its larger **DUG Permian Basin conference and exhibition** coming up **April 15-17** at the Fort Worth Convention center.

The one-day **DUG Sand** and **DUG Water** conferences on **Monday, April 15** will deliver 360-degree perspectives on two of the thorniest logistical issues producers face in the Permian Basin and elsewhere. Both programs will delve into the current state of these critical sub-markets, from supply and demand fundamentals to regulations, logistics and emerging

## 2018 EVENT METRICS



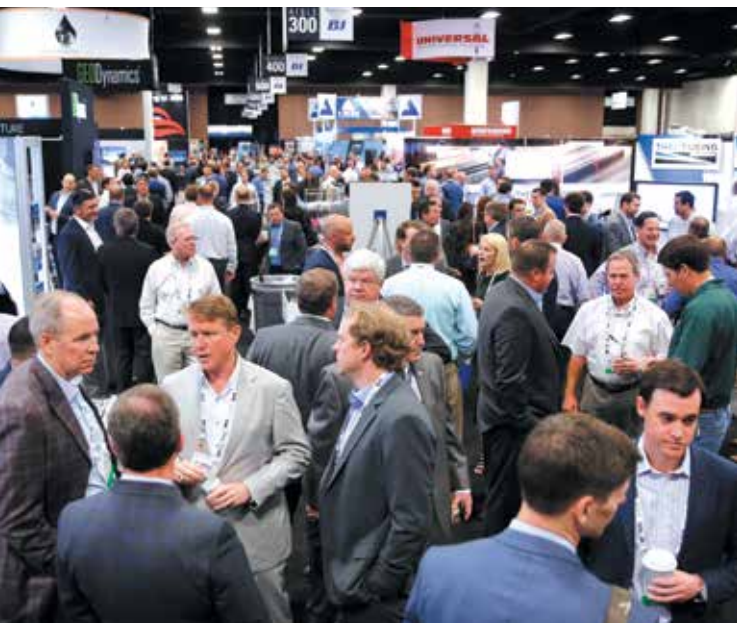
technologies. Operations managers and engineers grappling with these issues will find value in attending.

### Four conference events under one roof in 2-1/2 days

Beyond the **DUG Sand** and **DUG Water** conferences, the Monday schedule includes a separate half-day **Minerals Forum**. It's the perfect place for finance and asset managers (or investors) seeking to buy or sell minerals. As nearly everyone scrambles to live and prosper within cash-flow, an effective minerals strategy can be an effective hedge against volatile commodity prices and more cautious capital markets.

**DUG Sand's** opening keynote James Wicklund, managing director for energy research at **Credit Suisse**, will assess fundamental structural shifts in sand supply. Afterward, executives from leading sand suppliers and logistics providers will address product quality, safety and last-mile delivery. A sure highlight will be the E&P spotlight presentation by Jason Pigott, EVP – operations and technical services for **Chesapeake Energy**. He will discuss proppant use, its impact on short- and long-term well productivity, and offer perspectives on self-sourcing versus third-party suppliers, and in-basin vs northern white sand.

**DUG Water** attendees will start their day hearing an operator's perspective on the growing water supply challenge



The **DUG Permian Basin** exhibit floor hosts the best technology solutions and reflects proven best practices for producers in the region.

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Full-conference attendees at DUG *Permian Basin* will gather April 15-17 at the Fort Worth Convention Center to hear the region's top producers discuss key technologies, prospective targets and operating strategies.

### DUG *Water* conference topics:

- Water economics
- Water technology
- Water midstream
- Digital water – automation
- Regulatory landscape, with an emphasis on TX, NM and OK
- Induced seismicity

### DUG *Sand* conference topics:

- National and regional proppant providers
- Last-mile logistics solutions
- Trucking and transportation issues
- E&P case studies
- Special applications (ultra-lightweight, very fine mesh, ceramics, diverters)
- Self-sourcing versus third-party supply

from Mark Houser, CEO of **University Lands**. Afterward, a mix of executives from leading water technology and service providers, as well as oil and gas producers, will no doubt “cover the waterfront” in a far-ranging and insightful program.

All three Monday events — Minerals Forum, **DUG Sand** and **DUG Water** conferences — will conclude in time for attendees to enjoy the opening reception for Hart Energy’s annual **DUG Permian Basin** exhibition, an unmatched networking opportunity.

On **Tuesday** and **Wednesday, April 16-17**, the main **DUG Permian Basin** program once again will deliver must-see presentations and a “big picture” view of the world’s most active shale play. For business development, strategy and investment professionals, the session room provides the best venue for candid, in-depth presentations from leading producers (public and private) like **Diamondback Energy**, **BPX Energy** (the new name for BP’s lower 48 operations) and **Three Rivers Operating Co.**, a perennial favorite among DUG attendees. For complete information, visit [DUGPermian.com](http://DUGPermian.com) ■



Each year the **DUG Permian Basin** conference provides opportunities to build hundreds of valuable connections with face-to-face networking on the exhibit floor throughout each day.



CONFERENCE & EXHIBITION

**DUG**  
PERMIAN BASIN

[DUGPermian.com](http://DUGPermian.com)

Increased use of drones can better help operators detect leaks, encroachments and other problems during construction and operation of valuable assets.  
*Source: Heath Consultants Inc.*



# Send In The Drones

**Multiple drone services can provide astounding amounts of data to midstream operators. The problem is, what to do with it?**

*By Katherine Kraft and Katrina Engelsted*

**D**rones are a hot topic, they're taking over the energy business.

Drone technology is among the recent innovations with the potential to transform how the oil and gas industry assesses and manages exposure to natural and manmade hazards. The equipment is affordable, quick and easy to use and can collect

asset-wide, high-resolution imagery from flyovers of a site.

Combined with data processing and analytics, drones can be an efficient means of asset assessment and monitoring, from planning to construction to long-term operations.

The low cost of the technology has created a surge in the number of drone-

operating companies available for hire. These firms promise high returns, but their clients are most often sent gigabytes—even terabytes—of data without much guidance on how to interpret it.

Customers are left to sift for relevant information, searching for evidence of recent slips, eroding slopes, encroachments and other potential hazards.



### The drone challenge

The challenge for drone imagery is not collecting data points. It is generating insights that will save time and money on any large-scale land use project. That's where aerial analytics is changing the game.

Drones can give midstream operators a lot of information, but analytics are key to making that information meaningful and actionable. Aerial analytics tools empower asset operators to make strategic, well-informed decisions that optimize budgets, time lines and outcomes.

In any large-scale land-use project, operators must manage their exposure to hazards that could negatively impact pipeline integrity, adjacent landowners, surface waters and other sensitive infrastructure and resources. By understanding these hazards early on, a firm can proactively prioritize and mitigate issues before they escalate in size, significance and resource demands.

Employing the highest-quality aerial analytics will change use of drones by the industry for the better in three fundamental ways:

**1. Efficiency**—First, it will allow increased efficiency by providing a seamless transition of information between planning, construction and operations for better allocation of resources.

Executives in oil and gas predict that, on average, 2.5 out of 10 companies in their industry will fail because of their inability to keep up with new trends in digital technology. Aerial analytics are defining a new era for the energy industry, and having drones alone isn't enough.

High-quality analytics and models tell operators what they need and how to get it, and give rapid, clear and actionable results. These technological advances increase efficiency in capturing information, prioritizing resources and facilitating project transitions, and can save money at every stage of the asset life cycle.

The handoff between construction and operations can be challenging, and employing aerial analytics can facilitate that transition. Conducting flyovers from the start creates a consistent overview of the project at every step, and there is no lapse in continuity.

When the operations department takes over, there is often a limited budget to deal with problems that have been handed off, and they have little time to get up to speed. Aerial analytics models give operators a cohesive map of essential information so they can get to work on high-priority maintenance and use resources more effectively.

Upfront planning and transitional stages between divisions are major challenges when it comes to launching projects on time. Issues in those early stages are costly and can negatively impact the industry, communities and the environment. Getting the right models to make the right plans empowers maximal execution and performance in the field.

A single slip can cost a minimum of \$500,000 to fix. Natural and man-made hazards, if unmanaged, can severely impact budgets and timelines. A comprehensive understanding of potential and existing hazards upfront can save millions of dollars down the road.

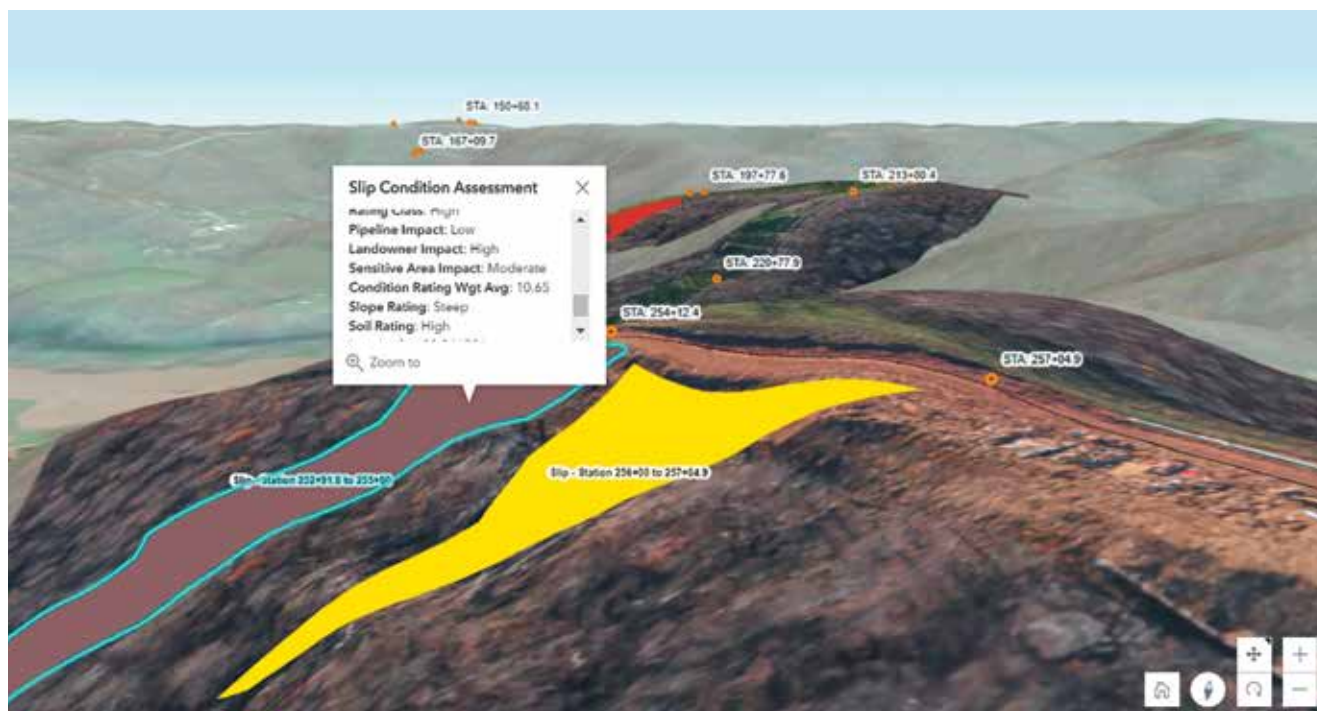
**2. Safety**—Second, increased safety for personnel, field and structural operations will be available via data collection.

A right-of-way can be steep and rugged. The terrain can present any number of challenges to company crews. Excavators can slip. Winches may be needed to hoist equipment up and down hills. It's possible you'll encounter any number of challenging situations that can leave a project vulnerable to delays and failures or other issues.

There's a lot going on, and safety is the highest priority. Drones and other aerial data acquisition technologies can quickly capture information in flyovers and reduce interference on the worksite.

Ultimately, drone imagery can reveal hazards that aren't visible to the naked eye. Drones provide more consistent and data-driven insights than subjective observations by humans, leading to more accurate results that support confident decision making. Flyovers take a fraction of the time and are able to get to areas that are difficult to access.

Data can be gathered from flyovers at any stage in the construction and operations processes with little to no impact to the worksite. It can be disruptive and dangerous to have people



Computer-assisted analysis of raw, drone-gathered data can provide useful information on right-of-way slippage and other potential problems.

Source: SolSpec LLC

assess the space, and progress, as often as operators would like, for example after every significant rain event.

The more we can do to keep people out of precarious situations, the safer it is for everyone. Aerial flyovers provide a highly detailed look at the entire area—and fast—without disruption to work and additional risk to employees on site. The data can be processed almost immediately so teams can begin consulting the models, such as landslide condition and landslide potential, providing informed actions right away.

**3. Positive social equity and public perception**—Third, in-depth planning and high-quality, long-term restoration will be crucial for the energy industry at a time when failures can evoke negative public and political backlash. Incidents can lead to litigation, diminish community support and create impediments to future work.

Modeling existing and potential hazards empowers teams to stop costly incidents before they happen and plan and execute projects with pipeline integrity, community safety and environmental resources in mind. Using the most advanced aerial analytics technology ensures that assets are planned, built, and managed to optimize

efficiencies, minimize risk and build trusting relationships with communities.

With so much to gain from engaging aerial analytics on large-scale projects, how can midstream operations find the best support? Accurate, actionable information provided quickly is in high demand, and unfortunately many drone companies cannot offer it.

According to SolSpec LLC Co-founder Toby Kraft, drone operators must be “driven to make data actionable, to answer questions that solve real-life industry problems effectively and efficiently.”

### One tool

Kraft added SolSpec has emphasized designing a platform that serves for widespread use of aerial imagery. And while drones and other aerial data acquisition tools are an important part of the process, the Golden, Colo.-based firm emphasizes the drones are but one tool on a belt, he added.

Data analytics can be used from the outset of oil and gas infrastructure projects to inform route and site planning, permitting, compliance attainment, and contract management. In the asset operations and maintenance phase, their models help operators

identify, understand, and prioritize the mitigation of existing and potential hazards to asset integrity, the environment, and adjacent landowners.

Data processing by drone operators should be fast, he said, noting SolSpec has reduced the time it takes to process and deliver aerial data into the hands of clients from four months to 72 hours.

Overspending and delays caused by regulatory and permitting issues, dealing with problems not identified in the planning period, and other challenges will translate into an estimated \$5 trillion for the oil and gas industry by 2035. The advancement of analytical tools will determine the destiny of the industry as better models support improved performance and efficiency.

For large construction and monitoring efforts, the missing piece of the puzzle is making aerial data translate quickly into actionable information. The drones may be here to stay, but without advanced aerial analytics, the data they provide won't translate to optimized time, budget and resources. ■

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*Katherine Kraft is a public policy and government affairs analyst and Katrina Engelsted is a business analyst for SolSpec LLC.*



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**Senior Secured Revolving  
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# Doing It Right

**Proper procedures allow efficient construction—and operation—  
of rail-to-truck propane terminals.**

*By Derek Rimko*

**R**ail is crucial to transporting propane to where it is needed, especially when customers are not in close proximity to a propane pipeline. Rail car-supplied propane terminals help keep propane costs stable because they eliminate the need for additional trucks to transport the fuel great distances to rural areas, where it is used for home heating, agriculture and other uses.

Utilizing a terminal builder with experience in all of these areas can make a substantial difference in the success of the build and operation.

## **Terminal design**

Overall design and terminal storage need to be addressed first and foremost when building a rail terminal operation. Distances and aggregate storage capacities—total storage available—can place certain limits on storage and rail capabilities. It is also critical to assess necessary storage required to meet regional peak demand.

The midstream supplier must assess past purchases, logistics associated with

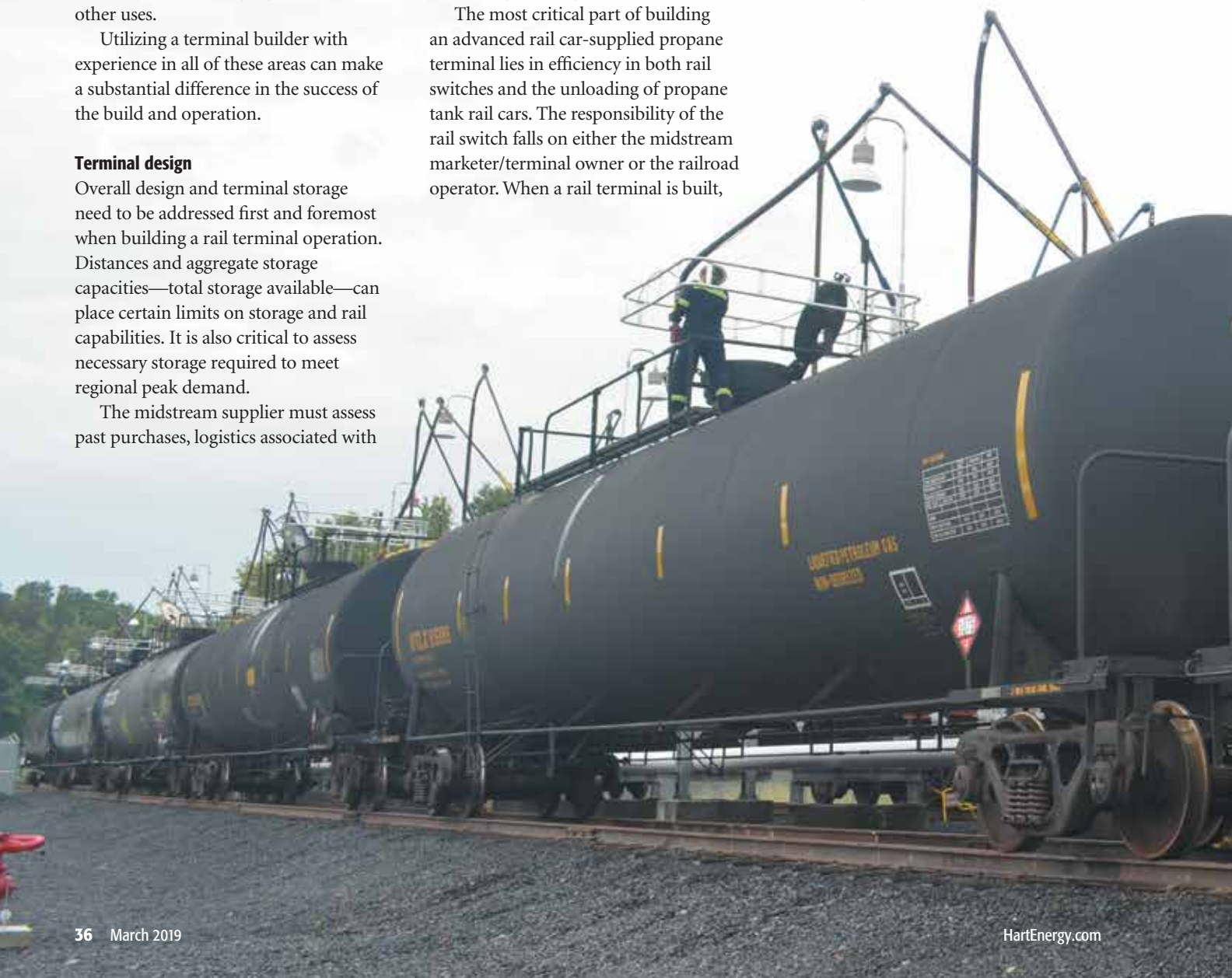
moving fuel from nearby refineries, and geographic needs based on historical data, and supply and demand.

The National Fire Protection Association (NFPA) 58 code regulates container spacing. A maximum of six storage containers can be located in a group, regardless of size, and the code requires 50 feet of separation between groupings.

The most critical part of building an advanced rail car-supplied propane terminal lies in efficiency in both rail switches and the unloading of propane tank rail cars. The responsibility of the rail switch falls on either the midstream marketer/terminal owner or the railroad operator. When a rail terminal is built,

many logistical motions come into play related to the movement or addition of track, the amount of rail car storage and the necessity of separate onsite or offsite rail car storage locations.

The addition of rail siding is necessary to offload rail cars off of the main rail line. Average rail cars range from approximately 50 to 60 feet in length with a turning radius of



approximately 240 feet. Engineering software programs allow terminal builders to determine the amount of land and length of rail siding required to meet the switch demand.

The switch demand, therefore, determines the number of gallons the midstream supplier will be able to move out of the terminal in a 24-hour period.

### **Rail car unloading**

The efficient unloading of rail tank cars affects the entire terminal operation, determining the speed that gas is unloaded and subsequently, the number of tanker trucks that can be loaded in a given amount of time.

The amount of land space determines single- or double-sided rail towers. Double-sided rail towers are much more efficient, allowing unloading personnel to unload two cars without walking

farther down the rail car line. Double-rail car siding requires more land space, and the two rail lines must be separated by 21 feet, allowing the rail cars to move with ease. If less land is available, single rail towers are placed along the siding, requiring personnel to travel to each tower to connect rail cars to the liquid transfer system.

Compressor size and unload pressures make a crucial difference in offload speed, as does the process used to remove the propane. Top connections are used to remove liquid propane, due to the nature of the fuel.



Rail terminals create key hubs in moving LP gas from suppliers to customers, but proper procedures must be followed to make sure they meet standards and make full use of available technology. *Photos courtesy, Superior Energy Systems*

## Construction

Vapor removal and recovery is a significant detail that must be taken into account as well, in order to avoid losing potentially thousands of gallons of fuel over time.

Compressor size affects the time required to move liquid from rail cars to storage tanks. It also directly contributes to the time required to recover valuable vapors from an otherwise empty rail car. Larger displacement compressors have the ability to recover vapor faster, but require larger motors, which consume additional electricity during the transfer/recovery process. A highly efficient terminal with 15 spots has the ability to offload about 1 million gallons per day.

### Truck transport

Also important in rail terminal efficiency is the truck transport loading process. Land space determines the access road and driveway available to maneuver and stage transport trucks. To meet high-performance requirements, terminal operations load trucks at a rate of 550-600 gallons per minute, allowing a transport truck to be filled in less than 15 minutes.

At the truck loading rack, truck metering skids are calibrated for

accurate custody transfer. Automation is also key. Bill-of-lading management, the programmable logic controller (PLC), tank-level system and terminal management software all come together to benefit both the marketer and the customer.

Additional automated features, such as a lockable gate-control system necessary for terminals open 24 hours a day with unattended access, must be installed to meet NFPA code. The NFPA standard serves as the industry benchmark for safe propane storage, handling, transportation and use.

### Permitting, safety, compliance

Permitting, safety standards and code compliance are key measures that must be taken into account in a rail terminal project. Terminals must meet expectations and regulations set by NFPA 58, the local government authority having jurisdiction (AHJ), and various local and regional entities including the fire department, city and zoning departments.

Adding the following aspects helps ensure a safe and compliant operation:

**OSHA rail guards**—Permanent hand rails are installed alongside the rail towers and stairs. Removable safety rails are designed in a hoop-like shape to move up and down with the catwalk, providing the OSHA-required 42-inch fall protection. The rails enable the operator to complete their task without the use additional safety tie-off or harness mechanisms.

These features streamline the connection of rail cars for unloading or loading.

**Shutdown devices**—Operator devices that are installed per NFPA 58 code, in convenient locations at each rail tower, enable operators to open and close the liquid and vapor connections to each rail car. In addition, one emergency shutdown device is installed 20 to 100 feet from the point of transfer, which can be used to close connections to the entire rail rack.

**Hydrocarbon leak detection**—Detection mechanisms installed around points of transfer and pumping systems (vapor compressors and liquid pumps) to detect propane leaks. When detected, the leak is reported to the PLC, enabling the emergency shutdown device and closing all valves to contain the leak.

## Cochin Spurs Terminal Growth

Rail car-supplied propane terminals make a lot of sense for many applications, but perhaps none more crucial than when changes are made to major pipelines.

Perhaps one of the best examples of this occurred a few years ago when Kinder Morgan Inc. reversed its Cochin Pipeline.

For decades, propane had been transported via Cochin from Saskatchewan, Canada, to Chicago, reliably serving residents, businesses and farms in the U.S. Upper Midwest. But in early 2014, Kinder Morgan began sending light condensate westbound from Chicago to Saskatchewan as crude diluent. Thus, a reliable regional propane source disappeared for farm cooperative CHS Inc., one of the nation's largest propane wholesalers.

The most viable solution for CHS was to build a series of rail-supplied propane terminals along the route of the Cochin Pipeline. Superior Energy Systems constructed three terminals for CHS, located in Hannaford, N.D.; Glenwood, Minn.; and Hixton, Wis., over the span of 18 months.

Efficient site design and safety compliance were CHS's main priorities with the multi-terminal construction. The terminals each comprise a system designed to offload propane from rail cars via vapor compressors into several 90,000-gallon tank farms.

The stored propane is then loaded via pumps into transport trucks for delivery to bulk plants. The safety and security systems as well as terminal management software are fully automated, using programmable logic

controls for loading and unloading, which allows for 24-hour operation.

They are also efficient. Two terminals have the ability to offload six rail cars roughly every four hours with two truck loading bays capable of loading six trucks per hour. In addition, each terminal meets or exceeds CHS safety standards.

"The construction of the three propane terminals, nearly simultaneously, was challenging yet very necessary due to the reversal of the Cochin pipeline," said Liz Woods, rail terminals manager for CHS. "Superior designed each location according to regional gallon demands as well as coordinated each step of the terminal construction process, allowing CHS to solve a major logistical challenge."

—Derek Rimko





Fifteen 90,000-gallon propane storage tanks serve the truck rack in the foreground at a recently opened CHS Inc. rail terminal in Glenwood, Minn.

**Fire hydrant/monitor nozzles**—A fixed nozzle or hydrant is installed at ground level around the tanks to provide cooling to the tank in the event of fire. The installation of nozzles reduces tank separation requirements set by NFPA 58, allowing additional tanks to be installed in closer proximity.

**Backflow check valves**—Safety valves that allow propane to flow into the piping system, but not back out, are critical in case of hose separation or piping damage.

**Positive shutoff valves**—Valves installed throughout the terminal allow for convenient isolation of various portions of the system to allow for service, without having to evacuate the entire piping system. They also provide a redundant positive shutoff in conjunction with emergency shutoff valves.

**Breakaway devices**—Installed at unloading stanchions to separate at a predictable point in the event of an accidental transport truck pull-away, preventing damage to the loading or unloading equipment and loss or product from the system.

**Hydrostatic relief valves**—Installed in the piping system at any point where propane has the potential to be isolated between two positive shutoff valves. This protects the piping system from excessive pressure due to liquid expansion from an ambient temperature increase.

**Crash posts**—Located around all tanks or piping. The posts protect the system from damage by vehicular traffic accidents.

#### **Fire safety**

In addition to the measures mentioned above, the terminal supplier develops a Fire Safety Analysis (FSA), required by NFPA 58. The main goal of the code is to prevent any unintentional release of propane into the atmosphere.

The FSA must be completed prior to terminal operation but is often required much earlier, during the permitting process. The FSA determines the safety of the terminal itself based on safety features required by NFPA and additional measures put into place to prevent propane release accidents.

Key sections of the FSA include:

- Installation description and applicable codes;
- Evaluation of the total product control system;
- Analysis of local conditions; and
- Probable effectiveness of local fire departments.

The FSA ensures the terminal will be built to—and likely exceed—customer requirements, along with appropriate federal, state and local codes and standards. The standards require that:

- All container openings are properly equipped to meet the requirements that incorporate mechanical, thermal and remote means of operation, including activation and emergency shutdown as required by code;
- Containers have the required liquid level devices, such as a float gauge, rotary gauge, slip tube gauge or a combination to prevent overfilling;
- Vapor pressure and temperature gauges; and
- Properly sized tank relief valves to protect the tank from overpressure.

#### **Challenges and solutions**

Soil preparation can create certain challenges that must be addressed prior to a build. Existing utilities including power, water and site drainage must be taken into account and prepared to handle the new operation. Various site challenges and solutions can include the following:

**Soil contamination**—Existing soil can be contaminated with various substances including arsenic, industrial waste and stone formations. Contaminated soil must be removed and relocated to a containment facility. High-compaction fill is added to replace the



A rendering illustrates the efficient layout of the rail-to-truck terminal built recently to serve Crestwood Equity Partner's Montgomery, N.Y., propane hub. The terminal greatly improved propane deliveries to New York state and New England.

layers of contaminated soil according to the site plan elevations.

**Drainage**—The challenge comes from underground and aboveground streams, or wetlands, existing in various locations around the site. The water source must be rerouted with underground tiles, swales and retention basins to drain away from facility.

During construction, existing water must be pumped out to install any foundations. Landscape shrubbery, including plants and trees, and river rock and retention walls, can also be installed around the site perimeter to aid in soil conservation and water erosion.

**Permitting**—Difficult site conditions, including differing soil conditions around the site, can cause each area of the terminal to be separately designed. In that situation, most local jurisdictions require separate building permits for each structure—buildings, rail towers, truck loading stations, tank piers and compressor foundations. This can create additional timing and engineering challenges. Overcoming authority misconceptions, including that propane is a dangerous gas, has also become part of a process that can be challenging.

The solution can be to utilize a reputable builder with the knowledge, experience and resources to identify

site challenges prior to construction. The builder should have the ability to estimate timing and engineering resources accordingly and meet requirements and expectations of the AHJ, regardless of misconceptions.

**Commissioning**

The terminal supplier will begin the commissioning process about two weeks before project completion, which includes testing the installation of every part of the system per the design plan.

The rigorous evaluation process includes:

- Performance and function testing of the compressors, pumps and motors;
- Pressure testing the piping system;
- Testing of the PLC, the core of the terminal's system;
- Testing of additional safety systems, including the hydrocarbon detectors, liquid level systems and emergency safety devices; and
- Meter calibration.

The terminal contractor then coordinates all inspection approvals to ensure compliance with each permit, including walk-throughs by all inspectors.

Following full testing and inspection approvals, the terminal's onsite

operations personnel should be trained. Local AHJ personnel also are trained on the terminal's features and safety systems.

The startup and first product-transfer is often monitored by the terminal contractor, as well as the operations team.

**Experience counts**

Rail car-supplied terminals are an integral part of the midstream propane landscape, for the simple fact that they ensure propane gets to where it is needed. Terminals allow transport trucks to drive shorter distances for fuel deliveries to local propane providers. This makes the delivery process more cost-effective for those local and regional propane providers.

Developing a rail car-supplied propane terminal is a complex process that requires a high level of design and engineering acumen to ensure a terminal is a safe place that meets requirements of national and local authorities as well as the governmental AHJ. In other words, experience counts, and working with a provider that specializes in the nuance of terminal building can significantly increase your savings in both capital and time. ■

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*Derek Rimko is vice president of operations for Superior Energy Systems.*

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**Dave Marchese**  
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**Becca Followill**  
Senior Managing Director  
*U.S. Capital Advisors*



**Robert Coble**  
Portfolio Manager, Senior  
Research Analyst  
*OppenheimerFunds*

### —ADDITIONAL SPEAKERS—

- **Phil Anderson**, Senior Vice President Corporate Development, *Enbridge*
- **Stacey Morris**, Director of Research, *Alerian*
- **Laura Chandler**, Manager of State Government Affairs, *GPA Midstream Association*
- **Louis Krannich**, CEO, *Remote Operations Center LLC*
- **C.R. "Bubba" Saulsbury, Jr.**, Executive Vice President - Corporate Strategy, *Saulsbury Industries*
- **Greg Haas**, Director, Integrated Oil & Gas, *Stratas Advisors*

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# Back To The Drawing Board

**Miniaturization of rupture disks requires re-design of equipment.**

*By Geof Brazier*

**F**or more than 85 years, the rupture disk has served as an effective passive safety mechanism to protect against overpressure or potentially damaging vacuum conditions in tanks and other enclosed vessels. However, as these pressure relief devices become increasingly miniaturized to sizes as small as 1/8-inch to meet the demands of a new generation of smaller, lighter applications, the industry is running squarely into design and raw material challenges that often require reengineering the product itself.

Fortunately, leading rupture disk manufacturers have embraced this challenge with novel structures and design elements that have led to a new category of miniaturized options from 1/8-inch to 1-inch at all ranges of pressure including low, 15-1,000 psi; medium, 350-16,000 psi; and high, 1,500-70,000 psi.

Equipment manufacturers and design engineers currently developing the next generation of tankage, fire suppression systems and other fields will likely benefit from this.

## The evolution

To understand the challenge requires understanding the origins of rupture disk technology.

When it comes to pressure relief devices, the two most common are safety valves (reclosing) and rupture disks, also known as bursting discs (non-reclosing). Rupture disks are designed to fail within milliseconds when a predetermined differential pressure, either positive or vacuum, is achieved. The device has a



Technological improvements have allowed the use of rupture disks as small as a coin. This disk compares in size to a Euro 10-cent piece, roughly the size of a U.S. dime. All photos courtesy, BS&B Safety Systems

one-time-use membrane usually made out of various metals, but also exotic alloys and graphite.

In many applications the superior leak tightness and flow characteristics of a rupture disk are preferred over safety valves, which are known to leak. In fact, it is a common industry practice to install a rupture disk on the inlet side of a safety valve to economically protect against corrosion and provide the required leak tightness.

In another potential use unrelated to pressure relief, rupture disks can be designed to activate as one-time fast acting valves or triggering devices to initiate a sequence of actions with high reliability and speed.

## The transition

For decades, rupture disks have been used in oilfield, petrochemical, rail and other applications. In these applications, rupture disk sizes ranged

from 1-inch to 6-inches, with larger sizes up to 60-inch for the largest piping configurations. To install the product, the rupture disc is placed in a holding device called a safety head and installed between flanged pipe ends.

However, as equipment manufacturers strive to make their products smaller and lighter, the rupture disk industry has been challenged to deliver miniaturized options well under 1-inch in diameter.

Due to a delicate balancing act between the shrinking diameters, a complicated choice between two rupture disk design philosophies, the limitations of the specific raw materials utilized for the membrane, and the variations required to meet the requirements for low-, mid- and high-burst pressures, have forced rupture disk manufacturers to the drawing board.

The first major decision when selecting any rupture disk of any size is

## Rupture Disks



Miniature rupture disks can be threaded, welded, soldered or crimped in place, depending on the application and tightness requirements.

the choice between forward-acting and reverse buckling technologies.

In the traditional forward-acting design, the loads are applied to the concave side of the disk. The thickness of the raw material employed and the diameter of the fitting in which it is mounted determine performance.

However, with this approach the rupture disk is prone to metal fatigue caused by aggressive cycling and operating conditions that can limit its operational life. Traditional rupture disk technology is additionally limited to applications having an operating to burst pressure ratio of 75% or less to avoid fatigue effects leading to potential unwanted activation.

Exacerbating the issue, forward-acting miniaturized disks with low set pressures require the use of tissue-paper thin raw material that is fragile and prone to leakage when assembled.

This has caused a somewhat negative view of this type of disk, even though it is still utilized in many static pressure applications and suffices for certain high pressure applications.

In a reverse buckling design, on the other hand, the dome is inverted toward the source of the load. Burst pressure is accurately controlled by a combination of material properties and the shape of the domed structure.

**In many applications the superior leak tightness and flow characteristics of a rupture disk are preferred over safety valves, which are known to leak.**

By loading the reverse buckling disk in compression it is able to resist operating pressures up to 100% of minimum burst pressure even under pressure cycling or pulsating conditions.

The result is greater longevity, accuracy and reliability over time.

### The challenge

However, miniaturization of reverse buckling technology presents its own unique challenges.

As burst diameters decrease, it becomes increasingly difficult to design a reverse buckling dome that will reliably collapse through such small orifice sizes. In many ways it can be like trying to fit a camel through the eye of a needle.

To resolve this issue, some manufacturers have created novel structures that control the reversal of the rupture disk to always collapse in a predictable manner.

This includes, for example, a hybrid shape that combines reverse buckling and forward bulging characteristics that are pre-collapsed. In this type of design, a line of weakness is typically placed into the rupture disk structure to define a specific opening flow area when the reverse type disk activates.

Small nominal-size rupture disks can also be very sensitive to the detailed characteristics of the orifice through which they burst, causing normal variations in holder support machined part dimensions to have an unwanted impact on burst pressure accuracy.

With small size pressure relief devices, the influence of every feature of both the rupture disk and its holder is amplified.

For miniaturized products ¼-inch and up certified for high burst pressures up to 70,000 psi, there are now rupture disks and holders from a single piece of material, eliminating the usual connection between a rupture disk membrane and its support fitting. The rupture disk is intrinsically leak-tight by virtue of its unitary construction.

As for installation, these miniature rupture disks are available as a single, integrated assembly certified to perform at the desired set pressure. The devices are typically threaded, but are also available in configurations for welding, soldering, or crimping based on the application conditions and leak tightness requirements. ■

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*Geof Brazier is managing director of the custom engineered products division of BSE&B Safety Systems.*



At bottom, a pipe specimen exposed to several months of saltwater corrosion shows some 10% of metal loss. At top, a control specimen used in the trial. *Photos courtesy, Cosasco*

# Controlling Corrosion

**A field trial confirms a novel corrosion-under-insulation monitoring technique.**

*By Roland Anderson*

**A** joint U.K. and Norwegian consortium has spent three years working together to develop a completely new solution based on Electrical Impedance Spectroscopy (EIS) that provides a solution for one of the biggest global challenges facing the oil and gas sector: the non-invasive detection of corrosion under insulation (CUI).

With this system, there is absolutely no need to remove the outer cladding or underlying insulation, and there is only a need for a single access point to a long continuous pipeline, which means it can very easily be retrofitted onto aging assets.

Other advantages are that:

- It scans very long lengths of insulated pipeline in seconds;
- The sensor network can become a SCADA system and operable

from a single location or control center; and

- It will detect both sudden catastrophic leaks and gradual long-term changes as CUI progresses in very large, distributed pipeline networks.

## Test results

Presented here are the results of a 15-month long field test of the system, deployed in a real-life setting, on location in Norway.

Conventional methods of non-destructive testing (NDT) for CUI largely rely on the periodic removal of outer cladding and underlying insulation to check visually for corrosion. Such an approach is not cost-effective to perform in real-world deployment environments.

Indeed, they are often too expensive to implement as they generally cover too small an area and inspection speeds are very slow. Moreover, they are usually highly labor intensive, require extensive preparation and often involve shutting down operation.

Hence, there is an urgent need to develop technologies/techniques that enable industry to adopt more cost-efficient and reliable inspection and monitoring methods.

To address this vital industrial need, Inspection Technologies Ltd. (ITL) in the U.K. consulted with plant installation and maintenance company SolidTech AS of Norway, and ITL has now developed, and fully field-tested, a new system based on Electrical Impedance Spectroscopy (EIS), which can continually detect and monitor the progression of CUI in large

## Pipeline Protection

pipeline networks in industrial settings without the need to physically remove outer cladding or insulation.

The oil and gas sector in particular would benefit greatly from such a technological step-change in inspection technology, as it would enable early detection and preventative maintenance in the large energy sector.

Thus, the need for better monitoring technology is an enormous “market pull.”

Other sectors apart from oil and gas that also greatly benefit from this technology include power generation,

material characterisation that has grown tremendously over the past few years and has made its way into the service environment due to smaller-sized and more portable units.

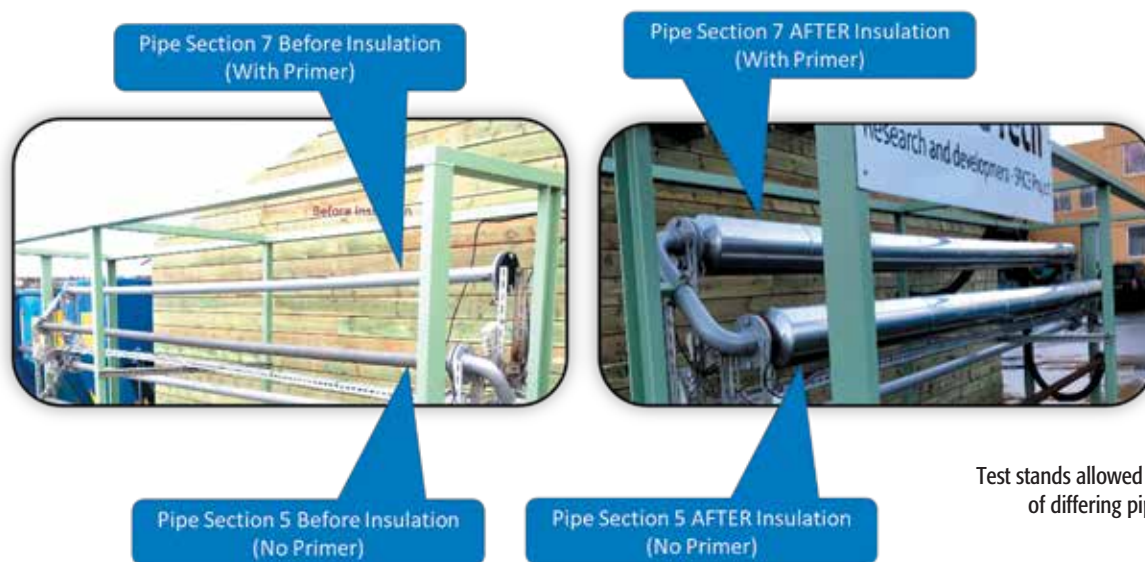
However, the consortium’s system is the first of its kind to be used in full-fledged industrial use.

It differs from conventional lab-based EIS by using an embedded controller and associated circuitry that uses onboard Fourier engines to speed up measurement times by several orders of magnitude. This makes it a commercially

outside of pipe at the interface with the thermal insulation.

This highly surface-specific ability to detect corrosion/metal loss only at the outer wall of a metal pipe is of special interest to commercial users as it also means that—unlike some other techniques—the EIS system is totally insensitive to the actual content of the pipeline system itself.

Hence, it only monitors, and tracks, events related to corrosion and maintenance issues directly under the thermal insulation.



Test stands allowed monitoring of differing pipe sections.

food and pharmaceuticals, chemical refineries, paper mills, and infrastructure common to many industrial sectors where pipes are underground or enclosed in concrete.

According to the U.S. National Association of Corrosion Engineers (NACE), the annual cost of CUI across the main production and manufacturing categories is in the billions of dollars per year—in particular some \$3.7 billion for refining and \$1.4 billion for oil and gas production.

### The technology

The EIS system consists of a dispersed network of small and inexpensive transceivers. Each small transceiver has an individual footprint of less than 50 square centimeters. EIS is a powerful and well-established technique for

viable instrument that is capable of scanning 3-4 kilometers of pipe an hour to non-invasively detect corrosion under thermal insulation.

These small transceivers are easily retrofitted at strategic nodes of a pipeline network, such as junctions, valves, flanges and other places, which are normally free of thermal insulation during day-to-day operations.

All miniature EIS transceivers are integrated via local hubs and routers into a SCADA system and operable from a single control center, and the entire network of pipes is constantly monitored 24 hours a day by specially written corrosion detection and condition monitoring software.

### Metal loss

The system specifically identifies metal loss/corrosion only on the

Of all the current state-of-the-art methods, which attempt to function in a similar way, only ultrasound techniques have experienced a market take-up of some size. Even for these techniques there is a limited uptake. That’s because of their high cost and the inherent limitations that require partial insulation removal, cover small areas and are only sensitive to quite drastic losses in wall thicknesses rather than smaller metal losses associated specifically with corrosion at the thermal insulation at the pipe wall boundary.

The EIS system reported here has the commercial advantage of being able to continuously monitor entire pipeline systems, being much cheaper and easier to install, with higher sensitivity to shallow surface corrosion. If desired, degrees of corrosion and associated metal loss can



be can classified by the system as light, moderate or severe.

#### Field trials

The aim was to establish the sensitivity of the EIS system, prior to field deployment, to even minimal levels of CUI. The system was able to specifically identify metal loss/corrosion on outside of pipe at the interface with the thermal insulation.

The findings of the lab-based characterization trial were consistent with theory. That is, only metal loss/corrosion on the outermost surface of the pipe was detected by the EIS system and that even mild metal loss/corrosion on the outer surface was readily detectable.

A beta-test of the EIS system was trialled over 15 months on location in Norway to characterize the system in live operation under the demanding conditions of a real-life deployment environment.

This test installation itself consists of a specially constructed closed-circuit system, which continuously circulates high-temperature water through a pipeline network with various degrees of paint system, corrosion protection and thermal insulation. The EIS system is connected at convenient nodes of the pipeline system and provides full real-time streaming telemetry back to a U.K. control and monitoring center.

Over time, a data-based response matrix was created in order to correlate EIS measurement readings with a specific corrosion/maintenance event.

#### The results

After the end of 15 months, the trial was terminated and the cladding and insulation removed from the pipeline sections. Of special interest was the fact that Section 5 [see photo] was not painted in primer prior to being insulated, whereas Section 7 was.

Upon removal of the cladding and insulation, it was revealed that Section 5 (unprimed) had experienced corrosion and Section 7 (primed) had not.

In fact, early warning signs for Section 5 appeared early in the test and monitoring software was advised of an intervention

In the coming months, it is intended that the system will be deployed in larger facilities and retrofitted onto ageing assets. It will then be possible to characterise the long-term EIS findings by cross referencing readings with specific corrosion/metal loss events.

From there, supported by continued data-collection, it will be possible to produce predictive models and empirical response matrices that characterise the precise nature of the defect/ ROI—whether corrosion, creep, deformation, cracking, etc., occurred. ■

*Roland Anderson is executive vice president of Cosasco.*

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New technology enhances, and adds to, traditional cathodic protection techniques. *Source: Shutterstock/Cpaulfell*

# Next Gen Technology

**Improved techniques can better protect pipelines.**

*By Mary Holcomb*

**A**s instances of stress corrosion cracking persist, the established Electromagnetic Acoustic Transducers (EMAT) system is still the preferred pipeline inspection technology.

The EMAT essentially generates an ultrasonic pulse into the test subject indicating, or not, an occurrence of cracks or coating disbondment.

Although the crack and coating detection technology has been around since the early 2000s, companies like The Williams Cos. Inc. are still seeing the system emerge and transcend.

Tulsa, Okla.-based Williams ranks No. 6 on this publication's Midstream 50 list.

"EMAT technology is not new technology, however what's really

changing right now is the wide acceptance and application to pipeline infrastructure, and being able to use the highest and best technology to find those things that are hidden and difficult to locate before they rear their head and become an incident," Amy Shank, Williams' director of pipeline safety and asset integrity, told

## Integrity Management

attendees at Hart Energy's recent DUG Midcontinent conference.

Shank said that through the EMAT system, Williams has been able to tackle stress corrosion cracking, cut costs, optimize usage and safety of personnel, and assess the productivity of its 33,000 miles of pipeline across all its hubs in the U.S.

"With this technology we're able to get a lot more information that we then can apply to the rest of our pipeline systems, it better tells us where to go look and it is giving us data that is making us safer every single day out there because we know exactly where these features are [located]," she added.

The analytics drawn from EMAT also give live data comparison and offer warnings for critical spots and potential failures, which she said is crucial for anyone on the integrity side of a company.

"It's really hard to identify all of those things that you are preventing from happening and put a price tag on it, to look at all the value you are adding, so we're constantly having to defend and make sure we're taking a balanced approach to looking for those things that are waiting to bite you vs. accepting the appropriate level of risks," she added.

Furthermore, the technology still requires approval from the U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA), which has had a hand in regulating and sometimes funding all advancements related to the EMAT system.

For example, PHMSA has lent financial support to Q-InLine's recently introduced In-Line Inspection (ILI) development—an addition to the EMAT system that is expected to advance the difficult pipeline and inspection process.

Considering the tedious regulation process, Shank suggested companies that have assessed for cracking and wish to deploy the system work with companies like Williams that have already been through the trial stages.

"Let's share lessons learned. I am a firm believer that an incident for one of us is an incident for all of us, so it behooves us to all work together and use the latest, greatest and best technology to keep us safe."

The midstream has access to other technologies that promise to increase safety and reduce operations costs. One, Unmanned Aerial Vehicles (UAV), or drones, still comparatively new to the market, are continuing to advance in midstream sector usage.

Mike Sever, general manager at SolSpec LLC, a developer of analytic tools that process aerial imagery into information and predictive analytics, told the conference UAVs will only work and be valuable for the sector when paired with other advancements.

"At SolSpec, we believe that the advancement of UAV technology is really going to be highly dependent upon and driven on the advancement of the tools that are around it," Sever said. "You can have aerial imagery, but what do you do with it and how is it going to best serve the midstream industry? So we believe that the analytical tools that have become available are going to lead that industry."

Sever said there are four main categories in oil and gas that UAVs can enhance:

- Safety;
- Efficiency;
- Regulatory compliance; and
- Social equity.

Integrating the software, he said, would increase safety for personnel, field and structural operations and information gathering. Subsequently, improving safety would help efficiencies in operations as companies could better assess use of manpower and better manage the use of equipment as UAVs take on more responsibility in the field.

As more integrated UAVs are able to assess potential hazards, there will be a positive impact on regulatory monitoring and environmental concerns, Sever added. That will drive the sector forward in its contacts with landowners, communities and governments.

Through UAVs, midstream companies can draw analytics on potential hazards, erosion issues, encroachments and the overall integrity of a pipeline.

SolSpec's programs include its Hillslope Threat Assessment Model that uses machine learning and imaging to predict the soil and land features

most susceptible to landslides. With more than 1,000 previously detected landslides, the model can assess the threat level of any area on a percentile basis for 0% to 100%.

With the analytics from Hillslope Threat Assessment Model, the firm uses its Centerline Risk Assessment Model to determine the threat level to pipelines. The centerline tool maps

**"Let's share lessons learned. I am a firm believer that an incident for one of us is an incident for all of us, so it behooves us to all work together and use the latest, greatest and best technology to keep us safe."**

— Amy Shank, *director of pipeline safety and asset integrity, The Williams Cos. Inc.*

adjacent slopes, environmentally sensitive areas and deposition off-easement to construct the percentile of threat for event response and mitigation management, according to the company.

Also included are features to detect condition and impact of landslides, storm water flow direction and accumulation, erosion conditions and sediment deposits, and change detection heat maps. Collectively, Sever said, all of these facets support pipeline integrity and environmental compliance. ■

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# Augmented Adoption

**Multiple trends make midstream's digital transformation a priority but operators must consider how to make it happen.**

*By Evyatar Meiron*

**C**urrent market trends, including the increased activity in the various domestic oil fields, are driving the need for change in the energy industry. In particular, midstream companies are looking for ways to operate efficiently and seeking new methods to maintain the highest degree of uptime for their major pieces of equipment.

The need for maximum efficiency in the midstream sector is driven by the demands to get hydrocarbons into the market as quickly as possible.

With the right outlook and vision, the need for midstream assets—such as pipelines—to work reliably can become opportunities for organizations to introduce the use of new technologies. In particular, midstream companies

with extensive assets in the field have significant upside opportunities to improve efficiency levels through the introduction of the latest in field service technologies.

#### **Leverage**

For example, augmented reality (AR) and Internet of Things (IoT) are tools capable of helping midstream

engineers improve the uptime of more field assets, while spending less of an engineer's valuable time. Specifically, AR and IoT can be leveraged to eliminate the need to dispatch a limited number of highly qualified subject-matter experts on-site to troubleshoot or update midstream equipment.

Experienced engineers can be more efficient with their time, by using AR with live video and guiding junior technicians to a resolution. Such technology can also capture how-to videos, with necessary instructions stored for future reference, thereby protecting against the dreaded "brain drain" in the era of an aging workforce.

However, what can midstream companies do to help their engineers understand the positive, bottom-line impact the adoption of digital technologies such as AR can have?

Companies that have many traditional hard assets in the field have a lot to learn about what we call digital transformation initiatives, the process by which old analog tasks can be integrated with digital technologies for greater efficiency. Organizations that embrace digital transformation in the field have the opportunity to become more technologically advanced and establish market leadership by massively reducing cost and increasing their productivity.

It should be noted the process of digital transformation is not solely about technology. Digital transformation initiatives can create value, whether they harness AR, smart glasses, IoT, cloud computing or even artificial intelligence. To truly benefit, the digital transformation process must focus on how to engage and encourage field technicians, engineers and experts on how to use these new technologies in their daily routines.

To put it in a real-life context, digital transformation in the midstream industry can be implemented in many different existing processes and routines. It can cover the dispatching of field personnel to a site, scheduling and prioritizing jobs, accessing real-time and IoT data or managing a spare parts inventory.

Fieldbit has devised a roadmap for making a digital transformation

process work. A proper methodology for managing digital transformation includes a joint requirement analysis, feasibility testing, key performance indication (KPI) evaluation, roll out, and a scale-up.

Fieldbit is a leading developer of real-time augmented reality collaboration solutions. Its enterprise class, cloud-based technology enables on-site service engineers to collaborate seamlessly with

**Without embarking on a digital transformation effort to document and systemize the vast knowledge that exists today primarily in the minds of experienced field personnel, many important skills and techniques could be lost.**

experts at a service center, and to receive needed know-how and guidance to solve issues quickly, increase remote resolution and first-time fix rates, and minimize costly downtime.

Through a careful, managed process, digital transformation can be achieved quickly, and midstream companies can adapt to today's challenges.

### Implementation

Today, new market trends in the energy industry should cause midstream organizations with field assets to reconsider their approach to existing structures, practices and business models. As we have seen how digital transformation already revolutionized field services in other sectors such as healthcare,

industry trends are often the main driver for change.

Within midstream companies, executives and leaders know all too well the market value for speed and efficiency.

Possibly the most important trend driving the need for change in the industry is the aging workforce. While often dismissed, an aging workforce can be a death knell for an organization, as it can result in a knowledge drain. Field service organizations must retain knowledge even as good talent is being lost to competitors, age, or other factors that cause an employee to leave your workforce.

As experienced field personnel retire or leave the workforce, organizations must find ways to capture these experts' practical and technical knowledge to prepare the next generation of service engineers and technicians. Moreover, in light of the increasing complexity of today's equipment, organizations should take proactive steps, such as establishing technical competence and support centers, to improve the skills of their field engineering teams.

Without embarking on a digital transformation effort to document and systemize the vast knowledge that exists today primarily in the minds of experienced field personnel, many important skills and techniques could be lost.

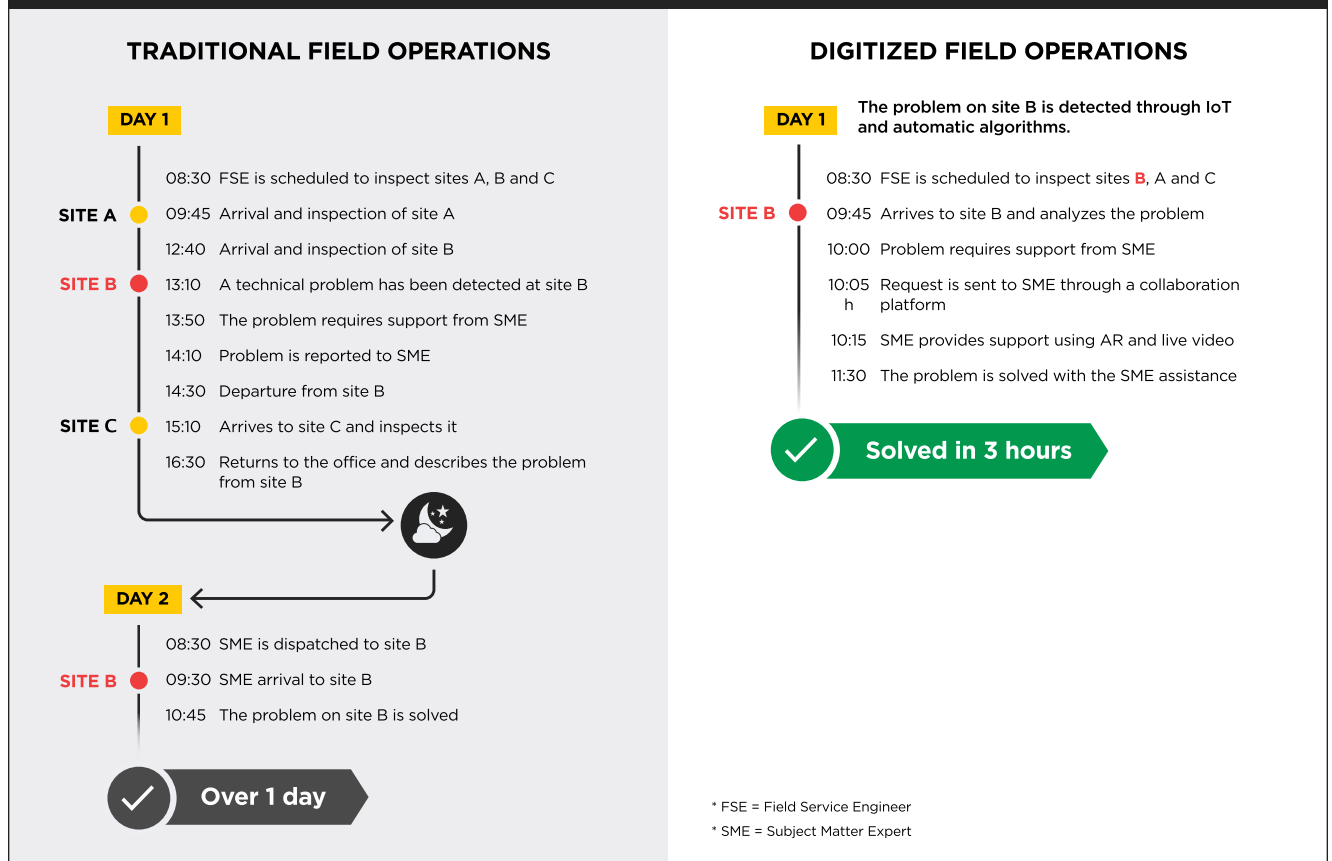
### Knowledge maintenance

One solution for knowledge maintenance and transfer we have found valuable is the use of video integrated with augmented reality annotations to capture on-site processes. By using augmented reality graphics within a video, useful knowledge can be maintained, categorized and ultimately shared across the organization.

Despite the trends driving the need for digital transformation across the sector, there remains resistance in the form of the status quo. We're all guilty of going with what is most comfortable, which is usually what has worked for us in the past. For many, overcoming this resistance to change is the greatest challenge. For the most part, energy companies follow historically successful and thus comfortable practices, especially if



## A DAY IN THE LIFE OF A FIELD SERVICE ENGINEER (FSE)



Source: Fieldbit Ltd.

oil prices are high enough to make everyone complacent.

This is especially true in field services, where implementations of new technologies often require changes to entrenched workflows, processes and practices.

### The payoff

In order to adapt and remain competitive in the market, digital transformation can be a competitive differentiator for your business. Yet it's helpful to realize some technologies may be easier to adopt depending on the conditions of the industry. Due to the need for field engineers to connect with vital information and data, technologies that can connect with additional information would be a significant benefit for midstream engineers.

Whether data are accessed through augmented reality, smart glasses, IoT, or cloud computing, any of these technologies could help

midstream engineers improve their work. While such technologies could benefit companies of all sizes, the real payoff is seen in oil and gas companies with multi-field assets across large geographies.

We have seen this first-hand. We worked with a major energy company to deploy a new technology to help manage more than 10,000 well sites. Before our engagement, field engineers were required to drive long distances between well sites to fix automation and control equipment. Additionally, many of these issues were not resolved on the first visit because of the technical nature of the problem.

By using a systematic digital transformation process, we were able to reorganize the old process by moving experts to regional support centers and then introducing revolutionary AR technologies to connect these experts to the personnel already in the field. As a result of the technology deployment, we were able to reduce problem backlogs.

More importantly, we were able to take tasks that previously needed eight site visits and 15 days, and instead resolve these issues in only six minutes.

Thankfully, these technologies are not just part of a potential future, but are accessible and available today. Through our experience of introducing our enterprise platform for visual interactive collaboration, we have learned how to optimize the process for digital transformation.

In fact, Fieldbit has developed a unique methodology for digital transformations. The result is that we have learned how to help field service enterprises maximize their technological advantages and increase efficiencies.

### Managing change

Managing change through digital transformation requires a careful planning and preparation process. It also takes a certain level of commitment, and a thoughtful evaluation of the

## Digital Transformation

entire organization must be behind the desire to change. In addition, the process requires a buy-in across the entire organization and a collective understanding that may present changes to the current work processes.

Another important aspect of a digital transformation is close collaboration and open communications between technology experts and field implementation teams throughout the process. Open communication and collaboration creates synergies and buy-in that will ultimately drive significant value beyond the mere deployment of a new digital tool.

The most critical step for managing the implementation is the joint requirement analysis. During this phase, managers, experts, technicians and field engineers come together to analyze the existing procedures and requirements of implementing any new technology. This phase is important as it establishes realistic goals for an organization and

defines the necessary requirement to reach the organization's goals such as ROI and operational KPIs.

### Proving ROI

During the implementation process, information is collected and analyzed in order to prove ROI assumptions and KPIs that had been mutually set with the implementation team. At this time, requirements—which for our engagements include IT network, data protection and integration—are finalized and carefully planned for deployment.

As soon as relevant goals are achieved, the scaling-up process can begin. The scaling-up process defines a detailed operational plan for introducing the system to additional teams or business units across the organization, evolving organizational structure and work processes as needed, and integration with back office or other control systems.

Managing the implementation of a digital transformation is an essential

part of success in today's energy industry. An effectively managed digital transformation can help service organizations improve and define new workflows, capture and share practical knowledge, streamline communications within the organization and build new business models.

A responsible and well-prepared management team will create a system to align expectations and reduce uncertainty during a digital transformation. Ultimately, digital transformation of the oil field must happen, as it brings unprecedented efficiency, lower cost and, most importantly, preserves knowledge and skills for the future.

There should be no reason for large enterprises not to embrace this exciting and potentially more profitable future. ■

*Evyatar Meiron is CEO and founder of Fieldbit Ltd.*

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Integrated compressor lines combine the power source and gas compressor into a single unit. Source: GE Power Conversion

# Integrated Compression

**Design advancements and a reliable power grid make electrically powered compressors a serious option.**

*By Azeez Mohammed*

**N**atural gas abounds in North America. At the end of 2016, Canada and the U.S. shared 414 trillion cubic feet of proved reserves, with the U.S. the world's largest producer and Canada the fourth largest.

Unsurprisingly, there's a keen appetite for developing LNG facilities across the continent.

In recent years, we've seen several large-scale LNG projects take shape, including five new export terminals coming online in 2018 and 2019. Once

in operation, they will make the U.S. one of the top three LNG exporters in the world.

Over the years, an extensive pipeline network has spread over a vast area—and this presents some exciting opportunities in terms of gas compression. Historically, the midstream market has been dominated by gas turbine technology, with conventional low-speed electric compression barely getting a look-in.

But that's about to change. Indeed, I see four new trends that are helping

to catalyze a favorable environment for integrated compressor line (ICL) electrical compression technology in this part of the world:

**1. Shifting attitudes**—Electric vehicles, vessels and even planes are edging ahead, showcasing the strength and potential of electrification. Similarly, engineers and operators are increasingly convinced that electrical technologies are now mature enough to be considered viable options for the gas industry. This was not the case a few years ago.

**2. Tighter regulations**—Some states are changing mandates to limit emissions, environmental footprint and noise in proximity to cities. This is forcing new approaches as customers seek low-emission solutions that help facilitate faster government authorization.

**3. Shrinking talent pool**—Many oil and gas operators are reaching retirement and the capacity of project teams to address maintenance is diminishing. To stay competitive and reduce costs, companies are having to adopt new technologies that require fewer maintenance hours.

**4. A better electricity network**—The vast power grid network in North America is largely matured and can provide reliable power at all times. The readily available, stable supply of electricity again opens doors for adopting electrical solutions at scale.

In terms of electrical compression solutions, there's also an exciting evolution on the horizon that provides a viable and attractive option for the North American market. Integrated machines that encase a suite of innovations and, most importantly, steer away from the need for a gearbox and connect the compressor directly to the motor is, to me, the natural next step for gas compressor solutions.

Here's why:

**They're safer**—Both gas turbines and conventional electrical compression technology carry the risk of gas leakage—a major safety hazard. Thanks to high-speed motor technology, integrated machines can embed both compressor and motor within the same casing, eliminating the gearbox and therefore the risk of leakage. That's a big advantage in an industry where safety is always paramount.

**They save money**—The gas market may be growing, but cost pressures are still high. Integrated machines help reduce costs across the board in several ways. First, they don't require auxiliaries such as a gearbox, and magnetic bearings eliminate the need for oil or a cooling system. This makes them lighter with a smaller footprint, and considerably lowers capex costs.

And because integrated machines are more reliable, operating costs go

down, too. That's because having fewer components reduces the risk of failure and breakdown. For example, there's no need for dry gas seals, the main contributor for failures on these systems. As a result, they cost less to maintain and are generally more efficient to run.

**They respond quickly**—As every gas supplier knows all too well, the price of gas fluctuates hugely, so the ideal scenario is to be able to supply gas at the highest market price. To do this however, you need machines to react quickly to fast-changing market conditions. Where traditional compressor solutions take hours, integrated machines can be up and running within just five minutes—literally the time it takes to make a cup of coffee.

**As every gas supplier knows all too well, the price of gas fluctuates hugely, so the ideal scenario is to be able to supply gas at the highest market price.**

Such is the case that gas suppliers using integrated machines can respond rapidly to surges in demand due to a power outage or unexpected cold weather, for example, and release gas from storage into the market. In this way, they're able to secure the highest price every time and maximize their revenue.

At GE, we've been able to deliver an integrated machine that leverages proven technology from across our business. Packaged by BHGE, our Integrated Compressor Line combines the centrifugal compressor from their Turbomachinery & Process Solutions and the high-speed electric motor from GE's Power Conversion business. Both are sealed in a single casing, with no need for lubrication, thanks to active magnetic bearings technology.

The motor, which has clocked four million hours of successful operations over 15 years, requires very little maintenance. Customers can also choose to have a resident engineer available over the warranty period, as well as a spare motor readily available on U.S. soil, in case of the unlikely event of failure.

What's particularly attractive is the option to integrate data analytics for the variable frequency drive, motor, compressor and bearing. It's then possible to access the data remotely and identify potential faults or deterioration before they become an issue. In this way, customers can move to a predictive maintenance model, minimizing potential downtime and costs even further.

The technology is long proven in the energy market elsewhere, most recently with key orders signed to supply eight units to energy operators Open Grid Europe and Trans Austria Gasleitung GmbH to transport gas across the heart of Europe, responding to the area's needs in terms of safety, gas transport system availability and efficiency.

Up to 14 megawatts per unit, it is GE's largest ICL offering in terms of power capacity.

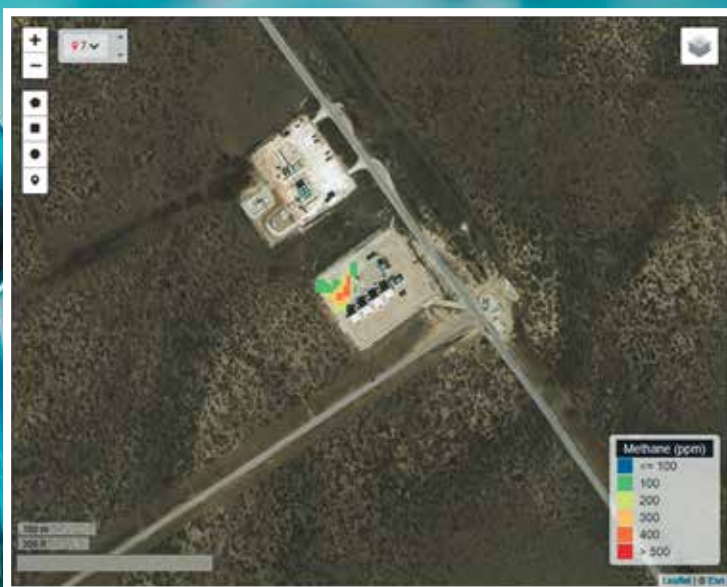
The technology also broke ground in the Middle East, where natural gas is one of the primary fuels utilized to generate electricity. Using more secure, efficient and cleaner solutions such as ICL to transmit and distribute gas to key economic sectors and wider consumers is a solid step forward for the region to build a safer and more efficient future for gas.

In my opinion, as an oil-free, zero-emission solution, integrated electrical compression technology lowers risks and costs and allows gas suppliers to respond more quickly to market demand. The fact that electrification is now widely recognized as a mature technology overcomes a major barrier to adoption within the industry.

Integrated machines are the next step in the evolution of the electrical gas compressor, and for the growing North American market, I believe they're a perfect match. ■

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*Azeez Mohammed is president and CEO of GE Power Conversion.*



Satellite imagery plots the location and intensity of methane leaks around a Texas compressor station.  
Source: Satelytics



# Methane Management

Opportunities exist to further reduce natural gas emissions.

By Joel Bluestein

**A**ccording to the U.S. Environmental Protection Agency's (EPA) "Inventory of U.S. Greenhouse Gas Emissions and Sinks," methane accounts for about 10% of U.S. greenhouse-gas (GHG) emissions. Of this, one-quarter is from the natural gas industry.

Expressed as a percent of natural gas production, this equates to 1.3% of production. While other studies have suggested much higher emissions levels, some as high as 7.9%, the most recent and most comprehensive non-EPA study—a multiyear study organized

by the Environmental Defense Fund and involving various universities and research organizations—found emissions only slightly higher at 1.7%. The paper tabulates emissions for both crude oil and natural gas systems at 2.3% of gas production. Consulting service ICF International estimates that the natural gas portion equates to 1.7% of emissions.

ICF has been a leader in measurement and mitigation of methane emissions from the oil and gas industries for more than 20 years. This has included work for the industry, regulators and nongovernmental organizations ranging

from policy analysis and development to direct support for industry operations.

Over the last five to 10 years, the company has seen increasing focus on methane emissions from these industries for several reasons. Among those is that the climate-forcing effect of methane is greater than that of CO<sub>2</sub>. The global warming potential (GWP) describes the ratio of methane equivalent to 1 ton of CO<sub>2</sub> and can range from 34 to 86, depending on the timescale being considered.

On the positive side, this means that reducing 1 ton of methane is equivalent

## Emissions

to reducing 34 to 86 tons of CO<sub>2</sub>. In addition, there are available methane reduction technologies for most of the emission sources.

### Tracking emissions

When methane emissions can be captured and sold, the value of the gas offsets the cost of the reduction measure. In some cases, the value can be greater than the cost. That said, the value cannot always be directly monetized by the operator due to regulated pricing structures (e.g., for pipelines and distribution companies).

On the other hand, reducing methane emissions is complicated by the fact that the natural gas industry is actually several different industries with different types of emission sources and ownership and regulatory structures.

The EPA inventory includes more than 100 different industry segment/emission source categories. The nearby graphic shows the EPA estimate of emissions in the various industry segments. Gathering and boosting is the largest, followed closely by development and production, and then transmission and storage.

**When methane emissions can be captured and sold, the value of the gas offsets the cost of the reduction measure. In some cases, the value can be greater than the cost.**

Methane emissions from oil and gas operations have declined significantly since the EPA started tracking them, decreasing from almost 200 million tons of CO<sub>2</sub> equivalent (MMtonCO<sub>2</sub>e) in 1990 to 164 MMtonCO<sub>2</sub>e in 2016.

According to the EPA, the unit CO<sub>2</sub>e represents an amount of greenhouse gas emission whose atmospheric impact has been standardized to that of one unit mass of CO<sub>2</sub>, based on the global warming potential of the gas.

Moreover, natural gas production has increased significantly during that same period, so emissions per unit of production have been declining continuously, falling by 45% from 9 kilograms CO<sub>2</sub>e/Mcf in 1990 to 5 kilograms CO<sub>2</sub>e/Mcf in 2016.

There are several reasons for this continuing decline.

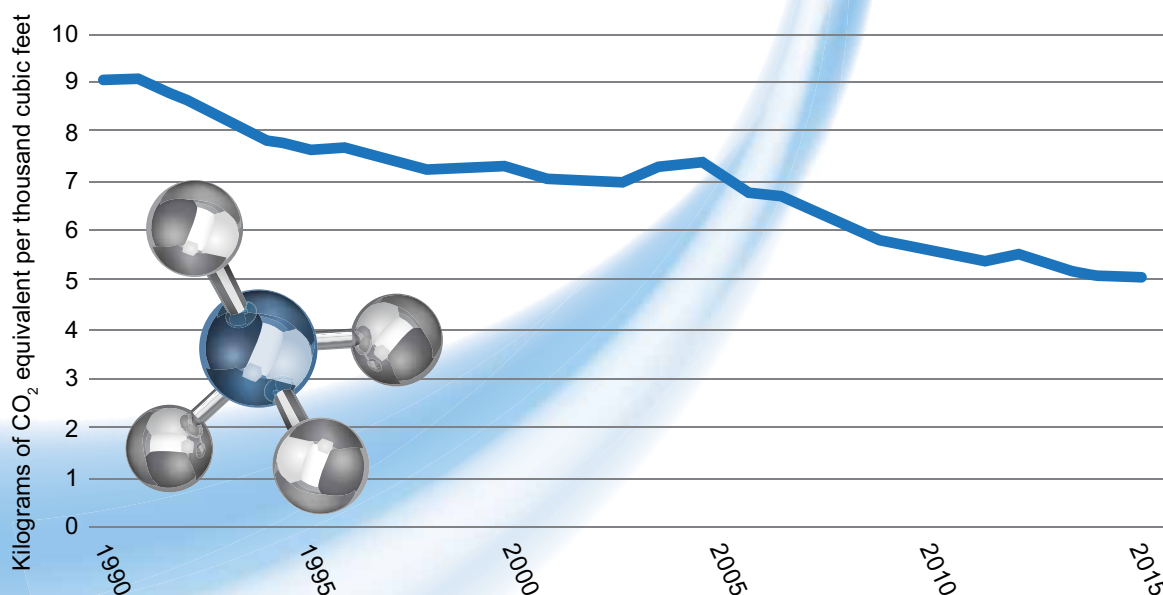
As equipment is replaced and new equipment comes online, the new equipment is typically cleaner and more efficient. The industry has also made significant voluntary reductions, including those made in cooperation with the EPA Natural Gas STAR program, which has reported more than 28 billion cubic meters (equivalent to 1 trillion cubic feet) of methane reductions.

### New regulations

In recent years federal regulation (e.g., New Source Performance Standards) and state regulation (e.g., Colorado Reg 7 and Pennsylvania GP-5) also have resulted in reductions. Nevertheless, there are still opportunities for further reductions.

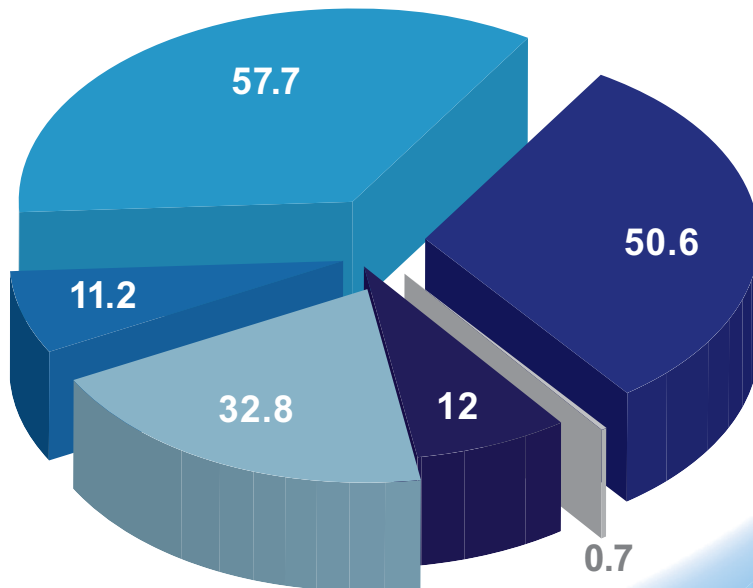
In 2014, ICF completed a study that quantified the opportunities and costs

## Methane Emissions and Natural Gas Production



Source: ICF International

## 2016 Gas Industry Methane Emissions (MMtonCO<sub>2</sub>e)\*



Gathering & Boosting: 57.7

Development & Production: 50.6

Transmission: 32.8

Distribution: 12

Processing: 11.2

Exploration: 0.7

**Total = 164.9 MMtonCO<sub>2</sub>e**

\*Million tons of CO<sub>2</sub> equivalent

Source: ICF International

for methane reductions in the natural gas industries. Since then, the quantification of baseline emissions technologies has improved, new regulations have changed the baseline, mitigation technology costs have declined and new technologies have been developed. Although the specific results of the study could bear updating, they are useful for an initial survey of current opportunities for reductions.

Some of the opportunities, while still cost-effective, are no longer as large because they have now been implemented at many facilities or are now required by regulation. For example:

- Emissions from well completions for hydraulic fracturing are regulated to a high degree of reduction;
- Many high-bleed pneumatic devices have been replaced and low-bleed pneumatics are now required for many applications;
- Instrument air is required in certain applications as a replacement for gas-powered equipment;
- Scheduled rod packing replacement is now required for reciprocating compressors in some applications; and

- Wet-seal compressor emissions are lower than previously thought.

### Management opportunities

Although many of these opportunities might be smaller than projected a few years ago, some of them still might be attractive. In addition, other opportunities that have changed less present good possibilities.

One is leak detection and repair programs and control of nonstandard emission events. Structured periodic inspection and leak detection programs are important to maintaining good equipment performance, identifying equipment problems that create emissions and avoiding intermittent malfunctions that can result in large emissions.

Another such opportunity might be better control of liquids unloading. Well venting to control liquids is a potentially large source of emissions. There are a variety of alternative measures depending on the age and other characteristics of a well, so there is no one solution, but lower emitting solutions exist and should be pursued. New approaches might be required for horizontal wells as they age.

A third opportunity could be replacement of pneumatic pumps. Electric pumps or instrument air can be highly cost-effective alternatives where electricity is available, either from the grid or onsite gas- or solar-powered generators.

Vapor recovery from tanks is still an important option even though more tanks have been regulated in recent years.

Finally, flaring of stranded gas from oil wells could be an opportunity for implementation. Even as flaring is being reduced via improved infrastructure and due to regulation, there are still opportunities to reduce flaring through onsite gas use and/or capturing the gas via compressed natural gas methods or LNG.

Although the emissions are small in the overall inventory, reduction of methane from the natural gas industries can be a cost-effective option. While much progress has been made and is continuing to be made in GHG sustainability strategies, there are additional cost-effective opportunities to pursue. ■

*Joel Bluestein is a senior vice president of ICF International.*



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Substantial new petrochemical capacity in the “Shale Crescent USA” will require extensive new midstream assets in coming years. Source: Shutterstock/P and P Studio



# A New Hub

**Support for the Ohio Valley’s booming petrochemical development challenges the midstream.**

*By Wally Kandel*

**L**ast June, the U.S. Department of Energy (DOE) released its “Natural Gas Liquids Primer” update. The report showcased the incredible potential of the Appalachian Basin as a target for investment for numerous industries—including manufacturing and ethylene or polyethylene projects.

The DOE report projected surging production of natural gas in the Appalachian Basin, now expected to quadruple total eastern U.S. production from 2013 levels by 2050. Because the region is a major wet gas producer, DOE also projects NGL production will increase more than 700% by 2023.

Those trends represent a major market for the midstream over and above outbound gas transmission lines.

#### **New interest**

Ethane, propane, butane and isobutane are building blocks of the petrochemical industry, and the abundance of these resources is drawing newfound interest in the region from the companies that process them.

In 2017, natural gas from the Marcellus and Utica plays accounted for about 30% of total U.S. production. If the developing states in what some call “Shale Crescent USA”—the portions of Pennsylvania, Ohio and West Virginia

along the Ohio River—were a separate country, they would rank third in terms of natural gas production, behind only the entire U.S. and Russia.

With vast NGL resources, the Shale Crescent USA region has become a greater value for investment than the Gulf Coast for ethylene projects, a fact echoed in a recent report by IHS Markit.

The report, “Benefits, Risks, and Estimated Project Cash Flows: Ethylene Project Located in the Shale Crescent USA vs. the U.S. Gulf Coast,” shows an ethylene project in the Ohio Valley region is expected to produce a net present value (NPV) on EBITDA of \$930 million over the life of the project,



Processing and refining along the banks of the Ohio is nothing new. Marathon Petroleum's Catlettsburg, Ky., refinery—where Kentucky, Ohio and West Virginia come together—began operation in 1916. Source: Marathon Petroleum

compared to a NPV of \$217 million for a similar project on the U.S. Gulf Coast.

That's an NPV cash flow advantage of \$713 million for an investment—more than four times higher than in the U.S. Gulf Coast project, using a 15% discount factor.

Over a 20-year period, that divergence is expected to equate to a pre-tax profit advantage of some \$3.6 billion.

#### Profit potential

In simpler terms, it's far more profitable to build a plant in the region than it is on the Gulf Coast, the long-time juggernaut of the petrochemical world.

The advantages of the region were recognized by Shell in its decision to build a \$6-billion ethane cracker outside of Beaver, Pa., near Pittsburgh.

It marks Shell's re-entry into the polyethylene market.

But it's not just the region's natural gas resources that are advantageous to Shell and other petrochemical companies looking to invest. Seventy percent of all polyethylene market demand is within a day's drive, and with delivered costs 23% lower than the Gulf Coast, the opportunity is ripe for a greater return on investment for those looking to set up shop in Appalachia.

**But it's not just the region's natural gas resources that are advantageous to Shell and other petrochemical companies looking to invest. Seventy percent of all polyethylene market demand is within a day's drive...**

More than half of new U.S. resin supplies are expected to be exported to markets in Asia, Latin America and Europe, according to the American Chemistry Council (ACC). As ACC President and CEO Cal Dooley noted, the Ohio Valley "has distinct benefits that could make it a major petrochemical and plastic resin-producing zone ...

proximity to a world-class supply of raw materials from the Marcellus/Utica and Rogersville shale formations and to the manufacturing markets of the Midwest and East Coast has already led several companies to announce investment projects, and there is potential for a great deal more."

The region also has drawn significant investment from Thailand's PTT Global Chemical, which has spent more than \$100 million in engineering and design for a proposed multibillion-dollar ethane cracker plant in Belmont County, Ohio.

All of the data that we have suggests a changing of the guard is underway in the petrochemical industry.

And while the idea of relocating the nation's petrochemical hub may challenge conventional wisdom, the well-thought decisions by several international energy companies that have already chosen Shale Crescent USA as the location for major multibillion-dollar projects should serve as a harbinger of things to come. ■

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*Wally Kandel is senior vice president and Marietta site manager for Solvay Specialty Polymers. He also is a co-founder of the Shale Crescent USA economic development organization.*



Hans-Gerd Brummel works for Siemens AG at its Berlin, Germany, turbine plant. He has received multiple awards for his research into optimizing gas turbines used in the midstream and other industrial applications. Brummel received the firm's Inventor of the Year award in 2016 for his improvements in remote diagnostics and self-learning burner adjustments. *Source: Siemens AG*

# Tops In Technology

**Multiple engineering firms, fabricators, construction contractors and support operations help midstream operators do their job.**

*By Erin Pedigo*

**H**ow far we have come.

Advanced polymers coat new pipe—replacing the “granny rags” of another era. Gas plant valves open and close at the electronic order of a computer half a continent away—in lieu of in-place, out-in-the-weather employees listening for coded whistle blasts.

But the best may be yet to come as the midstream continues to evolve.

The inaugural 2019 issue of *Midstream Business* compiled a selected cross-section of various providers offering an array of services and technology for this segment.

Some are mega-corporations, while others are small, family owned

businesses based out in the oil patch. All focus on offering improved technology in their products and services as evolving advancements promise safer operation, lower cost and greater dependability.

## **Baker Hughes, a GE company**

■ **Houston**

An historic name in the oil and gas business, the news of Baker Hughes becoming “a GE company” remains fresh.

“The world’s first and only fullstream company” for the industry says it offers a suite of equipment and services for LNG and pipeline and storage, which includes

gas turbines, centrifugal compressors, pumps, valves and gearboxes.

One of the biggest players on the service and supply side, in third-quarter 2018, the company had revenue of \$5.7 billion, which was up 7% year-over-year at the time; and GAAP operating income of \$282 million for the quarter.

## **BCCK Holding Co.**

■ **Midland, Texas**

The parent of BCCK Engineering, a global oil and natural gas engineering company, and NG Resources, which handles structural steel manufacturing and fabrication for the oil and gas industry, BCCK is another well-known



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name to those in the midstream. Resources include premium skids, pipe racks, pressure vessels, structural assemblies and cold boxes for gas processing and other industries, according to its website.

According to NG Resources, it completed a facilities expansion, which added more production space and expanded fabrication capabilities.

BCCK Holding entered an engineering, procurement and construction contract with Blue Mountain Midstream LLC recently for the Chisholm Trail cryogenic gas plant in Oklahoma, which serves the Merge, Scoop and Stack areas of the Midcontinent.

## Caterpillar/Solar Turbines

■ Peoria, Ill.

Caterpillar manufactures diesel and natural gas engines, as well as industrial turbines and construction equipment. Its energy-focused arm, Caterpillar Energy Solutions, recently reported it spent 2017/2018 concerned with sustainable energy generation, the security of gas-powered cogeneration power plants, reduction of CO<sub>2</sub> emissions through gas-fired combined-heat-and-power plants, and gas engine testing.

The Mannheim, Germany-based unit provides “customer-specific power plant solutions, complete turnkey systems, container cogeneration plants as well as flexible modular power plants for quick, economical and

eco-friendly deployment on site,” to produce electricity and heat, it says.

San Diego-based Solar Turbines, another Caterpillar subsidiary, provides a suite of services for oil and gas production and gas transmission from engineering/design to commissioning, both onshore and offshore. The company’s more than 50 years’ experience with compressors for gas transmission—having produced more than 6,500 of them—allows “low life cycle costs, high reliability and availability [and] compressor performance is refined through 3-D numerical analysis tools [and] component testing” to maximize “simplicity, flexibility and value,” it says.

## Enduro Pipeline Services

■ Tulsa, Okla.

Enduro Pipeline Services provides services for pipeline inspection, tracking, cleaning and other functions.

Among its offerings is advanced data analysis with its digital flux logger (DfL) and digital data logger (DdL) tools that it says “export data to a suite of advanced software that provides accurate reconstruction of pipeline data in multiple views ... Our software also provides reports with a multitude of output options...”

Enduro’s also maintains a detailed resource library containing charts and spec sheets for technical specialization and data, and other expert areas.

## Gas Equipment Co. Inc.

■ Houston

This firm has six segments specializing in the needs of NGL and gas suppliers and refiners, from LP gas and ammonia to project-ready electronic and software systems that include radio frequency identification and emergency stop and mobile fleet fueling.

The company provides catalogs of equipment for cryogenic and industrial gas, LP/ammonia and cylinder and automotive gas segments, and also offers services and training in the field.

It also boasts its GasEquipmentTV channel on YouTube, which features playlists of product demonstrations and the “MinuteMan Anchors” segment.

## GE Power

■ Massy, France

The General Electric Co. is one of the best-known providers of high-technology equipment for multiple industries, including oil and gas.

Its GE Power’s gas power systems segment, which handles gas power plants, gas and steam turbines, and generators, is focused on achieving “the right balance between power plant performance and environmental sustainability,” converting “the full spectrum of liquid and gas fuels to energy,” the firm says.

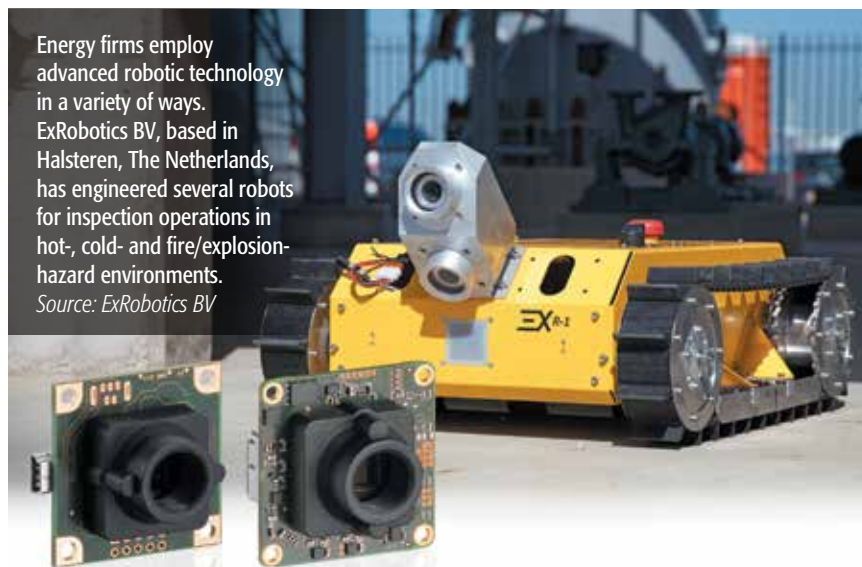
“Gas is the fastest-growing of the fossil fuels and, within the next 18 years, is forecast to become the single-largest source of installed capacity,” it says.

“Gas turbine power plants serve as a complement to intermittent renewables generation, offering such valuable features as rapid start, output flexibility and turndown capacity,” it adds.

## Henkels & McCoy

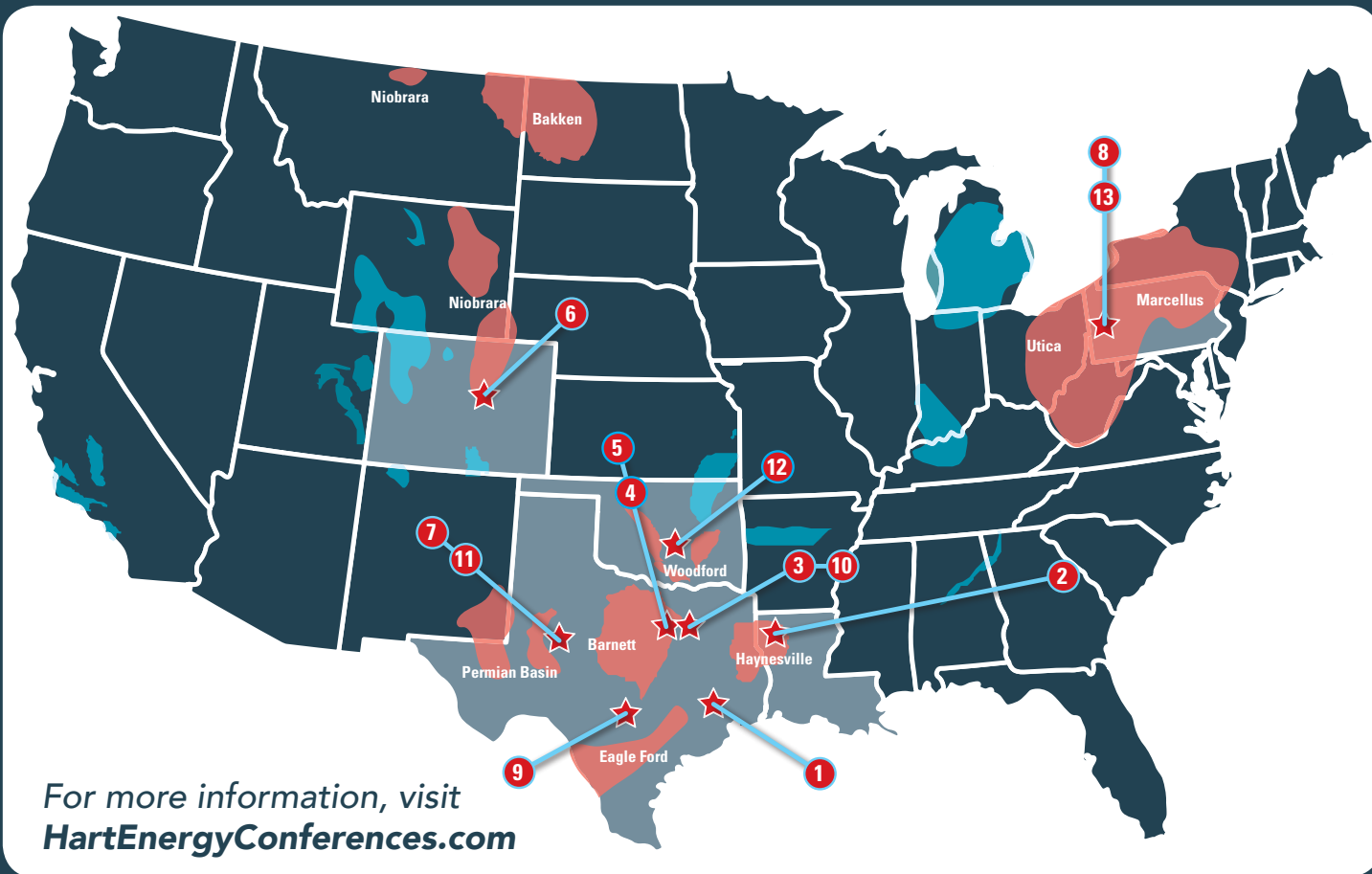
■ Houston

This general contractor boasts of “building the pipelines that fuel the country. ... Henkels & McCoy has been at the center of this vital element of infrastructure development for more than half a century.”



Energy firms employ advanced robotic technology in a variety of ways. ExRobotics BV, based in Halsteren, The Netherlands, has engineered several robots for inspection operations in hot-, cold- and fire/explosion-hazard environments. Source: ExRobotics BV

# 2019 Hart Energy Events



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- 2**

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**DUG**  
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- 3**

**energy capital**  
CONFERENCE

**March 5**  
Dallas, TX
- 4**

**DUG**  
SAND and WATER

**April 15**  
Fort Worth, TX
- 5**

CONFERENCE & EXHIBITION  
**DUG**  
PERMIAN BASIN

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**DUG**  
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TEXAS

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## MIDSTREAM EVENTS

From gathering and processing to transportation, storage and exports, the midstream conferences connect operators, service providers and their financial partners to core issues affecting midstream business.

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**MIDSTREAM**  
TEXAS  
**June 5 – 6**  
Midland, TX  
[MidstreamTexas.com](http://MidstreamTexas.com)

NEW DATES

**MARCELLUS-UTICA**  
**MIDSTREAM**  
CONFERENCE & EXHIBITION  
**Dec. 3 – 5**  
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## Key Players

The firm has an established record in building a variety of projects, including gathering and transmission lines.

“We have the project management skills and experience to help our customers engineer and build safely and efficiently, while navigating the increasingly complex regulatory environment. We take great strides to minimize impact on communities and meet all environmental compliance requirements throughout the engineering and construction process,” it says.

According to a September 2018 press release, Henkels & McCoy ranks eighth in the Top 600 Specialty Contractor list by the *Engineering News-Record*. In addition to its oil and gas pipelines, the company also works in gas distribution.

The range of services for both sectors includes emergency management, project management, construction, design and maintenance.

### Honeywell International Inc.

#### ■ Charlotte, N.C.

A well-known technology focused conglomerate, Honeywell makes a variety of commercial and consumer products, engineering services and aerospace systems for a wide variety of customers, from private consumers to major corporations and governments.

The conglomerate does plenty of work in the oil and gas midstream, from refining and petrochemicals to adsorbents, to personal safety equipment and security.

One major project is for China’s Zhejiang Petrochemical Co. Ltd., which will use process technology from Honeywell “for the second phase of an integrated refining and petrochemical complex in Zhoushan, Zhejiang province,” Honeywell announced. “This second phase of the complex by itself will process 20 million tons per year of crude oil and produce another six million tons per year of aromatics when completed.

A subset of Honeywell, Elster American Meter, provides “metering solutions, smart meter systems and a complete line of gas distribution products that allow installers to make safe, fast and easy connections from



Pipeline construction firms and midstream operators have adapted the bar code technology retailers use to check out customers to track pipe inventory and joint placement during construction. *Source: T.G. Mercer/Spread Boss*

main to meter and tank to home.” It is part of Honeywell’s Smart Energy line of products and services.

### Holland Services

#### ■ Fort Worth, Texas

This land services company provides midstream-focused oil and gas lease sale negotiation and acquisition services, including title, due diligence and right-of-way, it says.

In late 2018, the company expanded its right-of-way and surface land services that would “utilize cutting-edge technologies, along with sound processes, to set the benchmark for speed and efficiency in land acquisition, abstracting and due diligence for pipelines and midstream, temporary and permanent waterlines, water impoundments, source points, well pads, containment facilities, communication towers and overhead transmission lines,” it said in a recent announcement.

### Jasper Ventures Inc.

#### ■ Whitehouse, Texas

Based in a Tyler, Texas, suburb, Jasper Ventures Inc. is comprised of Veritas Gas Processing, Vulcan Field Construction, Vanguard Processing Solutions and Viking Dew Point Conditioning.

Veritas Gas Processing “provides engineering, design, fabrication, and assembly of cryogenic gas processing

plants, NGL fractionation, crude oil stabilization, and other midstream-related processing equipment. In the past decade, the owners of Veritas have been involved in the engineering and design, fabrication and assembly, and installation of over 30 projects,” it says.

Vulcan Field Construction “delivers expert project management and installation teams to complete the construction, commissioning, and startup of Veritas-designed and fabricated cryogenic gas processing plants, as well as project management and installation teams for other gas processing plant projects.” Jasper’s Vanguard Processing Solutions provides staffing to manage cryogenic gas processing facilities, while Viking Dew Point Conditioning provides mechanical refrigeration units to clients.

### Linde Plc

#### ■ Guildford, England

The international conglomerate’s Linde Gases Division offers plant and pipeline services for the midstream sector, including “testing, piping, pigging and drying of existing and new pipelines—especially in challenging, off-road locations—to managing plant turnarounds and maintenance/repair/overhauls.”

The company also boasts a major industrial gases supply operation, application solutions, hardware and other technical services.



## Siemens AG

### ■ Munich

A longtime player in the worldwide oil and gas business, this German conglomerate's products and services include a line of gas turbines and related equipment and support.

Other energy industry products and services it provides include water management and communications and control technology.

## SNC Lavalin

### ■ Montreal

Engineering and construction firm SNC Lavalin has more than 100 years' experience in the oil and gas sector.

In September 2018, the company's oil and gas sector operations won a framework agreement to develop the big Mishrif and Yamama formations of the West Qurna 2 oil field in Iraq, a three-phase undertaking.

The Canadian firm has a major presence in natural gas processing and LNG plant design and operation.

## Stupp Corp.

### ■ Baton Rouge, La.

The company produces pipe for "oil, gas and associated products" throughout the U.S. and Mexico to advanced specifications.

According to its website, Stupp holds the oldest active American Petroleum Institute pipe specification license in the U.S. The firm says it tests every joint of high-frequency welded pipe to ensure strength and has a state-of-the-art radiography unit.

## TD Williamson Inc.

### ■ Tulsa, Okla.

The company provides services for hot tapping and plugging, pipeline pigging, pipeline integrity and inline isolation for pipeline projects. It says it offers an array of pigging products, including trackers and transmitters, and offers non-destructive evaluation tests for inline inspections.

Hot tapping products and services include fittings and valves, repair and hot tap welding.

The firm is on its third generation as a family business, led by Chairman Emeritus Richard Williamson.

## T.G. Mercer Consulting Services

### ■ Aledo, Texas

T.G. Mercer is a long-time expert in pipe transportation, pipe unloading, pipe handling and pipeline logistics for the oil and gas construction industry. "We have consistently added to our knowledge and resources as well as utilized emerging technologies to improve our services," the company says.

Its services include state-of-the-art tagging and integrity management with its SpreadBoss bar code software, as well as the right-of-way surveying expertise through its Mercer Technical Services unit.

The firm is a subsidiary of Quanta Services.

## Tuboscope NOV

### ■ Houston

This high-technology segment of National Oilwell Varco provides "newest-generation technologies and services for inspection, corrosion control, hardbanding, machining, line pipe connection systems, artificial lift technologies, rope access and derrick services, and asset management," it says.

## Weldbend

### ■ Argo, Ill.

Weldbend manufactures carbon steel fittings and flanges for the industry, from half-inch to 60 inches. It is a member of several organizations including ASTM and the Manufacturers Standardization Society.

The company's website provides downloadable catalogs of products it offers, including elbow presses, fitting finishing machines, concentric reducers and flanges.

A welder finishes work on a panel made of an aluminum alloy fabricated for a non-ferrous metal application. LNG plants and other advanced processing facilities require a variety of specialized metals.

Source: Linde Group



In October 2018, Weldbend began installation of a 1.2 million pound cold-form tee press, "the largest cold-form tee press in the Americas and Western Europe that will significantly expand Weldbend's forging capabilities," it announced. "The machine will be able to forge up to a 20-inch XS Tee with material grades including Y70."

## Willbros Group Inc.

### ■ Houston

One of the sector's major contractors, this construction engineering company's oil and gas segment of pipeline and facility construction and maintenance offers such plant services as meter and pump stations, storage facilities, cryogenic plants, measurement systems and manifold systems.

The oil and gas group's services also include construction of wellpad installations, new transmission pipelines and midstream gathering systems.

In June 2018, Dallas-based Primoris Services Corp. acquired Willbros. ■

*Erin Pedigo can be reached at [epedigo@hartenergy.com](mailto:epedigo@hartenergy.com) or 713-260-4631.*

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1. US Energy Information Administration, Short Term Energy Outlook, September 12, 2018.