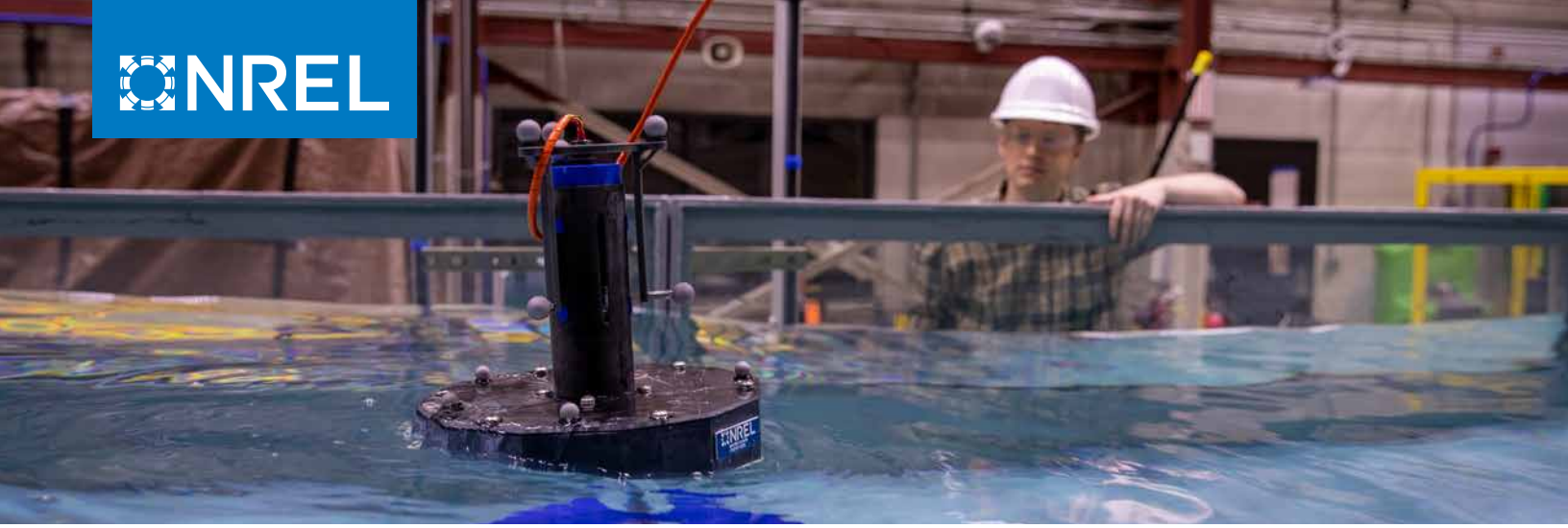

Advancing Water Power Technology With State-of-the-Art Facilities

At the National Renewable Energy Laboratory's (NREL's) water research facilities, our experts have access to a suite of capabilities needed to develop the next great water power innovation and optimize existing ones.

The lab's facilities cover five phases of the validation life cycle to ensure marine energy technologies can survive harsh open-water environments. From prototype fabrication to grid integration at all scales, NREL offers end-to-end marine energy device design and validation capabilities.

Cutting-Edge Capabilities: CoMET

NREL's Composites Manufacturing Education and Technology (CoMET) (nrel.gov/wind/facilities-comet) facility supports water power in advancing materials and manufacturing research. At 10,000 square feet, the cutting-edge facility enables researchers to design, prototype, validate, and manufacture marine energy components in one location.

CoMET Research Capabilities

- Provides access to 3D printing, composite material mixing equipment, state-of-the-art manufacturing techniques, and novel materials for rapid prototyping
- Allows simulation and modeling of designs and manufacturing methods and can characterize the structural properties of prototypes
- Expedites manufacturing innovation.

Testing the Waters: Wave Tank

Located in the Sea Wave Environmental Lab (SWEL) at the Flatirons Campus, NREL's wave tank (nrel.gov/water/wave-tank) is an ocean-simulation facility that can validate offshore technologies, including marine energy devices. At 14 meters long, 1.3 meters deep, and 2.5 meters wide, the tank holds 13,000 gallons of water, provides a robust mooring system capable of withstanding 500 pounds of hold force, and features a flap-type 2D wave generator.

SWEL Research Capabilities

- Provides a versatile testing environment allowing for wet validation of prototype devices that are approximately 1/75 the size of a full-scale device
- Offers a glass flume wall for external underwater observation and imaging
- Allows users to precisely control their experiments, specifying spectrum type, significant wave height, and wave period.

Recreating Extreme Conditions: Structural Validation Laboratories

NREL's structural validation laboratories (nrel.gov/water/structural-validation-laboratories) assess designs and structural performance under specific extreme loading and dynamic conditions. Engineers can use these facilities to conduct structural validation on their technology and extract extensive data on structural properties.

Structural Research Capabilities

- Offers mechanical and dynamic property validation through the measurement of intrinsic structural properties, including mass, center of gravity, and stiffness properties for complex components and systems
- Allows the ability to perform marine environmental degradation testing on composite and polymeric materials from coupon- to subcomponent scales, as well as submerged fatigue testing to simulate in-service conditions
- Offers static fatigue and strength durability testing.

Validating New Grid Systems: Nanogrids and Microgrids

NREL's facilities can emulate nanogrids and microgrids (nrel.gov/water/nanogrids-microgrids) connected to marine energy and other renewable technologies, offering a safer, cheaper, faster, and lower-risk way to ensure that devices can safely connect to electric power systems while maintaining grid stability and reliability.

Nanogrid and Microgrid Research Capabilities

- Provides emulators—both direct current and alternating current—to simulate how multiple technologies can be paired together to create smaller-scale grids that support remote or island-based communities
- Pairs modeling tools and hardware (hardware-in-the-loop) to more accurately evaluate emerging technologies.

Bringing the Ocean Onto Land: Motion Platform

The large-amplitude motion platform (LAMP) (nrel.gov/water/motion-platform) can replicate powerful ocean waves in a low-risk laboratory setting, allowing technology developers to identify potential flaws and fine-tune their designs before subjecting their prototypes to open-ocean trials—cutting time, cost, and risk. This platform serves as a valuable addition to NREL's theory-to-ocean support continuum.

LAMP Research Capabilities

- Allows researchers to test marine energy power take-off (PTO) systems, components, and full devices
- Uses real wave data to mimic actual sea conditions and modify motions in real time, reducing risks and costs
- Performs the six degree-of-freedom motions that occur in the ocean, including surges of up to 2.5 m, sways up to 2.3 m, and heaves up to 1.8 m.

Researchers test a tidal turbine blade in the Structural Testing Laboratory. *Photo by Joe DelNero, NREL 79222*

Customize With Size: Dynamometers

The Flatirons Campus features dynamometers (nrel.gov/water/dynamometers) for PTO system validation that simulate ocean conditions.

Dynamometer Research Capabilities

- Provides a variety of components and subsystems, including generators, gearboxes, mechanical or electro-dynamic brakes, power electronics, control systems, and software
- Connects to the controllable grid interface (nrel.gov/grid/controllable-grid-interface) to demonstrate how PTOs react to grid disturbances
- Offers an array of dynamometer sizes, ranging from 3 kilowatts to 5 megawatts.

How Can You Partner with NREL?

If you're interested in taking advantage of all the capabilities NREL's facilities have to offer, we encourage you to get in touch with us. Our Flatirons Campus offers a suite of instrumentation that can help you hone your theoretical design, stress test your generator, or collect data on how your full-scale prototype handles a simulated ocean.

https://bit.ly/waterfacilities

Get a closer look at all our facilities have to offer at nrel.gov/water/facilities.

Learn about our data acquisition systems support for to in-lab testing at nrel.gov/water/open-water-testing.

Contact Rebecca Fao to learn more: Rebecca.Fao@nrel.gov.

Cover image: Researcher adjusts wires connected to a technology being tested in the wave tank. *Photo by Joe DelNero, NREL 79170*

NREL

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