RP 108 Wear Debris Collection and Analysis for Wind Turbine Gearboxes

Operations and Maintenance Recommended Practices

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Methods of Wear Debris Collection

The discovery and analysis of wear debris is very subjective across the industry. The debris itself is rarely collected for analysis. Other industries have successfully extracted debris for laboratory analysis from small filters or employed purpose-built filters with removable test patches and used the data to enhance predictive maintenance. Several limited options may currently be available on wind turbines. However, purpose-built debris traps will provide a more consistent, cost-effective CBM solution.

Oil sample
The periodic oil sample is an unreliable source for collecting wear debris due to variation in settling time for large particles and the short duration of the sample collection.

Magnet sweep of filter housing or sump

Stalin—Moller filter patch

One operator has successfully added test patches to a commonly used offline filtration system filter. The patches collect a representative portion of the debris collected in the filter. They are easily removed and sent to a laboratory for analysis.per

WDA Implementation for Gearbox CBM

A general guideline for implementing WDA by wind project owner and operators is provided in this section. Items listed under most of these steps are following a logical sequence for users of this RP to evaluate. Given the diverse nature of wind projects, it is not uncommon for WDA implementation to vary from one project to another.

Step 1: Gather information

- Identify and evaluate effectiveness of existing condition monitoring
    - o Supervisory control and data acquisition (e.g., chip detectors, filter bypass, and differential pressure)
    - o Filters (main or sidestream) and magnets
    - o Online wear debris monitoring
- Gearbox history by make and model
    - o Failure modes, age, wind regime, oil condition history (e.g., International Organization for Standardization particle count cleanliness, water, and metals)
- CBM budget

Step 2: Scope WDA program within budget, need, and entire oil condition monitoring program

Option 1 Additional analysis of debris suspended in periodic oil sample ($50-$150 semiannual analysis)

- o Ferrography, wear debris count, chemical elemental
- o Understand limits, especially eight micron particle size limit for chemical elemental analysis

Option 2 WDA, offline ($0-$250 hardware, $75-$500 semiannual samples)

- o Review hardware options to trap particles over a periodic operating interval (e.g., 6 months)
- o Select laboratory, identify analysis methods, determine costs

Option 3 Online wear debris monitor ($3,000-$10,000 hardware plus monitoring costs)

- o Consider installing online wear debris monitor hardware on turbines that have been selected based on WDA warnings, versus installing on all turbines, which may reduce large capital expenditures
- o Support online data with hard evidence from more sophisticated WDA analysis

Step 3: Determine particle collection method