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Industry Advisory

Turbine Combustor Lean Blowout

Issued June 26, 2008

Status:	**Informational Only**
Distribution:	Generation Owners, Generation Operators, Planning Authorities, Planning Coordinators, Transmission Operators, Reliability Coordinators, and Regional Entities
Background:	On Tuesday February 26th, 2008, the FRCC Bulk Power System experienced a system disturbance initiated by a138 kV transmission system fault that remained on the system for approximately 1.7 seconds. The fault and subsequent delayed clearing led to the loss of approximately 2,300 MW of load concentrated in South Florida along with the loss of approximately 4,300 MW of generation within the Region. Approximately 2,200 MW of under-frequency load shedding subsequently operated and was scattered across the peninsular part of Florida. The depressed voltages in the area of the fault led to protective equipment trips of the two Nuclear generating units and one of the fossil units at the Turkey Point site. Due to the peninsular nature of the Florida system, the delayed clearing of the fault also resulted in a damped, frequency swing with initial amplitude of approximately +/- 0.6 Hz in South Florida and +/- 0.3 Hz in North Florida. The frequency swing (initiated by the acceleration of generation during the fault), along with the resulting voltage perturbations, radiated up the Region and resulted in additional fossil generation tripping off-line due to various factors including the one discussed below. During the protracted fault, voltage locally went to near-zero, which effectively reduced the area load and thereby caused area generators to accelerate. Indications are that six combustion turbine (CT) generators within the Region that were operating in a lean-burn mode (used for reducing emissions) tripped offline as result of a phenomenon known as “turbine combustor lean blowout.” As the CT generators accelerated in response to the frequency excursion, the direct-coupled turbine compressors forced more air into their associated combustion chambers at the same time as the governor speed control function reduced fuel input in response to the increase in speed. This resulted in what is known as a CT “blowout,” or loss of flame, causing the units to trip offline. This phenomenon is not well understood throughout the industry as it may be dependent on various frequency parameters that include frequency magnitude, rates of change, and the source of the frequency excursion. In the past, such CT generator trips may have been reported as “sympathetic trips” as this phenomenon may not have been initially identified. This particular issue may be difficult to identify since the trip does not result from a direct machine protective action, but from the various impacts external system frequency excursions have on the internal machine combustion tuning and control systems.

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Advisory:	Generator Owners and Operators who own or operate large frame combustion turbines should be aware of potential “turbine combustor lean blowout” under certain frequency excursions. Generator Owners and Operators are encouraged to consult their CT manufacturers to understand and identify the plant’s susceptibility to “turbine combustor lean blowout” as a result of a system over-frequency transient and work with them to identify steps that may mitigate this issue. Generator Owners and Generator Operators are also encouraged to inform their associated Planning Authorities, Planning Coordinators, Transmission Operators, and Reliability Coordinators of any generators that are susceptible to the “turbine combustor lean blowout” phenomenon. Planning Authorities, Planning Coordinators, Transmission Operators, and Reliability Coordinators are encouraged to incorporate these generator response characteristics in dynamic analysis modeling. Specific coordination between the generators’ manufacturers and bulk power system analysts may be required to ensure that machine performance is appropriately modeled in specific dynamics analysis studies.
Primary Interest Groups:	Plant Managers, Planning Engineers, and Operations Engineers
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