Annual Report 2024

Task 56

Photo: *The OC7 Project launched in 2024 to advance modeling tools for floating wind turbines to drive innovation and support the development of more cost-effective, reliable floating wind systems.* *(Photo credit: Besiki Kazaishvili, NREL)*

Offshore Code Comparison Collaboration 7 (OC7)

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Launched in January 2024, the Offshore Code Comparison Collaboration 7 (OC7) project advances modeling tools for floating offshore wind turbines (FOWTs) to address challenges posed by evolving industry designs.

Building on the successes of OC3-OC6, OC7 focuses on improving hydrodynamic, structural, and aerodynamic modeling to enable cost-effective, reliable floating wind system and farm designs.The project brings together global collaborators, including universities, research institutions, manufacturers, testing laboratories, consultants, and certification bodies from over 13 countries.

Phase I in 2024 concentrated on validating viscous hydrodynamic load modeling for FOWT substructures. Key accomplishments included completing WP 1.1 subphases Ia and Ib, validating hydrodynamic excitations and responses under diverse sea states using datasets from the University of Maine and SINTEF Ocean's WIND-MOOR campaign.

WP 1.3, focused on high-fidelity simulations supporting WP 1.1 modeling, was also completed. Additional sub-work packages on breaking wave impacts (WP 1.4) and vortex-induced motion (WP 1.5) were launched and are on track for completion in 2025.

A major Phase I deliverable under WP 1.2, scheduled for completion in 2025, is the development of guidance for constructing hydrodynamic viscous load models to support next-generation floating wind designs. Phase II will launch the same year, shifting focus to structural dynamics and global-to-local load transfer. Two in-person meetings are scheduled for 2025, in Norway and Canada, to support these efforts. Extending through 2027, OC7 will continue to foster global collaboration, driving advancements in offshore wind modeling tools and industry practices.

Introduction

The Offshore Code Comparison Collaboration 7 (OC7) project, launched in 2024, builds on the successes of the OC3-OC6 [1,2] initiatives to advance modeling tools for floating offshore wind turbines (FOWTs). As turbine designs grow larger and more cost-efficient, traditional modeling approaches need to evolve to accurately predict system loads.

OC7 addresses these challenges by advancing hydrodynamic modeling for innovative floating structures (WP1), integrating structural flexibility into floater design frameworks (WP2), and enhancing predictive capabilities for turbine performance and loads in floating wind farms (WP3).

The goal of OC7 is to enable the design and optimization of cost-effective, reliable floating wind farms, strengthening the wind energy sector's ability to meet evolving demands. The project will deliver validated benchmark models, best practices for model tuning, and advanced methodologies for load predictions, ensuring the reliability and efficiency of future floating wind systems.

Expected outcomes include increased confidence in predictive modeling tools, the development of validated benchmarks, and the identification of areas for further research. Deliverables encompass technical papers, validated methodologies, and collaborative platforms to share knowledge and advance industry practices.

OC7 unites a global network of participants, including universities, research institutions, equipment manufacturers,

COUNTRY/SPONSOR	INSTITUTIONS
Belgium	Joining in late 2024
Brazil (as a Limited Sponsor)	Federal University of Rio de Janeiro
CWEA	Zhejiang University, Dalian University of Technology, Shanghai Jiao Tong University, Ocean University of China, Chinese General Certification
France	PRINCIPIA, Électricité de France, Bureau Veritas, France Energies Marines
Germany	Hamburg University of Technology, Technical University Berlin, Ramboll, University of Duisburg-Essen
Ireland	University College Cork, Gavin & Doherty Geosolutions Ltd. (Venterra Group), Wood PLC
Italy	Politecnico di Torino, University of Salerno
Japan	Japan Marine United, University of Tokyo
Netherlands	Maritime Research Institute Netherlands, TNO, blueOASIS
Norway	SINTEF Ocean AS, Norwegian university of Science and Technology, Simis AS, Institute for Energy Technology
Spain	TECNALIA, CENER, Universitat Politècnica de Catalunya, IH Cantabria, Universidad del País Vasco, SENER, Saitec Offshore Technologies, Eureka!, CIMNE, Universidad Politécnica de Madrid
United Kingdom	Lloyd's Register, Akselos, ORE Catapult
United States	NREL, University of Central Florida

Table 1. *Countries Participating in Task 56*

testing laboratories, consultants, and certification bodies. Research and industry members collaboratively contribute to the project's objectives, fostering innovation and driving the offshore wind energy sector toward cost-effective, reliable solutions. Table 1 provides a summary of those organizations that were active in the project in 2024.

Progress and Achievements

The OC7 project is organized into three sequential phases (see Figure 1), targeting key challenges in hydrodynamic, structural, and aerodynamic modeling. In 2024, Phase I focused on validating and improving hydrodynamic load modeling for floating offshore wind turbine (FOWT) substructures, addressing the evolving requirements of innovative designs that differ from traditional oil and gas platforms.

An in-person meeting was held alongside ASME's 43rd International Conference on Ocean, Offshore & Arctic Engineering (OMAE2024) in Singapore in June [3].

Accomplishments in 2024 across the five Phase I work packages include:

WP 1.1 (Main work package of Phase I): Validated viscous load predictions across a range of configurations, with results aimed at identifying model setups and hydrodynamic coefficient tuning approaches that best capture loads across various FOWT designs and wave conditions. This work was divided into three subphases (Ia, Ib, and Ic), each targeting different platform types. Phase Ia assessed component-level loads from tests at the University of Maine, Phase Ib evaluated the INO WINDMOOR platform's response to combined waves and currents, and Phase Ic (to be completed in 2025) involves blind validation of the VolturnUS-S platform's hydrodynamic response.

WP 1.2: Started development of a set of recommendations for hydrodynamic model building, leveraging insights from WPs 1.1 and 1.3; deliverable expected in 2025.

WP 1.3: A comprehensive series of high-fidelity computational fluid dynamics (CFD) simulations was conducted to evaluate viscous forces on rectangular members common in modern floating platforms. Fifty-two 2.5D simulations and thirteen 3D simulations were completed, examining forced oscillation, free decay, and regular wave cases. The 2.5D studies showed strong agreement across participants, providing a baseline dataset for model coefficient selection. The 3D simulations further explored complex hydrodynamic interactions at the full platform level, with findings informing Phase Ic validation efforts and showing good alignment with experimental data.

WP 1.4 & 1.5: WP 1.4 (Breaking Waves) and WP 1.5 (Vortex Induced Motion), were launched in 2024 and are on track for completion in 2025. These efforts address critical loading phenomena that impact floating platform reliability and fatigue performance.

Additionally, under WP4, significant progress was made in integrating ongoing task work with broader validation efforts and exploring Digital Twin applications. WP 4.1 fostered international knowledge sharing by inviting leaders to discuss global offshore wind validation initiatives at OC7 meetings, helping identify key gaps. WP 4.2 included workshops where OC7's validated modeling capabilities were discussed to support future Digital Twin development, gathering industry input on measurement needs and modeling challenges.

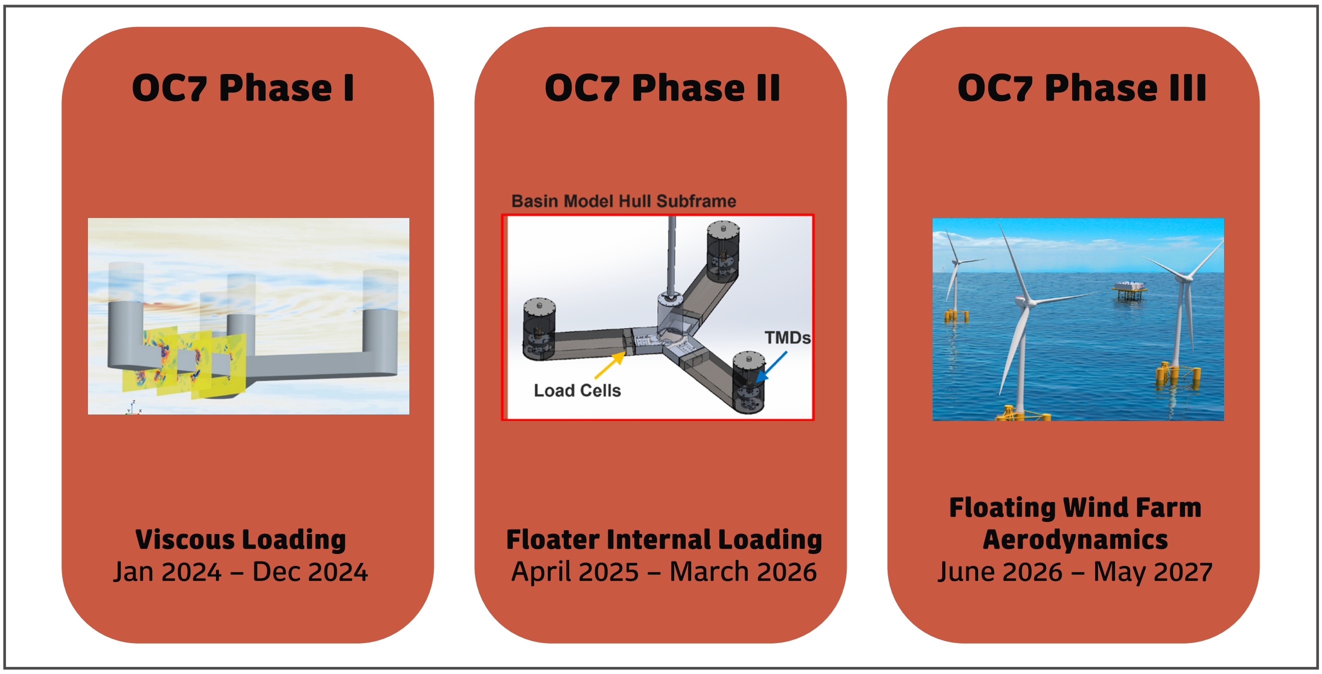

Figure 1. *The three phases of the OC7 project. (Photo credit: Phase I – image generated by Yingqian Liao (NREL); Phase II – image taken by Matthew Fowler (University of Maine); Phase III – image generated by Besiki Kazaishvili (NREL))*

Highlights

For Phase Ib, a collaborative investigation leveraged experimental data from SINTEF Ocean's WINDMOOR campaign (see Figure 2) to refine hydrodynamic modeling of viscous drag and damping for floating offshore wind platforms.

A key objective was to establish general guidance for tuning model coefficients, such as drag and damping, to improve predictions across varying sea states. This study represents a significant advancement over prior OC6 efforts by incorporating numerous load cases across diverse sea states, enabling a more comprehensive validation process.

Participants utilized hybrid modeling approaches, combining potential-flow theory with drag and damping enhancements, to calibrate models against experimental measurements. The results demonstrated marked improvements: 56% of surge motion predictions and 75% of heave motion predictions fell within ±15% of experimental data, outperforming OC6 outcomes. Key modeling needs included the adoption of wave stretching models and better-tuned drag coefficients for cylindrical columns, significantly enhancing predictions of resonance motion.

Insights from the study yielded practical recommendations, such as tuning splash zone drag coefficients based on sea state parameters and scaling Aranha's wave drift damping for higher wave conditions. NREL's alternative drag model for rectangular pontoons also showed strong potential for predictive accuracy.

While focused on practical engineering solutions, the study identified areas for future research, including flow mechanics around complex geometries and further validation on additional platform designs. Overall, this collaborative effort has enhanced confidence in hydrodynamic modeling tools, enabling cost-effective and reliable design of floating wind platforms.

Next Steps

In 2025, Phase I of the OC7 project will conclude with the completion of all sub-work packages, paving the way for Phase II, which begins in April 2025 and will focus on the structural dynamics of floating substructures. WP 2.1 will validate member-level loading in the VolturnUS floating wind semisubmersible, while WP 2.2 will verify the process of transferring global loads to local substructure components, a critical step for detailed structural design.
Two in-person meetings are planned for 2025: one in January in Norway, aligned with the DeepWind conference [4], and another in June in Canada, coinciding with the OMAE conference [5]. The OC7 project will continue advancing offshore wind modeling and validation efforts through 2027.

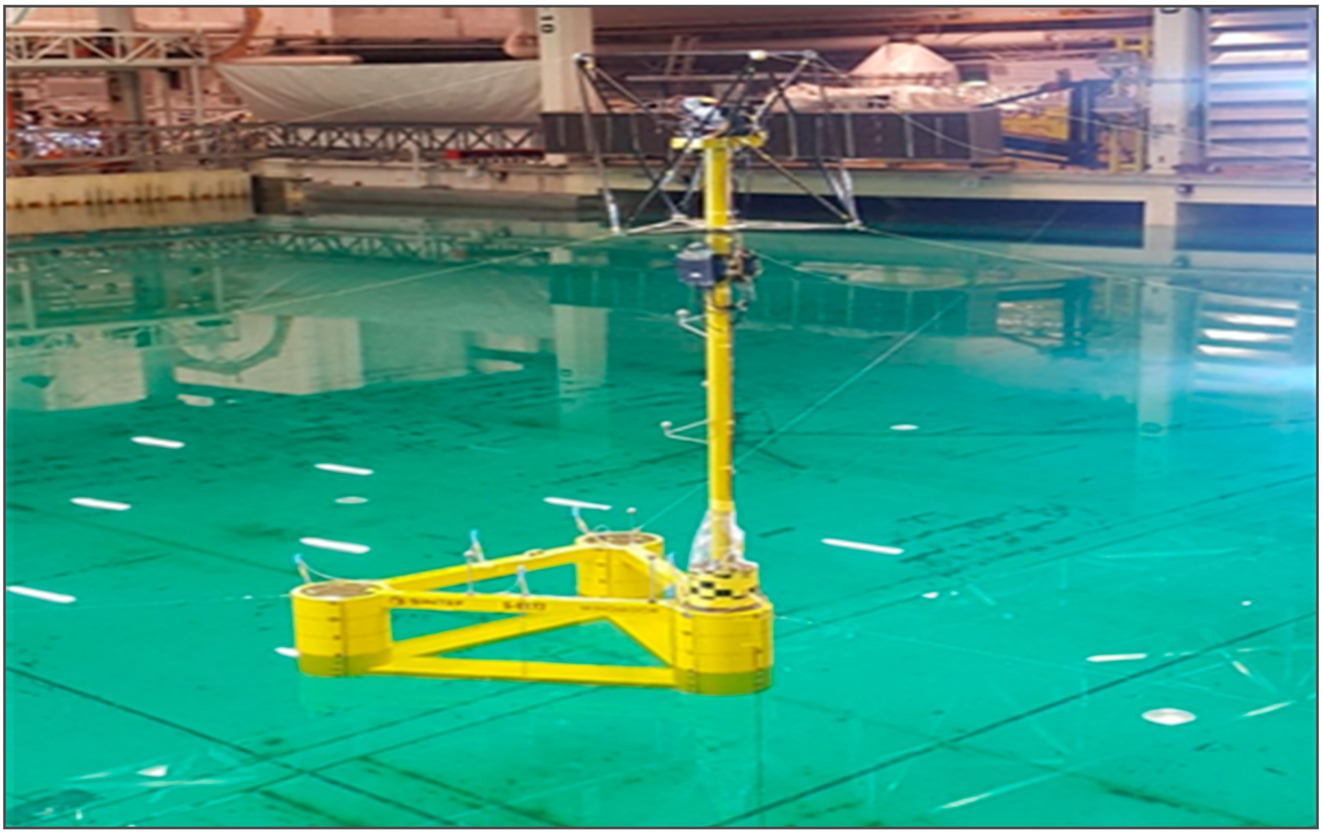

Figure 2. *Model tests of the INO WINDMOOR 12 MW floating wind turbine used in OC7 Phase Ib, performed at 1:40 scale in SINTEF Ocean's Ocean Basin (March 2020), utilized Real-Time Hybrid Model testing for rotor and aerodynamic load modeling.*
(Photo credit: SINTEF Ocean)

References

[1] Robertson, Amy. Offshore Code Comparison Collaboration, Continued, with Correlation. 2018. *wdh.energy.gov/project/oc5.*

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