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CASE STUDY:

Electrical Signature Analysis for Power Plant Pump Performance Assessment

One nuclear power generating facility, located in the Northeastern United States, relies on four vertical service water pumps to feed water to a heat exchanger which cools the sealed ultrapure water/steam that drives the turbine generators. Of the four identical service water pumps, all of which had 30-foot long shafts, two of the pumps began to exhibit some performance issues.

This motivated the maintenance team to conduct a performance study on their vertical service water pumps, which were quite old (they had been installed when the nuclear power generating plant had been built in the early 1970's). The nuclear power generating facility's maintenance team planned to analyze a number of measurements, including vibration, pressure, and flow. They also wanted to perform electrical signature analysis as part of the pump performance assessment, so they contacted Bob Dunn at I & E Central; a company known for providing on-site predictive maintenance services as well as distributing industrial test equipment for predictive maintenance (PdM), electrical and reliability professionals. In January 2016, Dunn went to the nuclear power plant to perform the electrical signature analysis on two of the 350-horsepower, 480-volt motors.

Performing the Electrical Signature Analysis

Electrical signature analysis is performed by connecting current sensors and voltage leads to the motor, and then capturing high resolution current and voltage wave forms, which can then be analyzed as FFT's as well as raw wave form data. The resulting data gives insight into the entire motor system, both mechanically and electrically, from the incoming power through the driven load. This technology actually uses the motor as a transducer for the mechanical analysis. Any mechanical phenomena will be modulated onto the current waveform where they can be detected and analyzed. Dunn used the ALL-TEST Pro On line II™ energized motor testing instrument to perform the electrical signature analysis. He connected the ATPOLII™ to the system, which was set to a flowrate of 5600GPM for the test. The motor terminal box was kept opened for the test, and the ATPOL II™ data collector was placed near the motor. The ATPOL II™ collected and transmitted the data via Bluetooth while Dunn and the maintenance team were positioned a safe distance away from the high voltage equipment.

"The ATPOLII™ collected & transmitted the data via Bluetooth while Dunn & the Maintenance team were positioned a safe distance away from the high voltage equipment."

The electrical signature data was collected in two segments: a high resolution low fmax (100 Hz) current acquisition of 50 seconds which primarily shows issues at running speed (misalignment,unbalance), and below the synchronous speed (rotor bar or load related issues).

A high frequency capture and FFT of both voltage and current which shows:

1. Electrical issues including power harmonics, power factor issues, voltage and current versus name plate and balance;

2. High frequency mechanical faults (stator mechanical and electrical issues, airgap,and even bearing issues.

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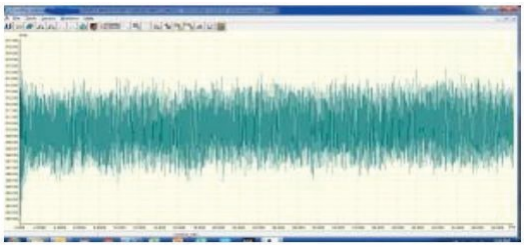
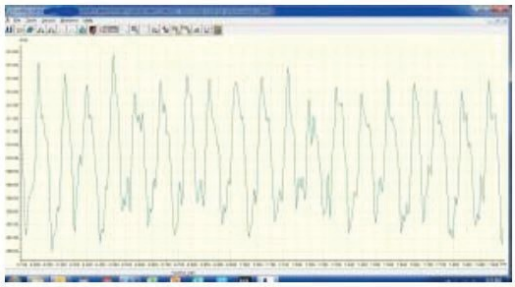
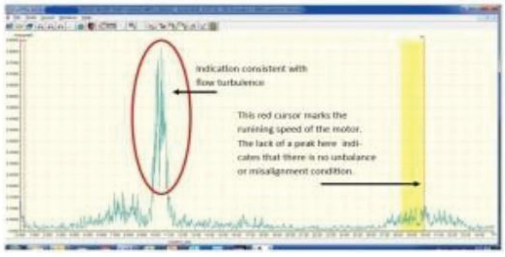


Above is a raw waveform of the current acquisition over 50 seconds. You can see the variation, in this case between about 306 and 313 amps.



This is an expanded view showing about 2 seconds of the waveform, the pulsations can be clearly seen.



This is an FFT of the demodulated current spectrum where the pulsation is shown as a broad peak around 10 HZ. This is a typical indication of turbulent flow.

Test Results Revealed

- The motor was electrically perfect with balanced current and voltage, and 90+ power factor.
- The motor and pump were mechanically excellent with no indications of misalignment or unbalance, bearing issues, rotor,or stator issues.
- Tests showed a significant fluctuation in the current draw, pulsing at about 10 Hz. Dunn and the team collectively determined that this was caused by non-laminar flow, or **turbulence in the system.**

The indication of turbulence on the two under-performing vertical service water pumps was a revelation; and what was more surprising to the maintenance team was that the turbulence had not been detected with any of the other tests. **It was only the Electrical Signature Analysis that had revealed the underlying cause of poor pump performance.**

One of the key benefits of Electrical Signature Analysis is that it can show mechanical issues in the driven load –even in the case of this vertical pump with the impeller 30 feet below. This is in addition to detailed information on the entire system, both electrical and mechanical. Once the maintenance team understood the root cause of the performance issues, they were able to take the necessary steps to remedy the situation and get the pumps operating to the nuclear power plant's performance requirements.

Lessons Learned

Predictive Maintenance is important.

Monitoring your industrial equipment and evaluating performance issues before catastrophic failure occurs can save your operation from costly downtime and unwanted expenses.

If you are responsible for critical motor-driven assets, the ATPOLII™ is a powerful monitoring and diagnostics this case study shows, the ATPOLII™ is a great companion when taking vibration measurements. Performing Electrical Signature Analysis along with Vibration Analysis can provide a more in-depth look at what is really going on with your equipment. Making sure you have the proper tools to perform these kinds of analyses is critical to any Condition-Based Maintenance/ Predictive Maintenance program.

Safety is Key! Energized testing using the handheld ALL-TEST PRO On-Line II™instrument offers more safety because it is designed with wireless Bluetooth* technology, allowing operators to stay a safe distance away from energized equipment. ALL-SAFE PRO® connection boxes can also be installed to further increase operator safety during the data collection process. Invest in the tools needed to keep people safe.

About ALL-TEST Pro, LLC

ALL-TEST Pro delivers on the promise of true motor maintenance and trouble shooting, with innovative diagnostic tools, software, and support the enable you to keep your business running.

About I & ECentral

I&E Central, which was founded by Bob Dunn in 2001, is a distributor of industrial test equipment specifically designed for predictive maintenance (PdM), electrical and reliability professionals. Based near Rochester, NewYork, I&E Central represents several reputable manufacturers and offers products to support power quality monitoring, vibration monitoring, ultrasound testing, motor testing, laser alignment, thermal imaging and more. Learn more about their range of products and services by visiting www.ie-central.com.

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