DeepCwind CONSORTIUM

DeepCwind 1/50th Scale Floating Wind Turbine Model Testing Overview

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Research Motivation

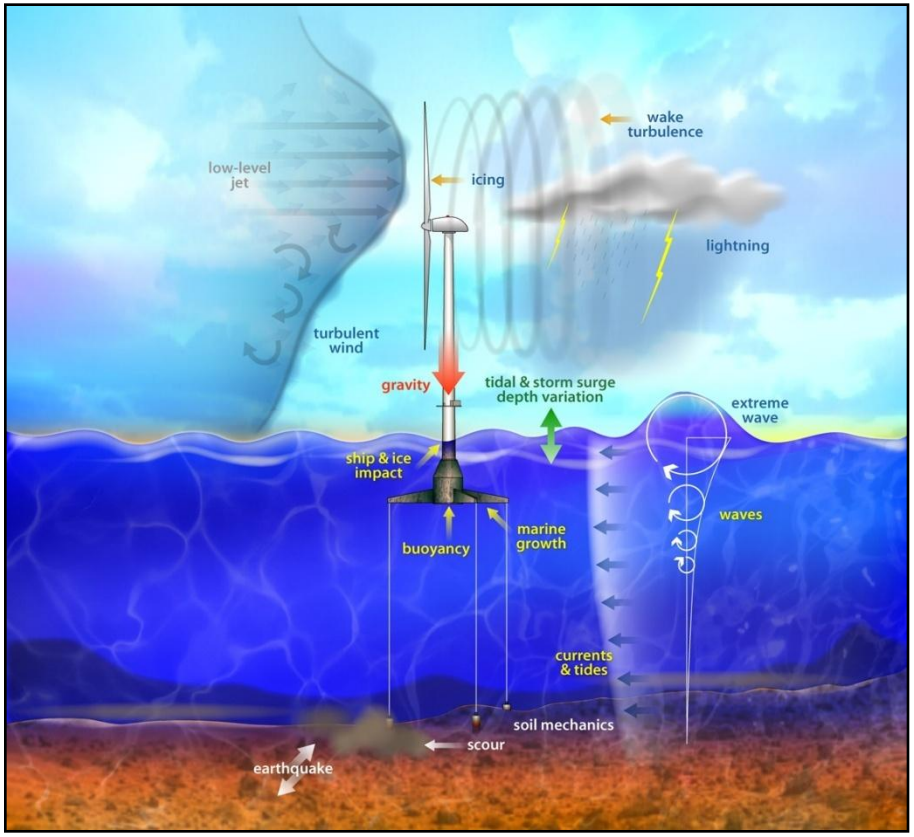


Image courtesy of J. Jonkman, Ph.D. NREL

Floating Wind Turbines are a Complex Multiphysics Problem:

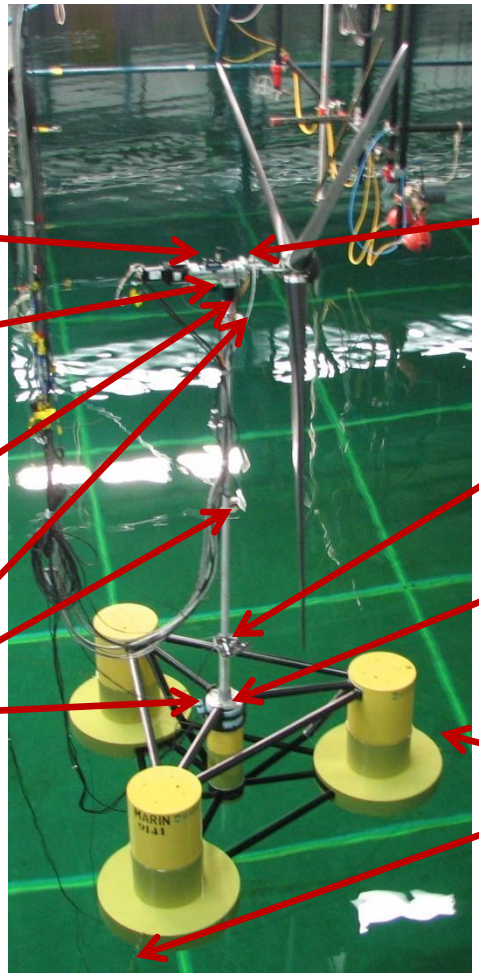
- Dynamic Wind & Wave Environments
- Aerodynamics
- Hydrodynamics
- Structural Dynamics
- Controls Systems

Technical Objectives

- Accurately capture all coupled aero-hydro-elastic behavior
- Cover the majority of the design space
- Create a data set that can be used to isolate individual phenomena
- Record all pertinent physical field variables
- *ULTIMATE OBJECTIVE: Create the world's most complete, comprehensive data set for scale-model testing of floating offshore wind platforms*

Instrumented Turbine

1/50th Scale NREL 5MW Reference Turbine



Torque

6-Axis Accelerations

6-Axis Loads (Forces and Moments)

3-Axis Accelerations

Rotor Position

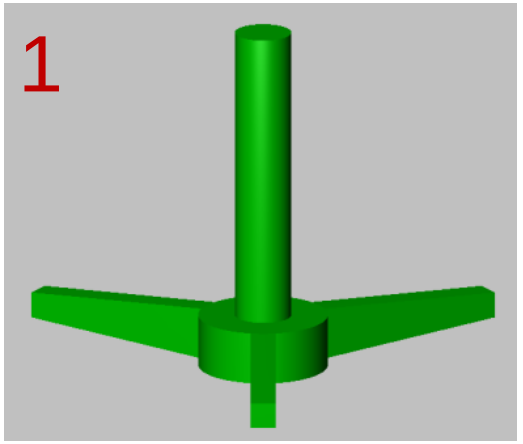
6-Axis Motions (Optical Tracking)

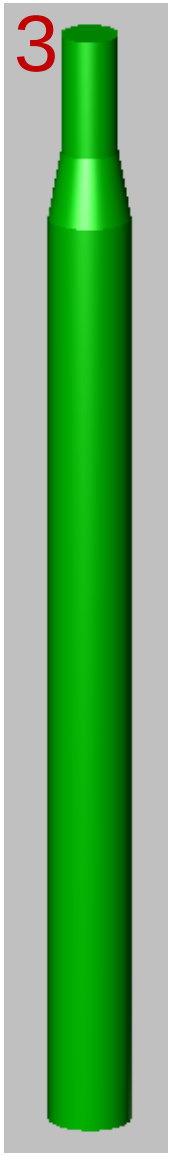
6-Axis Loads (Forces and Moments)

Mooring Tensions

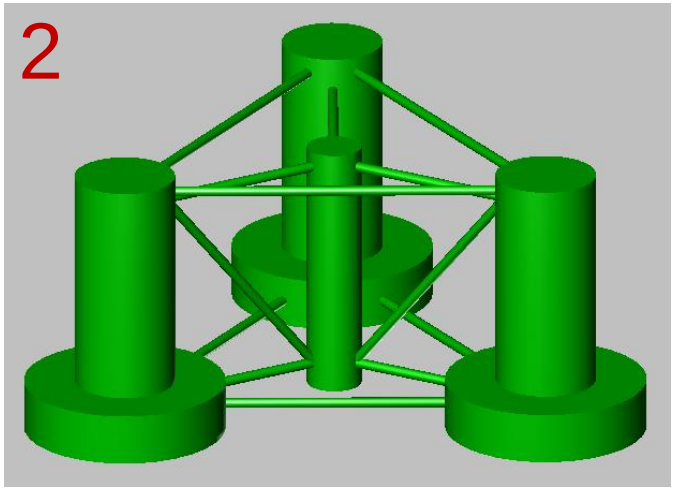
Floating Platforms

1) Tension Leg Platform (*Mooring Stablized*)
2) Semi-Submersible (*Buoyancy Stablized*)
3) Spar-Buoy (*Ballast Stablized*)





Platform Types

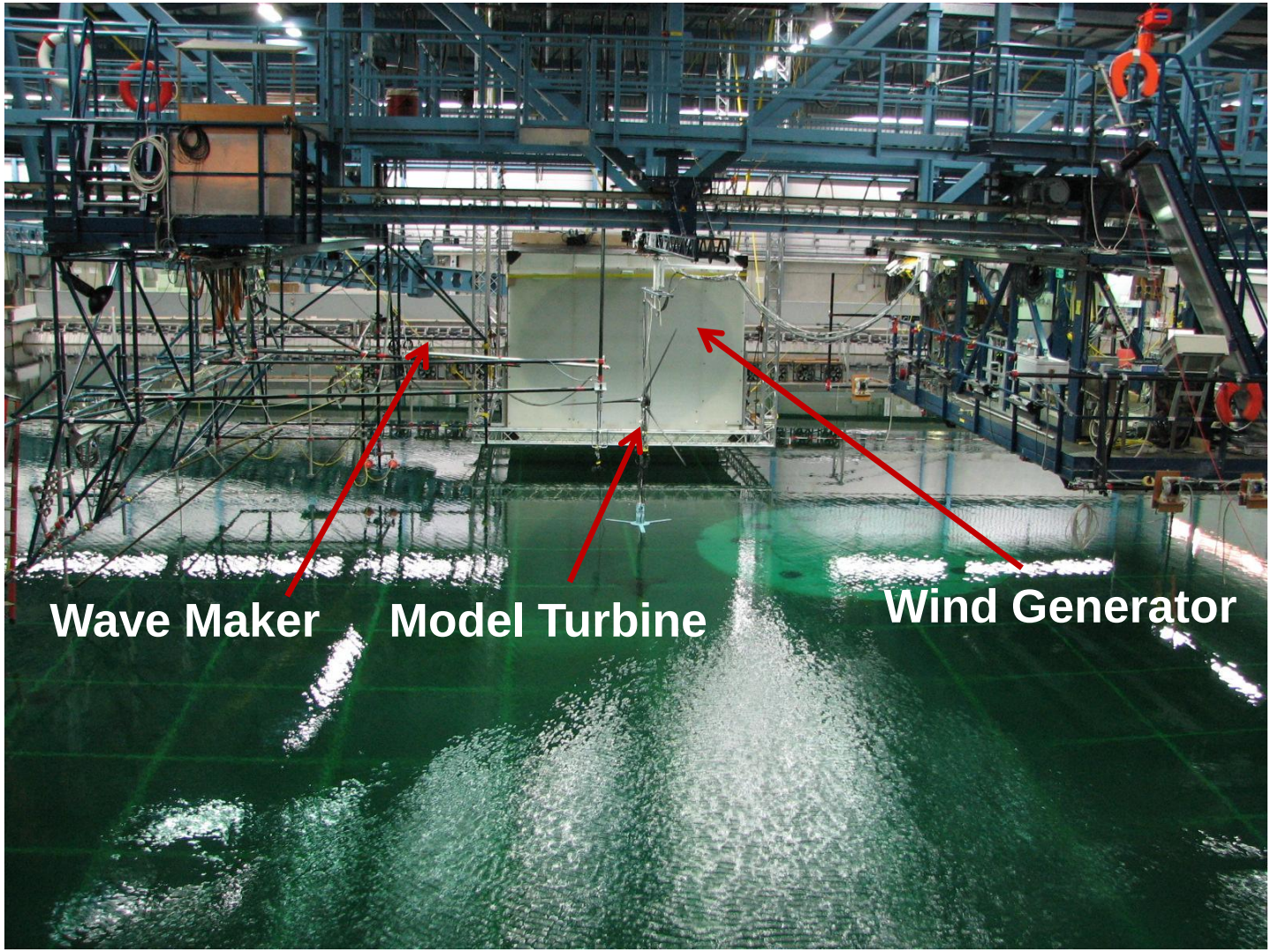


Test Matrix

Wind Speed (m/sec) / H_s Wave (m)		Operation	1 Year	100 year
		2.0	7.1	10.5
Operation 1	7.00	x		
Operation 2	9.00	x		
Operation 3	11.40	x	x	
Operation 4	16.00		x	
Operation 5	21.00		x	x
100 Year	30.50			x

Test matrix repeated for all three designs

MARIN Test Facility



Sample Results

TLP Comparison FAST vs. Data

Top: U_m = 11.2 m/s
H_s = 2.0 m, T_p = 7.5 s

Bottom: U_m = 21.8 m/s
H_s = 7.1 m, T_p = 12.1 s

FAST's omission of 2nd order wave diffraction forces is apparent in low energy sea states for the TLP floating wind turbine