Motor PDM

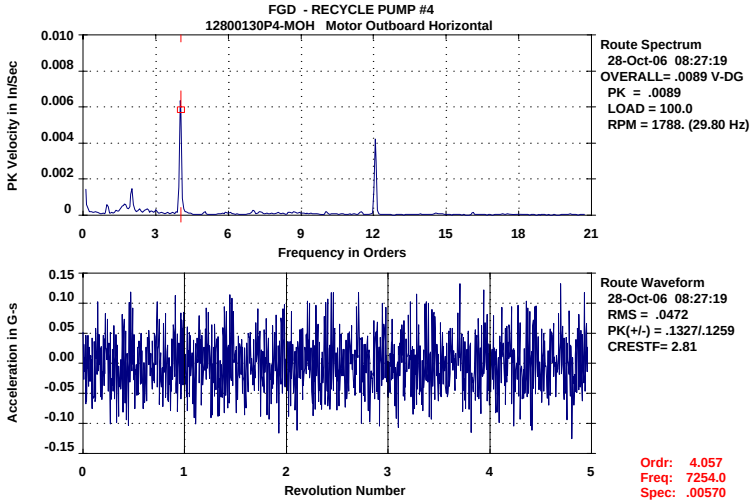
250 Horsepower, 1000 Horsepower, 18,000 Horsepower, there are some very large motors driving critical equipment at large electrical generating stations and keeping them reliable and operating efficiently is one of the key goals of any Predictive Maintenance (PDM) group. To do this PDM personnel routinely collect vibration signatures, waveforms and other data. They also collect oil samples, monitor EMI levels and listen and look for problems with Ultrasonic Acoustics and Infrared Thermography respectively. Not performing all of these tasks can lead to an unexpected failure and an equipment outage or in the worst case a unit outage.

Have a Reliability Basis plan … Determining the best method of monitoring motor performance must start with a Reliability Basis. Deciding what technologies to apply, how, when and by whom establishes the criteria needed for motor reliability.

Vibration Routes … Collecting useful vibration spectrums, waveforms and overall levels is the cornerstone of all motor PDM. How that is done is where things often get confusing. The frequency of data collection is based upon the Reliability Basis but a general rule is that periodic route data should be collected on critical motors at least once per month and non-critical ones every three months. However, if there is a upward trend of the vibration amplitude, data should be collected more often.

The type of data collected should be limited to overall vibration amplitudes in velocity, frequency spectrums that extend from zero cycles per minute (cpm) to a level two and half times the higher of the rotor bar pass or bearing frequency. A medium resolution of 800 or 1600 lines should be used to speed up data collection. Since the current data collectors in use can collect waveform data while collecting spectrums it should also be recorded. A must for proper motor PDM is the trending of vibration levels, so always make sure trend data is stored in the data collector.

If there is an increase in vibrations or some other indication of a problem through band alarms (such as an alarm for a frequency related to broken rotor bars) additional diagnostic data will need to be collected. Special vibration analysis techniques like 'phase analysis', 'high frequency scans', 'impact tests' or many others will need to be performed to identify the most likely source of vibration. This should be done separate from the periodic route data and applied according to the suspected problem. Route data provides only a small picture of what is going on inside a motor and these special tests can pinpoint problems if applied by trained PDM personnel.



Vibration Spectrum and Waveform

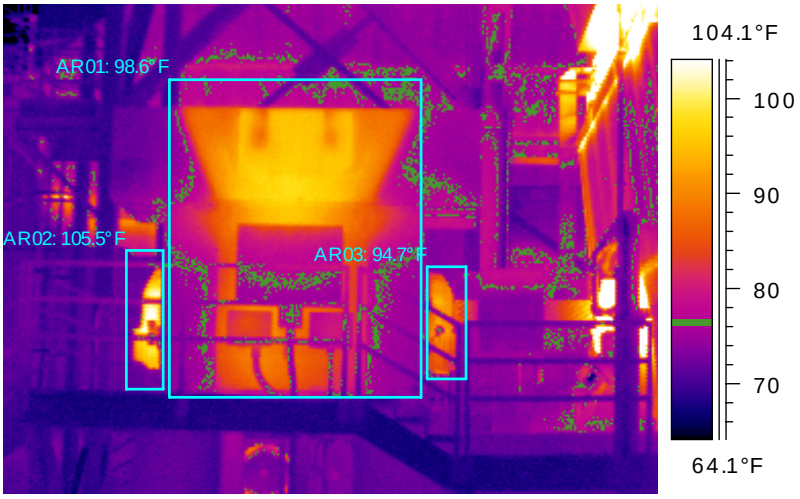
Oil Sampling and Analysis … Sampling and analysis of the motor bearings lubricating oil can be the first indicator of a bearing problem. Numerous organizations such as IEEE and EPRI have conducted studies to determine the most common cause for motor failures and one of the top causes is bearing failure. For bearing failures, one of the most common (if not the most) causes of bearing failures is "Improper Lubrication". This can be from lack of lubrication, using the wrong oil or grease, contamination from dirt or water or many other issues that lead to premature bearing failure.

Oil sampling and analysis should be performed with the same diligence as vibration data and on a similar schedule (once per month for critical motors and once every 3 months for non-critical ones). Samples must be collected properly and ASTM D6224-02 "Standard

Practice for In-Service Monitoring of Lubricating Oil for Auxiliary Power Plant Equipment" is a good reference document. Another source of information for oil PDM is EPRI 1004384 "Lube Oil Predictive Maintenance, Handling and Quality Assurance Guideline"

Oil Analysis is one of the earliest indicators of bearing problems and keeping a motor's lubrication in good shape will improve reliability dramatically.

Infrared Thermography … Performing routine IR scans on motors can benefit reliability by identifying hot electrical connections at the motor termination, hot bearings, and even plugged air filters. Stator problems and circulating currents heating the motor housing can also be detected with IR. Critical motors should be scanned every quarter and non-critical ones at least twice per year. Motors in dirty environments such as pulverizer motors may need to be scanned once per month. Determining the temperature of the air leaving a motor with filters on the cooling air inlets is a good way to detect plugged filters.



Ultrasonic Acoustics … Listening to a motor is always a good idea but in PDM one does not listen with human ears only but with Ultrasonic Acoustic ears. UA will hear items such as poorly lubricates roller bearings, electrical sparking, rubs or even loose parts such as stator windings.

UA surveys should be performed once every month for critical motors and quarterly for non-critical ones.

Adding grease to motor bearings with antifriction roller bearings should always be done while monitoring the ultrasonic sound of the bearings. By doing this the proper amount of lubricant is almost always applied.

Motor Testing and Evaluation … There are numerous non-PDM types of motor tests that can be performed and are documented in Circular Letter EL-M-CL-020B "Motor Testing and Evaluation Program". The main PDM motor test currently used is one that employs EMI to scan for problems. EMI stands for "Electro-Magnetic Interference" and detects micro-sparking that occurs when electrical insulation begins to breakdown in the windings. EMI can also detect micro-sparking that occurs from problems such as excessive bearings clearances, coupling misalignment, eddy currents and several other common problems.

Much like other PDM technologies, motor tests should be conducted according to a routine schedule and trended accordingly.

In Conclusion … Motor PDM is essential for plant reliability and only by developing a comprehensive plan to make sure all possible failure modes are checked on a routine basis will improved reliability be obtained. The first step is to determine the Reliability Basis for each motor and what technologies are going to be applied. Once the RB is determined all the tasks defined must be applied by qualified personnel and acted upon accordingly.

Knowing and documenting the condition of plant motors is the goal of motor PDM. Once the motor condition is known, maintenance becomes easier and reliability improves due to better planning and maintenance implementation.