

Site specific Conditions for wind ENergy risk reduCtion

Publieke samenvatting / Public summary

Aanleiding

The development of a wind project requires the knowledge of wind and weather conditions at the wind farm site, and preferably for each wind turbine location. This is important during project development, project realization and operation of the wind farm. The developer evaluates the performance and long term failure mode risks in order to estimate 1. the AEP and 2. the O&M strategy with associated costs and down-time in order to create a positive business case. The selected wind turbine supplier (an OEM) will 3. assess the risks associated to the supply of their product. These risks can be related to (high) loads and also to failures from e.g. lightning or erosion. For all three purposes, knowledge of the precise conditions at the wind turbine locations is key. Currently, these conditions are only known with relatively large uncertainties which can lead to conservative or inaccurate risk assessments and bloated project cost estimates. In this project a radically new approach is developed leading to a much smaller uncertainty in site assessment leading to a more accurate risk assessment, more site specific development and lower chances of failure.

Doelstelling

The overall goal of the project is to significantly increase the fidelity of site specific assessments for wind energy projects so that the risks and eventually costs for OEM's and developers are reduced. The main result is a methodology built around the Large Eddy Simulation (LES) tool GRASP

Projectinformatie / Project information

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Algemene informatie / General information

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developed by Whiffle and complemented by supporting tools like an aero-elastic design code and weather models with which a complete map of meteorological conditions and turbine response is generated for the assessment of performance and environmental and aero-elastic risks at the precise location of the wind energy project (and turbines). The methodology is demonstrated through case studies and where possible results are compared with measurements.

Korte omschrijving

Development of innovative methodology for high fidelity site specific aeroelastic risk assessment. High fidelity LES simulations will be used to downscale ERA5 input and identify site specific aero-elastic risk factors like wind speeds, turbulence levels etc. Site specific load cases will be defined to determine design, extreme and fatigue loads for the chosen project site. Development of innovative methodology for high fidelity site specific environmental risk assessment. The LES tool will be extended to include modelling of environmental factors like rain, lightning, icing which will be used to further improve the risk assessment of the site. Joint pdfs of weather events will be computed to identify risks that cannot be modelled directly, for instance combination of high wind speeds and rain can be used to determine risk of erosion. Demonstrate and improve the added value of site specific aeroelastic and environmental risk assessment. Case studies will be carried out to validate the new methodology, gather feedback from partners and where possible make comparisons against measured data.

Resultaat

The main result of the project is a methodology for high fidelity wind farm site assessment built around the Large Eddy Simulation tool GRASP extended with a module to estimate environmental conditions. For the farm site, environmental conditions and turbine responses will be calculated using long term high fidelity LES simulations combined with an aero-elastic design code. These results can be used for the assessment of

performance and environmental and aero-elastic risks at the very precise location of the wind energy project over its entire life time. The project leads to a service based on this methodology, available as a toolbox which consists of the extended GRASP tool (offered by Whiffle) for the prediction of environmental parameters linked to the in-house aero-elastic tools of TNO and GE. The toolbox will have several supporting tools for pre- and postprocessing as well as interfacing. The service is demonstrated through case studies which also assess the potential of risk mitigation measures (e.g. through control actions or add-ons).

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.

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