CONDITION MONITORING

LEVERAGING PLANNED OUTAGES AT POWER PLANTS

Many of the world's most efficient power plants are Combined Cycle Gas Turbine Plants (CCGT) incorporating gas and steam turbines. These turbines present demanding motion control challenges, which affect machine performance, safety, reliability and supply of power to customers.

Gas valve-actuator assembly undergoes factory acceptance test.

Process valve tagged for shipment to Emerson IVS repair facility.

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POWER PLANT operators are looking for ways to keep turbines running at peak performance. Some of the most important ways to accomplish this in a power plant are to make the most of planned outages and reduce the risk of unplanned downtime. Many industries can benefit from some practical approaches to the strategic use of long-life upgrades, retrofits and exchange programmes.

Why is motion control important?

In the turbine system, the hydraulically actuated fuel gas control valve is the primary interface between a complex control system and the mechanical portion of the plant. From a safety perspective, it is vital to ensure a rapid closing time for the main valve actuator in the case of an emergency shutdown to avoid collateral damage to the turbine.

The motion control system affects:

- The power output of the turbine and the revenue stream
- Energy efficiency that equates to profitability (i.e., 80 percent of the cost of running plants is fuel)
- Emissions level, which is both a cost and compliance issue since improperly calibrated equipment can cause a plant to exceed its emission allowance
- A safe, controlled shutdown, which protects human life and property

The challenge for power plants is keeping motion control systems operating at a high level in spite of around-the-clock operations in rugged environments. Turbine OEMs have recommended planned maintenance schedules that help plant operators to minimize downtime and ensure optimized energy output. All repairs and maintenance of critical components, such as actuators and servo valves, need to be scheduled during an outage along with thousands of other maintenance tasks involving numerous vendors and complex scheduling.

Maximizing maintenance budgets during plant outages

As an original supplier of fuel control valves for General Electric (GE) 7FA turbines, Moog routinely works with power plants to ensure that the actuators and valves can be refurbished to "as new" condition during very tight outage windows. With experience in advanced material gleaned from many years of developing products for demanding environments ranging from aerospace to downhole oil exploration, Moog developed a long-life actuator as an upgrade offering. When GE introduced a new technology called Advanced Gas Path (AGP), the maintenance interval was extended from 48,000 to 64,000 hours. Moog had the long-life product but needed to work closely with its partner Emerson to develop a process valve upgrade that is part of the gas valve assembly.

Over the life of the equipment, an OEM will use data on the performance of products and capabilities, such as failure analysis, to understand how to increase reliability for a long service life. Engineers identified several key improvements to ensure that the gas valve actuator would operate reliably for 64,000 hours, even in harsh conditions:

- Low pressure dual elastomeric seal design to eliminate galling on the piston rod
- New buffer seal for more durability
- Harder rod surface through proprietary aerospace coating that replaces chrome plating for extended life
- Hard, dense chrome coating added to cylinder bore surface

Likewise, Emerson, which manufactures the EAB process valve, engineered a retrofit to extend scheduled maintenance intervals in two key areas:

- The bonnet is machined to receive a Stellite™ alloy insert, eliminating the traditional coating that can degrade over time
- A live-loaded packing system replaces the original manually adjustable configuration to ensure the integrity of the packing seal for extended operating periods

Recently, Moog introduced a new Gas Control Valve Assembly 64 K Upgrade for General Electric 7FA turbines. It was the first offering able to extend the maintenance interval of gas control equipment from the typical 48,000 hours of operation to 64,000 hours.

To complete the 64 K Upgrade package, the actuator and process valve are returned to "zero-hour" condition. The actuator receives a factory overhaul, and the process valve undergoes a Fisher Encore™ repair performed at an Emerson IVS repair facility. The integrated assembly overhaul is a 100 percent OEM repair. This process ensures the turbine's valves are returned to as-new specifications and performance, resetting the inspection clock to hour zero.

For turbine plants with the Advanced Gas Path Technology, the benefits of synchronizing major inspection periods means managers will never find themselves trying to overhaul gas valves when they have a much smaller outage window. Of course, many operators see the benefits of the extended life even if they have the 48,000 maintenance interval due to high confidence in the reliability of the assembly.

Exchange programmes help leverage planned outage

Risks during a scheduled outage are eliminated through the so-called Advanced Exchange Programme, which offers a turbine owner rebuilt gas control valves that arrive prior to the start date of an outage. This allows managers to remove the used valves and install the rebuilt valves in sequence, saving money and time. When considering the complexity of an outage and all of the tasks a maintenance manager must juggle, having a spare actuator assembly on hand when needed can help prevent the cost of an extended outage or unplanned downtime.

One example of a power plant that effectively used its outage is a combined cycle power plant in the Southeastern U.S. that began planning for an extended outage months in advance.

The plant's managers had 21 days for the inspection of each combustion turbine and 18 days per steam turbine. Managers had to refurbish fuel gas and steam control valve assemblies during these outages. To maintain reliability, the plant had to return the equipment to as-new condition. The plant managers wanted OEM repairs and upgrades, and the timeframe to perform the repairs within the inspection window left no margin for error. If power was offline even for a single day, everyone knew the lost revenue would be significant. Moog service technicians proposed a service plan that included a combination of spares, repairs and exchange units to meet the plant's inspection schedules.

For the combustion turbine units, the plant purchased one spare set of actuators. These served dual roles as a rotatable set during planned outages and emergency spares during forced outages. Technicians used the power plant's spares and a set of Moog's exchange units complete with process valves. At the end of the preventative maintenance outage, technicians returned the plant's spare set to the site and replaced the Moog set in the exchange pool inventory. The plant managers and service technicians determined that the steam turbines' actuators and valves could be repaired within the allotted time, too. The plant's managers coordinated the repair and removed the steam process valves from the actuators and sent the actuators to Moog for repair. After completing the actuator repairs, technicians conducted a final acceptance test and sent the actuators to the power station with a two-year warranty. The plant reassembled the valve to the actuator, installed the assembly, and tested it for commissioning. ■