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Message from the editor Shayna Wiwierski

It was reported earlier this year that North Dakota oil exports were up last year.

Coming in at an overall \$1 billion, for a total of \$6.8 billion in tracked exports, North Dakota saw an increase of 16.2 percent above 2017 numbers. So what does that mean for the oil industry in the Bakken? Well, North Dakota is one of the top regions in the country for export growth.

In this issue of the *Bakken Oil Report* magazine, we explore where the industry is going and the various legislative topics that revolve around our controversial industry. A report by the Outdoor Heritage Fund (OHF) on page 14 takes a look at the OHF funds for the Bakken Development and Working Lands Program, which enhances landowner opportunities where energy development has occurred and provides options for grazing and land-use management. We also have a report by Meridian Energy on page 20, who is currently building the Davis Refinery, a greenfield project, which will be the most efficient, smartest, and ultramodern refinery ever built.

Of course, we also have all the regular features that we know you, dear readers, have come to know and appreciate. I hope you enjoy this issue of the *Bakken Oil Report* magazine and as always, if you have any story ideas, comments, or questions, please feel free to leave me a note.

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Advancing an all-of-the-above approach to reduce emissions while maintaining America's energy dominance

By Senator John Hoeven

Thanks in large part to the shale oil revolution in states like North Dakota, America has emerged as a dominant force in global energy production. Earlier this year, Rystad Energy projected that the U.S. will likely be the world's largest exporter of oil, natural gas liquids, and petroleum products by the third quarter of this year, surpassing Saudi Arabia and Russia. Further, the nation is set to export more energy than it imports in 2020, the first time since 1953, according to a recent report from the Energy Information Administration (EIA). These developments did not happen by accident, but came about due to our efforts to advance an all-of-the-above approach to energy development for our nation. That's what we did when I was governor of North Dakota. This has made our state the nation's second largest producer of oil and gas, and throughout my tenure in the U.S. Senate, I've worked to bring this same approach to the national level.

However, in order to build on this success, we need to reject the radical agenda that is being offered by some on the left. In March, I joined my senate colleagues in voting down the Green New Deal resolution, which is an attempt to completely eliminate affordable, traditional energy sources. Moreover, it proposes a federal government takeover of a significant portion of the economy, far beyond the energy sector. This would bankrupt our country, costing between \$51 and \$93 trillion over 10 years, increasing electric bills by \$3,800 per year for consumers and requiring families to spend up to \$30,000 on mandatory home energy efficiency renovations. Unworkable agendas like this are a distraction from other realistic and bipartisan efforts to produce more energy with fewer emissions.

One such effort is the ongoing development of carbon

capture and sequestration (CCS) technology. The Energy and Environmental Research Center (EERC) at the University of North Dakota has been hard at work for well over a decade to crack the code on this technology, establishing its feasibility and making it commercially-viable for both traditional and renewable energy sources. For example, along with its partners, EERC is working to advance:

- Project Tundra, a post-combustion technology to retrofit existing power plants, being led by Minnkota Power, as well as BNI Coal and Allele Clean Energy.

As a member of the Energy and Water Development Appropriations Committee, I have secured federal funding to help bolster investment into CCS by private industry and our state. At the same time, I am working on bipartisan legislation that will ensure CCS projects can make better use of federal tax credits, like my Carbon Capture Modernization Act, and to reintroduce my All-of-the-Above Federal Building Energy Conservation Act, which would ensure that federal buildings are able to use efficient energy sources like natural gas with the new energy efficiency standards.

We're committed to advancing these solutions because it is possible to responsibly develop all of our nation's energy resources while also being good stewards of the environment. In fact, implementing CCS won't just reduce emissions here at home, but it will also have global benefits as we export this technology to other nations. All the while, we will continue to have a vibrant, strong economy in the U.S., where families and businesses can enjoy the benefits of affordable and reliable energy, as well as the good-paying jobs provided by our energy sector. ▀



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Making the case for energy infrastructure

By Robin Rorick, vice president of midstream and industry operations, American Petroleum Institute

Pipelines are one of the safest ways to deliver the energy that American families and consumers use every day. As an industry, expanding and upgrading U.S. energy infrastructure is a top priority. Unfortunately, this issue has more than its fair share of hurdles – from inefficient and unclear permitting processes to potential trade barriers like quotas and steel tariffs – which is why our industry must continue pushing this message to the forefront of the conversation.

Infrastructure development has garnered bipartisan support, offering the opportunity for action that will benefit the American people. Yet, despite this, pipeline infrastructure development is still being restricted by unnecessary permitting delays and other political barriers, and Americans in some parts of the country

have been left critically under-served as a result.


The recent presidential permit for construction of the Keystone XL pipeline was a stark reminder of the herculean effort it can take to build critical infrastructure in the face of inefficient and ever-changing bureaucratic red tape. The Keystone XL project is critical to U.S. consumers and energy security. It has also undergone more than 10 years of extensive environmental review, including a total of six assessments by both the Obama and Trump administrations – all of which concluded that Keystone XL is safe to build. In fact, the last environmental review conducted by the State Department concluded that the pipeline's revised route would have "no significant direct, indirect or cumulative effects

on the quality of the natural or human environments."

Production in the Bakken reached 1.4 million barrels per day in January, and that number is expected to rise. While current pipeline capacity covers 1.3 million barrels, and the Bridger/Phillips 66 Liberty Pipeline should come online by the end of 2020 with an added 200,000 barrels per day of capacity, growth in production is expected to quickly outpace that growth in take-away capacity. Fortunately, North Dakota has a lot of rail terminal capacity, but this option comes with additional financial considerations and difficulties securing rail cars could still limit take-away capacity.

Promoting energy infrastructure across the nation could support one million jobs per year through 2035, add \$1.89 trillion to the U.S. economy, and enhance our national security. Approval of the Keystone XL pipeline would alone bring an estimated 30,000 jobs to the Bakken. Increasing efficiency, transparency and certainty in federal permitting is important to align needed oversight with responsible and timely action on vital projects. Perhaps that's why 84 percent of Americans support the increased development of the country's energy infrastructure.

New or expanded pipeline capacity will ensure that Americans in all regions can benefit from U.S. energy abundance. The exceptionally long approval process for Keystone XL should remind policymakers at all levels that a clear path must be developed to ensure our nation's infrastructure needs are met. ▀




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ND Legislature okays Operation Prairie Dog

Infrastructure bill to help meet workforce needs



Senator Rich Wardner (center) celebrating with Governor Doug Burgum and a number of legislators at the bill signing ceremony.

Legislation that outlines the formula for distributing North Dakota's five percent gross production tax on oil, including new infrastructure dollars for non-oil communities, has been signed into law by Gov. Doug Burgum.

House Bill 1066, dubbed Operation Prairie Dog by Senate Majority Leader Rich Wardner, provides a share of GPT revenue to the political subdivisions in western North Dakota impacted by oil development. The legislation also includes for the first time a direct allocation of oil tax revenue to non oil-producing regions to address their infrastructure needs. Wardner, a Republican from Dickinson, came up with the name for the funding package because the tunneling rodents are good at building infrastructure.

The bill is the outgrowth of an interim legislative study to determine the ongoing need to provide funding to the "hub cities" of Dickinson, Minot, and

Williston. While the study reaffirmed the need, Wardner was met with less than enthusiastic support from his colleagues in eastern North Dakota.

"Everywhere I went I kept hearing the same thing," Wardner said. "People asked, 'when do we get ours, we have needs too.'"

Wardner said the needs around the state are undeniable, so to garner support for funding the west, he teamed up with Rep. Al Carlson, the Republican majority leader from Fargo. The two, with the help of other legislators from the Bismarck-Mandan area, put together a plan to help meet infrastructure needs statewide. The end result is three new "buckets" in the tax distribution formula that will dole out \$250 million around the state.

The plan includes a \$115 million bucket for cities that will be distributed based on population and rate of growth, as well as \$115 million for counties and townships

that will receive money based on a road and bridge needs study. The final piece is a \$20 million bucket for airport infrastructure to be administered by the state Aeronautics Commission.

The legislation contains strict guidelines that the dollars are to be spent only on critical infrastructure projects which are defined in the bill. Wardner sees it as an opportunity to spruce up North Dakota communities, and make the state a more attractive place to live and work.

"Workforce is one of our biggest issues in the state of North Dakota, having enough people to fill those jobs," Wardner said. "If we can have good infrastructure in these cities, it's going to make a difference. People are going to say, 'I want to live there, they've got a nice community.'"

Important to western communities, the legislation retains a 70-30 state-local split of oil tax revenue. It provides a guaranteed minimum funding level for the hub cities because they all have debt to repay. But beyond that, the amount of revenue received by the political subdivisions will ebb and flow based on oil price and production.

One of the most important components of the bill is what's missing – it does not have a sunset clause. That means unless the legislature acts to change the formula when it meets again in 2021, the revenue distribution formula will continue to deliver funding in future years throughout the state. Legislative leaders say that's a good thing because it provides certainty to communities, allowing them to plan for the improvements they intend to make. ▀



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Conservation in the Bakken

North Dakota's Outdoor Heritage Fund (OHF) was established in 2013 as a multi-million dollar program to provide grants to state agencies, tribal governments, political subdivisions, and non-profit organizations, with higher priority given to projects that enhance conservation practices in this state by: providing access to private and public land for sportsmen; improving water quality, soil conditions, plant diversity, and animal systems; conserving and restoring wildlife and fish habitat; and conserving natural areas and creating other areas for recreation. Since its inception, the program has funded 145 projects totaling over \$41 million. In 2018, the North Dakota Industrial Commission awarded \$2.17 million of OHF funds for the Bakken Development and Working Lands Program (BDWLP) to enhance landowner opportunities where energy development has occurred and provide options for grazing and land-use management.

A unique feature of the BDWLP is that it partners with many different groups and organizations. During the winter of 2018/2019, several meetings were held with landowners, local NRCS and soil conservation districts, state agencies, and non-profits to review program capabilities and determine the optimal approach for serving landowners in oil-producing counties. For example, the expertise of your local NRCS/SCD office will have the ability to reach out to producers and guide them through program details. The Department of Mineral Resources (DMR) will continue to utilize the Abandoned Oil & Gas Well Plugging & Site Reclamation Fund to reclaim abandoned wells and well sites, but by partnering together with the BDWLP, the entire surrounding area will be revitalized. This will give producers options to enhance

Grass Seeding

- Length of agreements:

- Native 10 years
- Tame grass five years

- Cost share 60/40

- Landowner is responsible for 40 percent of the total cost. This can include the following as in-kind: seedbed preparation, seed planting, and seeding stand management
- Native plantings can be grazed, following the establishment period, but no haying until after July 15th (primary nesting season).

Grazing Systems – Fence and Water Developments

- 60 percent BDWLP and 40 percent landowner

- Fence Developments

- NRCS specifications used for rate calculations
- Will provide boundary fence cost-share on a case-by-case evaluation
 - No boundary fence on crop acres

- Water developments

- 60 percent of documented costs (receipts must be provided)

- Must follow approved grazing plan

their grazing systems and will create habitat on irregular lands near development sites and enhance the grassland ecosystem and the agricultural economy in the entire region.

The project will also create urban nature/interpretive sites near towns within the Bakken. Watford City will begin enhancement of walking trails, native grass and flower sites, and other public areas this summer. Another site is being planned for the community of Dunn Center. Public and private partnerships will be created to restore, maintain, and enhance native prairie ecosystems that contribute to native species conservation, as well as conservation of the ranching culture.

There are diverse landowner benefits available through this program, such as assistance with prescribed grazing strategies, recommendations for cover crops that would be well-suited for grazing and soil rehabilitation, establishment of vegetation and habitat by energy development sites, and/or establishing vegetation and habitat around energy development sites.

Grassland Establishment Incentives Program (GEIP)

- Available for native grass plantings only

- All agreements with GEIP will be 10 years

- \$50 per acre for two years (equating to a one-time payment of \$100/acre)
- The payment will be made after confirmation that grass is seeded

Agricultural – Energy Projects

- *Combination of all practices can be utilized*
- *Invasive tree removal (Russian olive, Siberian elm, eastern red cedar, Rocky Mountain juniper)*
- *Grass and cover crop plantings*
- *Saline cleanup (non-legacy sites)*
- *Land reclamation on private lands where there is no responsible party*
 - Slumping of reclaimed pipeline right of ways
 - 60/40 cost share - BDWLP will pay for 60 percent and landowner will provide 40 percent. Seedbed preparation, seed planting, and seeding stand management can be used as in-kind contributions toward the 40 percent
 - BDWLP will pay 60 percent of fencing on per foot NRCS specifications
 - GEIP applicable for native grass seeding

Cost-share is available for grass seeding (which may include payment during the establishment phase), installation of range infrastructure, and implementation of restoration activities. An example of cost-share structure would be 60/40 on cross fence and water infrastructure to create a rotational grazing system, along with technical assistance in developing the grazing plan.

Access to this program is available from a variety of resources. Supporting partners are available through NRCS, local soil conservation district offices, and the ND Natural Resources Trust (NDNRT). If you have a piece of property that you're interested in having assessed to see whether this program would be a good fit, contact any one of those resources and they can help make that determination. Visit the NDNRT website for the summary brochure for more information and resource contact details at www.ndnrt.com/image/cache/BDWLP_Promo_Brochure_w-partners_list.pdf.

You can also contact Jesse Beckers, conservation program coordinator with the ND Natural Resources Trust at (701) 223-8501, or Jesse@NaturalResourcesTrust.com. ▶

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- *One-year agreement length*
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- *Only season-long plantings*

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Another way to view the Bakken oil play

By Bette Grande

The Bakken in western North Dakota is, and always will be, a tight oil play. The associated gas has been an afterthought at best and more often, a headache for producers. I have written previously about the challenges of dealing with associated gas in the Williston Basin but recent information from the U.S. Energy Information Association (EIA) puts Bakken gas production in a new and interesting light.

On March 12, 2019, the EIA released a report, *U.S. natural gas plant liquid production continues to hit record highs*

and the Bakken plays a significant role in this increased production. The report shows that the production of natural gas plant liquids (NGPL) has increased from 2.5 million barrels per day in 2012 to 4.3 million barrels per day in 2018.

The Bakken is just the fifth-largest region in the United States for NGPL production, but it had the highest rate of growth over that seven-year time period growing from 19 million barrels per day in 2012 to over 93 million barrels per day by 2018. That growth is staggering.

But the real eye opener from the EIA report was that the Bakken has by far the richest natural gas with an average yield of 143 barrels per million cubic feet (b/MMcf) compared to the U.S. volume weighted average of 84 b/MMcf. The Eagle Ford has 107 b/MMcf and the Permian 95 b/MMcf in comparison.

The Bakken is not without its challenges and perhaps the biggest challenge is logistics. The Bakken is a long way away from fractionation plants in Texas and Kansas. And, the



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produced natural gas must be processed before the NGPLs can be delivered for final processing.

The growth in production of associated gas in the Bakken, combined with the high yield available, has led to the investment of billions of dollars in gas processing facilities and gas transportation infrastructure. In fact, according to a report in the Bismarck Tribune on December 25, 2018, Ron Ness, president of the North Dakota Petroleum Council, estimated that the industry has invested \$18 billion in gas capture and processing infrastructure so far. And significant additional investment is planned.

Additional gas processing plants are being planned and built. Plans have been submitted for seven new plants over the next seven years. There will be three new plants online by end of 2019, two more by 2020, and two more again by 2025. Each of these will require at least \$4.5 billion per plant, including the gathering and transportation pipelines.

As an example of new pipeline activity related to Bakken gas, the *Bismarck Tribune* reported on January 27, 2019 that WBI Energy, a subsidiary of MDU Resources Group, plans to construct the North Bakken Expansion Project, adding 67 miles of pipeline in Williams and McKenzie counties to transport gas processed at a plant near Tioga, ND to connect with the Northern Border Pipeline in McKenzie County. Similar projects dot the region.

This level of activity and investment makes sense in light of the data from the EIA. Gas processing in the Bakken is a significant value-added story that too often gets lost with the understandable focus of crude oil production.

Based on information prepared by the North Dakota Pipeline Authority, gas processing capacity in North Dakota will be just under 3,100,000 MCF/day by the end of 2019, up from just over 2,400,000 MCF/day at the end of 2018. And, based on numbers just released, producers will need all of that increased capacity. The March 2019 Directors Cut from the North Dakota Department of Mineral Resources reported that gas production in January 2019 hit an all-time high of 2,720,006 MCF/day.

Is all of this investment in natural gas processing and transportation going to pay off? Judging by the growing export markets, the industry thinks so.

Late last year, the *Houston Chronicle* ran a three-part article on natural gas production in the Gulf Coast and, specifically, the value of ethane. From Part 3, "Nobody could have foreseen the U.S. becoming a major exporter of plastics," said Neil Chapman, a senior vice president at Exxon Mobil. "It's a byproduct of shale gas. That is what's truly amazing about this breakthrough."

The *Houston Chronicle* feature focused on Texas gas production, but it also applies directly to the Bakken. While associated gas production is small compared to oil production in the Bakken, the gas, especially in the core Bakken area, is very wet, with ethane and propane being as significant components.

Yes, the Bakken is a tight oil play and it always will be. But, the rich, wet gas associated with the play is turning out to be a nice kicker even with the challenges.

Bette Grande is a research fellow, energy policy at The Heartland Institute. ▀

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North Dakota Industrial Commission approves updated Crude Oil Conditioning Standards

The North Dakota Industrial Commission has consistently made safe transportation of crude oil top priority, while maintaining market value and minimizing the footprint of production and transportation infrastructure. The vapor pressure of crude oil and crude oil conditioning was brought to the forefront around 2013 in the news, regulatory hearings, and legislative proceedings as a result of rail accidents involving trains carrying Bakken crude. These accidents rightfully drew attention to how Bakken oil is produced, processed, and transported from the well site. It appeared to many that there was something unique or different about Bakken crude which was causing it to be “more volatile” should an accident occur. This led to an increased discussion around safety regulations. Cue vapor pressure.

In its most simple definition, vapor pressure is the pressure measured when the first bubble of vapor is formed at a given temperature. For example, if you keep your oven at 350 degrees and place a skillet of water into the oven, the vapor pressure would be calculated when the first bubble is formed in the skillet.

Oil conditioning is the process operators can take to use temperature and pressure changes to produce crude oil which does not exceed a specific vapor pressure measurement. This conditioning process can be done with little to no additional surface footprint as high vapor pressure components are conditioned off the oil as natural gas and transported through existing or planned

pipelines to existing or planned natural gas processing facilities.

The North Dakota Industrial Commission, in December 2014, consisting of North Dakota Governor Jack Dalrymple as chairman, Attorney General Wayne Stenehjem and Agriculture Commissioner Doug Goehring, approved the state’s first crude oil conditioning requirements. Over the course of the regulatory review in 2014, it was determined that North Dakota’s oil conditioning standards should follow the standard of measurement used for crude oil: Vapor Pressure of Crude (VPCR). In addition, the national standard for stable crude oil is a VPCR ≤ 14.7 psi. The North Dakota standard requires that crude oil does not exceed a VPCR 13.7 psi at the point of custody transfer. Allowing for a vapor pressure of ≤ 13.7 psi or less adjusts for an error margin of one psi in the sampling procedures and measurement equipment, thus assuring the crude oil is stable even if errors are made in sampling and vapor pressure measurement.

After three years of collecting data under the commission’s 2014 order, analysis of that data supported the need for amendments to be made. A notice of the proposed amendments was published by the commission in early September 2018, written comments were accepted, and a public hearing was held prior to issuing a decision. Amendments were approved January 2019 in Commission Order No. 29398, including the addition of a commission-approved oil conditioning policy/

guidance that aims to continue the safe transportation and marketability of crude oil while more efficiently using the state’s resources. One part of the new policy/guidance is the approval of a waiver of vapor pressure testing should the oil and gas operator provide a sworn affidavit that the crude oil transporter is implementing a tariff specification as stringent as the commission’s current VPCR4 requirement. The approved order does not change the safety threshold requiring that VPCR not exceed 13.7 psi.

These new changes to North Dakota’s crude oil conditioning process will continue to produce a consistent and safer product for shipment to crude oil markets while utilizing the existing Bakken producer infrastructure footprint.

The reality is however that the vapor pressure of crude oil from the Bakken or from other resources is not the primary cause of the incidents that made news across the country. Keeping the VPCR less than 13.7 psi should reduce the severity of an incident should one occur, but it is just one of many layers required to maintain safe transportation of crude oil. Other safety measures include new tank car specifications, improved railway operating practices, track maintenance, increased pipeline takeaway capacity, and efficient regulatory oversight.

The updated North Dakota Industrial Commission Guidance of Oil Conditioning can be found on the Oil and Gas Division’s website at www.dmr.nd.gov/oilgas under Policies & Guidance. ▀

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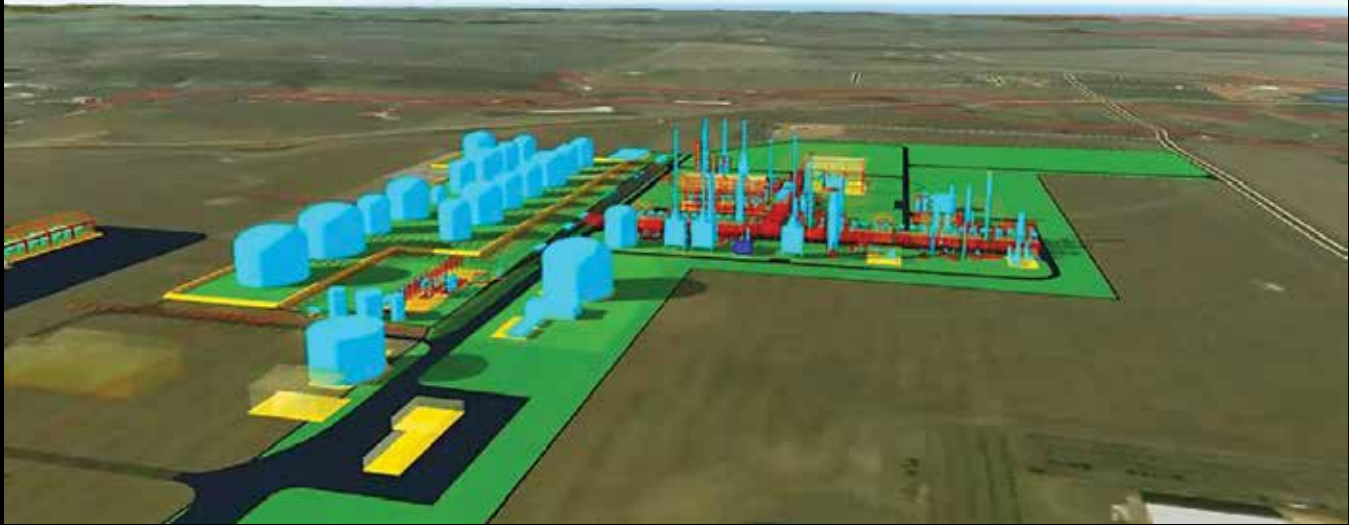
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**REYNOLDS
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How a refinery is leading the way to a clean energy future

By Meridian Energy Group Engineering staff & partners



Meridian's Davis Refinery in the Bakken has the distinct advantage of being a greenfield project, which will be the most efficient, smartest, ultramodern refinery ever built. It utilizes a distributed business model, self-funded and completely independent in its design and operation. The Davis Refinery will serve as Meridian's winning formula in future Shale Basin projects in the coming years. Davis is designed to meet the requirements of the State of North Dakota's Department of Health (NDDoH), among the strictest in the U.S. Additionally, it was designed to meet Class 1 EPA air quality standards.

The Davis physical and operational design includes implementation of state-of-the-art, lowest achievable emission rate (LAER) technology, and air pollution control equipment considered best available control technology (BACT) to minimize emissions throughout the plant. In fact, Meridian's design for Davis includes BACT requirements and controls that are considered maximum achievable control technology (MACT) within the industry.

A greenfield refinery like the Davis Refinery is not burdened with the need to make the new operating units work in

conjunction with pre-existing legacy operating units that might also represent old technology. This will ensure that the Davis plant can leverage the latest technology from the ground up and can much more easily and efficiently comply with modern environmental and safety requirements. Clean fuels technology leveraged in the Davis Refinery will ensure its operation and products comply with all regulatory requirements for the duration of its operational lifecycle.

ADVANCED DETECTION TECHNOLOGY

Meridian will ensure the required strict air quality standards are met with a comprehensive and enhanced Smart LDAR program which will be used to monitor fugitive emissions throughout the plant. This innovative solution greatly exceeds the current minimum regulatory requirement, which mandates periodic (monthly or quarterly) walkthroughs of the facility. This will minimize any potential sources of unintended leaks, which usually account for a large percentage of hydrocarbon emissions at refineries.

For this reason, and to minimize the potential for unintended leaks at the Davis Refinery, Meridian's LDAR program will utilize OGI (Optical Gas Imaging technology) to continuously

OUR REVIEW

Emission Calculation Review

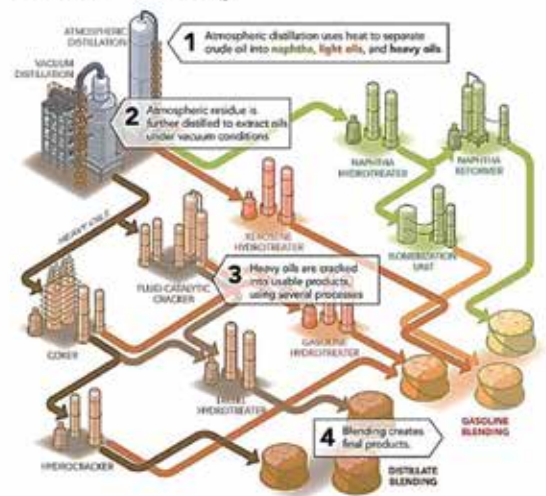
- Reviewed calculations
- Verify that emission factors used to calculate PTE are achievable in practice.

Technology

- Uses Hydrocracking Unit vs. FCCU
- Selective Catalytic Reduction
- Continuous Emissions Monitors (CEMs)
- Optical Gas Imaging (Camera)
- Fenceline Benzene Monitors

CONTROLS REQUIRED ON DAY ONE

Crude Oil Refining



Example Diagram, not Meridian Davis Refinery

scan the facilities. While fugitive gases are normally invisible to the human eye, OGI cameras employ specialized infrared filters which allow them to “see” gas should it ever escape. The Smart LDAR proposed by Meridian will allow automated early detection and notification of unintended leaks as they appear, and the visual confirmation provided by OGI will be extremely useful in pinpointing the exact source to begin the repair process immediately. Since 2015, OGI has been identified by the U.S. EPA as the “Best System of Emission Reduction” for detecting fugitive emissions from new equipment installation, upgrades, and modified sources.

Meridian is implementing a significant level of monitoring of emission levels via both an enhanced LDAR program, as well as stack test data and in-stack continuous emission monitors at all major point sources throughout the plant. In addition, though not required by regulation, Meridian has also decided to install perimeter fence monitors at the site to further ensure compliance with National Ambient Air Quality Standards. At the time that the Davis Refinery starts operations, there will be no other facility in North Dakota that will have as much monitoring in place, monitoring that is also specified by the permit to construct issued. Due to the significant level of controls that are being installed on the facility throughout the plant, the emissions are at levels that would be equivalent to a small concrete batching or asphalt plant, or less than 10 pump jack operations.

SOFTWARE SYSTEMS

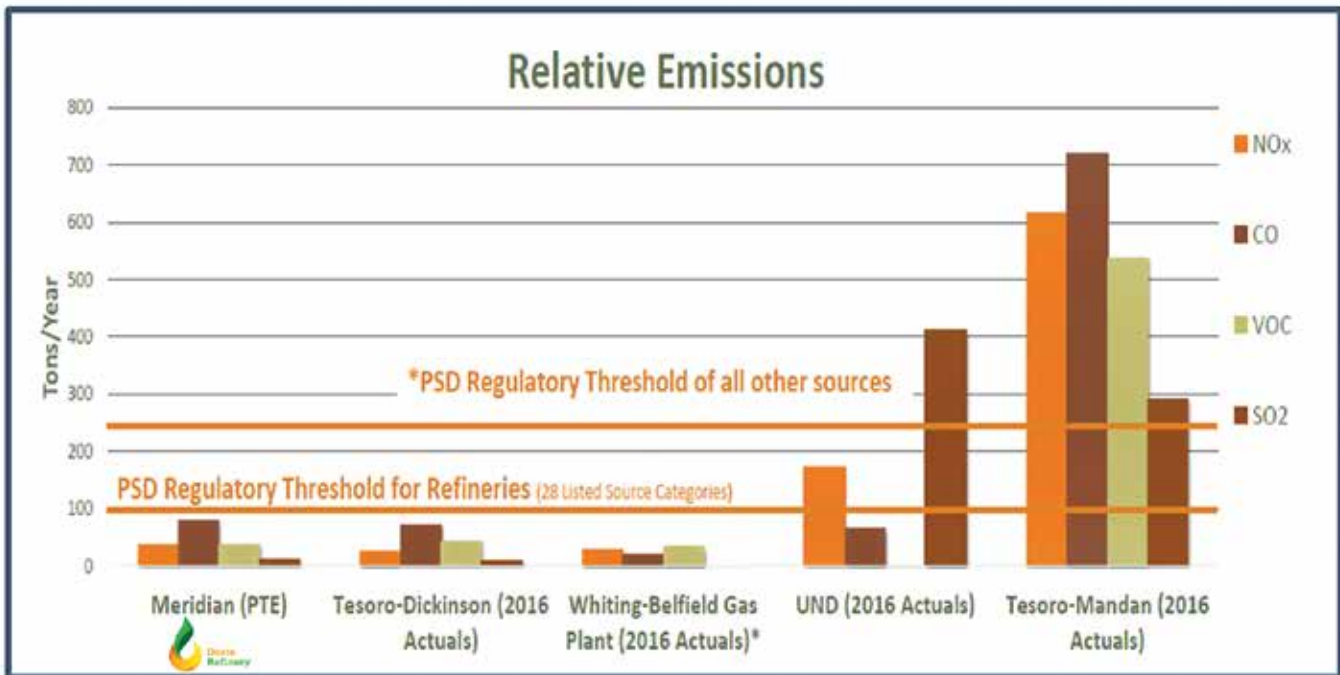
The Davis Refinery will utilize the latest generation of digital technology from the ground up to provide the most efficient and powerful data handling environment. This will include technologies such as a wireless smart grid, advanced process

The Davis Refinery will serve as Meridian’s winning formula in future Shale Basin projects in the coming years.

TABLE 3: INVESTMENT EFFICIENCY OF GHG EMISSIONS REDUCTION (REF: KARRE PHD 2019)

Technology	Assumed Life Span (years)	\$GHG Abatement Cost / mt Co2	\$1 million investment will result in reduction of GHG emissions in mt CO2e
High Penetration Wind	25	33.00	1212
Nuclear	40	14.00	1786
Solar Photovoltaic	20	28.00	1786
Low Penetration Wind	25	19.60	2041
Existing Refineries	30	12.40	2688
*Cars Plug-In Hybrid	10	28.99	3449
Davis Refinery	30	9.47	3520
Geo-Thermal	50	5.60	3571
Cars Plug-In Hybrid	10	15.40	6494

*Including emissions from electric generation



control, integrated field data management and predictive analytics to optimize the operation in real-time. In totality, these systems will generate intrinsic benefits in equipment reliability, health and safety, and environmental compliance. These include:

INFORMATION SYSTEMS

- Provide accurate and efficient data flow from design through operation
- Provide state-of-the-art plant information display and control systems
- Utilize cutting-edge software platforms for ERP and infrastructure control
- Ensure data integrity and security are maintained inside and outside the facility

OPTIMIZATION STRATEGY

- Utilize advanced process control to improve process efficiency
- Utilize preventive/predictive maintenance for equipment reliability
- Utilize economic optimization models for short- and long-term planning
- Utilize KPI's for measuring and achieving strategic goals

**REDUCTION IN GREENHOUSE GASSES:
A LOW-CARBON INVESTMENT**

The control systems, advanced technology, and continuous monitoring of the project will ensure that Davis will have the lowest emission rates for NOx, CO, SOx, VOC, PM 2.5, PM 10 and greenhouse gas (GHG) emissions than any other refinery constructed. The Davis Refinery is more cost effective at CO₂e reduction than any other refineries studied and is more cost effective than wind (1212 mt CO₂e) or solar (1786 mt CO₂e) technologies. Supporting this technological achievement of Meridian is in fact an investment in green technologies and the future. Meridian's refineries are a climate change solution – as a Meridian refinery reduces GHG emission by far more than that same dollar invested in either wind or solar power.

In developing Davis, Meridian has generated substantial trade secrets and corporate know-how dealing with the design and operation of small, cost-effective crude oil refineries. Green tech refineries such as Davis will serve local markets using crude oils with the ability to be placed into service quickly as synthetic minor sources (SMS) projects under state and federal permitting laws and regulations. Meridian will increase value by applying this know-how to additional Davis-style refinery projects in other shale basins. The company intends to build its second such facility in West Texas and has initiated siting and permitting for a third facility in another strategic area – setting a standard throughout the U.S. ▀

Highlighting the industry



Former premier of Saskatchewan, Brad Wall, will be doing a question-and-answer session at the 2019 Williston Basin Petroleum Conference.

The Williston Basin Petroleum Conference returns to Saskatchewan for 2019

The Williston Basin Petroleum Conference kicks off its 27th year from May 27-30, 2019, and event organizers have completely reimagined its purpose and intent.

In a period of profound challenges faced by industry – pipeline and transport capacity issues, emerging new methane emissions standards in Canada, water use, rapidly falling recovery rates alongside high drilling costs, and CO₂ use and availability – conference organizers began to look at developing a conference and technical trade show less focused on sales and equipment, and instead focused on business development, emerging technologies, and company innovation.

“Saskatchewan already has two substantive trade shows – in Weyburn in June and in Lloydminster in September – that deal with the suppliers and distributors,” notes Dan MacLean, the CEO of the Petroleum Technology Research Centre (PTRC), which directs the Williston Basin Conference. “It’s one of the differences between Regina and Bismarck when the Williston Basin is hosted north of the border. On even-number years, when the conference is in North Dakota, the trade component is enormous. We’ve come to realize that the event in Canada needs to be more business and technology directed.”

Norm Sacuta, the director of communication at the PTRC agrees. He’s seen the conference evolve in Canada over the last 10 years.

“We will still have an important trade show component at Williston Basin. That

will never change,” notes Sacuta. “But a preference will be given to companies that have innovative technologies that will address current and future challenges of the oil industry in Saskatchewan. The conference will focus on Saskatchewan’s heavy and light oil challenges, and on the rising importance of CO₂ availability and use in tight, light and heavy oil operations.”

The reinvigorated focus will include discussions and presentations on pressing issues like flow line and pipeline integrity, CO₂ availability and use in tight formations, artificial intelligence and block chain use in oil and gas, and managing methane emissions – all are planned in presentations and panel discussions.

An exciting new component to Williston Basin 2019 will be a one-day business conference on May 28th that will include high-level panels and discussions that include speakers from industry, banking, government, regulatory bodies, and politics.

“We are very excited to have the former premier of Saskatchewan, Brad Wall, for a question-and-answer session at the business conference,” notes MacLean. “We have several more high-level speakers from Calgary-based investment firms, our own Minister of Energy and Resources Bronwyn Eyre, and executives from the oil and gas industry.”

The conference will again kick off with two sessions of the Core Workshop on May 27th providing scientific and geological analyses of drilling cores from SE Saskatchewan that will be of particular

interest for industry participants. It is hosted by the Saskatchewan Geological Society.

The technical conference includes important research applicable to heavy oil fields in Saskatchewan, to tight/light formation in the Bakken and Viking, and will include work by such groups as North Dakota’s Energy and Environmental Research Centre and the Saskatchewan Research Council.

Details on registration for the conference can be found at www.wbpc.ca/. ▶

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Investing and expanding with education

Companies operating throughout North Dakota and in the Bakken region may differ in size, scope and mission, but many of them share one common challenge – recruiting, developing and maintaining a skilled workforce. One effective solution to the challenge has been for organizations to look within themselves and invest in developing the employees they already have. Once a company hires an individual for any position, expanding that employee's skills and knowledge benefits both the employer and the employee.

The Bismarck State College National Energy Center of Excellence has helped employers across the country develop and retain their existing workforce through an array of offerings directly pertaining to the energy industry. BSC

offers 12 energy degree and certificate programs that focus on operations, maintenance, instrumentation and energy services, all of which are in high demand in the Bakken region. State-of-the-art technology and equipment, interactive simulations and 3D modeling are all used to train BSC students for careers in the energy industry throughout the nation.

Most of BSC's energy programs are available online, allowing students to continue their education wherever they are. All that is needed is an Internet connection. The instructor-led coursework is available 24 hours a day and is delivered autonomously. Employees can take online classes while maintaining full-time employment, allowing them to immediately apply

their learning to their position. The hands-on components required for some programs can often be completed at the employee's regular worksite.

Once an employee has completed an energy degree through BSC, they have the option to continue their education and earn a Bachelor of Applied Science in Energy Management. This program, offered entirely online, develops and prepares individuals currently employed in the energy industry for management and supervisory positions. This allows companies to identify individuals with leadership potential and equips them with the additional skills needed for success in those roles.

Many times, companies will offer tuition assistance and reimbursement programs for their employees which can build a



Students enrolled in online coursework through Bismarck State College discuss a steam supply line for a soot blower under the direction of a supervisor at a power plant. Online students in operations programs must complete an 80-hour job shadow requirement at an approved facility.

To learn more about the Bismarck State College National Energy Center of Excellence, visit bismarckstate.edu/energy, call 701-224-5651, or email bsc.energy@bismarckstate.edu.

more loyal, dedicated workforce and reduce turnover rates. Studies show that companies who invest in their employees experience an increase in employee retention and overall morale. Having employees understand their role in an organization and the impact they have on the overall efficiency, safety and productivity of the company is invaluable.

What can you do as an employer? Identify high-performers in your organization and approach them with the possibility of going back to school. Make sure your employees are aware of tuition assistance and reimbursement programs, and encourage them to take advantage of them. Foster an environment of continuous learning and training and set an example by enrolling in coursework yourself. ▶

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Let's fight for our homeless veterans and their families!

By James Gillespie

I will never forget the first time that I met DeLisa. She was walking down the hallway of the Comitis Crisis Center with her two small boys on each side of her, holding their mother's hands. Comitis is a homeless shelter in Aurora, Colorado. When I first met her, I asked "Who are you here visiting?" My assumption was that she was a donor touring the building. Her reply surprised me: "We just moved into the third floor, the Veterans' wing."

It turned out that DeLisa, an honorably-discharged U.S. Army veteran, and her boys, ages five and two, were separating themselves from a domestic violence situation and drove all of the way from Georgia just to find safe shelter here in Colorado. Though once a highly-successful businesswoman, DeLisa had to choose between her unsafe home and a safe homeless shelter.

The Comitis Crisis Center is one of the few homeless shelters in the United States that will take a veteran and his/her family and provide them all with a place to stay, for free, for up to two years. The program itself is a part of the United States Department of Veterans' Affairs (VA) Homeless Providers Grant and Per-Diem (GPD) Program. This program awards grants to community-based agencies that provide transitional housing and supportive services to assist homeless veterans in achieving residential stability and self-sufficiency. The VA provides per diem payments to non-profit organizations to help offset the operational costs of these programs.

DeLisa's story, unfortunately, is not that uncommon. It is estimated that there are at least 37,878 veterans experiencing homelessness in the United States. Can you imagine voluntarily signing up to serve your country, only to return home and not have a place to call your own?

What is causing an impediment to the access of shelter services for homeless veterans with children? The answer can be found in policy. Currently, if you are a non-veteran homeless family in the United States, federal funds will pay a "head-in-bed" per diem for each family member to the service agency housing the family. However, if you are a veteran homeless family, the VA's Grant and Per Diem (GPD) program will only pay for the cost of occupancy for the veteran, but not for the attached and dependent children. This issue causes a barrier to access shelter services for both male and female veterans with children, but more so for veteran women who usually have children in tow.

That is why the Comitis Crisis Center is supporting H.R. 95 and S. 91.



H.R. 95 will amend title 38, United States Code, to ensure that children of homeless veterans are included in the calculation of the amounts of certain per diem grants. H.R. 95, also known as the Homeless Veteran Families Act, was introduced on the first day of the congress by Congresswoman Julia Brownley (D-CA).

S. 91, known as the Creating a Reliable Environment for Veterans' Dependents Act of 2019, also seeks to provide coverage for dependents of our homeless veterans. The bill was introduced by Senator Cory Gardner (R-CO) and co-sponsored by Senator Patty Murray (D-WA).

So what can you do? Write to or call your member of congress and your senators! Encourage their support of H.R. 95 and S. 91.

We owe it to the brave men and women who have fought for us to speak up and ensure that their needs, and the needs of their children, are taken care of.

They fought for our families and now it is time for us to fight for theirs.

James Gillespie is the community impact and government relations liaison for Mile High Behavioral Healthcare and the Comitis Crisis Center. He can be reached at jgillespie@mhbhc.org. ▀

NO WELDS. NO THREADS. NO LEAKS.



The Bakken region, home to one of the largest contiguous deposits of oil and natural gas in North America, is no stranger to extreme weather, easily dropping to sub-zero temperatures in winter and rising to over 100°F in the summer.

But even more significant than the extremes is the fast fluctuation of temperature, often swinging from -20°F to 40°F in less than a day. In January of 1943, for example, Spearfish, South Dakota, experienced a 49-degree increase in temperature in only two minutes, crashing back down to where it started 27 minutes later. And on February 13 of just last year, Fort Belknap, Montana, experienced a temperature flux of 82 degrees between their morning low and their afternoon high.

“Thermal cycling can wreak havoc on any connection, especially with the large temperature gradients that can exist between the internal product and external climate,” says Marty Rodriguez, VP of engineering for the Boss Division. “We develop one-piece castings for items that are typically fabricated as weldments. We design our parts to eliminate as many weld seams and connections as possible. They get cold temperature tested and rated for -20°F to capture those extreme conditions.” Temperature variations like these demand incredible strength, flexibility, and durability from machines, parts, and people—including those in the hydraulic fracturing industry.

Crimping a hose with the right amount of force is difficult because extreme weather conditions can cause major dimensional changes through thermal expansion and contraction—too tight and the hose is damaged, too loose and the hose can leak, which may cause an environmental issue and equipment downtime.

One way to mitigate this risk is by offering a wide array of sleeves and ferrules. This allows end users to produce the perfect crimp on nearly any hose, based on its OD. A consistent, machined pattern of serrations when matched with the right-sized sleeve or ferrule makes this coupling very easy to assemble and creates an ideal and reliable seal.

“Dixon has done a very good job of simplifying the process,” says James Henderson, energy market specialist.

Another challenge in the Bakken region is extending the lifespan of couplings that undergo constant abusive wear from abrasive slurries. As the sand slurries are pumped from blender to missile to the pressure pumper, the fittings and connections are sandblasted and seams are prematurely eaten away.

“So, again, we’ve removed as many weld seams as we can,” says Henderson. “When we came to market with our Boss LPS products, our goal was to provide low-pressure, one-piece weld and flange adapters to replace fabricated flange adapters that are traditionally welded together.”

Extending the life of equipment with single-cast fittings, offering a wide selection of sleeves and ferrules that alleviate the dimensional challenges caused by extreme temperatures and also protect against leaks saves valuable production time and the cost of maintenance.

“Hoses and fittings are part of every process in hydraulic fracturing, and Dixon products will outperform traditional components based on our design and engineering,” says Henderson. “We make it our mission to deliver no welds, no threads and no leaks by eliminating as many weld seams and threads as possible at every step of the process.”

High productivity while maintaining quality with RD-6 Coating System

By John Strong, NACE Senior Corrosion Technologist #24198, NACE CIP II #33324



RD-6 quickly bonds to the heated surface and can be permanently adhered.



Polyguard Products RD-6 Coating System maintains efficiency in cold weather applications while performing as an excellent non-shielding corrosion coating.

The temperature's not the only thing that drops for coating applicators as winter blows in. Lower temperatures also mean increased cure times for liquid epoxy coatings, and therefore productivity will be slowed. In some cases, this can affect the project completion date and deadlines associated with the job. The curing of the standard two-part epoxy for buried field joints begins to slow or even stop at 50°F. As the weather changes, the coating specification should also change to incorporate different strategies to keep the same level of production for the applicators.

Polyguard Products RD-6 Coating System maintains efficiency in cold weather applications while performing as an excellent non-shielding corrosion coating. Unlike epoxy coatings, RD-6 doesn't require a cure schedule so it can be immediately backfilled. Granted, the same cold weather pre-heat methods used for epoxy coatings are essential when applying RD-6. At this point of the project, the level of productivity has not been affected. Once the desired pre-heat temperature is reached, application of the RD-6 coating system can begin. The process starts with a thin coat of liquid adhesive followed by spiral wrapping the RD-6 to the surface. The total time for the application of liquid adhesive and RD-6 is approximately two to four minutes for a field joint weld on an eight-inch pipeline. You should be aware that this

time range is assuming those performing the application are properly trained, and there are no unusual circumstances. RD-6 quickly bonds to the heated surface and can be permanently adhered. Following holiday detection, the coated surface is ready for backfill. Assuming holiday detection for the weld takes approximately one minute, then most field joint welds are ready to backfill in under 10 minutes from beginning of application. In comparison, an epoxy coating on the same single weld can take upwards of 10 hours at 50°F to reach a cure that will be suitable to backfill over. 120 field joint welds, or close to a mile of welds along a pipeline right-of-way, can be coated with RD-6 and inspected in 10 hours.

Winter weather is unpredictable. But having alternative coating options is a good way of staying on time with your coating project. The RD-6 Coating System is an excellent choice for applicators with a need to maintain efficiency and get backfill ready. Polyguard Products offers free in-person training to all applicators of RD-6. This service is performed worldwide and free of charge. Further information on the benefits of cold weather application of RD-6 can be obtained at www.polyguardproducts.com/pipeline/ or by calling directly at (281) 580-5700. Polyguard Products is a 100 per cent employee-owned company and proud to make all pipeline products in the United States. ■

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Thermal mass flow meter technology in the Bakken

As spring comes with warmer weather, the number of producing wells is expected to reach an all-time high. At the same time, exploration in the Bakken is moving into the upper midwest grasslands which is predicted to further increase this number. Gas producers are looking to measure flare gas, gas from separators, vent gas, and other well site gases with the most accurate flow meter for the job. There are several things to keep in mind when initiating a search for the right technology for these applications.

WHY THERMAL MASS FLOW MEASUREMENT TECHNOLOGY?

Gas producers are looking for a cost-effective device to measure the flow of gases at the well site. Thermal mass flow measurement technology most commonly offers direct mass measurement of gases in standard volumetric or mass units with no need for additional pressure or temperature compensation. Thermal mass flow meters are repeatable, offer a broad measurement range, and have a low pressure drop.

Unlike many flow measurement technologies, there are no moving parts with a thermal mass flow meter, and they are easy to install. Most manufacturers offer insertion-type flow meters, remote mounting capabilities, and in-line styles.

WHY FOX THERMAL?

The Fox Thermal engineering team has dedicated considerable time developing the most accurate and feature-rich thermal mass flow meters available on the market today.

NEW DATA LOGGER

Most recently, Fox Thermal created a data logger feature with seven-year history that was designed to meet BLM standards for flare gas measurement on federal land leases. The data logger has these advanced features:

- 40 daily totals (24-hour totals)
- Settable contract time defines contract day
- Time/date stamped alarm & event logs; seven-year history
- Power off totalizer; power failure creates event log entry

CALIBRATION VALIDATION

In response to calls from operators to verify that their meters were measuring accurately in the field, Fox Thermal developed the revolutionary Calibration Validation feature. This test was the first



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of its kind to allow the operator to initiate a verification procedure that would not require any additional equipment, canisters or instrumentation. The test is performed in-situ and produces a pass/fail result. When used in conjunction with a free PC-based software tool, it will produce a certificate with recorded data values and a pass/fail result that can be kept on record.

INNOVATIVE DIGITAL SENSOR DESIGN

The DDC-Sensor™, a direct digitally controlled sensor, is interfaced directly to the meter's microprocessor for more speed and programmability. This unique sensor design provides a technology platform for calculating accurate gas correlations. The correlation algorithms allow the meter to be calibrated on a single gas in the

factory while providing the user the ability to select other gases in the Gas-SelectX® gas menu(s).

FIELD-SELECTABLE GAS SELECTION MENUS

Gas-SelectX® was designed to answer the need voiced from many customers that experience changing gas compositions most commonly found in biogas, flare gas, and natural gas flow measurement applications. The menu of available gases in the oil & gas menu offered in Fox Thermal flow meters has proven to be a highly valuable feature in these instances. Tuning gas mixes in 0.1 percent increments to create custom gas mixes "on the fly" has provided the following benefits:

- Higher accuracy with custom gas mixes
- In-situ custom gas mixes at the push of a button
- Avoid frequent shut-downs when gas composition changes
- Avoid factory re-calibrations when gas composition changes

In short, Fox Thermal cares about its customers' needs and listens to demands in the marketplace. We bring innovative technology that provides solutions to common and complex problems. Contact Fox Thermal today to explore the benefits of this technology further or use the online product configurator to customize a Fox Thermal product for your application needs. Fox Thermal is located at 399 Reservation Road, Marina, CA, 93933. Reach them by phone at (831) 384-4300, by email at sales@foxthermal.com, or online at foxthermal.com/configure. ▶

TOP FIVE TIPS FOR CHOOSING A FLOW METER

1) Regulations, compliance

- a) What local, state, regional or national regulations impact the measurement location?
- b) Are there additional recording, data logging or calibration verification requirements to comply with regulations?
- c) What agency approvals must the flow meter have?

2) Fluid type at the measurement point

- a) Dry or wet gas conditions may affect sensors
- b) Corrosive components in oil may affect sensor material selections
- c) Flow back contains mixtures of oil, gas, solids, chemicals, and water that must be separated

3) Fluid conditions

- a) Does the accuracy spec of the flow meter change based on the composition of the fluid type?
- b) Does the fluid composition change over time?
- c) What is the pressure and velocity in the pipe? Is it constant?
- d) Are there installation limitations (straight pipe runs, limited access to the pipe, tight spaces)?

4) Additional equipment

- a) Does the flow meter require additional equipment or instrumentation to operate successfully at the point of measurement?

5) Additional calculations

- a) Will you need to do additional calculations to determine an accurate flow rate?





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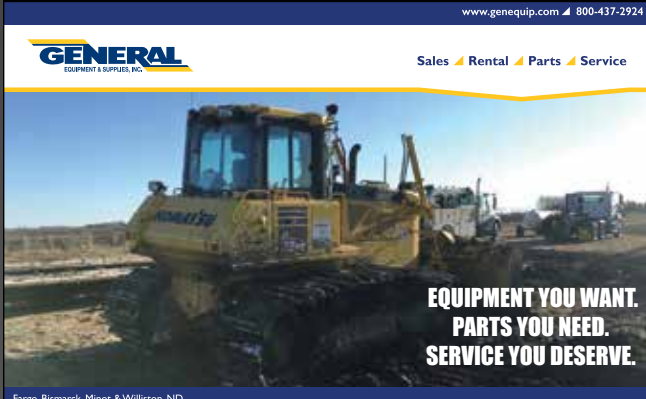


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Contractor sees 68 percent TRIR improvement after implementing standardized learning

As the energy industry evolves, many operators and contractors are seeking efficient and effective safety solutions for their workforce. Standardized learning is one of the best ways to ensure workers are trained according to industry standards. Standardization eliminates the guesswork of hiring qualified contractors. It saves contractors thousands of dollars on multiple trainings and helps operators prevent million-dollar mistakes.

Standardization and retraining save lives.

A recent study conducted by a third party showed that nearly 80 percent of workers believe standardized learning improves overall safety. Forty percent of workers return to standardized learning materials repeatedly, valuing material that keeps them up-to-date on regulations and refreshed before arriving on site.

Contractors operating in the bustling Permian Basin have turned to SafeLandUSA to train their growing workforce. Permian-area contractors without SafeLand have a six-times-higher Total Recordable Incident Rate (TRIR) than those who have SafeLand.

Thousands of contractors recognize the value of standardization; over two-million workers have already completed SafeLandUSA since its inception. More than 80 percent of the top oil production clients in the U.S. depend on the SafeLand orientation for their contractor workforce. Yearly refreshers can cement the fundamental information needed to recognize and prevent deadly accidents. Leading safety agencies even recognize the importance of retraining; per the ANSI Standard, Hydrogen Sulfide (H₂S) retraining is required annually.

SafeLandUSA is proven to reduce contractor TRIR. One contractor began working with PEC after receiving a SafeLandUSA orientation mandate from one of their hiring clients. Before implementing PEC training, the contractor had approximately 1,400 employees with a TRIR of 1.17.

Over time, all maintenance-oriented employees were required to complete PEC Basic Orientation, a SafeLandUSA-accredited course, as part of new hire training and retraining on an annual basis. This contractor was sharply focused on worker safety and wanted to address issues that arise from natural learning loss over time.

SUMMARY OF CASE STUDY	
2011	2018
1,400 Employees	6,600+ Employees
3.5 Million Man Hours Worked	20 Million+ Man Hours Worked
93 Employees Trained (PEC Basic)	6,000+ Employees Trained (PEC Basic)
1.17 TRIR	0.38 TRIR

With over 20-million man-hours annually, the overall TRIR of this contractor is now 0.38 - a 68 percent TRIR improvement.

In contrast, companies who do not implement SafeLandUSA are twice as likely to have an incident. Recordable incidents costs an average \$190,000 per accident, according to a National Safety Council study.

To help prevent these costly incidents, many contractors in high-hazard regions choose to include geo-specific training as a complement to standardized programs, which helps ensure workers are oriented to the location-specific working conditions of job sites.

In response to hazards specific to the Bakken area, PEC developed PEC Bakken, a geo-specific standardized module. Course topics discuss the sources and extraction of Bakken oil, its properties and characteristics, and work hazards specific to the Bakken, including environmental issues and toxic exposures. The new Bakken module easily adds on to Basic Orientation or can be taken independently.


As a compliance partner, PEC's safety experts ensure all safety learning content adheres to industry standards and regulations, while also offering substantial positive impact on your workforce. Complete safety learning standardization establishes that, together, we can help bring every worker home safe.

To learn about how PEC's standardized learning can help keep your workforce safe, visit www.pecsafety.com. ▀

BAKKEN WORK IS DIFFERENT. YOUR SAFETY SOLUTION SHOULD BE, TOO.



PEC BAKKEN REGION OVERVIEW

 pec your compliance partner.

This Bakken-specific safety orientation discusses properties and characteristics of Bakken oil, sources of oil extraction, and hazards specific to the region. Additional components covered include:

- Bakken Region Host Company & Contractor Relations
- Tribal Employment Rights Office (TERO) & Mandan Hidatsa Arikara (MHA) Energy Compliance
- Winter/Severe Driving Conditions
- BTEX (Benzene, Toluene, Ethylbenzene, and Xylene)
- And many more!

PEC Bakken & PEC Basic Orientation combine to create the leading safety orientation for workers in this region. Choose the most trusted safety and compliance partner in industry and help bring workers home safely. Schedule classes today!

LEARN MORE AT [PECSAFETY.COM/BAKKEN](https://pecsafety.com/bakken)

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