

Wind Turbine Performance Monitoring Automation and Implementation



Key Research Question

Wind turbine performance tracking practices are not standardized, nor is physical performance testing cost-effective to apply to each individual wind turbine. As the wind industry matures, utilities/operators are looking for cost effective methods for performance monitoring of their entire wind fleet.

The following are the key issues that operators have been trying to address to increase fleet power production.

- What are the data requirements and specifications for turbine performance monitoring?
- What are the best practices for turbine performance monitoring that can be used on an entire wind fleet?
- How are my turbines performing vs. expectations?
- How can I quantify the impact of software/hardware upgrades on individual turbine performance?

Objective

The goal of this project is to improve wind turbine production and reduce operation and maintenance (O&M) costs through automation and implementation of performance monitoring methods and techniques outlined in EPRI Report 3002016451 "Wind Turbine Performance Monitoring Methods Development and Demonstration". This work includes:

- Conducting onsite and remote technology transfer sessions for successful performance monitoring implementation

- Digitalization of wind assets for effective monitoring to increase revenue and reduce operation and maintenance (O&M) costs
- Performance analytics automation to monitor entire wind fleet
- Identification and prioritization of turbines to address underperformance issues promptly

- Automating performance monitoring methods
- Implementing turbine performance analytical methods to monitor wind fleet.

Approach

The project transfers the necessary information and expertise to implement performance analytical techniques for effective monitoring of a wind turbine fleet. This includes the following three tasks:

Task 1: Data Specifications, Filtering, and Quality Assurance

Review key data collection and filtering needed for digitalization of wind assets to conduct accurate performance monitoring. Review funder's data streaming process and the typical 10-minute SCADA, met tower data, site data, and fault/alarm events that are mandatory inputs for performance analytics. O&M events data will be used to track the turbine health and maintenance activities and troubleshoot any performance changes.

Task 2: Performance Monitoring Automation and Implementation

Analytical methods will be applied to a clean data set from Task 1 at both macro and micro level to demonstrate how performance monitoring can be implemented to identify and address turbine issues.

Participants should expect to appoint a performance engineer, data analyst, or digital tools developer to participate with EPRI staff.

Macro-level analysis assists in selecting and prioritizing turbines to address underperformance issues. This analysis is based on turbine production and energy variations to identify changes in turbine production with respect to neighboring turbines.

An in-detail micro-level analysis identifies the reason for performance issues specific to an individual turbine. This assessment includes nacelle anemometer and meteorological (met) mast power curves, pitch/yaw analysis, power coefficient (C_p) analysis, tip-speed ratio (TSR) analysis, and alarm/fault analysis.

Effectiveness of performance monitoring will be demonstrated by implementing macro and micro analysis on a funder selected wind farm.

After completion of task 2, funders can conduct macro and micro-level analysis on a daily/weekly/monthly basis or as needed to identify and fix their fleet and individual turbine performance issues.

Task 3: Collaboration and Results Review

The final task will be a collaborative meeting to share and discuss lessons learned from Task 1 and 2.

Research Value

Detailed review of wind farms can uncover opportunities to optimize operation and performance. Additionally, turbine underperformance may be associated with mechanical issues such as pitch/yaw misalignment that could impact component life and O&M costs. Wind turbine performance analysis provides the following benefits:

- Immediate increase in wind fleet production
- Early detection of performance shortfalls from wind turbine monitoring and diagnostics (M&D) centers
- Identify and Validate O&M actions and performance improvements

Deliverables

Participants will receive performance monitoring automation code and sample analysis techniques for the funder to implement with EPRI assistance in their own choice of systems or languages. The sample code includes performance monitoring data filtering, and macro and micro analysis.

Price of Project

The cost of this project is \$60,000 per participant. This project qualifies for Tailored Collaboration (TC) and Self-Directed Funding (SDF).

Project Schedule

Task No.	Description	Est. Schedule
1	Data specifications, filtering and quality assurance	2-3 months from kickoff
2	Performance monitoring automation and implementation	4 to 8 months from kickoff
3	Collaboration and results review	12 months from kickoff

Who Should Join

Utilities and companies that own/operate wind farms with a desire to improve production and reduce O&M costs could benefit from participation in this project.

Contact Information

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).

Technical Contact

Raja V. Pulikollu at 704.533.0468 (rpulikollu@epri.com)
Brandon Fitchett at 704.595.2047 (bfitchett@epri.com)

EPRI

3420 Hillview Avenue, Palo Alto, California 94304-1338 • USA • 800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com

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