PO.193

From Early Warning to Targeted Inspections : A Before-During-After Framework for Lightning risk Management in Wind O&M

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METEORAGE

A structured approach to lightning risk management in wind operations, integrating early warning, real-time tracking, and targeted inspections to drive operational decisions and enhance safety.

ABSTRACT

Lightning is a major source of turbine damage, with ~80% of insured failures attributed to lightning (Arboleda et al., 2003). Its intermittent and localized nature complicates operational decisions. This poster presents a standards-based before–during–after framework, currently applied across European fleets and covering several thousand wind turbines. It enhances anticipation, improves lightning event characterisation, and supports more targeted post-event inspections.

LEARNING OBJECTIVES. How to :

- Anticipate thunderstorms using 48 h forecasts and Thunderstorm Warning Systems with up to 1 h of lead time.
- Assess storm severity and movement to adapt operational procedures.
- Trigger targeted post-event inspections through multi-criteria lightning analysis.

METHODOLOGY:

A standards-based "before–during–after" approach (IEC 62793/62858/61400-24/62305):

Before — Early Warning : High Probability of Detection (POD) supports proactive crew protection and reduces downtime.

During — Real-Time Tracking : Lightning-jump detection highlights storm intensification, helping adjust operational decisions.

After — Targeted Inspection : Multi-criteria thresholds (proximity, strike density, peak current) help prioritise inspections and focus efforts where they matter.

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Illustration : From facing lightning risk to mastering it

RESULTS & OPERATIONAL IMPACT:

Application of this framework across European wind farms has shown:

- **Reduced personnel and asset exposure** through earlier anticipation.
- **Higher inspection relevance** through objective prioritisation and clearer discrimination between severe and non-critical lightning events.
- **Improved traceability** supporting regulatory and insurance requirements.
- **Support to asset lifetime extension** by reducing undetected lightning-related degradation.

CONCLUSIONS:

A structured lightning risk framework strengthens safety culture, optimizes inspections, improves documentation, and supports long-term asset integrity. By reducing undetected lightning-related degradation, it also contributes to the lifetime extension strategies increasingly adopted across the industry. Future work will address upward lightning and develop probabilistic models to refine inspection decision-making.

REFERENCES

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