WHITE PAPER

Electrification of Oil and Gas Wellfields Is Go-To Solution for Long-Standing Challenges

By Brian Despard and Simon Palacio

The race is on to electrify oil and gas wellfields in West Texas and other oil and gas production regions throughout the U.S. Exploration and production (E&P) companies are jostling to get to the front of the line to apply for grid interconnection agreements, due largely to a growing urgency to reduce carbon emissions and lease operations expenses.

Until recently, most oil and gas producers relied on temporary power configurations for the energy needed to drill, pump, compress and transport hydrocarbons. This was mainly because oil and gas reserves often are located in remote locations with minimal power grid infrastructure available. Setting up a network of portable diesel or natural gas generators was the most efficient way to get power to drilling rigs, compressors and other vital equipment.

While on-site generators provide flexibility to quickly ramp up operations, relying on these units often creates other challenges, such as high lease operating expenses (LOE), spotty reliability and negative environmental impacts.

Although these temporary power options were often considered just a cost of doing business, that reality is quickly changing.

Over the past six years, institutional investors and large banks, government regulators and consumer advocates have been increasing pressure on the oil and gas industry, along with other heavy industries, to reduce the carbon intensity of primary operations. Compliance with environmental, social and governance (ESG) goals has become a boardroom priority, with a number of major producers announcing intentions to reach net zero carbon emissions by 2050, with some targeting goals by as early as 2030.

Electrification of oil and gas production equipment has emerged as a key strategy to meet ESG goals — offering the potential to cut emissions by as much as half. while also helping achieve significant energy cost savings. Grid-supplied power can significantly reduce one of the top five LOE line items while improving resiliency and generally derisking operations.

Energy Landscape

Large E&P companies operating in the Permian and Eagle Ford basins of West and South Texas and Southeastern New Mexico are investing billions of dollars to build out hundreds of miles of distribution feeder circuits, substations, transformers and other components of power distribution grids. Many are essentially becoming electric distribution utilities.

For example, BPX Energy, the U.S. shale subsidiary of oil and gas giant BP, has now electrified nearly 100% of its operations in the Permian Basin of West Texas. Burns & McDonnell provided a range of studies, design engineering and construction management services for a 25-kV network of distribution feeder lines spanning more than 400 miles. The system includes four 138-kV substations that will serve as interconnection points with the regional grid. BPX now owns, operates and maintains this power distribution network providing the energy needed for a number of high-production well platforms.

BPX executives speak favorably of the cost savings and decarbonization benefits of its electrification strategy, despite a capital spend that could total approximately $1.3 billion once all of its Permian operations are electrified. The company acquired its shale assets in the Permian Basin in 2018 and has moved quickly since then to develop distribution infrastructure to use power supplied by the regional grid.

The BPX grid distributes hundreds of megawatts of power to drilling rigs, fracking rigs, electric submersible pumps, electrified air compressors and a wide variety of other equipment. One key element of BPX's electrification plan is integrating centralized processing facilities that also run off of grid power to process output from a number of wellheads. With each facility processing up to 35,000 barrels of oil per day, the need for individual compressors, tanks and other equipment at each well is eliminated and the emissions footprint is further reduced.

The BPX grid is set up much like the smart grids of public utilities, with capacitors, reclosers and other devices that help prevent outages and voltage sags while maintaining consistent power quality.

Planning for Electrification

Design and construction of a distribution grid begins with a detailed analysis of the production basin, along with the expected load created by various pieces of equipment needed throughout all production areas. Planning for increased electric loads due to electrification requires rigorous modeling of existing electric system capabilities, identification of infrastructure needed to meet higher electric loads, and valuation of the electrification value chain based on the new infrastructure, avoided gas costs (i.e., sale of gas not used) and lower CO2 emissions. The evaluation of new infrastructure requirements includes various grid connection points that may be available.

With each drilling area and basin having unique characteristics, this preliminary evaluation and design will be crucial in helping define the expected capital costs of the overall project as well as evaluating the portfolio of generation assets available in the area. The findings of the initial study often serve as a basis for a more detailed front-end engineering and design (FEED) effort that quantifies costs and options for the equipment needed for substations and on feeder circuits and control centers.

The FEED is the point at which expected procurement lead times can be projected. With some items like high-voltage transformers and specialized switchgear taking two years or longer for delivery, this early-stage planning is essential.

The detailed plan also is the core element for an interconnection application that must be submitted to the regional transmission authority. In West Texas, it is common practice for utilities to facilitate applications filed with the Electric Reliability Council of Texas (ERCOT). In order for the application to be placed in the queue for consideration and final approval, it must cover all the bases, including an assessment of projected load growth resulting from the number of facilities expected to be energized as on-site fossil-fueled generators are taken offline.

Emerging Challenges

Applications for interconnection approvals typically take extended periods of time. Significant delays can be expected, depending on how many applications are already in the queue when an application is filed.

Nearly all operators in the Permian, Eagle Ford and other shale basins are actively pursuing plans to electrify facilities via their own self-funded behind-the-meter systems that connect with area transmission grids. Although BPX appears to have jumped out ahead of the pack with its early decision to electrify, other producers now pursuing similar electrification strategies are creating considerable competition for available megawatts of generation and transmission capacity.

Due to the remoteness of many of these production areas, some estimates project that grid capacity will need to grow by three or four times in order to serve all the load expected from these production areas.

As a further challenge, developers have announced plans for construction of a number of large new datacenters in Texas. These facilities will create enormous additional power demand.

The ability to meet future load growth is already prompting considerable discussion among utilities, regulators and transmission system operators. ERCOT has announced that it would take steps to begin curtailing large noncritical power loads if reserve margins drop below acceptable levels during peak usage months.

In addition, the Public Utility Commission of Texas has publicly questioned requests by Texas utilities for approval to build new transmission infrastructure serving the shale basins. Concerns

stem from the possibility that some producers could defer drilling operations due to volatility of oil and gas prices. Regulators are concerned that if this happened, other ratepayers would be on the hook for cost recovery of these transmission assets.

With an outlook pointing to potential constraints in transmission and generation capacity, the race to apply for interconnections to the grid is becoming intense. Although some major datacenter developers have announced plans to build their own generating capacity, it is still likely that most will file applications for approval to interconnect with the regional power grid in order to create additional resilience and redundancy to meet needs for uninterrupted power supply.

E&P companies face similar urgency to maintain uninterrupted power supply. If a breaker is flipped at the substation and power is shut down to the wellfield for a day or more, it could result in catastrophic losses of one or more wells. If this scenario occurs, the operator would be required to redrill and recomplete the entire well, often at a cost of several million dollars.

The response to this risk among some operators is to begin looking at plans to build their own backup gas-fired generators. This backup contingency plan comes with its own set of risks, however, as these units would be considered new generation and would be required to meet today's stricter air quality emissions regulations.

Grid-Focused Solutions

With the trends pointing toward significant load growth in Texas — much like other areas of the U.S. — holistic solutions for expanding both generation and transmission capacity are being discussed. Though there is adequate generation in West Texas, for example, the transmission infrastructure needed to wheel that power to other areas of the state is constrained.

A proposed 765-kV transmission program connecting major population centers in East, Central and North Texas with the West could help ease some congestion. Recent public hearings to explore whether this ultrahigh-voltage should be reined back to a 345-kV program drew numerous comments, including requests from the oil and gas industry to please proceed with the 765-kV program.

Though it has been uncommon to build transmission infrastructure at these extreme high voltages, it is a solution that could resolve some concerns over power grid congestion in regions that are currently facing power supply issues.

Supporting Load Growth

The merits of oilfield electrification via grid-connected power are no longer in doubt. With an overwhelming business case supporting the potential for double-digit reductions in carbon emissions and similar significant savings in operations costs, the industry is now working on resolving the challenges that could create significant delays in grid interconnections, pose serious operational risks or lead to steps backward in carbon emissions.

The prospects of electrifying oilfield operations is no longer a straightforward cost-benefit calculation, given the external risk factors that now are emerging. However, with the unique characteristics of each production area and the demonstrated willingness of the industry to push forward with novel solutions, it is quite likely that momentum will continue to build toward building, owning and operating robust, carbon-free power distribution facilities serving wellfield operations.

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