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Study confirms business case for using large power block gas turbine trains in compression duty

The case for large power block gas turbine trains

Three Siemens SGT-750 trains in pipeline service.

To remedy North America's shortage of gathering, transmission and pipeline capacity, pipeline operators should consider compression station design approach with the lowest cost of ownership, which can be achieved by using large power block gas turbines in their compressor trains.

This model can help them deploy new infrastructure much faster and more cost-effectively than using small power block turbines. This can also dramatically lower the capital expenditure (CAPEX), maintenance expenditure (MAINTAINEX) and the operational expenditure (OPEX) of their new pipeline assets — enhancing investment returns, while also reducing emissions.

Traditional station designs feature a large number of compressor trains using smaller power blocks. When compression stations were built years or decades ago, those designs made sense for their flexibility, availability and efficiency. But today's advanced turbine technology now makes a case for deploying large power block gas turbines instead.

A comparative study of the two approaches by a major, Houston-based midstream Engineering, Procurement and Construction (EPC) contractor found that a single, large turbine-driven compressor package is more cost-effective than using two smaller packages. It also reduces the operating footprint and environmental impact of a station's compression function. A summary of the findings in favor of a large power-block approach follows:

- CAPEX: 30% less
- OPEX: 11% less
- Footprint: 15% less
- Emissions: 27% less

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Shared assumptions to level-set comparisons

The study compared a single compressor station (1 X 100%) with a dual train (2 X 50%) compressor station, each having the same available horsepower for compressing pipeline-quality gas. Respective plot plans and equipment lists were developed for: a single compressor station using a Siemens SGT-750 turbine capable of nearly 55,000 hp (41,013 kW) to drive an RFBB36 compressor; and the dual compressor train station using two smaller turbines, each capable of nearly 30,000 hp (22,371 kW) to drive an appropriately sized pipeline compressor.

Schedules were also developed to compare construction CAPEX and operational information for OPEX. Operating assumptions were:

- Pipeline flow rate: 1778 MMcfd (50.3 X 106 m³/d)
- Standard ISO conditions (60°F [15.5°C] ambient air at sea level)
- Gas specific gravity: 0.61
- Discharge pressure: 1440 psig (99.3 barg)
- Suction pressure: 800 psig (55.2 barg)
- Total brake horsepower requirement of nearly 52,000 hp (38,776 kW), adequate for providing 120 miles (193 km) between compressor stations using a 42 in. (1066.8 mm) mainline.

The scenario also assumed the stations are operating a cross-country pipeline where other stations can maintain flow in the pipeline should any compression be lost at the subject stations.

Single compressor vs dual compressor solutions

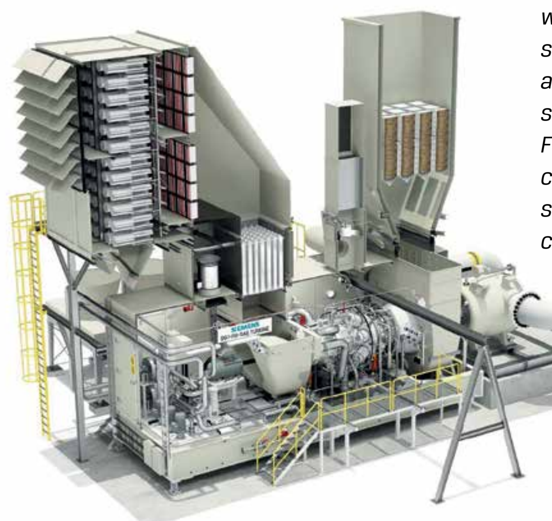
In addition to direct cost comparisons, the study's findings support six advantages made possible by compression station designs using fewer compression trains driven by larger power block turbines:

- **Reduced CAPEX, implementation time and risk** – Compressor trains driven by turbines with larger power blocks means fewer units need installation. This reduces CAPEX, as well as installation, commissioning lead time and overall project risk. Those costs, time and risks can be further reduced by sole-sourcing compression drive trains that arrive on-site factory integrated and tested. This can reduce installation and commissioning times by months.
- **Reduced OPEX via lower fuel consumption** – In the study, natural gas fuel consumption for the single large block turbine compressor train is 11% lower than using two smaller gas turbine compressor trains.
- **Reduced emissions** – Although the study calculated that both models generate NOX emissions of < 15 ppm, the total exhaust-gas emissions of the large-block, single compressor model is 27% less than the small-block, dual-compressor (i.e., 2 x 50% hp) model: 59 tons per year vs 75 tons per year, respectively.
- **Reduced OPEX via maintenance costs and sparing** – With modern sparing concepts for gas turbines and centrifugal compressors, operators can use them without the capital cost and operating expense of standby spare units. That's because remote diagnostics and fast-turnaround remediation capabilities can mitigate and remediate performance issues before disruptions and outages can occur. Of course, if one unit of a dual-compressor train model goes down, the impact on the entire pipeline system will be less compared to the downtime of a single-compressor train model. However, having capital spares can mitigate downtime issues if one unit requires maintenance. Another factor to consider is Average Capacity under Failure, which is similar for both solutions. More units mean additional fuel consumption, which will impact the gas delivered at the delivery point.
- **More availability** – Online condition-monitoring enables condition-based proactive, even predictive maintenance models to eliminate unplanned outages. Advanced metallurgical materials combined with innovative designs and reliability engineering has improved performance and reliability to such an extent that the traditional N+1 configuration for compressor trains is now obsolete. This can offer a much lower total cost of ownership (TCO). Operators should look at planned downtime impact of increased A, B and C inspections because of additional trains installed.
- **Improved operational flexibility and efficiencies, lowering operating costs** – Although in times past, the argument that large power blocks lack flexibility across varied loads – especially low ones – could be made, it's not the case today. Advanced turbine technology allows for low-load operation, while DLE combustion technology can keep emissions output in compliance with regulations.

Conclusion

The business case for using compressor trains driven by large power block gas turbines vs smaller turbines can be compelling. According to the study:

"Where large amounts of turndown are not required, and in a transmission system where there are several compressor stations, it clearly makes sense to install a single, large compressor over two smaller compressors at these stations. For larger compressor stations where the comparison is between two large and four small compressors, for example, the larger compressors clearly become a superior choice." CT2



A study from an EPC compared a single compressor station (1 X 100%) with a dual train (2 X 50%) compressor station to determine which of the two options was more cost-effective.

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