Using proven, safe and robust equipment from the mining and power generation industries, electrification of pressure-pumping operations with high-density power solutions can boost efficiency and lower emissions — and total lifecycle costs — to help improve productivity, agility, and profitability in unconventional oil and gas completions.

Unconventional energy production, such as in the Permian and Bakken formations, has unlocked enormous wealth in the U.S. According to the U.S. Energy Information Administration, prospects are bright for this good fortune to continue. The Administration forecasts tight oil to continue being the top source of U.S. crude oil production through 2050, although it expects output to plateau at 11–12 million barrels per day (bpd) in the next few years. Still, those levels are healthy by any measure and will far exceed a 9.6 million bpd record set in 1970. Nonetheless, with the pain from the free fall of market prices in 2014-16 still fresh in mind, today’s unconventional producers want to maximize their efficiencies, yields, and profitability in all market conditions. Even before that time, they were starting to implement new approaches and techniques in well stimulation and completion, then accelerated their efforts as margins eroded almost by the day.

Some might mark this period as the start of Fracking 2.0, the next-generation hydraulic fracturing of unconventional oil and gas resources marked by a focus on operational efficiencies and improving the return on capital deployed. Part of this story has seen the emergence of greater electrification, automation, and digitalization of fracking operations. This paper will focus on the electrification of pressure-pumping applications as a core trend in fracking’s continuing evolution.
Greater operational density spawn new challenges
Multi-well pads, zipper fracking, and longer laterals, often stacked, have become less novel and more the norm. These trends are making the unconventional much more conventional — supported by greater automation to improve efficiencies, flexibility, and speed. After all, fracked wells produce most of their oil and gas in just 18 months, so E&P operators must drill faster and faster to keep pace.

But two key challenges are emerging that threaten to slow industry growth. They come from the greater operational density that these techniques bring. And that’s in addition to the ever-expanding reach of E&P activities, often in remote areas where unconventional oil and gas resources are found.

One big challenge is the limitation of horsepower available on current pumping trucks as well as the high associated maintenance costs. More and more horsepower is needed to drive next-generation pressure-pumping equipment, and today’s diesel drivers, whether mechanical or for power generation fall short and diesel fuel costs are proportionally increasing.

The other challenge is regulatory limits on the flaring of produced gas, which is flared because remote production wells often lack the gathering pipeline infrastructure to get it to market. While some states are stricter than others in their flaring regulations, some producers have reported having to ramp down production because they would otherwise exceed the limits of their flaring permits.

Safe, electrified pressure pumping with SEAM™ solutions — power to drive Fracking 2.0
To address these issues, Siemens offers electrified pressure-pumping capabilities from its SEAM™ portfolio. It consists of a wide range of electrical and mechanical solutions to support hydraulic fracturing of tight oil and gas resources. Truck-borne (or available on skids), they are compact, turbine-based drive trains. Modular in design for easy scalability, they’re equipped to safely provide both onsite power and mechanical drivers economically and safely by using produced gas or other fuels that are more cost-effective than diesel.

The drive packages from the SEAM portfolio feature rugged, severe-duty, and outdoor-rated Siemens traction motors and drives that have been operating reliably in the mobile mining industry for nearly 20 years.

They are used on huge mining trucks and excavators that are the size of large buildings, often operating in the harshest conditions. These drives are operating in Western Australia, where ambient temperatures are oven-hot and penetrating dust is a constant threat. They also are deployed in Siberian mining operations, where winter operations consistently subject them to sub-zero Arctic cold.

Exceptional power-density. Siemens developed the SEAM portfolio to provide more hydraulic pump horsepower in a smaller operational footprint by using powerful gas turbines for both electrical power and mechanical drives. Current diesel and gas-hybrid reciprocating engine drivers, which top out at 2,500 shaft horsepower (SHP), fall short of the 3,000+ SHP needed to drive next-generation pumps. That’s because bigger diesel or gas-hybrid engine drivers are simply too large to fit on a mobile trailer.

In contrast, Siemens SEAM solutions can generate up to 8,000 SHP per pump trailer in a very compact footprint. Each solution provides extremely quiet gas turbines; electrical distribution switchgear; drives; outdoor-rated motors and inverters (each without an E-house); generators; transformers; and other associated components. Those components include wireless monitoring, controls, and diagnostic technology.

The SEAM solution is the most flexible and scalable system available that provides options based on required pressure/flowrates and also variability of hot/cold environments or hard to maneuver lease roads, among other deployment requirements. In a typical configuration, one mobile power unit will supply three 2,500 SHP pump trains. But total power output can be scaled by simply selecting the required number of mobile turbine packages.

In fact, compared to diesel-engine solutions, Siemens SEAM solutions can cut onsite power-generation fuel costs by as much as 80 percent and maintenance costs by 60 percent. What’s more, if well-head gas is used as fuel, flaring can be reduced or eliminated. Importantly, these mobile, turbine-based drive trains can be rigged quickly, both up and down,
in just a couple of hours for smaller units and a day for larger ones.

“Compared to diesel-engine solutions, Siemens SEAM solutions can cut onsite power-generation fuel costs by as much as 80 percent and maintenance costs by 60 percent yet generate up to 3x the hydraulic horsepower.”

To summarize, the Siemens SEAM portfolio of high-density, pressure-pumping electrification solutions can provide unconventional E&P operators and their pressure-pumping service providers these benefits:

- **Lower OPEX and lifecycle costs** with savings in fuel, parts, and labor while increasing efficiency and productivity of well-site drilling, completions, and operations.
- **Fuel-flexibility**, with dry low emissions (DLE) gas turbines that can burn well-head gas — resulting in huge cost-savings and reducing or eliminating flaring — or burn other fuels, in all cases without the water-injection that competitive solutions require.
- **Improved environmental compliance**, by reducing flaring and emissions, as well as by addressing noise issues and reducing truck logistics to well sites and through communities of populated areas. Also, DLE gas turbines burning natural gas are much cleaner than diesel engines.
- **Quieter operation**, by using ultra-quiet gas turbines and eliminating loud diesel generators.
- **Gains in speed, agility, and efficiency**, through the benefit of all-electric/smooth power shifts. No mechanical transmission means precise power control at any level, plus a smaller operational footprint, faster rig-up/down capabilities, and more scalable modularity.
- **Maximum asset availability and utilization**, while minimizing the operational footprint of well-site equipment and reducing onsite congestion of people, equipment, piping, and related activities.
- **More operational visibility**, with real-time data collection that eliminates time-consuming, error-prone manual approaches and provides more of a 360° view of pressure-pumping operations.
- **Enable greater automation and digitalization**, tapping data for insights to new efficiencies and improved decision support, both onsite and at a distance.
- **Enable new products and services**, even business models, such as pay-as-you-go charging for power delivered, for oil services providers, OEMs, and integrators.

Modular electrification solutions that easily scale

With the SEAM portfolio, Siemens offers multiple solutions with varied power outputs to provide options based on specific power needs, portability, available fuel sources, and other requirements. These range from both mobile industrial and aeroderivative gas turbines that link together to create full-scale microgrids. Many Siemens SEAM solutions are available through flexible financing agreements, including long-term leases and deferred payments, provided by Siemens Financial Services.

For example, consider a fully mobile SEAM solution based the Siemens SGT-A05 aeroderivative gas turbine. As a 5.8 MWe power solution, it can be rigged up to start generating power...
in four hours or less. Of nearly 1,700 of these models operating worldwide, nearly half are in use by oil and gas operators.¹

If onsite power is required for a year or more, Siemens offers the SGT-A45 TR aeroderivative gas turbine solution. While still a mobile solution, this SEAM solution was designed specifically for delivering reliable, portable power in remote areas, such as unconventional shale oil plays in the Permian and Bakken formations in the U.S. and remote fields in Argentina. Its lightweight, 44 MWe turbine generator is fully integrated with all required electrical gear into a mobile unit that can be installed and commissioned in under 8 days.

SEAM solutions can configure any number of the many different Siemens gas turbine models into fully integrated, mobile microgrids. Smaller turbine units, such as the 5.8 MWe Siemens SGT-A05 aeroderivative gas turbine described earlier, can be linked together using portable e-houses, combining the turbines individual generating capacity into a much larger power output depending on a site's needs.

By deploying gas turbine packages that burn well-head gas or liquid fuels, operators can save diesel fuel costs and reduce or eliminate flaring and emissions. This approach also eliminates the need for fuel deliveries from third parties, saving costs and relieving congestion and stress in and about the well-site as well as the public roads to get there. The turbines can then be used to drive generators, which supply power to prime movers, such as electrical motors and variable frequency drives. By eliminating traditional diesel generators, operators gain cleaner, more efficient fracturing operations.

Electrification, automation, and digitalization: Keys to Fracking 2.0
Siemens SEAM mobile pressure-pumping solutions also include wireless monitoring and controls, plus remote diagnostic technology. With these tools, operators can collect and analyze equipment data in real-time, with alerts to flag operating anomalies.

This can provide actionable intelligence for condition-based monitoring of equipment, even from afar. In turn, operators or their service providers can enact more precise, less costly condition-based maintenance models, leading to less downtime and greater asset utilization.

Cloud-based digital services and analytics via Siemens MindSphere can also be deployed. This way, data can be gathered and analyzed across entire fracturing fleets to continually optimize operations.

Electrification, automation, and digitalization are the keys to Fracking 2.0 and the greater operating efficiencies, visibility, savings, reliability, and profitability they can bring.

Siemens has been supplying equipment and engineering solutions to unconventional operators since the early days of shale resource development. These include:

- Power generation solutions
- Artificial lift systems
- Reciprocating and centrifugal compressors
- Gas processing solutions, such as onsite LNG conversion
- Motors and drives
- Switchgear, transformers, circuit breakers
- Automation, controls, and monitoring

In addition, Siemens has a dedicated team of experts in unconventional applications as well as a full range of financing solutions to minimize capital outlays and maximize returns on equity.

By electrifying pressure-pumping operations using mobile, turbine-based solutions from the Siemens SEAM portfolio instead of using traditional diesel solutions, unconventional E&P operators and their service providers can start to realize these benefits — while also addressing their noise, flaring and emission issues. The sooner they electrify their pressure-pumping operations with gas-turbine solutions, the sooner they’ll gain these advantages and sharpen their edge over their competition.


³ Shane McElroy SEAM presentation, p. 20.