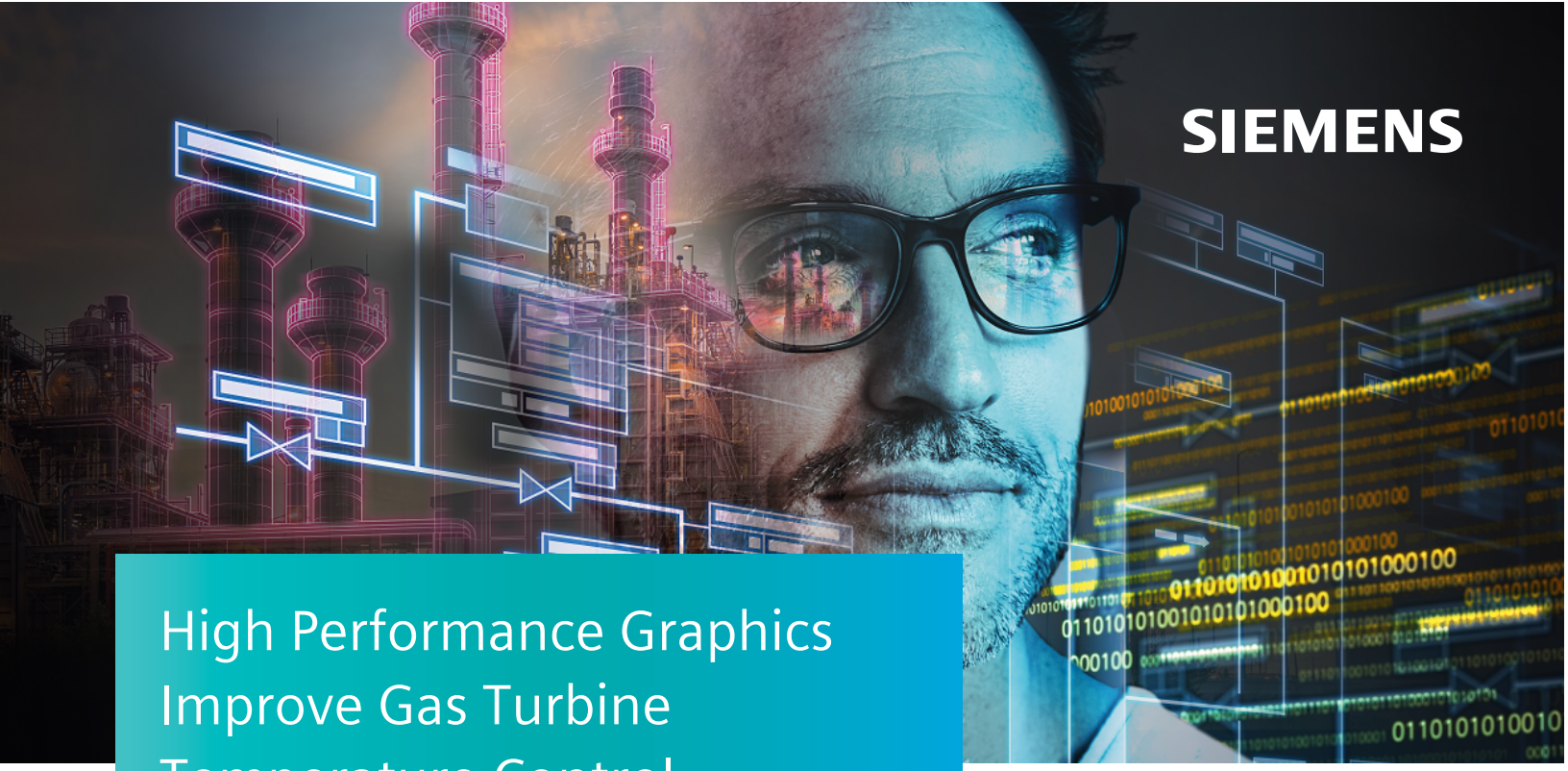

High Performance Graphics Improve Gas Turbine Temperature Control

Author: ISA

March 23, 2016 - When it comes to fuel valve control, gas turbines require quick response times and accurate adjustments to ensure reliability and safety.

Gas turbines run on explosive mixtures so it's important for operators to make sure that temperatures are equally distributed within the internal combustion engine. If a fuel control valve is closed too quickly, for example, the flame in the combustion chamber could go out. If opened too fast, the gas turbine could stall.

If temperature inconsistencies are not quickly identified and precisely corrected, hot spots could impair the integrity of the multimillion dollar turbine, potentially leading to a catastrophic failure.

Recently, Pigler Automation worked with an engineering company that upgrades and maintains gas turbines worldwide. The company was retained by a well-known paper producer to upgrade a General Electric Frame 6B gas turbine used to produce electricity and steam for facility and industrial processes at one of its mills in Western Europe.

The paper producer already standardized on Siemens SIMATIC PCS 7 process control system for many of its international operations. Now they wanted to upgrade the European mill's gas turbine's standalone GE Mark V control system to be in line with the rest of the plant's control systems. This created an opportunity for the engineering company to create a process control template that would become a new gas turbine standard for its operations across the globe.

The client worked with Pigler Automation to use Siemens' PCS 7 control system to completely control their gas turbine. The client chose Pigler Automation for the project because of their reputation and expertise as a Siemens Solution Partner with five certified PCS 7 engineers on staff with more than 50 years of combined PCS 7 experience. Pigler Automation also has decades of power generation experience which they applied to this project and they support customers in the chemical and mining industries so their engineers are well versed in numerous process control technologies.

Upgrade Focuses on Speed and Control

The upgrade began when the engineering company removed the existing standalone control system. The next step was to install the new hardware that consisted of a redundant Siemens AS-410-5H processor system and 7 redundant I/O racks.

Pigler Automation provided an engineer onsite during the transition to oversee the installation and commissioning of the PCS 7 software and new control system. The software was intelligently programmed to automatically provide default mechanisms to correct potential problems. It would also inform operators when and how to make manual corrections in response to certain events, making the software operator friendly. For example, an event may be an indication that the instrumentation is failing and requires operator manual interaction to ensure that the turbine does not trip.

Pigler Automation upgraded a Siemens Simatic PCS 7 used to produce electricity and steam for a paper company at one of its mills in Western Europe.

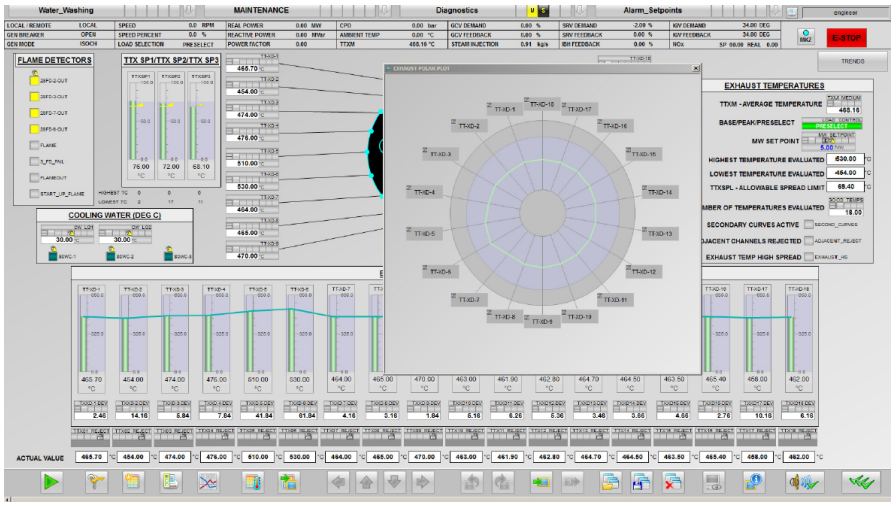

Figure 1: Gas Turbine Exhaust Temperatures with Polar Plot

This enhanced operator interaction was the highlight of the project and was enabled by PCS 7's Advanced Process Graphics (APG) product that presents high performance graphics features providing accurate displays of the health and status of the gas turbine over a user interface utilizing a schematic representation of the operation of the turbine.

While the paper producer's DCS control system is programmed to compensate for many predefined problems, the APG package provides an additional safety measure to quickly correct out of proportion parameters. It combines the advanced process control technology of PCS 7 with state-of-the-art graphics that intuitively monitor the turbine's status.

The human eye can quickly detect visual deviations in displays, such as when lines are not perfectly straight or when a circle is not perfectly symmetrical. The APG feature clearly and simply indicates, in a well-arranged manner, if something is not quite right with the turbine.

The APG's object visualization was based on data collected by an APG connector block in the automation system. APG objects were easily connected to process tags using a dynamic wizard in the OS. The graphic objects of the APG were adapted to the customer specifications including indicating alarm levels and changing colors on the bar graphs.

State-of-the-Art Graphics

Identifying any deviation from normal gas turbine operation at the paper mill at just one glance is the main benefit of the APG's leading edge graphics. A spider graph chart, polyline displays and bar graphs present multiple information sources that allow the operators to determine if they are "good" or "in trouble."

The circular spider graph dynamically measures predefined temperature parameters assigned to exhaust emissions exiting the back of the turbine. Operators can instantly identify cold or hot spots within the turbine, or a faulty thermocouple, by viewing bulges in the circle. They can immediately determine if the problem with the flame, flame detectors or gas flow among other issues.

Implementing the spider graph was simple. Pigler Automation just copied the block icon and the 18 tags used in the process. The dynamic wizard assigned the tags appropriately and automatically positioned them around the spider graph, saving a great deal of time. They just assigned a positon number to each tag. Tag number one went to the top dead center and the wizard evenly spaces them counterclockwise around the spider graph.

The exhaust temperatures are also displayed in a polyline graphic that moves as temperatures change. If a spike or drop in temperature happens the line will shoot straight up or down, respectively.

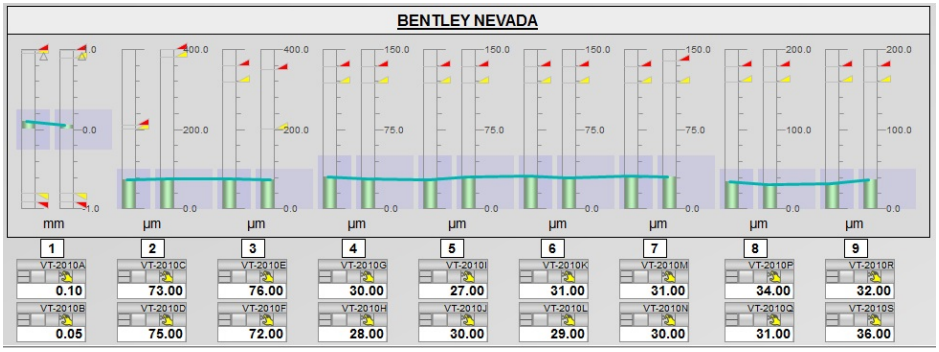

Figure 2: Vibration Monitoring with Multiple Polylines

Other operating values, including vibration, shaft displacement, and motor temperatures were also displayed using Siemens' APG graphics. Several different polylines measure vibration ranges for non-drive-in bearings, drive-in bearings, gearboxes and the generators.

More than 140 analog devices were used in the project, 105 of which are monitored in bar graphs summarizing the information on several pages in the HMI. The bar graphs display low and high alarms which are dynamic, depending on whether the turbine is starting up, in warm up phase or at full load. The bar graphs are easily customized when they are combined with the APL icon.

The bar graphs can also be combined in frames. The frames represent analog monitoring blocks or PID controller blocks. If an operator clicks on frame, a faceplate is opened that belongs to that analog measurement or PID controller.

The APG bar graphs come standard in grey outline, the preferred strategy per ISA 101, and can be easily modified as per customer requirements. The paper company wanted to clearly sees if alarm limits were being approached, so the graphics were customized to change colors – red, yellow or blue – as the process value passed the set points. Pigler Automation also customized the display to include shaded areas indicating preferred operating ranges.

International Goal Achieved

This is an early example of how PCS 7 has been used to control a GE Gas Turbine. The successful completion of this project enabled the engineering company to achieve its goal of finding a gas turbine control template for its international operations. The PCS 7 APG package is living up to its promise of identifying deviations from normal operations, even before threshold values are reached or warning limits are violated.

As a result, operations at the paper mill have been improved because operators now have a clearer view of the turbine's status. They are empowered to make decisions quicker because the chances for errors have been reduced. In sum, the APG has improved the paper mill's availability and, ultimately, the quality of its products.

Siemens Industry, Inc.
5300 Triangle Parkway
Norcross, GA 30092

1-866-663-7324
info.us@siemens.com