



Helping to Meet the World's Demand for Clean Energy Generation

In June 1949, the first gas turbine system used for electricity generation in the United States was deployed by General Electric at Belle Isle Station in Oklahoma City. This amazing achievement was the result of extensive re-engineering of earlier aircraft gas turbine designs into long-life, high reliability, low-maintenance devices that operate effectively in a power generation application. This milestone set the stage for the revolution in clean power generation that is rapidly approaching.

Today, companies around the world are focused on advancing this technology using hydrogen and hydrogen blend fuels to decarbonize the process of power generation. Mitsubishi Heavy Industries, for example, announced in 2020 that it was supplying hydrogen-capable gas turbines to a Canadian utility that would deliver up to 1.36GW of net capacity and decrease carbon emissions to a level 60% below the provincial government's regulation benchmark. Manufacturers worldwide are developing this technology at scale to support similar regulatory initiatives.

Advantages

- **Fuel flexible**
Fireeye's Turbine Sensor products are ready from day one to sense flame from a variety of sources, including hydrogen and hydrogen blends
- **Rugged**
Designed to operate in the most challenging environments, in extreme temperature and vibration
- **No maintenance required**
The Turbine Sensor is completely sealed with no serviceable parts, no adjustment, no calibration needed
- **Easy to Install**
The Turbine Sensor threads into already existing ports in the turbine housing and is powered by a single pair 4-20mA closed loop also used to communicate the flame status
- **Safety**
Designed to meet a Safety Integration Level of SIL 3



Turbine Sensor

Business Opportunity

In the early 2020s, Fireye combined its applications expertise in using fiber optics together with its experience designing solid state flame scanners and started a development effort to produce turbine flame sensor that operated with a variety of clean fuel options. Different fuels exhibit different characteristics depending on how the flame is managed, and the company developed a plan to create a solution that would address the needs that gas turbine users has today, with existing fuels like oil and gas, as well as fuels of the future. The Fireye design team had an additional challenge because of the unique characteristics of the operating environment adjacent to a turbine, where extreme vibration and temperatures of 325C are possible.

The Solution

Fireye develops flame scanners and burner controls and has a 75-year history of managing the safety aspects of ignition in burners. That expertise of the team and the fuel independent nature of the Fireye technology is not available from any other product on the market. Fireye's General Manager, Sean Byrnes, is proud to point out that the Fireye technology works with today's fuels and those that will help with future decarbonization. "Fireye's earliest products developed in the 1930s could detect flame from available fuels such as natural gas and oil, but the products were ahead of their time in that they could just as reliably sense flame from hydrogen". Using 100% hydrogen as fuel for a gas turbine will lead to elimination of essentially all CO2 emissions relative to operation on natural gas or other hydrocarbon fuels.

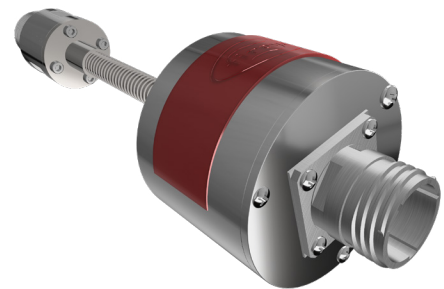
With this in mind, Fireye's Turbine Sensor design team took a novel approach to avoid the very high temperatures around an operating gas turbine. Instead of locating the electronics in that inhospitable environment, the team decided to use a fiber optic cable to collect the light from the combustion chamber and sense it at distance from the chamber where the environment worked for electronics. Fireye was familiar with this type of remote sensing, as Fireye products have been using this technique for decades.

Since only a fraction of the light arrives at the exit point from the fiber, a very sensitive detector needed to be engineered and a high cleanliness manufacturing process needed to be piloted and proved out.

In addition to the concerns with the operating environment, product compatibility with a wide variety of gas turbines sizes from 35MW to 1.8GW required the team to factor in adaptability. The mechanical and electrical components in the design are easily customizable to accommodate any gas turbine and fuel combination on the market. With its conventional 4-20mA output signal, it's compatible with monitoring equipment operating in the facility today. The device is factory calibrated and tested as a single unit with no field adjustments required.

Results

After evaluation of the performance of prototypes and additional lab testing, Fireye's solution was selected by a major gas turbine manufacturer after passing its acceptance phase testing. Fireye has developed a new production cell and is ordering material for volume production. Top tier gas turbine manufacturers worldwide are bullish on the future of gas turbine technology and how it can help meet near term and future demands for electricity and Fireye is proud to participate in that challenge.



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