POWER Engineering®

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Remote Vibration Monitoring Keeps Power Plants Running at Full Capacity

BY DEANE HORN, EMERSON

You can get the monitoring and analysis you need without requiring your equipment specialist to be on-site at the plant. In fact, you could send your equipment specialist to a conference across the country knowing that when he goes, he will carry with him the power to monitor the condition of rotating machinery at your power plant. With only a cell phone, he can provide graphical evidence of unusual vibration activity to an OEM expert anywhere in the world for a second opinion. If necessary, the equipment specialist can even take action to protect equipment thousands of miles away, improve safety for plant personnel, and prevent a disruption in service to your plant's customers – all without leaving the conference. That's exactly how a power plant in North America uses this capability.

> "Power plants can monitor every rotating machine in the plant continuously with the CSI 6500 for critical machines."

WHAT MAKES UP THE REMOTE MONITORING NETWORK?

Three components make this possible: a monitor that provides continuous protection and prediction, software that provides predictive machinery health displays and analysis tools, and a network that feeds the website.

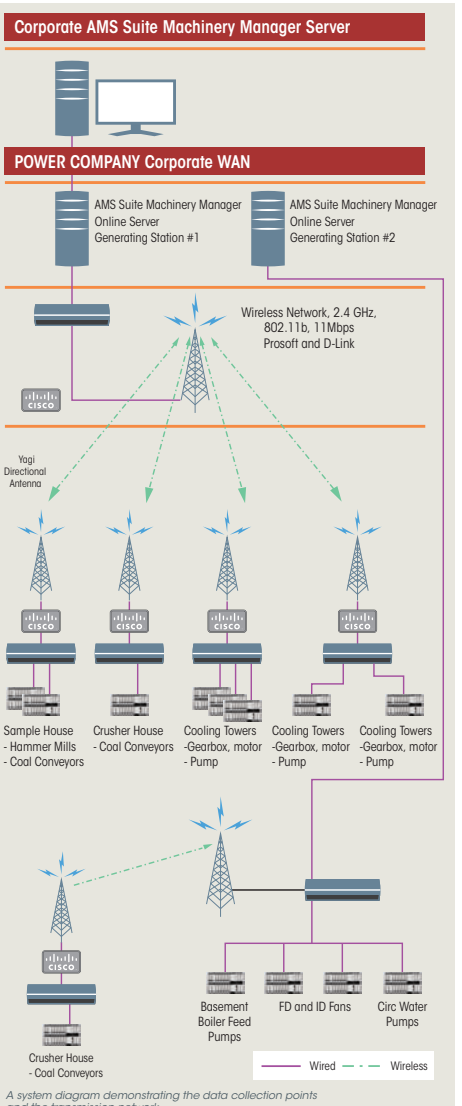
Using the website, the equipment specialist keeps track of the condition of rotating equipment in three widely separated power generating stations without having a vibration specialist in each plant to monitor every developing situation.

If a turbine blade were to crack due to a coiler upset at one of the power generating stations, the equipment specialist will learn about it and keep that machine under close surveillance – no matter where he might be.

Figure 1 is a system diagram demonstrating the data collection points and the transmission network. The generating station on the right side of Figure 1 shows Emerson's CSI 6500 Machinery Health Monitors wired directly to an AMS Suite: Machinery Health Manager predictive maintenance server. The left side of the figure shows how data is also transmitted wirelessly from monitors in remote locations.

The data acquired from each online monitor are stored on a hard drive in

Vibration Monitoring Network 1



A system diagram demonstrating the data collection points and the transmission network.

the server, buffered, and presented on a screen in high-definition plots that depict what is happening in a given machine.

The result is a comprehensive view of each monitored machine for accurate diagnoses when changes in a machine's condition are discovered. In addition, AMS Machinery Manager provides analytical tools that help trained personnel diagnose problems and generate a prognosis on the health of the machine.

Power plants can monitor every rotating machine in the plant continuously with the CSI 6500 for critical machines and periodically with the portable CSI 2140 Machinery Health Analyzer for less critical machines.

The CSI 2140 is used by the walk around analyst where he can safely approach machines and when machine failure has no derate consequence. The portable analyzer uploads data to the predictive maintenance software where information can be accessed from anywhere in the world.

The plant's corporate WAN connects the server in each generating station to AMS Machinery Manager in the headquarters.

Data residing at each site is accessible via a web-based platform by remote personal computers or smart phones like the one the equipment specialist uses from any location. The specialist in our example has accessed the network to do remote diagnostics at locations ranging from Fort Myers Beach, Florida to Anchorage, Alaska. Experts from Emerson, GE, Siemens, and ABM Technical Services have accessed the network as well.

The network is used for critical equipment for each operating unit. This equipment is monitored for vibration characteristics, exceptions are captured, and time-based historical data are saved weekly, at the user-determined optimal interval for that machine.

If vibration exceeds a pre-determined alarm, the signature and waveform data are immediately saved for analysis. When this happens, it triggers a yellow or red indication on the AMS Machinery Manager screen to signify specific points and parameters in alarm.

The equipment specialist reviews this equipment list daily for alarming or trending of vibration plots, and machines showing signs of trouble are watched very closely.

WHY REMOTE MONITORING WORKS

Remote monitoring enables the facility to maintain critical equipment for maximum availability while keeping their expensive machinery running as long as possible.

> "Production doesn't have to be compromised while the plant waits for an expert to come out and analyze the issue."

The frequent scans pick up anything unusual and provide ample warning of a potential failure. The equipment specialist analyzes the scans and identifies the fault, tracking it until it becomes obvious that repairs will be necessary.

The result is greater plant reliability, improved safety, and more uptime, which means more income, especially during peak periods.

Using this technology, the power plant's resources are able to efficiently monitor and maintain critical assets including turbine/generator sets, boiler ID and FD fans, boiler feed pumps, condensate pumps, circulating water pumps, etc.

Safety has increased for plant personnel by eliminating the need for taking frequent vibration readings with handheld analyzers on difficult-to reach machinery such as icy cooling tower fans.

At this power plant, the practice had been to derate the plant while a potentially crippling condition was being analyzed and a course of action was being determined.

With the introduction of online monitoring, production doesn't have to be compromised while the plant waits for an expert to come out and analyze the issue. Instead, real-time plots are sent to a Level IV vibration specialist or OEM expert; they can see the problem without being physically on-site. The expert analyzes the problem, determines root cause and recommends a course of action more quickly and with less expense. This approach allows plant personnel to be more productive, tapping experts only as needed.

In one facility, using data from online monitoring, the internal expert identified a fault in the turbine blade.

He monitored the vibration; it wasn't catastrophic but it was getting higher by the day.

In fact, it was on track for reaching shutdown levels in five days. He sent the plots to remote turbine services for analysis. Since they knew it was a cracked blade, they got the right people and parts onsite, scheduled the shutdown for the weekend when demand would be lower, made the repair over the weekend and were back online very quickly.

As reflected in the example above, mechanical equipment seldom fails without giving signals well in advance.

Breakdowns can often be predicted by watching for the warning signs.

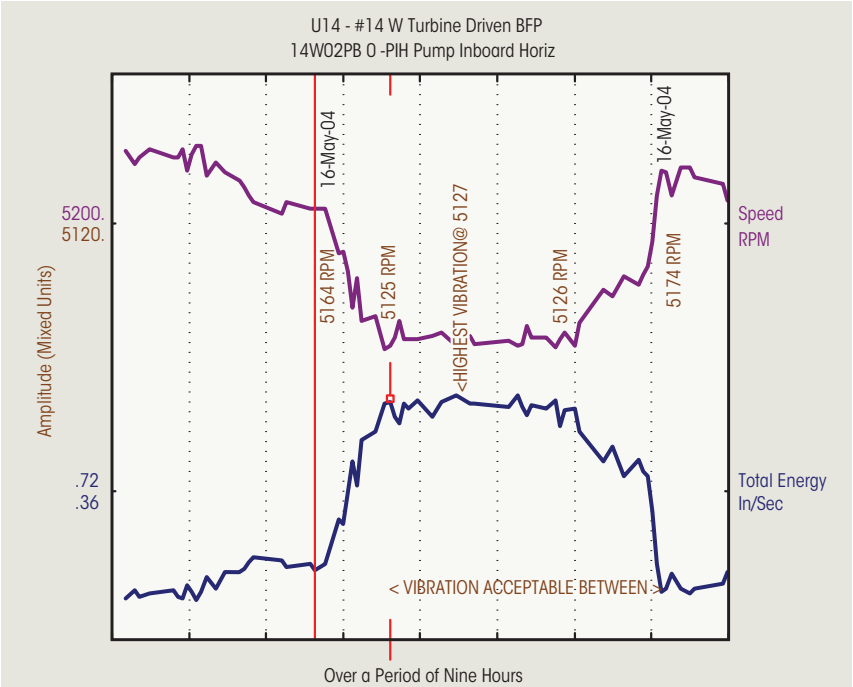
Vibration monitoring and the analysis of the resulting data are proven ways to identify changes in machine behavior.

The advance knowledge provided by online monitoring enables the power plant staff to address the problem as part of a planned outage.

For the power plant in our case study, using online remote monitoring has yielded savings in time and dollars.

With the decreased number of derating periods and the delay of repairs until

Snapshot of Turbine Driven Feed Pump's Vibration 2



A snapshot from a nine-hour trend study of the CSI 6500. The upper line shows the pump speed in revolutions per minute, and the lower line shows total vibration energy in inches per second.

planned outages, online remote monitoring has paid for itself many times since the first online vibration monitors were installed in the power plant nearly ten years ago.

TROUBLE ON A SUNDAY

Operators identified an abnormality in a turbine driven boiler feed pump's operation, and they brought it to the specialist's attention on a Sunday.

The CSI 6500 works like a black box on aircraft; when the pump so much as hiccups, the data can be retrieved and played back as if watching it live. Figure 2 is a snapshot from a nine-hour trend study of this machine. The upper line shows the pump speed in revolutions per minute, and the lower line shows total vibration energy in inches per second.

As illustrated in the figure, the vibration increases rapidly from 0.4 in/sec at 5164 RPM to 0.65 in/sec at 5125 RPM and drops back to an acceptable level as the speed increases to 5174 RPM. This trend continued throughout the nine-hour period.

Based on the historical vibration data and the allowable limits for operation, the equipment specialist was certain that a bearing was going bad and needed to be replaced. He was able to make this diagnosis remotely, so he didn't even have to go in to the plant on Sunday.

"The advance knowledge provided by online monitoring enables the power plant staff to address the problem as part of a planned outage."

No immediate operational adjustments were needed for the pump, so production continued without disruption. The necessary part was ordered and the repair was managed as part of a planned outage.

SUMMARY

Online vibration monitoring of critical equipment has achieved a number of positive results for this power plant, including:

- Improved plant reliability and uptime, resulting in more revenue during peak operations
- Decreased safety risk for plant personnel
- Closely monitored assets without increasing resources
- Saved time and money by diagnosing problems remotely
- Reduced need to derate units while waiting for analysis

The power company's goal is to keep these plants up and running without risk to the machinery or personnel. At the same time, they strive to get the most out of the equipment. With online vibration monitoring, the company has the ability to achieve both of those goals. pe