Remote Turbine Vibration Monitoring

using the ZonicBook™

Energy

Application Note #60

Application Summary

Numerous 8 to 215 megawatt electrical generators owned by Calpine Corp., Pasadena, Tex., help supply the enormous amount of energy needed for the power distribution grid spread across the North American continent. And the turbine-driven generators must continuously run smoothly without much vibration; otherwise they could sustain significant damage. Machine downtime costs could easily run in the thousands of dollars per hour. So, to keep the systems up and trouble free, their vibration signatures are recorded endlessly. The experts who watch over the equipment can frequently detect an imminent failure just by noticing changes in the shape of the waveform. The data acquisition equipment that monitors the health of these generators is permanently connected to vibration sensors including displacement transducers and proximity probes strategically placed around the generators, particularly to monitor shaft vibrations on the bearings. A critical requirement is that the equipment ties into the plant's DCS (distributed control system) and provides remote monitoring.

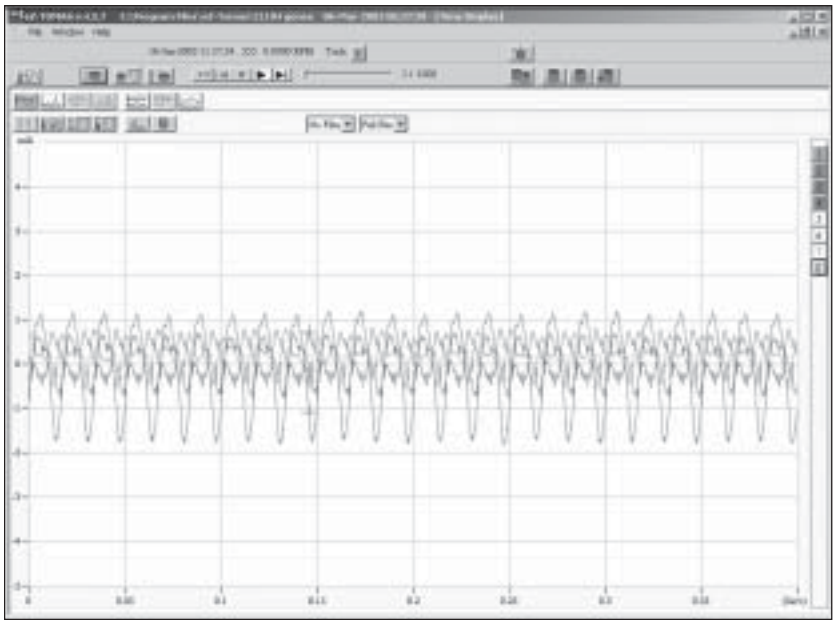
Potential Solution

The data acquisition equipment that Calpine used initially is relatively expensive and has some serious operational shortcomings. The system hardware is large, not easily transportable, does not have remote monitoring capability, shows only the RMS amplitude of the signals, and is unable to show an adequate level of waveform detail to help the engineers detect an impending failure. It does not provide signature analyses or FFTs.

IOtech's Solution

Because of these limitations, Calpine is now supplementing the old equipment with two 8-channel, ZonicBooks™ and its companion eZ-TOMAS™ software. Says Greg McAuley, Outage Services Manager, "We primarily bought the ZonicBooks to measure shaft vibrations before and after an outage. Our secondary use is to remotely measure vibration levels and signatures. We can tie into the plant's DCS via our Calpine server and see what the direct amplitudes are. But without the ZonicBook, we can't remotely monitor phase angle, one, two, or three-times amplitudes, and more discrete parts of the vibration signal." McAuly emphasizes that it's easy to say there's a problem when the vibration is increasing, but being able to see what part of the vibration signal or amplitude component is changing is the most important aspect for diagnostics. The engineers monitor the signals over a period of time, so they can see what's developing and how rapidly.

A laptop computer is connected to the ZonicBook as a server on the Calpine network. And then the engineers remotely access that from another location via network neighborhood to see what is happening. But because the old equipment doesn't have the remote interface capability, currently, the engineers must carry the ZonicBooks to the site, connect them to existing



Calpine TMG uses IOtech's ZonicBooks to capture generator and exciter vibration signals on a gas-turbine-powered machine. The wave forms are typical displays of historical data that engineers need to monitor trends over time. Any subtle changes in the data as seen through the eyes of an expert can be enough information to alert the maintenance engineers of possible failures.

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monitor and control panels, access and record data, and then examine the data on site. Alternatively, they take the computer back to the office, analyze the data, see what's happening, and figure out what needs to be done. They can use the information to calculate a balance shot and then return to the site to install it, or make the changes necessary to solve the problem. They then restart the machine and take another set of data. If it's good, they had solved the problem.

When a balance problem has been pinpointed in a combustion or steam turbine, the one-time amplitude and phase angles have to be observed and analyzed. The eZ-TOMAS software isn't used to calculate a shot directly, but it can break down the direct reading into various components, and then that information is used to calculate or plot the location and size of the needed balance weight.

For the present time, all the IOtech equipment is on-site. The engineers are familiar enough with the ZonicBook to set it up and collect the discrete vibration component data needed to be analyzed, but so far, it has not been programmed for remote collection. "There is sure to be a learning curve because it involves networking and a little higher level IT information," says McAuley, "but with the very complete instructions that came with the manual, the engineers should be able to figure it out quite easily. They are in the process of doing that right now."

Conclusion

The IOtech equipment is performing well at each site for Calpine, although they are still in the early stages of implementation and learning more each day in their goal to employ it for remote data collection. The major advantage McAuley claims is the ZonicBook's portability. In addition to the displacement transducers and proximity sensors, Calpine runs a few Aero-Derivative engines that use accelerometers, velocity pickups, or seismic probes, all of which can be analyzed by the ZonicBook, but most of the new generators are outfitted with proximity probes and built-in displacement transducers.

ZonicBook

The ZonicBook™ allows you to record, playback, analyze, and archive vibration or acoustic data in both time and frequency domain. ZonicBook provides real-time display of up to 16 channels, including real-time FFT displays. Other PC-based vibration analyzers record only frequency-domain information, making it impossible to play back time-domain waveforms and perform post-acquisition analysis.

Features

- Perform vibration measurements and real-time analysis with this portable, integrated hardware and software solution
- View real-time frequency-domain and/or time-domain data while streaming gapless data to your PC's memory and hard drive
- Replay acquired data for post-acquisition annotation, peak labeling, and easy generation of professional looking reports
- Export acquired data in a variety of report formats for further analysis and report generation
- Available in either 4-, 8-, or 16-channel configurations
- One 16-bit Sigma Delta A/D per channel provides low-noise, linear phase measurements
- 51.2 kHz max sampling per channel
- All input channels are sampled simultaneously for excellent phase matching
- Analysis frequency:
  4- & 8-channel, DC to 20 kHz
  16-channel, DC to 10 kHz
- 92 dB stop-band filter per channel
- Inputs are isolated from ground and PC to eliminate ground loops
- Includes high-speed PC-Card (PCMCIA) interface to notebook or desktop PC's
- DBK70 vehicle bus option (J1850 VPW, J1850 PWM, J1939, ISO-9141, CAN) enables simultaneous measurement of vehicle bus parameters along with vibration measurements
- Powerable from AC line or 12 VDC for in-vehicle applications
- Optional battery module for portable applications
- Operates under Windows®

Optional eZ-TOMAS™ Software

- Continuously monitor up to 16 channels of inputs
- Attach accelerometers, tachometers, proximity probes, and other sensors directly to the ZonicBook™
- Use with notebook PCs for portable applications
- Designate up to three channels as tachometer inputs
- Define up to 10 spectral bands per channel, per tachometer reference
- Automatically set limits and define alarm conditions based on historical spectral levels
- Store statistically significant data based on transient or alarm conditions
- View vibration data from anywhere using your networked computers
- Save and recall your specific vibration reports