Row of fuel gas modules with actuators.

Actuator Maintenance is Linchpin for Producing Power

Turbines at power plants are demanding applications for actuators and servo valves because motion control is the key to machine performance and safety.

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GAS AND steam turbines use rugged inlet guide vane actuators and fuel gas control valves that regulate the correct ratio of air and fuel in varying loads and ambient environments for efficiency and minimal emissions. For the turbine system, the fuel gas control valve on an actuator is the primary interface between a complex control system and the mechanical part of the plant. Maintaining that link is a linchpin for producing power.

In 2007, a North American electric company's 400-megawatt combined-cycle power plant began operation. The plant serves residential, commercial and industrial customers and it is the largest electric utility in its state. At the heart of the combined cycle plant is a Mitsubishi 501G combustion turbine along with a Mitsubishi steam turbine. This combined cycle power plant uses natural gas fuel to fire a combustion turbine, generating electricity and exhaust heat. The heat is converted to steam in a heat recovery steam generator (HRSG) and used to power the steam turbine, which also produces electricity.

> This facility provides supplemental power during dry seasons.

This facility provides supplemental power during dry seasons when the regions hydro-generation facilities are not able to operate at rated capacity. The unpredictable and intermittent operating modes make it difficult to predict and budget for major maintenance outages.

– Our experience shows that running a turbine for more than five years with minimal maintenance could result in a forced outage, said **Craig Whited** of Hydra-Power Systems, Inc., which provides maintenance support services for power plants.

– To maximize efficiencies, critical components can be custom designed for a particular site. An unplanned outage could require extended down time due to the long lead time for parts that may not be on hand when needed.

In 2014, a team of Moog engineers, sales representatives and service technicians along with Hydra-Power Systems approached the plant's managers with the idea of performing a site inspection of the gas turbine's two, smaller Moog hydraulic actuators and the process valves made by Nakakita Seisakusho Company. The plant agreed to the cost-effective site inspection during a planned outage period, and Moog ensured that it had the right parts on-hand in the event the inspection necessitated a replacement of any critical components.

Uncovering Maintenance Issues

The site inspection showed varnishing of the hydraulic system, which came as no surprise to the maintenance manager. But he needed physical proof of the varnishing to justify repairs. A simple cotton swab during the disassembly process revealed loose varnish within the manifold and actuator; it was all the proof the maintenance manager needed.

Inspection of the process valve by the team from Hydra-Power Systems and Moog revealed internal leakage and carbon deposits on the plug and stem. And the team's inspection of the actuators indicated the beginning of a hydraulic leak, which the site maintenance manager hadn't predicted.

According to Whited, Hydra-Power Systems approached the plant's managers to inform them that Moog, the maker of the turbines' actuators, already had a program in place for servicing actuators like the ones at the plant.

– The hope was that in the future the plant wouldn't turn to a third-party repair house to try and refurbish the actuators, because those repairs, while less expensive, would not use genuine parts and could cause future mechanical failures and leakages, Whited added.

Among the plant manager's concerns about working with an OEM on repairs were the expense and lead time for parts if needed. It was then that Whited suggested a long-term service agreement with the utility. Hydra-Power Systems and Moog teamed up to perform a site audit and generate a proposed list of critical spare parts.

Hydraulic actuator attached to a process valve.

– We proposed a customized service agreement for the plant, Whited remarked.

– It would reduce the lead time for parts from waiting 3.5 months to making them readily available, which is critically important. If the plant unexpectedly lost the functioning of an actuator, managers might have to buy power on the open market at tremendous cost.

Making a Case for Regular Maintenance

After the site inspection, Hydra-Power Systems and Moog recommended that the utility sign on to have Whited's team perform a periodic inspection on the actuator, since it could grow progressively worse pending run time. By proving the value of regular inspection of the electric company's equipment by the OEM or its authorized distributor, the team made a case for buying spare parts and scheduling a complete overhaul that would prevent a potential forced outage of many months.

– It's pretty uncommon for a turbine actuator to fail, remarked Whited.

– But within the last year, I know of a case where a Northwest U.S. power plant's actuator did fail on one of its turbines. Moog had the parts on the shelf, and we were able to get the plant up and running the next day.

Critical components can be custom designed for a particular site.

When it comes time for a plant to remove a turbine actuator for service and repair, there are two major items: First, a plant must inspect and possibly overhaul the actuator, including the cylinder, servo valves, piston rod, spring cage and bearings; and second, the service technicians must inspect the process valves and, if needed, put them back into like-new condition.

When you work with an OEM, these types of repairs from customer sites around the world are typically conducted. The right OEM knows what parts are likely to fail. And if they see, for example, a certain class of actuators all failing at a specific point, the savvy OEM will design upgrades and put these back into its regular repair service to help end users. The best OEMs are the ones who will schedule these inspections and repairs well in advance to coincide with a plant's planned outages to minimize disruption and down time.

Plant maintenance managers must be vigilant, too. Inspecting turbine actuators at regular intervals and looking for telltale signs such as external leakage are a trigger to overhaul the actuator in question and, perhaps, all of the turbine's actuators. Plant managers might also see hysteresis, a lag between cause and effect, in the actuator's digital control systems that show the actuator undershooting or overshooting commands. ■

About the author

Jonathan Roberts is a Field Service Engineer for Moog Industrial Group, a division of Moog Inc. He has extensive experience in product, application and system engineering and sales. Roberts holds Bachelor's and Master's of Science Degrees in Electrical Engineering from SUNY at Buffalo.