DNV·GL

HOLLANDSE KUST (WEST) WIND FARM ZONE

Review of Geotechnical Report, Synthetic CPT Profiles

Netherlands Enterprise Agency

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Objective: To confirm that the synthetic CPT profiles report data carried out for Hollandse Kust (west) Wind Farm Zone can be used as input for design of future offshore wind farms.

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1 EXECUTIVE SUMMARY

The Hollandse Kust (west) Wind Farm Zone is located in the Dutch Sector of the North Sea, approximately 51 km from the coastline. As part of the tender preparations, the Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland, RVO) commissioned a geophysical site investigation and a geotechnical site investigation at site, including a geotechnical laboratory test program.
The gathered information was used to train a neural network model and predict synthetic CPT profiles between geotechnically investigated locations.

DNV GL was assigned to review the corresponding procedure, focussing on the results of the method and its possible use within a Design Basis for Offshore Wind Turbine Structures.

2 DOCUMENTATION FROM CUSTOMER

This review comprises the list of design documentation as well as comments and conclusion of the DNV GL evaluation.

Ref.	Document No.	Revision	Title
/1/	P904711/08	Issue 3 2020-10-14	Geotechnical Report, Synthetic CPT Profiles, Hollandse Kust (west) Wind Farm Zone, Dutch Sector, North Sea
/2/	-	-	RVO_HKW_20201015_FNLM_Synthetic_CPT_profiles_ DigitalDeliverables_V02-F

The documents have been reviewed and commented with DNV GL's VCS:

Ref.	Document No.	Revision	Title
/A/	HKW-DNVGL_644235-VCS-15	0 2020-09-10	Voxel CPT and GIS data

3 EVALUATION WORK

DNV GL have reviewed the documentation for the synthetic CPT profiles. Such synthetic CPTs are novel to the wind industry. As there are no codes and standards applicable for the development of synthetic CPTs the review is purely based on DNV GL's geotechnical expertise and experience in the design of offshore wind farms.

The following comments and main discussion results shall be seen as possibility for improvement as well as help to specify uncertainties within the design process when considering the use of synthetic CPTs.

DNV GL is of the opinion that the results presented tend to indicate that the model is capable of predicting CPT profiles at the measured locations. Our evaluation of the blind tests (i.e. comparison between field CPTs and synthetic CPTs) shows that a reasonably good best estimate for coarse soils can be determined with some exceptions, which may be critical for a detailed design. Compared to manual CPT evaluations and extrapolation to positions with no tests, it appears the method provides a significantly improved documentation as shown for the presented positions. However, at this stage the interpolation between the CPT locations and the site-specific geophysical survey can be used for forecasting purposes only.

The use of predicted CPTs in geotechnical practice is novel, the designer must achieve a cautious design approach, taking account of uncertainties. This needs to be considered for the specific project. The report gives insights of uncertainties that come with synthetic CPTs, these can be used as a starting point.

4 CONCLUSION

In summary, the development of synthetic CPTs by using machine learning is novel to the wind industry. In case synthetic CPTs shall be considered during the geotechnical design, its use is limited to cone resistance estimates of eventual turbine locations at the current state.
However, DNV GL anticipates the advantages mainly in tender estimates due to the flexibility of the system to account for changing wind farm layouts and the possibility to cover the complete designated Wind Farm Zone with foreseeable certainty.
DNV GL sees this cutting-edge development as a huge step forward in terms of project area overview with respect to geotechnical site conditions and also as a valuable tool to improve and understand the correlation between future geological, geophysical and geotechnical investigations.

The synthetic CPT profiles report /1/ can be used as background information to support the design basis for design of future offshore wind turbines in the project area.

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