

GOING WITH GAS

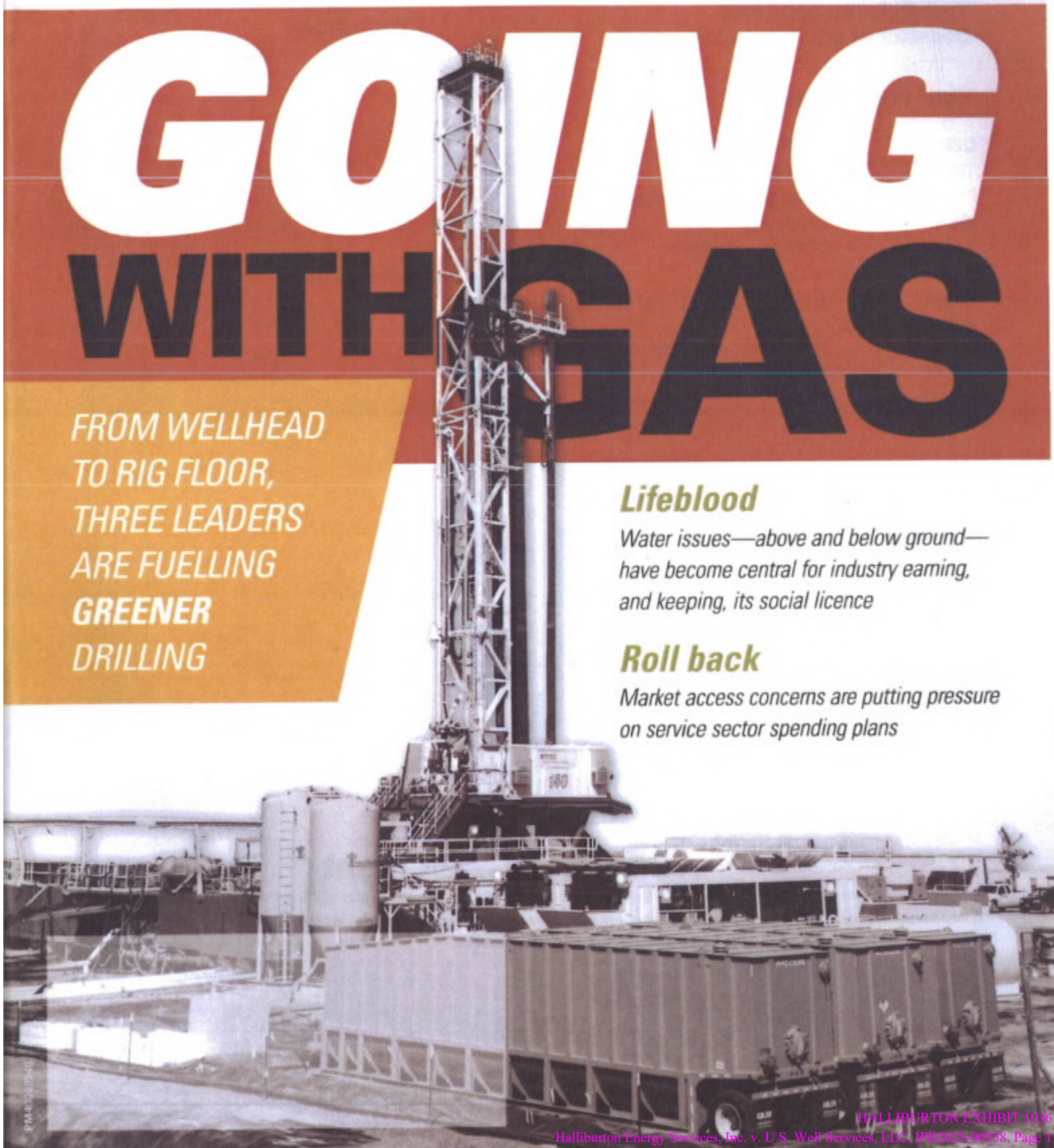
FROM WELLHEAD
TO RIG FLOOR,
THREE LEADERS
ARE FUELLING
GREENER
DRILLING

Lifeblood

Water issues—above and below ground—have become central for industry earning, and keeping, its social licence

Roll back

Market access concerns are putting pressure on service sector spending plans



ON THE COVER

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BY DANIELA TRNKA



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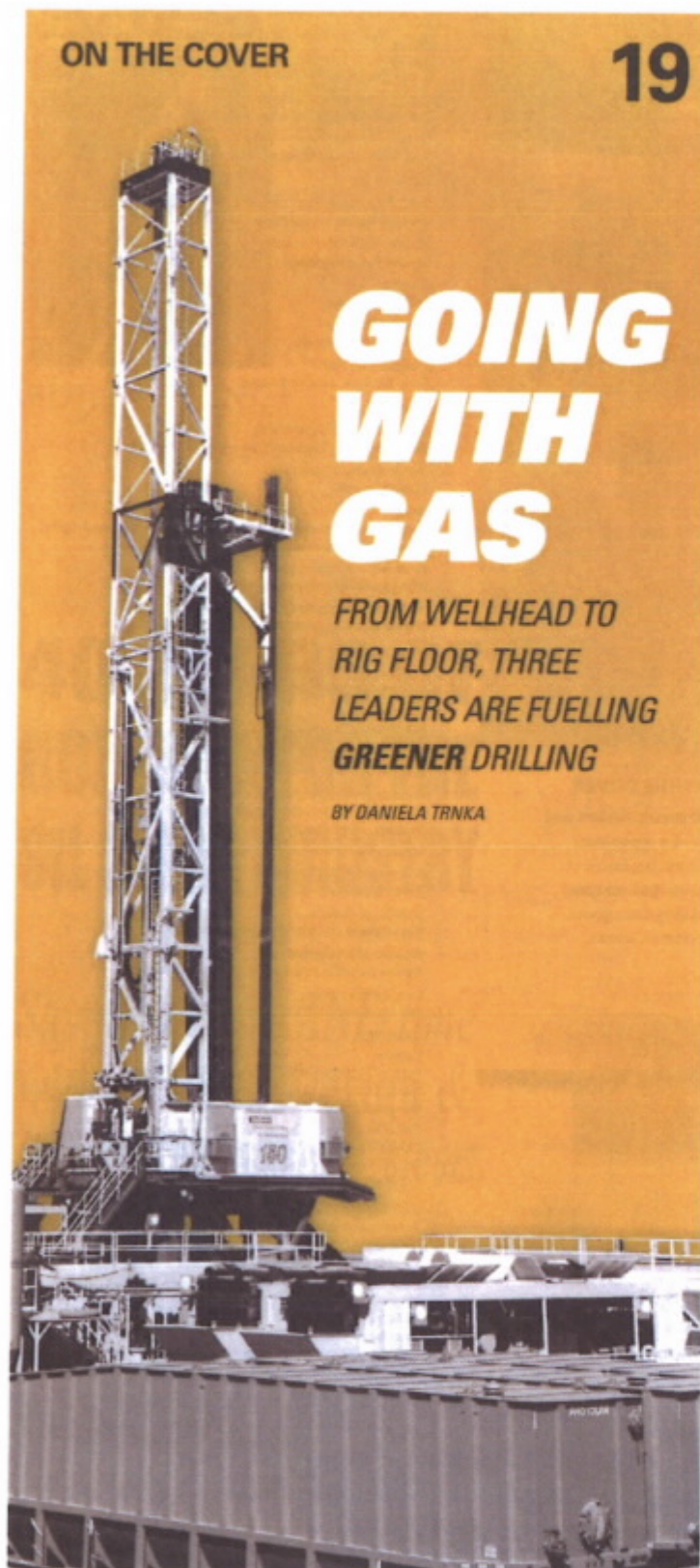
BY JIM BENTEIN

MARKET MONITOR

39 Liquid liabilities

Natural gas liquids markets are eroding as oversupply builds in western Canada

BY DALE LUNAN



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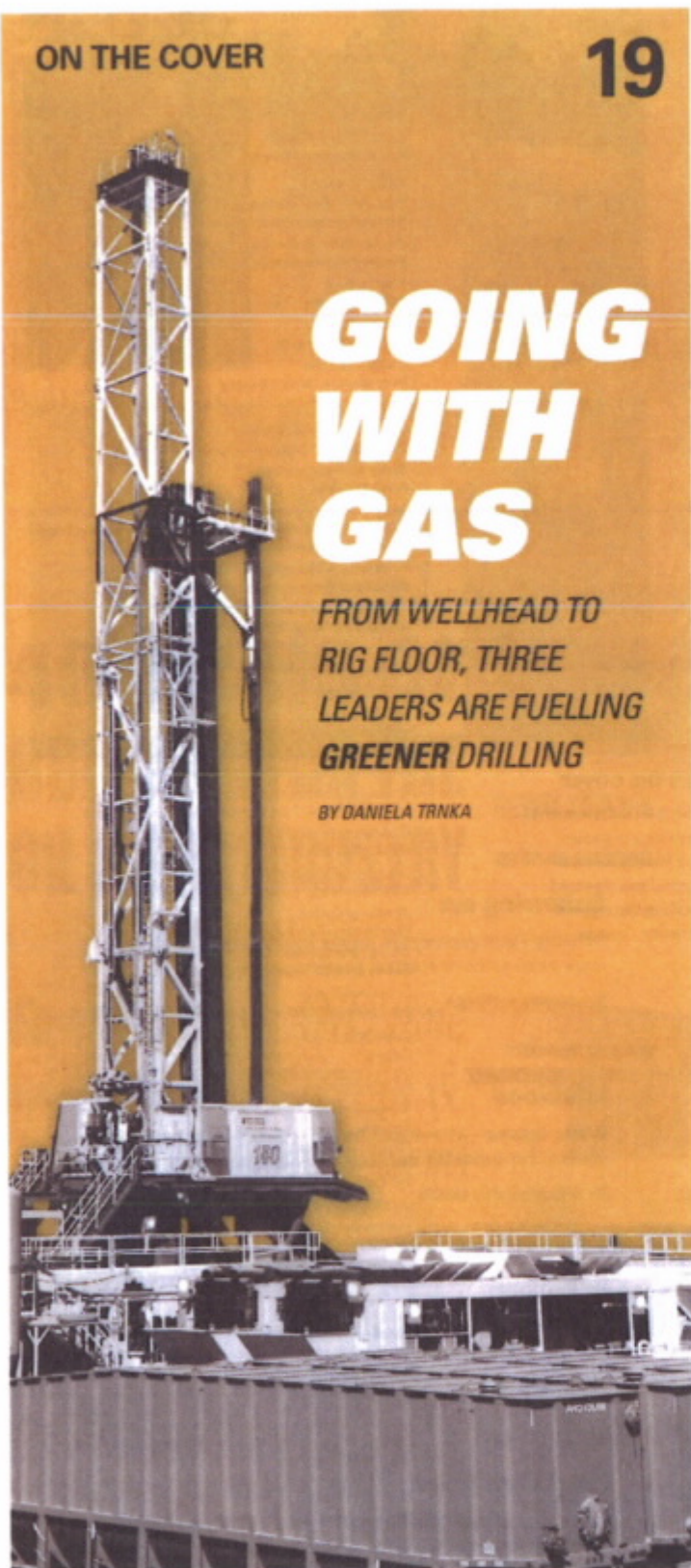
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PHOTO: ENCANAC CORPORATION

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oilweek

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SUBSCRIPTIONS

Subscription Rate

In Canada: 1 year \$89 plus GST, 2 years \$139 plus GST

Outside Canada: 1 year \$179

Single copies & back issues: \$10 plus GST & \$2.50 postage & handling

Subscription Inquiries

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GST Registration Number 82625554RT. Printed in Canada by PrintWest.

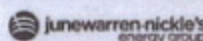
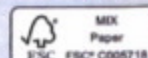
ISSN 1204-4741 | © 2013 JuneWarren-Nickles Energy Group. All rights reserved. Reproduction in whole or in part is strictly prohibited.

Publications Mail Agreement Number 49055240. Postage paid in Edmonton, Alberta, Canada.

If undeliverable, return to: Circulation Department, 80 Valleybrook Dr., North York, ON M3B 2S9. Made in Canada.

We acknowledge the financial support of the Government of Canada through the Canada Periodical Fund of the Department of Canadian Heritage.

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DRYING OUT

Water has become a central focus of fracking opponents, but perfecting a water-free frac has become a target for unconventional thinkers

BY JIM BENTEIN

A FORMER EXECUTIVE WITH CALGARY-BASED GASFRAC Energy Services Inc. says oil and gas producers and the service sector must develop technologies that deal with the environmental impacts of fracking or risk losing their social licence to operate.

"There is quite a litany of environmental issues [associated with fracking]," says Grant Nevison, who was chief operating officer with GasFrac before leaving the company to launch ENFRAC Inc., a company that he says has developed a technology that will virtually eliminate water use in fracking.

"Water use is certainly one [environmental concern], but there are also problems with well cleanup, greenhouse gas emissions and truck traffic."

There are also environmental concerns associated with the chemicals used in fracking, which include hydrochloric acid, citric acid, methanol and some unidentified chemicals that can cause kidney and liver damage. However, some other oilfield service companies have started using organic and semi-organic fracking fluids.

Nevison, a 32-year oilfield service industry veteran who worked around the world for larger firms before becoming chief operating officer at newly formed GasFrac in 2007, says other issues with fracking include the disposal of fracking fluids and produced water and induced seismicity, although he says the latter is not as serious an issue as are other environmental impacts, particularly water use and impact.

"Water creates a huge amount of truck traffic," he says.

A single fracked well can consume three million to five million gallons of water, but Nevison says there are several promising technologies either starting to be deployed or in development that address the issue of water—sourcing it, recovering it and treating it.

"If you pump one million gallons of water in a well, you recover 300,000 gallons," he says. "Recovery and handling of that water can be a nasty thing. You end up hauling it and there is a spillage risk. And you dispose of all of that water in pits."

The 70 per cent of the water left behind can pose an even bigger problem, at least from a productivity standpoint.

"It actually blocks recoveries," he says. "With all of that water staying down, you block a lot of the native hydrocarbons from being produced. As a result, you need to pump in even more water."

And that's where ENFRAC's technology enters the picture.

The company uses liquefied natural gas (LNG) as an energizer, either along with water or with a conventional frac oil. A patent is pending for the company's proprietary method of injecting the gas into the frac stream, and ENFRAC is working with a California company on a technology that can liquefy natural gas.

It would be used along with diesel or biodiesel.

"We believe we can reduce the water use by up to 90 per cent, and certainly by 75 per cent," says Nevison.



It could substitute CO₂ or nitrogen for water as well.

Using LNG would reduce costs because produced gas could be used, a particular benefit in fracking for crude.

In addition, he said the use of natural gas-fuelled turbines, instead of using turbines fuelled by diesel, will reduce emissions considerably.

The heavy truck traffic needed for fracking (especially given water hauling needs) also generates emissions.

"Emissions management will be a major challenge for the industry," he said.

A directive issued by the U.S. Environmental Protection Agency (EPA) in April 2012 will force companies involved in fracking of gas wells to substantially reduce emissions from fracking by Jan. 1, 2015.

Flared gas, fugitive emissions and other causes of air contaminants will have to be cut by compelling the industry to use what the EPA calls "green completions," technologies that capture, rather than combust, gas that would otherwise escape during completions.

The EPA estimates the rule will impact more than 11,000 newly fractured wells and 1,400 refractured wells. It requires the industry to reduce volatile organic compounds by 190,000–200,000 tonnes per year and air toxins by 12,000–20,000 tonnes per year.

The new rules are also expected to reduce methane emissions from the oil and gas industry (which account for 40 per cent of all U.S. methane emissions) by one to 1.7 tonnes per year.

So far there have been no comparable initiatives by Canadian jurisdictions, although the Canadian Association of Petroleum Producers has introduced principles to guide its members involved in fracking, which include a promise to safeguard the quality and quantity of groundwater, to measure and disclose the industry's water use and to support the use of fracturing fluids with the least environmental risk.

Nevison has been working on his company's technology for 2.5 years and believes, after extensive testing, it is a viable method that will substantially reduce water use—which he sees as the most serious environmental issue in fracking—as well as air emissions and surface disturbance.

Because the ENFRAC method involves the use of natural gas, which can be separated from the water and other fluids and pipelined, it eliminates flaring, he says. And because it is more efficient, he thinks fewer fracs will produce more gas and oil.

But he cautions that, despite extensive testing at a lab in Calgary, it still needs to be proven in the field. ►

The oil and gas industry is working diligently to make hydraulic fracturing more efficient and to reduce the footprint the process has on the environment.

IMPROVING HYDRAULIC FRACTURING

1 Flowback Recycling

About 10–30 per cent of the fluid used to fracture a well returns to the surface and is captured with produced gas. This fluid is called flowback water.

Today, a majority of major gas producers are recycling flowback water for use in new wells. Recycling of flowback water reduces demand for fresh water and reduces the need for disposal of waste water.

Water use
in central
Alberta

A typical Cardium
oil well frac uses

660,000
gallons of water

The natural gas
industry only accounts
for 0.1 per cent of
additional water
usage

2 Reduction in Chemical Additives

Many natural gas companies actively developing shale gas resources have found ways to reduce the amount of chemical additives used in fracturing fluid while still effectively producing gas from shale.

These diluted, common
additives account for

<1%
of fracturing fluid

Source: Industry estimates

"We haven't fracked a well yet," he says. "Until we do that, it's a gleam in your eye."

Although ENFRAC may still be a few years away from taking its technology to the field in a broad way, others have their own solutions to the myriad of issues associated with fracking. Here are a few of their stories:

NCS OILFIELD SERVICES

NCS Oilfield Services Canada Inc. has designed its Half-Straddle padless frac system with the goal of reducing frac water consumption and chemical use while lowering well completion costs.

To help companies deal with the issues around horizontal multistage fracturing, NCS developed the Half-Straddle CT (coiled tubing) frac system, a new method that combines the best of coiled tubing annular fracking with frac-through CT techniques. The system eliminates much of the wasted fluids associated with conventional methods and dramatically reduces water use.

As an example, a 29-stage job would normally require about 800 cubic metres (about 5,000 barrels) of water. But NCS is pumping the same amount of sand, and doing the same number of stages, with just 300 cubic metres of fluid.

Reductions of 50 per cent in water use are common, and completion costs are 15–25 per cent cheaper.

First developed by the company's Houston office, the company, once involved in the rental space, quickly moved it to Canada, where it now has the greatest presence, after the technology was developed about three years ago.

"Two years ago, we had 15 employees in Canada, and now we have 85," says Eric Schmelzl, a 22-year veteran of the oilfield service business and NCS's strategic business manager. "About 60 or 70 operators are using the system."

The advantage of using a coiled tubing system is that operators gain greater access to the reservoir, boosting production. Because of the coiled tubing approach, fracking fluids can be

more accurately directed to the rock face and fluids can more easily be recaptured.

"As we have refined the frac sleeves it has become more reliable," he says.

The NCS approach has taken off in Canada "because the coiled tubing fleet in Canada is probably the best in the world," Schmelzl says.

Because the coiled tubing takes up some of the space in the wellbore, it can't be used where some high-rate frac pumping is required. But that hasn't stopped NCS from dramatic growth, he adds, reflecting on the acceptance of its technology.

"Our sales were less than \$1 million in 2009, and in 2013 we'll be over \$100 million."

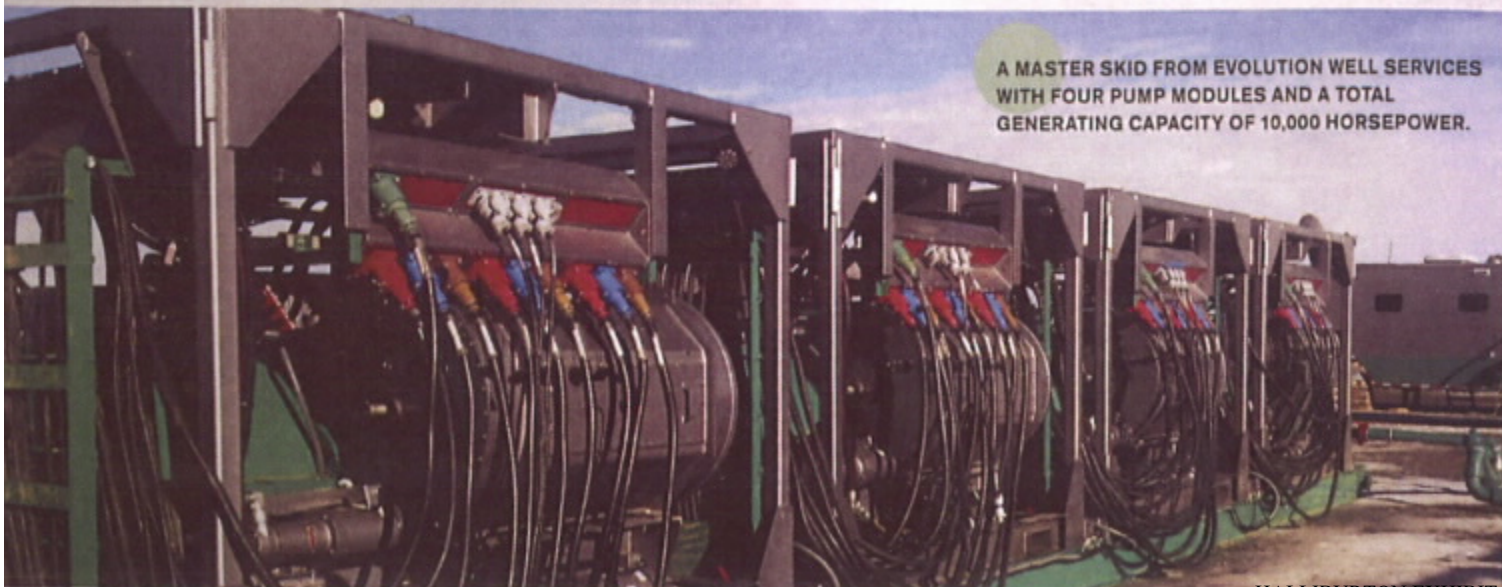
EVOLUTION WELL SERVICES

Calgary-based Evolution Well Services has developed a fracking system that relies not on diesel to fuel the massive pressure pumpers needed for big frac jobs but rather natural gas-fuelled electricity, offering the opportunity to eliminate diesel engines and their related emissions and help with manpower and maintenance issues.

"Because our system is modular and is placed on a skid, we can scale it down, reducing the footprint," says Eldon Schelske, Evolution's president. "Also, one skid with a 10,000-horsepower unit replaces five tractor-trailer units."

Schelske, an oilfield service veteran with 28 years of experience, incorporated the company about two years ago and has been working on the technology for three years. He says the system is extremely energy efficient, which offers an initial level of savings.

"We're looking at a tenfold decrease in the amount of money spent to create the same amount of energy, relative to diesel," he says. "Fracturing is all about torque. With our system, you only provide the amount of pressure needed."



A MASTER SKID FROM EVOLUTION WELL SERVICES WITH FOUR PUMP MODULES AND A TOTAL GENERATING CAPACITY OF 10,000 HORSEPOWER.



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[ASSOCIATED WITH FRACKING].
WATER USE IS CERTAINLY ONE, BUT
THERE ARE ALSO PROBLEMS WITH
WELL CLEANUP, GREENHOUSE GAS
EMISSIONS AND TRUCK TRAFFIC."**

— GRANT NEVISON, PRESIDENT, ENFRAC INC.

Aside from the greater efficiency, the lower cost of gas relative to diesel helps to reduce costs.

He estimates that it costs operators in deep gas basins like Horn River \$80,000 a day to buy the diesel they need for a frac.

"With our system, it is \$1,500 a day to purchase gas, or operators can use their own gas."

Schelske says the turbine can be powered with LNG or compressed natural gas, or it can use wellhead gas, which optimizes the benefits applicable to pad drilling operators, who might drill several wells from a single location.

Schelske says he looked at the idea of using gas-fuelled electric power after other oilfields service firms he had worked for had considered using the system for offshore oil and gas development.

"It didn't make sense for that application, but a turbine could produce 32 megawatts of power in a package on land that is 72 feet by 28 feet."

Evolution didn't have to reinvent the wheel. It works with technology giant General Electric and will use GE's mobile TM2500 gas turbine to generate on-site power.

Emissions are estimated to be two-thirds less than conventional fracking methods. It also needs 75 per cent fewer workers to operate than systems in common use and produces lower decibels of sound. ▶

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EVOLUTION WELL SERVICES HAS SET UP A DEMONSTRATION SITE IN LETHBRIDGE, ALTA., THAT BOASTS 20,000 HORSEPOWER OF PUMPING CAPACITY. A SIMILAR SITE USING CONVENTIONAL FRACKING ASSETS WOULD BE DOMINATED BY 10 TRACTOR TRAILER PUMPS.

"Compared to conventional fracking crews of 30–40 workers, I can pick an experienced crew of eight to do the job," he says.

Evolution started demonstrating the system in an industrial park near Lethbridge, Alta., in early February.

EXPANSION ENERGY

Perhaps the most novel of the newly developed technologies that could improve the environmental footprint and economics of fracking is one developed by Expansion Energy LLC, a privately held company based in New York.

Expansion Energy uses a cryogenic-based approach, with modular units that can convert natural gas into cold compressed natural gas (CCNG), which, like LNG, can be pumped at a very high pressure. The firm's technology cools gas to between minus 160 and minus 170 degrees Fahrenheit, about 100 degrees warmer than LNG.

A variation of the CCNG concept, called Vantor's Refrigerated Gas Extraction (VRGE), converts associated gas from a fracking site to CCNG, and pumps it back to the reservoir at high pressures to open fissures in the formation to enhance recovery.

Company co-founder David Vantor, the firm's managing director and chief technology officer, says the process will allow operators to frac oil and gas wells without using water or fracking fluids.

Cost savings and the small environmental footprint of the technologies have led to a large amount of interest from both oilfield service firms and producers, according to Vantor and co-founder Jeremy Dockter, Expansion Energy's president.

There has been a good deal of skepticism expressed about the technology, including from ENFRAC's Nevison, with most skeptics wondering how the approach can allow for enough pressure to be created to fracture rocks.

Vantor, who describes himself as self-taught, is an architect by training and has never been involved in the oil industry. But the company has received 16 U.S. and global patents for his inventions, including patents for a device that can economically produce between 2,000 and 50,000 gallons of LNG per day from natural gas. Vantor says the 2,000-gallon-per-day version, which the firm calls the VX Cycle, can fit inside a trailer and can be hauled to a drilling site or any other location.

Field trials are expected later this year, Dockter says.

Doubters about the firm's suite of technologies might have to reconsider their positions in light of a technology licensing deal Expansion Energy signed last October with U.S.-based industrial giant Dresser-Rand Group Inc., which designs, manufactures and markets equipment for the oil and gas, chemical, power and other industries worldwide and generated revenue of \$2.63 billion last year.

The deal, for which no financial details were revealed, gives Dresser-Rand the exclusive right to market Expansion Energy's VX technology for the small-scale production of LNG. It is a very large potential market.

"In our ongoing evaluation of technologies to complete the value chain for the burgeoning shale markets, as well as solutions for addressing global natural gas flaring and the rapidly expanding markets for LNG vehicle fuelling, Expansion Energy's LNG production process met all of the requirements we identified and embodies technology that we can bring to the market quickly," Dresser-Rand vice-president and chief marketing officer Brad Dickson said in an email. "We already have several clients anxious to take multiple units to fuel their fleet operations. We presently believe that the market for this technology will be in the range of \$100 [million] to \$200 million within just the next two to three years, and will continue to grow robustly beyond that."