SupDet 2015 Abstract
Title: Evaluating Hybrid Fire Suppression Systems for the Protection of Aero-derivative Gas Turbines

Abstract: The purpose of this project was to evaluate the effectiveness of the hybrid inert gas/water mist fire suppression system on aero-derivative style gas turbines. A utility company and its fire protection engineer provided the opportunity to test the hybrid fire suppression system on an operating unit under load, enabling the research team to assess the system's efficacy in real-world scenarios. The utility company established the test criteria; testing would be deemed successful if the system could cool the turbine skin to less than 380°F within 10 minutes. 380°F represents the auto ignition temperature (AIT) of lube oil and turbine fuel plus a safety factor, as determined by the company. The 10-minute timeframe was established to match the performance of the existing CO2 extinguishing system.

Testing was conducted at a site in Holtsville, New York, where banks of Pratt and Whitney FT4 aero-derivative turbine generators provide power during peak energy use. A series of tests was devised to demonstrate the suppression system's effectiveness for cooling. The tests involved operating the turbine off and on the power grid at full speed/base load and allowing the unit to cool naturally, as well as on the grid and allowing the system to discharge. Systematic changes in water flow and installation parameters were used to find optimal results. Temperatures were recorded at the compressor section, combustion section front, combustion section rear, hot turbine section, exhaust diffuser and in the enclosure. O2 level under the unit near the fuel hose connections, outside air temperature, relative humidity and airflow through the secondary dampers were also logged.

Testing demonstrated that the hybrid fire suppression system is capable of quickly cooling the turbine skin to below 380°F without damaging the turbine, meeting the criteria established by the utility company's fire protection engineer. The test results show successful cooling with the emitters installed overhead and aimed toward the hot section of the turbine. However, the turbine body becomes an obstruction and reduces the velocity of the discharge below the turbine body where the fuel lines can reside. To resolve the obstruction and provide a more uniform discharge around the turbine, it is recommended that additional nozzle(s) be installed below the turbine.

The results of this field-testing indicate that the hybrid fire suppression system adequately protects aero-derivative turbines under normal operating conditions. The testing offers a proof point that the system is not damaging to equipment, overcoming historic objections to the use of water mist style systems on such turbines for fear of damage due to warping.

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