Ice Accretion on Floating Offshore Wind Turbines

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Ice accretion on a floating wind turbine (FWT) is a complex process that includes sea-spray and atmospheric icing forming on the floater, tower, nacelle and blades. This has significant impacts on aerodynamics, structural stability, and operational viability. Our research is developing new predictive techniques and experimental data for FWTs operating in northern offshore locations. The results are providing new information on ice accretion’s impact on stability, providing new mitigation pathways, and supporting optimal designs. This will improve the safety of operation and maintenance for FWTs in Canada and abroad.

This presentation will provide key insights from our research on the complex interplay between icing phenomena and dynamic response of floating turbines. Unlike fixed-bottom installations, FWTs are highly sensitive to changes in mass distribution and center of gravity. Accretion on the floater, nacelle, tower and blades shifts the system's equilibrium, potentially compromising the hydrostatic stability of the platform. To develop solutions, our research team is experimentally examining the saline droplet transport, impingement and freezing processes in our lab facilities. Experiments are being conducted in a climatic wind chamber designed to simulate cold offshore environments. The airflow and droplet motion near the blade surface are measured using advanced optical techniques, allowing detailed characterization of droplet trajectories, impact and freezing. In parallel, numerical simulations are being conducted on FWTs to examine sea spray icing, including droplet impingement, heat transfer, freezing, and runoff for varying environmental conditions.

The results are providing new insights on the way wind speed, temperature, and spray characteristics influence ice accretion on floating wind turbines. This is important for developing more accurate prediction tools and reliable designs for cold offshore operation. This research is supported by Waterford Energy Services Inc (WESI), Natural Sciences and Engineering Research Council of Canada, and Mitacs.