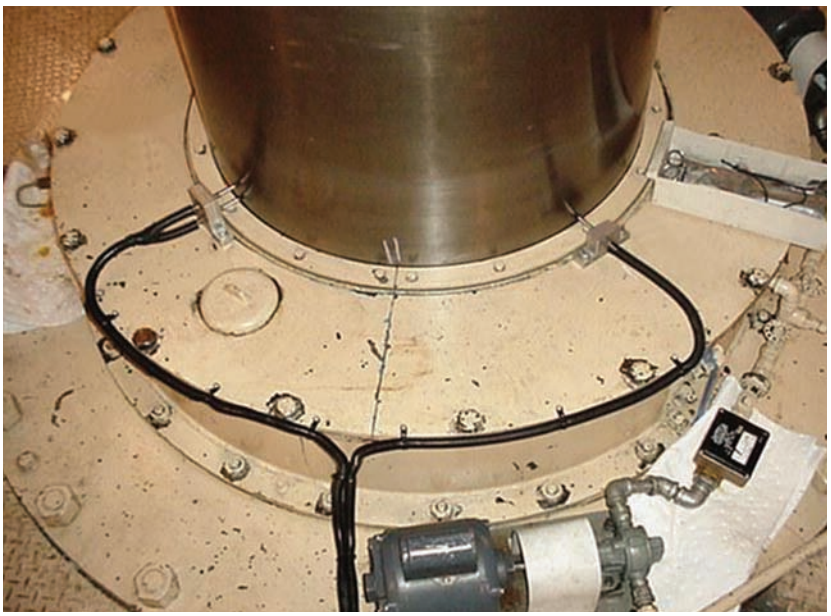
Hydroelectric Generator Testing
using the ZonicBook

It's hard to beat Mother Nature when it comes to maximizing efficiency. She does a wonderful job in performing any task from forming soap bubbles to creating extraordinary plants that adapt to their environment and survive adverse conditions. The same idea of efficiency holds true for producing electricity the North American continent consumes in the quest to sustain its manufacturing base and extend our high quality of life. In spite of the effort expended to deploy nuclear power plants over the past 50 years, the Pacific Northwest still produces 90% of its needs with water-powered hydro generators. They were among the first machines to supply our nation's electrical requirements during the 1800s, and some, almost one hundred years later, are still operating. Today, they require special attention to continue running trouble-free.

Application Summary

A large utility in the Pacific Northwest, for example, still maintains hydro generators that were installed as early as 1926. Excessive vibration, generated by any number of sources, is one of the most critical parameters that can bring a generator down, whether old or new. Vibrations must be detected in some way long before operators can hear them. By the time they are audible, the damage has been done.



Many machines have permanent Eddy-current displacement probes installed to measure vibration. The displacement probes, with an output of 200 mV/mil, are used instead of accelerometers. The machines run around 300 rpm, speeds that are not very effective for accelerometers.

Excessive vibrations frequently come from worn bearings or instability in the bearings, cavitations in the turbine, and rough load zones. Detecting the noise from worn bearings is relatively easy for experts who can recognize anomalies in an acquired vibration wave shape. Displacement transducers mounted on the bearings provide clues in a signal signature that lets the maintenance engineers take action before a catastrophic failure.

Rough loads are caused by cavitations in the turbine, normally localized phenomena, and depend upon the shape and condition of the turbine blades as well as the intake and discharge head. Cavitations often start in the draft tube downstream of the turbine impeller, and the noise it creates can be heard, but it does not necessarily damage the impeller. As the load on the turbine changes, the cavitation zone may progress upstream until it does affect the turbine blades. This changes the vibration signature of the turbine shaft, but it is not the vibration that causes the damage, it's the cavitation itself.

Because the rough load zones change depending on the head and discharge pressures, they have to be re-evaluated fairly frequently. The head and discharge pressures depend on the reservoir elevation, and regulating the speed that it drops often relieves the hazard. But ultimate control still depends on the amount of water entering the system.

Potential Solution

Several years ago, hydro-generator maintenance engineers for the utility had installed large, computerized monitor panels to watch over the health of the systems, but the equipment has some serious shortcomings. They are not portable, and they lack a means of capturing wave shapes sufficient for analysis beyond a simple rms signal. Says a Senior Maintenance Engineer, "We have several of the most widely used vibration monitoring panels available, but they strictly give us an overall vibration reading. They provide no spectrum, waveform, or anything else to analyze."

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IOtech's Solution

These drawbacks drove the engineer to evaluate alternative data acquisition systems based on cost and capability, and he selected the IOtech ZonicBook with eZ-TOMAS software. "I wanted something reliable, fairly easy to use, with a lot of flexibility. I have a lot of experience monitoring vibration with on-line systems, so it's a little hard to put into words exactly what I was looking for, but I knew what it was when I found it."

The ZonicBook is easy to set up and easy to use. For example, the senior engineer gave a young engineer a brief rundown on the ZonicBook, and within a couple of weeks she was extracting meaningful data and arrived at some excellent conclusions. "A lot of systems are available, but not like the IOtech ZonicBook. Many of the others require expert operators."

Conclusion

An IOtech ZonicBook is helping a Senior Maintenance Engineer maintain 29 hydro generators, ranging from 10 to 75 MW, that supply power to the Pacific Northwest, including British Columbia, California, and Alberta. He sets up preventive maintenance programs and uses a ZonicBook to troubleshoot problems and measure turbine shaft vibrations. Occasionally the ZonicBook is installed at one site for an extended time to log vibration data on a suspected turbine shaft, but more often, the engineer takes it from one site to another during his regular travel schedule.

ZonicBook/618E

Vibration analysis and monitoring has never been easier than with the ZonicBook/618E and eZ-Series analysis and monitoring software. The ZonicBook leverages 30+ years of experience providing vibration measurement solutions. This Ethernet-based solution adds another dimension — the *low cost,* full-featured 8 to 56 channel analyzer available. The ZonicBook hardware is the signal conditioning and acquisition engine, while the eZ-Series software in the PC defines the specific analysis and monitoring features of the system.

Features

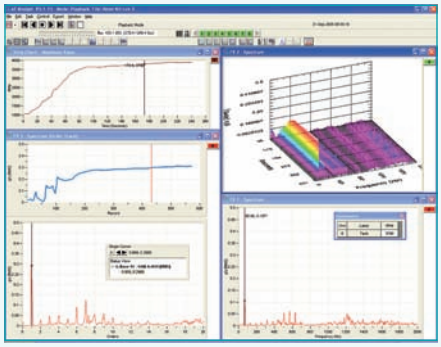
- 8 dynamic input channels, expandable up to 56 channels
- 4 tachometer channels for rotational measurements
- High-speed Ethernet connection to the PC for continuous recording
- eZ-Series software packages address a wide variety of vibration monitoring and analysis applications
- TEDS support for accelerometers

The ZonicBook/618E with eZ-Series software and your PC makes a real-time, portable vibration analysis monitoring system

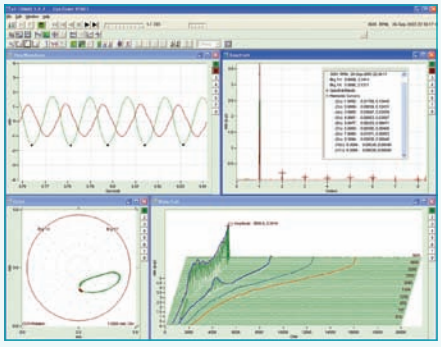
Software Overview

Various software packages are available for the ZonicBook, each tailored to a particular vibration measurement and analysis application. Choose the package that suits your application now, and upgrade to additional packages as your requirements evolve.

- **eZ-Analyst** provides real-time multi-channel vibration analysis, including overlay of previously acquired data while acquiring new data, strip charts of the throughput data files, cross channel analysis, and direct export to the most popular MODAL analysis packages, ME Scope and Star Modal.
- **eZ-TOMAS & eZ-TOMAS Remote** are highly sophisticated, yet easy-to-use tools for the monitoring and analysis of single or multiple machines, which allows the user to assess the reliability and operation of his process, and the critical machines pertaining to his process.
- **eZ-Balance** is used to balance rotating machinery with up to seven planes. A balance toolkit, including Split Weight calculations, supports the balance process. The balance vectors are displayed on a polar plot so the user has a visual indication of the improvement. Time and spectrum plots show detailed vibration measurement during the balance process.
- **eZ-NDT** package is exclusively used in production applications to determine the quality of composite-metal products at production rates of 1 part per second.



eZ-Analyst adds real-time continuous and transient data acquisition in the time, frequency, or order domain



View Time-Domain, Spectrum, Waterfall, and Trend simultaneously on one screen with eZ-TOMAS

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