UptimeAI

CASE STUDY

CUSTOMER PROFILE

Industry:
Onshore Wind Energy

Asset Type
2 MW Inox turbine generator

Tags Correlated
Bearing temp, vibration, generator speed, rotor speed, active/reactive power

Energy Preserved
169 MWh

Downtime Avoided
151 hours

WIND OPERATOR PREVENTS GENERATOR BEARING FAILURE AND UNCOVERS HIDDEN ENCODER FAULT COSTING 169 MWH

Threshold detection alone failed to explain why the turbine was quietly underperforming compared to the rest of the fleet.

Wind Energy's Margin Is Made or Lost Between "Available" and "Performing"

Wind operators manage fleets of hundreds of turbines spread across remote sites, each generating revenue under fixed-price PPA contracts. The economics for renewables is: every MWh you say you will produce is the revenue you'll achieve, when delivering on the commitment. There's no spot market upside to compensate—the margin between profitable and unprofitable operation is built into how well you maintain generation output against the contracted schedule.

The industry has gotten good at tracking availability. If a turbine trips, SCADA logs it, a work order is created, a crew is dispatched. That's a solved workflow. The harder problem is the turbine that never trips but quietly underperforms—generating less than it should for the available wind, bleeding MWh over weeks or months without triggering a single alarm. In a fleet of 50 or 100 machines, these silent losses compound into material PPA shortfalls that only show up in monthly generation reports, long after the window to intervene has passed.

One Turbine, Two Faults, But Only One Was Visible

On a 2 MW turbine, NDE bearing temperature began climbing to more than 20°C above its normal range. Vibration rose to more than double baseline levels. That's a developing bearing fault. Any threshold monitoring solution would eventually flag it.

But there was a second problem. This turbine's generator speed was consistently lower than comparable units in the fleet. Active power was below expected for wind conditions. Reactive power was swinging. Over three days the turbine lost nearly 20 MWh—while remaining online and technically "available." No alarm fired for this. The turbine never tripped. It was just running below its potential.

When the field team investigated, they found roller-element wear in the NDE bearing, a misaligned speed encoder feeding incorrect RPM to the controller, and heat-damaged cable insulation near the bearing. The encoder misalignment meant pitch regulation and torque control were operating on bad speed data—the turbine couldn't optimize for the wind it was receiving. The cable damage was secondary, caused by sustained bearing heat.

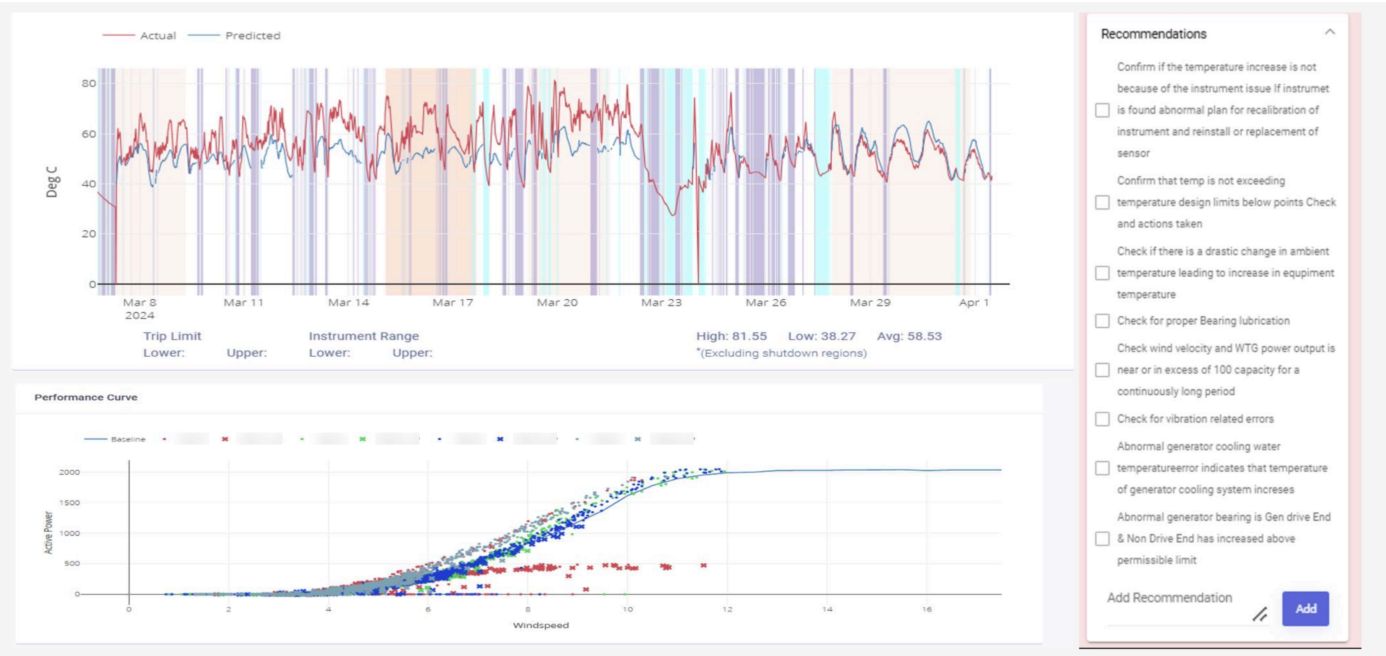
Evaluating the Turbine as a Connected System, Not Isolated Alarms

UptimeAI monitors across the full turbine signature—bearing temperatures, vibration, generator and rotor speed, active and reactive power—building a baseline across different load and wind profiles. When one parameter deviates, it's evaluated against everything else on the machine. A bearing running hot while the rest of the turbine behaves normally is a different diagnosis than a bearing running hot while generation is simultaneously underperforming.

CASE STUDY

The Catch: One Alert Surfaced Both the Bearing Fault and the Hidden Encoder Problem

UptimeAI correlated bearing temperature and vibration with generator speed, active power, and reactive power—and flagged that the performance deviation couldn't be explained by the bearing alone.



The alert also surfaced that generator speed was lagging the fleet and reactive power was unstable, pointing beyond a mechanical bearing issue to a control-path fault affecting how the turbine was regulating itself. Inspection confirmed both faults. The bearing was replaced, the insulation repaired, and the encoder realigned during a planned outage window. By a week later: temperature was back within normal range, vibration returned to baseline, and generation was at a comparable output to the rest of the fleet.

From Silent Underperformance to Measurable Recovery

Mitigate Risks Linked To Asset Performance

Quantifiable Gains

- 169 MWh of clean energy generation preserved
- 151 hours of unplanned downtime avoided
- $10-15k USD in PPA revenue protected
- Secondary drivetrain damage prevented

Operational Shift

- Turbine health and generation performance now evaluated together meant bearing faults and control-path faults surfaced in a single investigation
- Hidden encoder misalignment identified that was eroding output without triggering any SCADA alarm
- Unplanned trip converted to planned maintenance, protecting PPA availability commitments

What's Next?

The operator is extending fleet-level monitoring to close the gap between "available" and "high-performing"—catching the generation losses that accumulate across dozens of turbines running but not running right.

About UptimeAI

UptimeAI provides AI reasoning agents that help industrial operations teams make goal-oriented, real-time optimal decisions. Our solutions achieve 90%+ pilot-to-production success rates and are trusted by leading companies in cement, oil & gas, power generation, chemicals, and metals industries. Backed by industry leaders including ABB, Yokogawa, and Mitsubishi.

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