Reduction of Uncertainties in Wave load design offshore foundations (Runwave)

Publieke samenvatting / Public summary

Aanleiding

The design process for Offshore Wind Turbines (OWT) comprises to a substantial part on the consideration of wave loads resulting from extreme or moderate sea states. The loading as well as the structural response leads to substantial forces on the foundation, turbine tower and nacelle over the structure lifetime. In the current design workflow, the determination of design loads consists of individual steps each subjected to various uncertainties. The accumulation of these uncertainties can lead to a higher uncertainty in the design and subsequently longer downtime due to a narrower operational window and increased maintenance costs or increased design/installation costs for the industry. In addition, new designs or new types of monopiles will further increase uncertainties as knowledge on the impact of these trends on the wave load is still in development.

Doelstelling

The objective of the Joint Industry Project RUNWAVE is to define new design workflows for wave loads and/or structural response from extreme and fatigue sea states on bottom fixed offshore wind turbines, thereby limiting the accumulation of (conservative) design choices and more explicit quantification and handling of uncertainties. For this purpose, the current purely deterministic design workflows will be extended by a probabilistic model to a new design workflow, in which wave loads can be associated to a probability of occurrence for a specific location taking local environmental and hydrodynamic

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conditions into account. Decreased uncertainty on the probability of occurrence for wave loads during the lifetime of a structure can extend the threshold of operation for energy production of a windfarm and, thus, increase the annual energy production per windfarm. Further, a better understanding on the wave loading and induced structural response for larger monopile diameters and/or water depths will help during the design stage to optimise the steel element design for extreme limit states and fatigue loading. As a result, maintenance costs over the structure lifetime can be reduced.

Korte omschrijving

At the start of the project, the current design workflows for wave load design and structural response, as well as the state of the art will be investigated to identify and prioritize the uncertainties within the individual steps of the workflows. As a result, the individual steps and uncertainties will be utilized to determine probabilistic properties, which will be used to develop a probabilistic model concept. The probabilistic model concept will consist of building blocks, which provide the basis to associate the resulting design load of the workflow with a probability of occurrence. Subsequently, physical model tests and numerical simulations will be conducted to investigate wave loads on an OWT and the structural response of an OWT. The data generated with the physical tests and numerical simulations will be applied to develop new or update existing design formulations, provide statistical background for the probabilistic properties and their correlation and provide a basis for validation of the probabilistic model concept and design workflows. In a last step, all gained information will be combined to new design workflows for wave loads and structural response.

Resultaat

The result of the RUNWAVE project will be new design workflows for wave loads and/or structural response from extreme and fatigue sea states on bottom fixed offshore wind turbines. These new workflows will include updated empirical

formulations for wave load/response determinations as well as a probabilistic framework to associate the wave load/response with a probability of occurrence. With the new workflows it will become possible, to optimise the design of a foundation and turbine towards a load/structural response with a specific probability of occurrence. This will significantly increase the certainty of the wave load design and mitigate risks evolving from uncertainty accumulation within the currently existing design workflow.

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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