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TRACK: TECHNICAL TOPIC: Operation & maintenance

DERIVATION OF WIND TURBINE RELIABILITY PROFILES FROM OPERATIONAL DATA

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The paper describes the derivation of Reliability Profiles, showing failure rate and downtime for each wind turbine subassembly. Historical operational data available to wind farm operators include 10-minute SCADA, automated faultlogs and O&M reports. Processes have been developed to link these discrete and diverse data formats. The results allow the comparison between wind turbine subassemblies and, as more data is added, will permit wind farm operators to compare their machines against others of a similar type. The Reliability Profiles have also been used to validate a Failure Modes and Effects Analysis (FMEA) of a generic 2MW wind turbine.

This paper describes initial work undertaken as part of the Reliawind project, which is a European Union 7th Framework Integrated Project with an overall budget of ?7.7M, involving 10 industrial and academic partners. Reliawind has the aim of identifying and understanding critical failures and their mechanisms. The results will be used to improve turbine reliability through design for reliability and targeted condition monitoring.

The first stage of this work is a field study to measure the reliability of existing wind turbines at several operational wind farms. As part of this study, wind farm operators have provided historical data including 10-minute SCADA data, automated fault-logs and O&M reports from operational wind farms representative of those currently installed. These sources are discrete and often of varying quality, but the authors have developed systematic and consistent processes to connect these data.

The Reliawind project has developed a standard description of the structure of a wind turbine to assign each part to a subassembly, assembly and subsystem. A standard database format with a number of tables has also been developed. Events identified in the field study with a downtime greater than 1 hour and requiring at least a manual restart have been assigned to the relevant subassembly or part where possible. The database can be queried to derive Reliability Profiles showing downtime and failure rate for each subassembly.

The Reliability Profiles are of benefit to operators as they allow the comparison of their machines against a generic wind farm. As more data is added more detailed comparisons could be made.

Reliability Profiles, in an anonymous form, can also be used for wider reliability work. The second stage of Reliawind is focused on understanding failures and their mechanisms and as part of this work, a Failure Modes and Effects Analysis (FMEA) of a generic 2MW wind turbine has been developed. FMEA is widely used in other industries, but there is little experience in the wind industry, so it is important to validate the results. Therefore anonymised Reliability Profiles have been used to give the FMEA a firm basis in real operational data. In further stages of Reliawind the results will be used to demonstrate the cost effectiveness of design for reliability and design for maintainability.

The paper describes the methodology for deriving Reliability Profiles and shows how the results are of use to wind farm operators and wider reliability work.