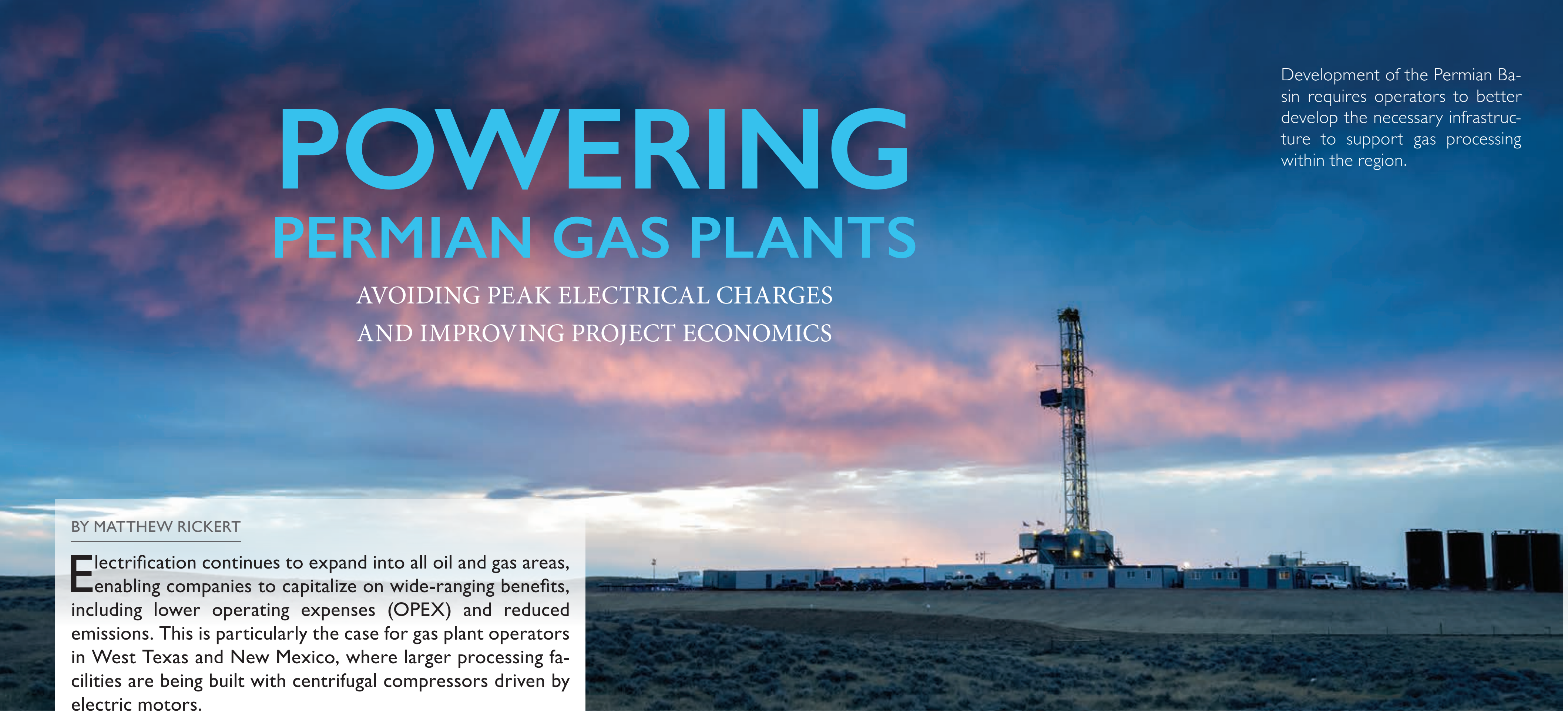


Development of the Permian Basin requires operators to better develop the necessary infrastructure to support gas processing within the region.

POWERING
PERMIAN GAS PLANTS

AVOIDING PEAK ELECTRICAL CHARGES AND IMPROVING PROJECT ECONOMICS

BY MATTHEW RICKERT

Electrification continues to expand into all oil and gas areas, enabling companies to capitalize on wide-ranging benefits, including lower operating expenses (OPEX) and reduced emissions. This is particularly the case for gas plant operators in West Texas and New Mexico, where larger processing facilities are being built with centrifugal compressors driven by electric motors.

The most popular approach for these plants when it comes to power has been to connect to the external grid. While this is attractive from a capital expenditure (CAPEX) perspective, it exposes operators to peak electrical (i.e., congestion) charges and grid instability. The latter has become especially relevant in recent years with increased penetration from renewables.

This article discusses how these issues can be addressed with on-site power generation using gas turbines and outlines the benefits the approach provides, including reduced risk and OPEX, elimination of boilers for heat, and greater control of the timeline for bringing gas plants online.

MOVING TOWARD LARGER POWER BLOCKS

Over the last five years, tremendous oil and gas production growth from the Permian Basin has spurred a corresponding need for the infrastructure to process and transport higher volumes of hydrocarbons to market.

In the early days of the shale boom, many gas plants built across the region had flow capacities ranging from 20 to 80 MMscf/d (5.7×10^5 to 2.3×10^6 m^3/d). Compression requirements for the facilities were typically met with reciprocating units driven by gas engines. However, as demand for both gas and natural gas liquids (NGLs) has increased, much larger plants are being specified – some to the tune of 200 to 300 MMscf/d (5.7×10^6 to 8.5×10^6 m^3/d).

The larger flow capacities have prompted a shift in the choice of machinery configuration. Today, many of the plants proposed and built use centrifugal compressors driven by electric motors. These setups offer numerous advantages over traditional gas engine-driven reciprocating trains.

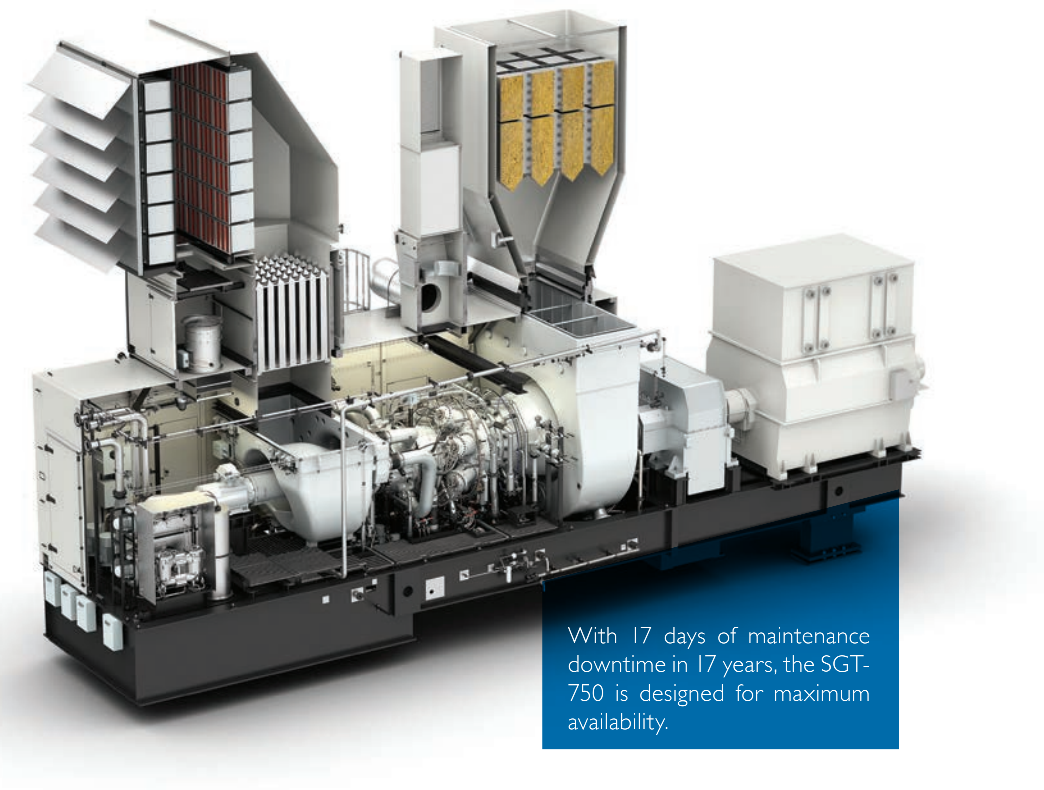
Net present value (NPV) analyses show that for a 100-MMscf/d (2.8×10^6-m^3/d) gas plant, CAPEX associated with centrifugal and reciprocating compressor solutions is nearly identical. But when the plant size increases to 200 MMscf/d, the CAPEX of the centrifugal compressor solution can be as much as 40% lower than that of the reciprocating compressor solution. These savings are attributable to the power density of the centrifugal solution and the fact that motor-driven centrifugal compressors do not require a standby.[1]

For example, in a 200- to 250-MMscf/d (5.7×10^6- to 7.1×10^6-m^3/d) gas processing facility, the entire inlet and residue gas compression duty can be handled by just one or two centrifugal compressors. On average, the same duty would require anywhere from seven to 10 reciprocating compression units.

Additionally, the total maintenance costs over the life of the centrifugal solution can be 85% to 90% lower than the total maintenance cost of a reciprocating solution. Other advantages include high operating flexibility and availability. It is common for centrifugal compressors to run uninterrupted for five to seven years between inspections. This is especially advantageous in remote plays like the Permian Basin, where access to skilled service personnel is limited.

GRID CONNECTION PAIN POINTS

When it comes to meeting electrical requirements for larger gas plants, most operators prefer a grid connection. While this is often the least capital-intensive route, it has drawbacks.



With 17 days of maintenance downtime in 17 years, the SGT-750 is designed for maximum availability.

Perhaps the most significant disadvantage of a grid connection is being exposed to spiking electricity prices (otherwise known as congestion charges).

The Electric Reliability Council of Texas (ERCOT) is different from other regional electrical suppliers across the United States because it does not have a forward capacity market. This means that excess electricity cannot be procured from outside the grid to meet peak demand, which increases the likelihood of unexpected shortages and price fluctuations. In some cases, the price increases can be substantial, and they often come without notice.

Take, for example, the afternoon of August 13, 2019, when high electricity demand, low supply, and depleted reserve margins caused power prices across the state to spike to US$9000 per MW/h.[2] The massive increase left many Texas energy consumers, including gas plant operators, paying a large portion of their yearly electric bill in a period of just a few hours.

Although this is an extreme example of how congestion charges can impact OPEX, every plant with a grid connection will experience slight, but often more frequent, price spikes throughout the year. Siemens Energy is aware of one gas plant operator in Texas who reviewed their utility bills and found that the average price of electricity was roughly double what they had budgeted for when the plant was built.

In addition to peak electricity charges, power generation in Texas is shifting. The state historically has relied on electricity production from coal-fired facilities. However, the push to reduce emissions has seen increasing penetration from renewables, including wind and solar. In 2019, more than 20% of all electricity consumed in Texas was generated from renewables.[3]

The intermittent nature of these sources, coupled with the retiring of many coal plants over the last three years, has increased grid instability when demand is high, particularly in the summer months. Many of these remote locations rely on a single transmission line to deliver power, which means that lightning strikes, storms, and downed power lines are significant risks. These issues increase the likelihood of extended outages for grid-connected gas plants, most of which have no form of back-up power.

Another issue that greenfield gas plant projects have to contend with is the time it takes to get a grid connection. ERCOT is the only agency in Texas permitted to install transmission and distribution lines. This has created a situation where operators compete with consumers across the state, including in metropolitan areas, like Houston and Dallas, and time to connection can be long.

Many plants have already been waiting two or more years for a connection. For facilities proposed in highly remote locations, a timeline of three to four years is not out of the question.

THE CASE FOR ON-SITE POWER PLANTS

In light of the pain points, a strong business case can be made for gas plant operators (of both brownfields and greenfields) to bring the provision of power under their own supply base with the construction of on-site, gas-fired generation facilities.

The SGT-800 turbine has more than 8 million operating hours of fleet experience.

Map Of The US Transmission Grid

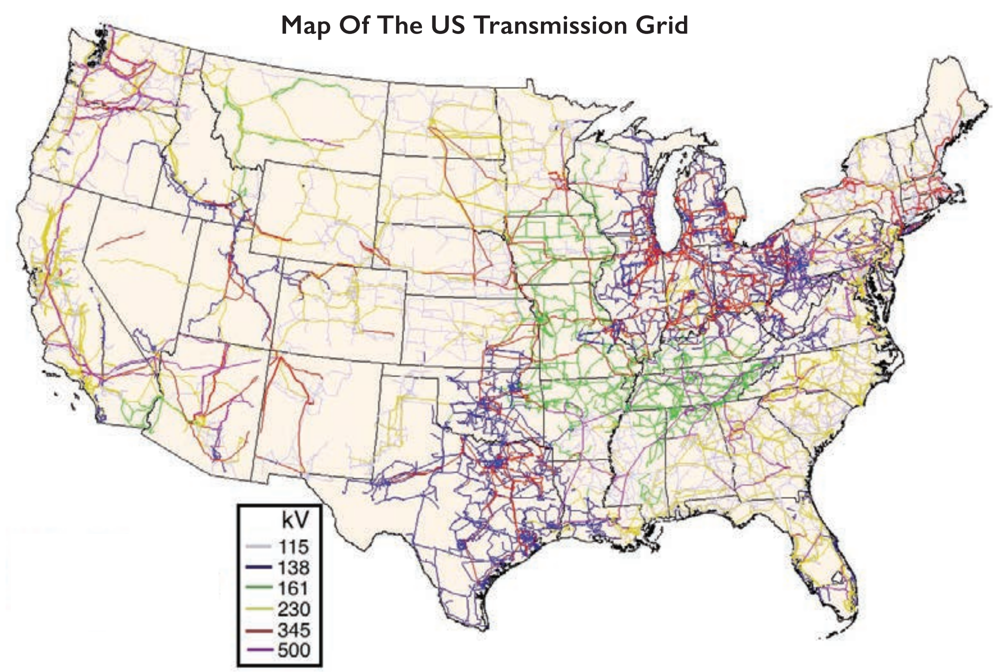


Image Source: FEMA

These power islands enable plants to enhance reliability and capture long-term electricity cost savings by avoiding peak electrical charges while complying with emissions regulations. Greenfields have the added benefit of being able to "control their own destiny" when it comes to the timeline for starting up. Since the gas turbine can provide process heat in combined cycle configurations, the need for boilers can also be eliminated, which reduces overall CAPEX.

Two primary models have emerged for the operation of these plants. In the first model, the operator retains ownership of the power generation facility and operates it using excess gas from the plant, which is virtually free fuel. This option requires a relatively high upfront investment but generally represents the lowest cost approach over the long term.

In the second model, an independent power producer (IPP) builds the power facility near the gas plant and then purchases the gas from processors/operators. Electricity produced is then sold back to the operator. The advantage of this approach is that it minimizes the upfront investment required by the operator, while still enabling improvement in the security of electricity supply.

High-efficiency gas turbines can be sized according to the power requirements of the plant. In preliminary discussions between Siemens Energy and operators in Texas and New Mexico, two gas turbine models have been identified as suitable options for meeting power needs, which are typically in the 40- to 60-MW range.

The SGT-800 industrial gas turbine offers outputs of up to 62 MW in a simple cycle configuration and 88 MW in a 1 × 1 combined cycle (up to 180 MW in 2 × 1 designs). The turbine has accumulated more than 8 million operating hours worldwide, with overall fleet reliability of ~99.7%.[4]

The SGT-750 industrial gas turbine can provide up to 40 MW of output in a simple cycle and 51 MW in a 1 × 1 combined cycle (103 MW in a 2 × 1 combined cycle). With just 17 days of maintenance in 17 years of operation, the SGT-750 can provide maximum availability.

Both the SGT-750 and SGT-800 are equipped with dry low emission (DLE) combustion systems to minimize nitrogen oxides (NO_x) and carbon monoxide (CO) emissions over a wide load range. For gas fuel, the models can achieve single-digit NO_x emissions levels, ensuring compliance with applicable regulations.

In a proposed power plant setup, one or two gas turbines would fulfill the gas plant's power requirements. This would provide sufficient power even without a grid connection, allowing operators to start their plants earlier. When available, a grid connection can be used as a backup in an outage event, for example, during planned maintenance activities.

The setup would create n + 1 redundancy at a lower cost than is typically seen in oil and gas power generation applications. As a result, there would not be a need for an additional gas turbine to remain on standby.

REPLICATING A PROVEN APPROACH

Although the idea of electrifying gas plants in the Permian Basin with on-site power generation via gas turbines is relatively new, it is by no means a novel concept for oil and gas operators.

The overwhelming majority of offshore installations have their own source of power generation. This is also the case with many downstream sites and, increasingly, in the oil field with electric fracking fleets. With electricity prices spiking and increased grid volatility from renewables penetration, a strong business case can be made for gas plant operators in Texas to follow suit.

While greenfields stand the most to gain from on-site power generation, the concept is also applicable for brownfields – particularly those undergoing expansion projects. In both scenarios, operators can realize numerous benefits, including lower OPEX, higher uptime, and reduced emissions.

ABOUT THE AUTHOR

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