Using Integrated Power Generation to Improve Flexibility and Reduce Operating Costs for Midstream Applications

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Introduction

On-site integrated power generation is quickly becoming an attractive option for midstream oil and gas operators. Concerns about grid power accessibility, transmission reliability, and the risk of increasing power costs are encouraging operators to consider on-site electricity generation. Integrated power generation uses existing site gas flows to generate electricity at the facility; this electricity is then used to power equipment used in oil and gas production and processing. In addition, engine- and turbine-driven generator packages provide waste heat that can be incorporated into the facility process design, further improving operational efficiencies and reducing emissions.

Integrated power generation facilities can operate in island mode—completely independent of the power grid. Operating in island mode prevents grid outages from affecting the uptime of the facility. For facilities dependent on grid power, this downtime can have a significant impact on site profitability. Unplanned downtime can also cause equipment stress due to unexpected start/stop cycling throughout the site, leading to major maintenance costs over the lifetime of the facility. In addition, the time required to commission a new facility can be greatly reduced with on-site power-generating equipment. On-site power can be installed in coordination with the project plan, eliminating dependence on utility infrastructure buildout and lengthy right-of-way negotiations.

There are many projects where integrated power generation can prove to be beneficial and economical. Exterran has been involved with several successful power generation installations and has the proven background and experience to fully design, install and operate integrated power generation systems for use in midstream operations.

Integrated power generation process overview

Integrated power generation uses gensets—equipment packages consisting of a driver (typically an engine or turbine) and an electrical generator. Gensets use natural gas fuel that is readily available on-site at a relatively low cost. This efficient approach eliminates the costs associated with transporting natural gas through a pipeline to a power producer, and in turn sending electricity from the power producer back to the oil and gas facility.

Where possible, on-site power generation should be considered during initial facility planning and construction, integrating it with the process design. However, installations can also be considered during the expansion of an existing site. In either case, generating power on-site eliminates the need to negotiate or renegotiate existing contracts with power producers. For existing facilities, electricity-generating capacity can be installed to accommodate both expansion needs and existing site demands. This approach further reduces the risk associated with grid capacity planning and pricing fluctuations.

Background: Traditional vs. integrated power generation

With Exterran's expertise in designing, installing and operating integrated power generation equipment, facilities can be immune to the changes in grid power availability, reliability and cost.

Midstream facilities have typically relied on grid power, but the extent of this dependence varies from site to site. In some cases, a combination of gas-driven compression is used along with auxiliary equipment powered by the grid. In other cases, sites use motor-driven compression and are completely dependent on the grid. In both of these scenarios, facility uptime is outside the control of midstream operators. The uncertain nature of power outage causes—for example, storms, vehicle accidents and animal damage—can lead to extensive production and profitability losses.[1]

In locations where grid power or additional grid power is inaccessible, the options for expanding an existing facility or developing a new facility may be limited. For midstream companies, this can play an important role when competing for contracts; whoever can get products to market in a shorter period of time will be the more attractive option for producers. An operator that can adequately generate power on-site has a distinct advantage compared to those relying on traditional grid power.

Not only is dependence on the reliability of grid power a concern, there are other issues with connecting to the grid, particularly in basins and regions that are experiencing high growth. Project timelines may be extended to account for landowner and regulatory approvals associated with the expansion of transmission lines. Additionally, the construction time required to construct new power lines can further increase project duration, delaying both start-up timing and the resulting revenue generation.

Several states impose strict emission regulations, limiting the amount of horsepower that can be installed at a facility. Compared to mechanical drive compression, integrated power generation can provide a better emission profile in some scenarios; this allows additional power to be installed on-site without compromising emissions limits.

Table 1: Traditional grid electricity vs. integrated power generation

	Traditional grid electricity	Integrated power generation
Planning	Multiple external stakeholders with conflicting agendas and timelines	Adheres to internally controlled project plan; adaptable in scale and timing
Pricing	Load profile and forecast may not align with power producer's rate setting practices	Self-generation costs are highly correlated with site throughput and are not subject to arbitrary rate increases

1. Eaton, Blackout Tracker United States Annual Report 2017, (Cleveland: Eaton, 2018), http://electricalsector.eaton.com/forms/BlackoutTrackerAnnualReport.

	Traditional grid electricity	Integrated power generation
Efficiency and emissions	Thermal heat transfer is not feasible	Using available waste heat can create efficiency greater than 60% while reducing emission profile
Timing of installation	18+ months for short-term solution, and as long as 4-5 years for long-term solution[2]	Less than 12 months and within plant construction timeline window; first mover advantage
Flexibility/ expansion	Dependent on accuracy of 5-year load demand schedule from all players	Modular, containerized units can be placed on simple foundations; minimal balance of plant is required
Cyber security	Growingly susceptible to large-scale cyber attack[3]	In island mode, the on-site power supply is isolated from large external security threats

Equipment considerations

The proper design of integrated power generation systems at midstream facilities requires an evaluation of several types of equipment. Although designing and installing these systems may seem complex, Exterran has the background and capabilities to provide properly engineered power generation equipment.

Gensets

There are a variety of drivers available for power generation. For oil and gas facility applications, typical drivers include reciprocating engines and gas turbines. Accurately sized generators and proper technology selection is critical for a successful integrated power solution.

Motors

Motors used for pumps and compressors are often the largest electricity consumers at a midstream facility. Careful consideration must be made to properly account for both start-up and operating electrical draw. Strategic use of soft start and variable frequency drives can reduce the amount of power generation required at a facility, limiting the overall cost.

Transformers

Transformers help to reduce the voltage used to serve the motors on-site. Selecting the proper generating voltage can greatly reduce the size and cost of on-site transformers.

2. The Electrical Reliability Council of Texas, Inc. (ERCOT), West Texas Reliability Study, (Taylor, TX: ERCOT, 2016), http://www.ercot.com/content/wcm/lists/89476/2016_ERCOT_West_Texas_Sensitivity_Report_EVA.pdf

3. Russell Ray, "Cybersecurity Risk and Reality," Power Engineering, March 20, 2018, https://www.power-eng.com/articles/blogs/power-points/2018/03/cybersecurity-risk-and-reality.html.

Motor control center

The motor control center (MCC) houses the controls used for the motors at a facility. Typically, the MCC consists of the motor starters, fuses, circuit breakers and power disconnects.

Back-up generators

Properly calculating the amount of back-up power required is crucial to site performance and safety. The appropriate amount of required back-up fuel, gas or diesel, must also be considered.

Auxiliary equipment

Auxiliary equipment (e.g. lights, guard shack, and control systems) and associated power needs also need to be reviewed during the design of an integrated power generation system.

Site assessment

Exterran proudly offers total solutions for integrated power generation projects. Exterran's total solutions include the following:

- engineering and project management
- manufacturing and procurement
- construction and installation
- operation and maintenance
- options for a turnkey sale, rental or lease agreement

Combining standard and custom-designed products with experienced engineering, project management and construction teams, Exterran can quickly and economically install turnkey projects.

Exterran's experience and capabilities ensure integrated power generation designs are optimized for efficiency and reliability. These designs use a modular approach and are streamlined for quick installation. Exterran also manages the coordination of the wide range of equipment required for these projects.

To determine whether integrated power generation is an economical and feasible option for a facility, Exterran will assess the following:

- Site characteristics: What role will the site elevation and ambient temperature play in selecting gensets, motors and driven equipment?
- Generator sizing: What is the expected power requirement? This will include a full review of the equipment load list, sequencing, frequency, voltage, and transformer consideration.
- Fuel gas: What is the best equipment and process solution for the available fuel composition and pressure? Electricity can be generated from a wide range of fuels, from flare gas to commercial quality gas.
- Facility footprint: How can the location and layout of equipment be optimized within the overall site design? Provisions can be made for future generation capacity and site expansion.

- Standby/emergency and redundant equipment: How much back-up power is required to ensure there are no interruptions if a genset is taken out of service for preventive maintenance?
- Emissions: What are the current emission restrictions? Is the site near the maximum levels?
- Grid connection: Is it best to operate in island mode, or should grid interconnectivity and sequencing be considered?
- Site construction: How does the area classification impact equipment selection and installation? What type of foundation is required?

Economics

Numerous economic benefits can be realized for midstream processing facilities when integrated power generation is considered.

Infrastructure

For locations that will require connections to the grid, a substation may be needed in addition to the expansion of the transmission lines. The further the distance to the grid, the larger the costs for the expansion. Table 2 shows an example of the potential costs for grid expansion and substations. These costs may or may not be explicitly passed on to the end-user.

Table 2: Costs of transmission lines and substations

Infrastructure required	Per mile cost[4]	5 miles	10 miles
Above ground transmission	$285,000	$1,425,000	$2,850,000
Right-of-way	$7,500	$37,500	$75,000
Substation	-	$2,500,000	$2,500,000
Total cost	-	$3,962,500	$5,425,000

Project timeline

Project delays are another source of economic loss when connecting to grid power. Power can often be the longest lead time on the project, requiring right-of-way availability/negotiation, permits, and substation and transmission line procurement and construction. Integrated power generation allows for a first-to-market value add for the producer. Examples of the cost of scheduling delays for a 15,000 HP compressor station and a 200 MMscf/d gas processing plant can be seen in Table 3.

4. Frank Alonso and Carolyn A.E. Greenwall, "Underground vs. Overhead: Power Line Installation-Cost Comparison and Mitigation," Electric Light & Power, January 2, 2013, http://www.elp.com/articles/powergrid_international/print/volume-18/issue-2/features/underground-vs-overhead-power-line-installation-cost-comparison-.html.

Table 3: Cost of delays for grid power connections

Facility type	Revenue per month	Operating margin	Profit lost over 6 months
Compressor station (15,000 HP)	$2,000,000	20%	$2,400,000
Gas processing plant (200 MMscf/d)	$5,000,000	20%	$6,000,000

- Revenues based on industry estimates and examples.

Grid pricing

For sites reliant on grid power, facility economics are also affected by shifting power rates. Midstream companies may experience arbitrary rate increases, causing operating expenses to decouple from production revenue. When gas is used as a direct input cost for integrated power generation, the cost to self-generate electricity is directly linked to the value of the gas commodity. Additionally, utility can be a large cost adder to a site's monthly operations budget, particularly when the timing of demand charge setpoints coincide with peak site throughput.

Waste heat recovery

The gensets used for integrated power generation produce a significant amount of waste heat that can be routed to facility processes requiring heat. For example, for a 200 MMscf/d gas processing plant with a thermal load of 13 MMBtu/h, available waste heat can be routed to the process for a savings of up to $340,000/year at $3/MMBtu.

Summarized equipment and operating costs

An example summary of upfront equipment operating costs based on power demand and usage is shown in Figure 1—these estimates are indicative of the average costs for a typical 15 MW site. It is important to note that specific sites can vary widely and may result in significantly larger savings.

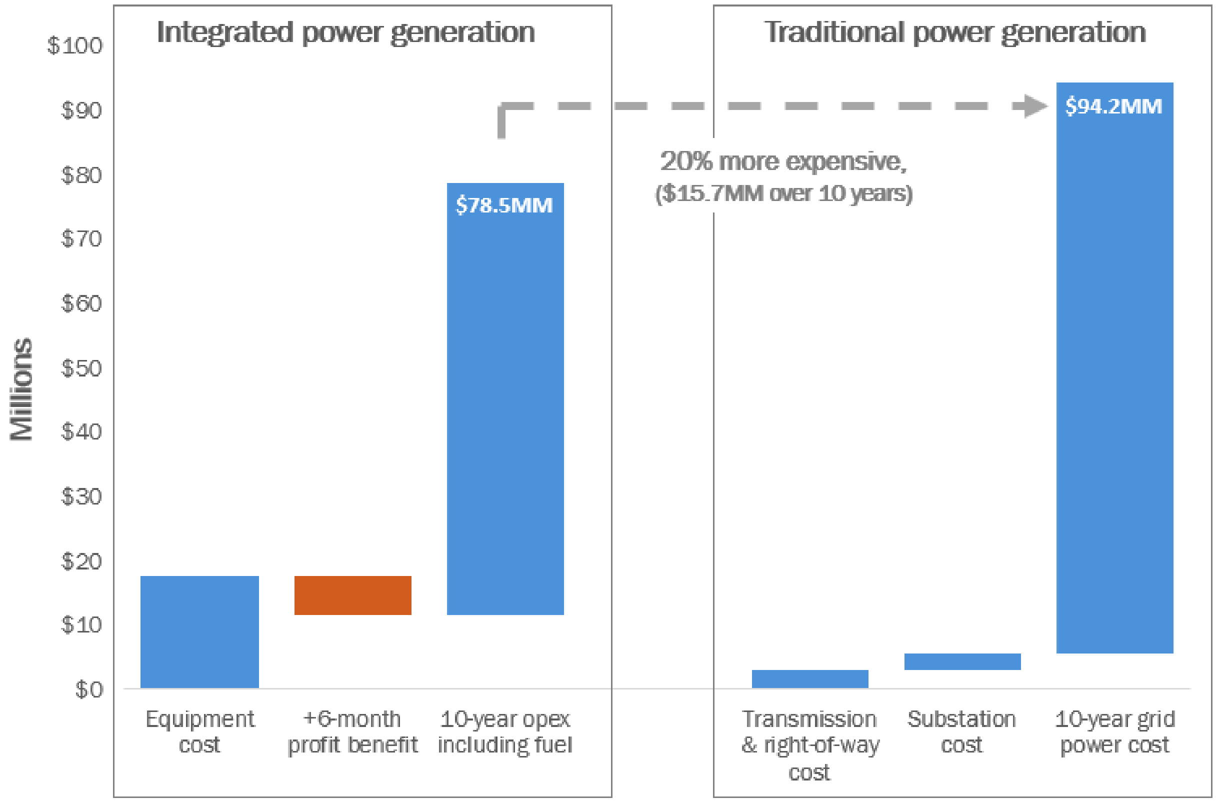

Figure 1: 10-year comparison of equipment and operating costs[5]

Applications

There are multiple midstream applications that can see benefits from integrated power generation, including well pads, compressor stations, and gas processing and treating plants. While these benefits are particularly relevant in the midstream segments listed below, they may also apply across other various applications.

Well pads

Modular design: Well pad production can fluctuate significantly, so the flexibility inherent in modular design is important in order to accommodate these changes. As new wells are brought online, several power generation units can be initially installed on-site to handle the high flows. As these wells deplete over time, the generation units can be redeployed to other areas where new production is driving power demands.

Grid availability: In the past several years, the oil and gas industry has seen rig counts rise.[6] This expansion has put additional stress on grid infrastructure, particularly in the Permian Basin. Access to power

5. Estimated input cost for grid power ($0.069/kWh) based on EIA monthly average US electricity cost for industry, August 2017: US Energy Information Administration. Electric Power Monthly with Data for August 2017. Washington, DC: U.S. Department of Energy, October 2017. https://www.eia.gov/electricity/monthly/archive/october2017.pdf.

6. "Rig Count Summary and Summary Count," Baker Hughes, accessed May 30 2018, http://phx.corporate-ir.net/phoenix.zhtml?c=79687&p=irol-rigcountsoverview.

within a reasonable timeline is particularly important in areas of high growth. Integrated power generation is an effective way to control the power supply within the project scope while reducing the impact of external risks.

Gas compressor stations

Grid electricity costs: Electricity costs can increase substantially for a compressor station due to its relatively long usable life; the electricity costs associated with motor-driven compression for a station built ten years ago can look drastically different from the costs today. Integrated power generation savings can be substantial over the long term.

Site expansion: A site expansion may require renegotiation with power producers to obtain the electricity required for additional loads. Sometimes, this request may be met with significant upfront expenses or increased fixed and variable rates—this is often due to limited available grid capacity and infrastructure. Integrated on-site power generation can provide the power needed for expansion, or facilities can be retrofitted with on-site power generation to accommodate the needs of the entire site.

Exterran's focus in midstream oil and gas facilities includes a wide range of power generation capacity from several hundred kilowatts up to tens of thousands of kilowatts.

Process and treating plants

Heat recovery: Process and treating facilities are unique because they have equipment and processes that require thermal heat. This thermal heat is usually provided by direct-fired equipment, burning valuable gas and increasing site emissions. Thermal waste heat is a by-product of gas engines and turbines used in integrated power generation; it can be used in place of direct-fired applications and is an excellent way to reduce costs and lower site emissions.

Efficiency: Process and treating sites produce high-quality fuel which can be used in the operation of high-efficiency power generation equipment. While gas streams found at well pads and compressor stations can generate on-site power, the commercial-quality gas available at process and treating sites is ideal for efficient and low-emission gensets.

Conclusion

Integrated power generation is quickly becoming an attractive option for midstream facilities, removing the concerns operators typically face with grid power accessibility and reliability, and increasing power costs. The time to first gas for a new facility can also be greatly reduced by eliminating the lead times associated with utility infrastructure expansions. Provided there is an available fuel source on-site, there are few limits to where Exterran can install power generation equipment.

Exterran has been involved with the complete design, construction, start-up and operation of several successful integrated power generation projects. Exterran's experienced engineering, project management and construction teams ensure facilities are designed and constructed efficiently and on time.

When you choose Exterran, you can be sure you have the proven experience, technical expertise and commitment to service needed to keep your operation running efficiently for the life of your facility.

About Exterran

Contact Exterran today at PowerGen@Exterran.com to explore integrated power generation options for your facilities.

Exterran is a global systems and process company offering solutions in oil, gas, water, and power. We are a market leader in natural gas processing, treating, compression, aftermarket parts and services, providing critical midstream infrastructure solutions to customers throughout the world.

Exterran has a 60-year legacy of project success as a leader in providing midstream infrastructure solutions to the energy industry worldwide by helping to lower operational and financial risk for global operators. We serve clients in approximately 30 countries in three ways—we sell our products, own and operate our products on behalf of our customers, and we provide after-market services and support on customer-owned products. Our corporate headquarters are in Houston, with key regional offices and manufacturing facilities across the globe which allows us to service our customers with local expertise.

Mark Harris is a Senior Product Manager at Exterran Corporation. Prior to joining Exterran, he worked in both project and product management at GE and was responsible for new product initiatives. Mark currently focuses on new business opportunities and streamlining products to market; he has over 10 years of experience in this capacity. Mark also holds a Bachelor of Arts degree from University of St. Thomas and a Masters of Business Administration from the University of Wisconsin—Milwaukee.

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All statements in this document (and oral statements made regarding the subjects of this document) other than historical fact are forward-looking statements within the meaning of Section 21E of the Securities Exchange Act of 1934, as amended. These statements may include words such as “guidance,” “anticipate,” “estimate,” “expect,” “forecast,” “project,” “plan,” “intend,” “believe,” “confident,” “may,” “should,” “can have,” “likely,” “future” and other words and terms of similar meaning in connection with any discussion of the timing or nature of future operating or financial performance or other events. Examples of forward-looking information in this release include, but are not limited to: Exterran’s operational strategies and ability to successfully effect those strategies; Exterran’s expectations regarding future economic and market conditions; Exterran’s operational outlook and ability to fulfill that outlook; demand for Exterran’s products and services and growth opportunities for those products and services; and statements regarding industry activity levels and infrastructure build-out opportunities.

These forward-looking statements rely on a number of assumptions concerning future events and are subject to a number of uncertainties and factors, many of which are outside Exterran’s control, which could cause actual results to differ materially from such statements. As a result, any such forward-looking statements are not guarantees of future performance or results. While Exterran believes that the assumptions concerning future events are reasonable, it cautions that there are inherent difficulties in predicting certain important factors that could impact the future performance or results of its business. Among the factors that could cause results to differ materially from those indicated by such forward-looking statements are: local, regional, national and international economic conditions and the impact they may have on Exterran and its customers; Exterran’s ability to secure new oil and gas product sales customers; conditions in the oil and gas industry, including a sustained decrease in the level of supply or demand for oil or natural gas or a sustained decrease in the price of oil or natural gas; the inherent risks associated with Exterran’s operations, such as equipment defects, malfunctions and natural disasters; any non-performance by third parties of their contractual obligations; changes in safety, health, environmental and other regulations; Exterran’s ability to implement appropriate changes to its internal controls and procedures in a timely and cost efficient manner.

These forward-looking statements are also affected by the risk factors, forward-looking statements and challenges and uncertainties described in Exterran’s Annual Report on Form 10-K for the year ended December 31, 2016, and other filings with the Securities and Exchange Commission available on the Securities and Exchange Commission’s website, www.sec.gov. A discussion of these risks is expressly incorporated by reference into this release. Except as required by law, Exterran expressly disclaims any intention or obligation to revise or update any forward-looking statements whether as a result of new information, future events or otherwise.