Prasentia™ Condition-Based Monitoring

VIBRO-IC Installation Case Study & Cost Benefit Analysis

Palm Springs, California

based on SCHENCK Balancing & Diagnostic Systems technology

PRASENTIA AND SCHENCK HAVE PARTNERED IN THE DEVELOPMENT OF DIRECT INTERFACE CAPABILITIES BETWEEN SCHENCK'S *VIBRO-IC CONDITION-BASED MONITORING* EQUIPMENT AND THE PRASENTIA SCADA AND RT-WPPM APPLICATIONS. THE INTERFACE CAPABILITIES ARE MADE POSSIBLE THROUGH THE VIBRO-IC EQUIPMENT, WHICH CAN BE INSTALLED ON ANY WIND TURBINE TECHNOLOGY, AND ALLOW THE OWNER/OPERATOR TO PROACTIVELY MEASURE VIBRATION SIGNATURES OF MAJOR COMPONENTS. IN THE SUMMER OF 2003, A COOPERATIVE PILOT STUDY OF THE INSTALLED CBM TOOL BEGAN AT A WIND FARM IN PALM SPRINGS, CALIFORNIA, THAT UTILIZED NEG MICON 700KW TECHNOLOGY.

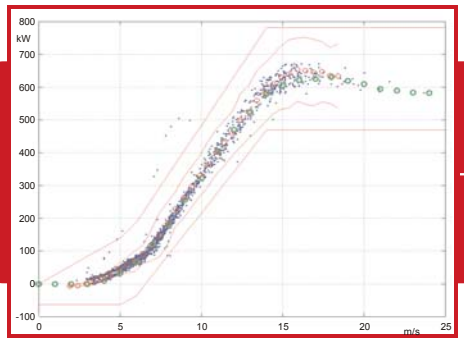


Chart indicates Average Values vs. Wind Speed, Calculation of Standard Deviation, Generation of Alarm Bands, and Monitoring "in Band"

The VIBRO-IC puts proactive control in the hands of project owners and operators by providing the tools needed to effectively monitor the condition of their wind energy assets.

THE BENEFITS.

The VIBRO-IC Condition-Based Monitoring (CBM) equipment allows project owners and operators to see in near real time any upward trend in vibration levels that can potentially lead to excessive wear and tear or damage to expensive components. The CBM service has significant advantages, including the potential to reduce maintenance costs for project owners, aid in keeping turbines operating at peak performance modes, and avoidance of unscheduled down-time.

THE PROCESS.

The installation of the VIBRO-IC CBM equipment entailed the strategic placing of vibration sensors on major components, such as the main bearing, the gearbox and the generator, so that the vibration signatures could be tracked and monitored. Once the sensors were in place, VIBRO-IC acquired all condition parameters of the turbines, including mechanical vibrations, bearing conditions, speed, and other process values and binary status signals. In order to distinguish between "good" and "bad" vibrations, VIBRO-IC correlated the vibration readings with operation data such as wind speed, power, and rotational speed. These values were continuously monitored and compared against pre-set limit values and 'learned' values. If these values were exceeded, alarms were generated in the SCADA system. Any values that fell outside the band, as shown in the chart above, caused these alarms and provided early warning signals that could then be addressed proactively.

THE RESULTS

Observation #1: Indication of Potential Misalignment Problem

In the case of the first observation, it was discovered that the difference between harmonic vibration values of the drive end generator bearing, when compared to a second set of harmonic values, was high enough to be indicative of an alignment issue. Initial observations revealed that an axial alignment check needed to be performed. The axial alignment check discovered that the misalignment was at a higher than acceptable tolerance. Once maintenance work was completed to correct the axial misalignment, the second harmonic vibration data was reduced by nearly 25%. A noticeable drop in the overall drive end generator was also observed once the realignment of the generator was implemented. *Reference Figures 1 and 2.*

Figure 1: Vibration amplitudes for first harmonics of drive end generator bearing.

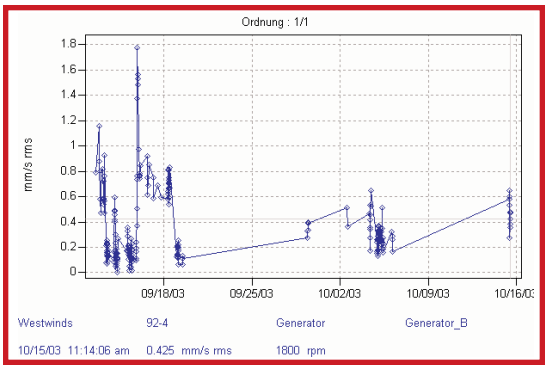
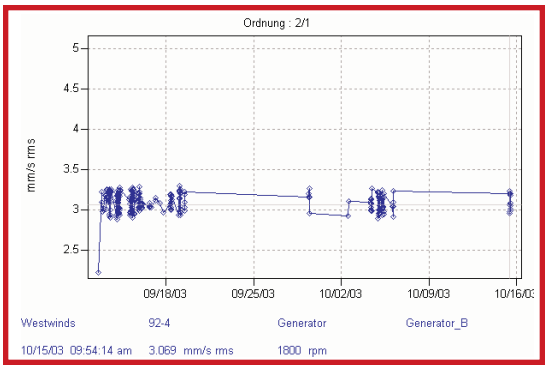


Figure 2: Vibration amplitudes for second harmonics of drive end generator bearing.



Observation #2: Decreased Vibration in Bearing Condition Unit
In the second observation, a noticeable drop in the Bearing Condition Unit (BCU) values were discovered. The BCU represents the energy of shock pulses coming from rolling element bearings, and is a good indicator of the bearing condition. The drop in values, which occurred on the non-drive end generator bearing, coincided with scheduled maintenance that included lubrication of the generator bearings. With the correct values now established, CBM can easily notice and communicate any upward trends.

COST BENEFIT ANALYSIS

Although excessive vibration may not cause a failure, it would likely cause damage to expensive components and lead to high maintenance costs. For example, replacement of a gearbox could cost over $50,000, and replacement of a generator as much as $40,000. It is clear that monitoring of vibration levels on these major components reduces the risk of damage and leads to substantial cost savings.

The analysis undertaken in this case study included such factors as average downtime, average lost production, average lost revenue, cost of components, replacement costs, applied over the number of turbines, component failures and timescale of five years. Based on the indicative results of the study, when applied across a utility-scale project, installation of the CBM system could potentially save project owners hundreds of thousands of dollars. The investment of the VIBRO-IC system, based on this specific case study, represented approximately 2% of the cost savings.

CONCLUSION

Although it may not always prevent a failure, the advance notification of excessive wear and tear by the intelligent CBM tool could potentially save replacement of a gearbox or generator worth in the range of $50,000, and in a worse-case scenario, prevent a catastrophic failure.

Other potential benefits include:
-- Limiting collateral damage
-- Reduce inventory carrying costs
-- Limit replacement costs by optimizing crane use and maintenance resources

ABOUT THE PROVIDERS

Schenck-USA. Schenck has been dedicated to rotor performance since 1881, and is recognized today as the world's largest manufacturer of dynamic balancing equipment. Schenck offers a complete line of balancing, vibration and performance test equipment for the production, maintenance and repair of rotating components.

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Prasentia. As a system integrator and service provider, Prasentia provides a wide range of wind power information services, including full turnkey services related to the specification, design, installation, service and post-installation customization of the Wind Power SCADA System. The Prasentia Wind Power SCADA System directly interfaces into its other Applications including the Real Time Power Portfolio Manager, Reporting and Data Analysis, Wind Power Production Forecasting Service, Computerized Maintenance Management System, and Comparative Performance Analyses.

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