POWER Engineering

Problems and Solutions for Remote Monitoring and Diagnostic Systems

BY JONATHAN AYLETT, BSC, TURBINE SERVICES

In an era where information is power and computational data is vital to plant operators, monitoring and diagnostic systems are supporting the operation of industrial gas turbines worldwide. These systems increase the reliability of turbines powered by natural gas, providing early warning and fault diagnostics. Early fault detection can provide significant benefits, including the avoidance of unscheduled outages and equipment damage. The systems also can monitor and assist in maintaining the turbine performance.

Monitoring and diagnostic systems supplied by independent service providers rather than turbine manufacturers can be deployed to suit the operators' requirements, rather than what might suit the manufacturer. And they can be used with different turbine makes and models, and for other types of plants.

For example, a power utility has a fleet of peaking turbines from different manufacturers and of different types, such as heavy industrial and aeroderivative. The utility company uses the same system via the internet to monitor all turbines remotely, and the system can send diagnostic messages to cell phones and email reports to company staff. It has a flexible client-server architecture which can be used in a centralized monitoring center, or decentralized to any location able to connect a client remotely to a server. It can also support remote clients running in web browsers.

A site data server acquires and archives data from the turbine controllers. Any number of remote clients can connect to it using the company internal network, or remotely via internet or modem connection.

Data update rates for the remote clients can be configured for the bandwidth of the network connection. This can be at once per second over fast LAN or internet connections, or once per hour for slow modem connections. For slow connections, remote clients can be configured to only download trend data and diagnostic messages each day, reducing data transfers.

A typical data set of 400 analogue and 1500 digital tags is acquired each second and analyzed 24/7. It is impractical to analyze this manually, so the system analyzes the data in real time using diagnostic rules and pre-alarm checkers, generating diagnostic messages which are archived on site.

Standard sets of diagnostics have been developed through the analysis of turbine data for many turbines over many years. They range from simple pre-alarm analogue checkers to complex diagnostic rules using Boolean logic combined with time based functions. Diagnostics are defined in parameter files and addition and adjustment of these parameter files is all that is required to adjust or add new diagnostics.

Diagnostic warning messages are generated at three fault severity levels and are generated if the turbine starts to migrate out of a tuned footprint, or if a fault occurs. Diagnostics parameters are tuned to each turbine footprint and the parameters are periodically reviewed and retuned as a turbine changes over time.

Digital controller data is acquired which enables the system to report controller alarms, and enables diagnostics in the context of the turbine run state (start up, base load etc.) and the detailed controller operation of the turbine.

For long-term trending, the system creates trend files of all data for each day. These trend files contain minimum, maximum and average values of the data within five minute time windows. These trend files can also be used to efficiently create trends for days, months or years.

The average trends show long-term changes such as a slow increase in vibration, whereas the minimum and maximum values can reveal changes that occur within the trend data sample window that would otherwise be lost by averaging, such as vibration spikes.

The system can also check the turbine using event graphs for start-ups, shutdowns and trips. This enables data for different time periods to be plotted and compared on the same multi-time event graph.

To analyze turbine incidents such as trips, data can be replayed. Historical data can be replayed by the system and viewed and analyzed, just as it occurred at the time of the actual events. This is possible as data is stored in a compressed format with no loss of resolution in time or value, so any past data can be replayed at the original resolution of one sample per second.

Remote monitoring and diagnostic systems can support an effective preventive maintenance program, enabling proactive identification of turbine problems that can be fixed in a timely manner. Turbine performance can also be monitored and maintained. Without such systems, maintenance may be reactive, and problems are more likely to occur with potentially serious consequences.