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Gas Turbines and Batteries: A Perfect Pairing

Battery systems for grid-scale energy storage is becoming economically viable in optimizing the performance of gas turbines.

A remarkable trend in the power industry over the past few years has been the rapidly decreasing cost of battery technology, particularly for the lithium-ion battery. Costs have fallen so fast that battery systems for grid-scale energy storage—installations with tens of megawatts of power and flexibility on capacity—are becoming economically viable in a growing range of uses like optimizing the performance of gas turbines.

At the same time, the rapid uptake of renewable energy sources, like wind and solar power, has driven the parallel development of the control systems and inverters needed to integrate renewables and other distributed generation technologies into electricity grids. Batteries, inverters, and increasingly sophisticated control systems are being combined to help manage renewable intermittency, giving these technologies an ever-larger role in ever-smarter electricity supply systems.

Less obvious are the possibilities that have opened up for batteries to provide grid support services that were once the exclusive province of other technologies until relatively recently—services such as frequency regulation, voltage control, and reactive power response.

Spinning Reserves and Non-dispatchable Assets

Because of their quick response to demand changes, gas turbines play a crucial role in electricity supply systems and help match supply to demand. The increasing proportion of non-dispatchable assets like wind turbines and photovoltaics embedded in the power network poses grid planning and load balancing challenges to managers. Maintaining increasing amounts of spinning reserves and frequency regulation compensates for the intermittency of non-dispatchable assets, but presents another set of issues that batteries may address.

Fuel conversion efficiency is compromised with gas turbines running below optimal loads. This, in turn, means that greenhouse gas (GHG) emissions are higher per unit of electricity generated and maintenance costs tend to be higher. Supporting gas turbines with battery energy storage technology allows batteries to act as virtual spinning reserves, a form of contingency reserve. In this way, costly inefficiencies are avoided by requiring turbines to operate at minimal loads less frequently.

Real-World Response

California is addressing these disadvantages with a ground-breaking new system ordered by power utility Southern California Edison (SCE) in the wake of a crisis at the Aliso Canyon natural gas storage facility. Between October 2015 and February 2016, large volumes of methane were released from the facility following a problem with one of its many wells. The release's severity prompted the state's governor to call for changes to the regulations governing gas usage and storage, as reported by NBC.

To help meet the need for reactive voltage support, primary frequency response, regulation, and contingency reserve, SCE has brought together gas turbines, grid-scale batteries, and sophisticated control systems in the world's first battery storage and gas turbine hybrid system. The system aims to reduce the amount of natural gas needed to operate the grid, improve used gas conversion efficiency, minimize GHGs emissions, and reduce maintenance costs. It has won the Energy Storage N.A. Innovation Award and 2017 Edison Award.