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New Sensor Design is Tailored to Frame 5 DLN1 Turbines

By Mike Spalding

Building light gas turbines from the ground up is a family affair at Baker Hughes. Our sister company, Turbomachinery & Process Solutions (TPS), builds and services a simple, robust Frame 5 turbine for the oil and gas industry. This turbine is designed to maximize fuel flexibility in mechanical-drive and power-generation applications.

At Reuter-Stokes, we focus on the sensing side of the business. We design and manufacture the UV flame sensors needed to ensure these gas turbines operate properly and safely. Our detectors respond quickly to changes in flame status for a wide range of gas turbines and industrial burners.

On a recent overseas Frame 5 installation, TPS chose to use Reuter-Stokes flame sensors. For most applications, our standard FTD 325 sensors are a great option. On Frame 5 DLN1 units the light intensity can be too low to detect with the standard sensors. TPS and Reuter-Stokes faced this challenge on the overseas Frame 5 project.

NOx Reduction Creates Flame-Sensing Challenges
Gas-fired turbines create an exhaust emission known as NOx. The amount exhausted depends on the combustion temperature. That's where the DLN1 (dry low NOx) combustion process comes into the picture. When the amount of air is precisely enough to consume all of the fuel in a combustion reaction, the fuel-to-air ratio is said to be stochiometric. This produces a large amount of NOx.

A DLN1 system uses a fuel-lean ratio to minimize the amount of NOx production. Lean combustion can be achieved only if the fuel and air are premixed to the correct ratio prior to ignition. During start-up, the DLN1 system must run through multiple modes to get to

premix mode. The gas turbine is run in premix mode for baseload (normal load) operation and minimum NOx production.

Each combustion chamber has a plane of primary nozzles that are lit first. A central, downstream, secondary is lit next. To transition to premix mode, it is necessary to turn off all the fuel to the primary nozzles. Those flames will extinguish, while the secondary flame continues to burn. When the primary fuel is restarted, the fuel and air premix without igniting and are combusted at the secondary nozzle. This is the transition-to-premix mode.

When this particular overseas customer would reach the transition to premix, the light reaching the secondary sensors dropped to low levels even though secondary flames were lit. The turbines needed a flame sensor with more sensitivity to keep operating during this transition to premix.

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Custom Engineering Eliminates Failures during Premix Transition

Reuter-Stokes' newest sensor offering, the Flame Tracker Dry 325, senses the ultraviolet (UV) wavelengths produced by a flame and signals whether a flame is burning or not burning. The sensor's hot-end assembly operates at an impressive temperature of 325°C. These features made it an excellent choice for TPS's overseas installation.

TPS requested that Reuter-Stokes engineer a new version of the FTD 325 for the customer's TPS Frame 5 DLN1 gas turbines. Our engineers turned up the sensor's gain, increasing sensitivity so it could react to smaller UV signals like the ones that occur during the transition to premix mode. We named this custom-engineered sensor the FTD 325 ILG, which stands for increased low gain.

The FTD 325 ILG is built to be more sensitive to dim light, which is ideal in the transition to premix on Frame 5 DLN1 turbines. It does, however, maintain the same sensitivity to bright light as the standard FTD 325 detectors for baseload operation.

At the aforementioned customer location, we set up four sensors on the two TPS Frame 5 DLN1 gas turbines. Two sensors were installed on each turbine on the secondary flame sensor locations. This allowed the customer to compare the two standard FTD 325 sensors with two FTD 325 ILG sensors on each turbine.

Using these new FTD 325 ILG sensors, the customer was able to easily make the transition from lean-lean to premix combustion without interruption, allowing both turbines to start up successfully. With the FTD 325 ILG outputs being significantly higher (double compared to the standard sensors), the new ILG sensors performed just as expected and are an excellent fit for the application.

Going forward, TPS has indicated that all Reuter-Stokes FTD 325 sensors on DLN1 Frame 5 turbines should be the ILG type. In the larger picture, this new product's success means that customers have yet another option, especially those that may want to replace older Geiger Muller-type sensors. Reuter-Stokes continues to engineer new solutions for the gas turbine industry.