Sizing Offshore Wind Substations for North American Storms

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Wave extreme values, such as significant wave height, peak period, and crest height, are central to design and operation practices for offshore wind structures. Accurately quantifying extreme wave parameters relies on representative ocean and atmospheric models of both normal and stormy conditions. This is particularly challenging in environments with mixed-type climates, as in the Atlantic coast of North America, where tropical cyclones (hurricanes) and extra-tropical cyclones (winter storms) occur at the same locations with varying frequency and intensity. Limited guidance is provided in major offshore wind energy standards for the minimum requirements of these ocean models and methods used for determining accurate design and operational metocean conditions for regions with tropical cyclones and mixed-type environments. Additionally, North-America-specific standards for adequate sizing of offshore substation (OSS) deck heights do not yet exist for the region, leaving designers and developers with a range of possible methods to choose for design certification.

Drawing on recently published work (*Quantifying Tropical Cyclone-Generated Waves in Extreme-Value-Derived Design for Offshore Wind*, Wind Energ. Sci., 2025), this study investigates the range of potential OSS design outcomes at a number of locations in North America, based on different models and standards. It provides recommendations on deck height sizing and highlights areas for future work to support safe and resilient development of the North American offshore wind industry.

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