



Load-Flow Analysis: Large Cogeneration Plant Maximizes Capacity

S&C Featured Solution: S&C's Power Systems Solutions

Location: East Coast United States

Customer Challenge

A large combined-cycle cogeneration plant on the East Coast uses five natural-gas-fired turbines and three steam turbines to drive eight 105-MVA, 13.8-kV generators. These generators supply power to the area's serving utility at 345 kV via step-up transformers, connected by means of pipe-type cables.

Under certain conditions in which the generators operate at a leading power factor, demand could not be met without exceeding the reactive capability limits of the generators. This is where S&C's Power Systems Services came into play.

S&C Solution

S&C was asked to analyze plant performance under leading-power-factor operating conditions. S&C's Power Systems Solutions engineering team developed an equivalent circuit of the plant's 345-kV, 13.8-kV, and 4.16-kV electrical systems for a load-flow analysis. This effort required extensive collection and analysis of specification data for the generators, step-up transformers, auxiliary transformers, and pipe-type cables, as well as utility and plant loads. The equivalent circuit was then validated by comparing results of the load-flow analysis to the actual measurements recorded in previously performed generator reactive-capability tests.



Results

The load-flow analysis revealed very clearly the effects of the pipe-type cables under leading-power-factor conditions. Under these conditions, the generators not only need to consume reactive power from the utility's leading-power-factor load, but also from the leading reactive power supplied by the large capacitance of the cables. The "underexcited reactive ampere limit" of the generators is exceeded in these instances. The load-flow equivalent circuit model allowed S&C to determine the operating parameters that would enable the generators to meet the expected reactive power demand. Several different scenarios were analyzed to determine the optimum operating parameters for the generators.

S&C proposed several solutions to the customer. Based on these recommendations, a full-blown reactive-capability limit test at the utility's specified leading-power-factor load was successfully performed soon after.

