Novec™ Brand

Protecting the Power Grid

Effective fire suppression for gas turbines

Gas turbines in power plants serve a critical role in keeping the lights on, data centers running and machines operating in millions of homes and businesses across the United States. Some plants use them as the sole power source, while others primarily use coal but rely on gas turbines to surge their generating capacity during periods of peak demand. The turbines are essential to the utility's ability to meet its customers' demands, and help to prevent operational interruptions, which are unacceptable.

Decades ago, power plants used both CO_2 and halon fire suppression systems to protect their critical operations. When the Montreal Protocol was adopted in 1987, halon was designated for a complete global phase out because of its high ozone depletion potential, and CO_2 became the only major gaseous fire protection agent used in power generation. Yet during that time the risks of CO_2 also became increasingly apparent: because it extinguishes fires by displacing oxygen from the protected space, CO_2 is lethal at design concentration. A 2003 report sponsored by the U.S. Environmental Protection Agency found that between 1975 and 1999, there were more than 100 deaths and 150 injuries from CO_2 fire suppression systems, mostly resulting from accidental or false alarms.[1]

A safer future without CO_2

When a major western US public power utility contacted Tech Electronics of Colorado to replace the CO_2 fire suppression system control panels in one of its generating stations, those panels and the CO_2 compressors had been experiencing daily fault conditions. Tech Electronics and generating station staff were concerned: a false discharge of CO_2 could endanger workers' lives.

A thorough review by Tech Electronics determined that the maintenance needs of the aging CO_2 systems protecting the generating station's five gas turbines had increased to the point where the entire system needed to be replaced. Additionally, due to CO_2's safety risks, the current National Fire Protection Association Standard on Carbon Dioxide Extinguishing Systems (NFPA 12) states that CO_2 shall not be used in occupiable spaces unless no other technically viable alternative is available from a safety standpoint.[2] New CO_2 systems must also include numerous complex and expensive safety upgrades. Knowing that there had been many advancements in clean agent technology since the original system had been installed, Tech Electronics and the utility decided to explore CO_2 alternatives that could reliably protect

their highly sensitive equipment for decades to come while providing a higher margin of safety for their employees.

When considering new systems, one requirement was clear – performance could not be compromised. So when the utility asked Rich Vance, director and sales manager at Tech Electronics, about alternatives to CO_2 fire suppression, 3M™ Novec™ 1230 Fire Protection Fluid immediately came to mind as a potential solution. 3M Novec 1230 fluid has a high margin of safety, has environmentally sustainable properties including zero ozone depletion potential and extremely low global warming potential, and is highly effective at extinguishing fires.

The key question remaining was whether it could meet the electric utility's requirements for hold time in the protected space. In the event of a fire, stopping a turbine too quickly will cause overheating and permanent damage to the turbine itself, so a fire suppression system must maintain its extinguishing concentration for 20 minutes or more after the initial discharge while the turbines wind down and dissipate heat. The NFPA 850 recommended practice for electric generating plants calls for a total flooding fire suppression system to be able to accommodate the needed air outflow for cooling hot components while maintaining extinguishing concentration long enough for that cooling to take place, and therefore hold time must be considered in the extinguishing system design.[3] Plus, while the NFPA 37 standard for gas turbines only mandates a minimum 20-minute hold time, the utility specified a 60-minute minimum to ensure a 300% margin of protection.[4]

[1] Review of the Use of Carbon Dioxide Total Flooding Fire Suppression Systems, Tables 4 and 5, https://www.epa.gov/sites/production/files/2018-10/documents/review-of-the-use-of-carbon-dioxide-total-flooding-fire-extinguishing-systems.pdf, accessed 10/29/19.

[2] NFPA 12, Standard on Carbon Dioxide Extinguishing Systems, 4.1, 4.1.1, 2018 Edition

[3] NFPA 850, Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations, 7.6.6*, 7.6.6.1, A.7.6.6, 2020 Edition

[4] NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, 11.4.4.1, 2018 Edition

3M™ Novec™ 1230 Fire Protection Fluid exceeds performance expectations

The electric utility collaborated with Tech Electronics, 3M, and fire protection systems distributor ETG Fire to develop an extended discharge system using 3M Novec 1230 fluid that would meet all of their requirements. Based on a preliminary design by Chris Vanderstokker, owner of ETG Fire, the team constructed a scaled test enclosure with the same leakage rate as the actual protected space. Then they developed a new system design using a two-cylinder model, with one cylinder immediately flooding the space with 3M Novec 1230 fluid while the other was equipped with an engineered restricted orifice to control the flow of agent and maintain the extinguishing concentration throughout the extended hold time. It was also designed to enable the extended discharge flow rate to be customized based on the leakage rate of the enclosure, so it could accommodate a range of protected spaces.

The team constructed a scaled down test enclosure and conducted an extensive system validation and optimization process, comparing predicted results against recorded data to ensure that the system consistently reached and maintained design concentration in alignment with NFPA 850.[5] More than a dozen potential extended discharge nozzles were developed and tested to ensure that the 3M Novec 1230 fluid would effectively atomize as it slowly discharged into the enclosure.

Finally, 3M and ETG Fire conducted a full-scale discharge test at the fully operational generating station. The test was witnessed and accepted by the local authority having jurisdiction, validating the effectiveness of a system using 3M Novec 1230 fluid for protecting gas turbines from fire. This real-world test exceeded expectations, with a demonstrated hold time of over 90 minutes – 50% over specifications and 450% over NFPA 37 requirements – effectively protecting the equipment and the company's power generation operations without the worker safety risks of CO_2. It also demonstrated the system's compliance with NFPA 2001[6] and ISO 14520[7] standards for testing and fire extinguishing performance. After the test, the electric utility immediately began installing new systems using 3M Novec 1230 fluid to protect its facilities. They had found their smart, safe, sustainable CO_2 replacement and fire suppression solution for the future of power generation.

[5] NFPA 850, Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations, A.7.6.6, 2020 Edition
[6] NFPA 2001, Standard on Clean Agent Fire Extinguishing Systems, 5.7.2, 2018 Edition
[7] ISO 14520-1, 7.8.2, 8.2.3.10, 2015 Edition

Smart. Safe. Sustainable.

The 3M™ Novec™ Brand Family

The Novec brand is the hallmark for a variety of proprietary 3M products. Although each has its own unique formula and performance properties, all Novec products are designed in common to address the need for smart, safe and sustainable solutions in industry-specific applications. These include precision and electronics cleaning, heat transfer, fire protection, protective coatings, immersion cooling, advanced insulation media replacement solutions and several specialty chemical applications.

3M™ Novec™ Engineered Fluids ▪ 3M™ Novec™ Aerosol Cleaners ▪ 3M™ Novec™ 1230 Fire Protection Fluid ▪ 3M™ Novec™ Electronic Grade Coatings ▪ 3M™ Novec™ Insulating Gases

Safety Data Sheet: Consult Safety Data Sheet before use.

Regulatory: For regulatory information about this product, contact your 3M representative.

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