



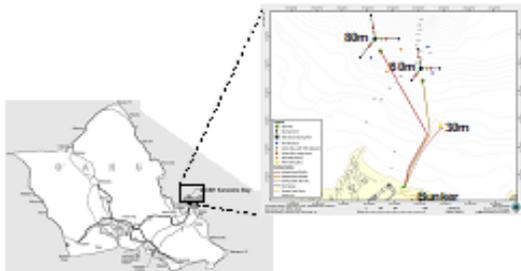
Hawai'i Natural Energy Institute Research Highlights

Ocean Energy

Research Support to the U.S. Navy Wave Energy Test Site

OBJECTIVE AND SIGNIFICANCE: Wave energy has the potential to address global renewable energy goals, yet it poses daunting challenges related to commercializing technologies that must produce cost-competitive electricity while surviving an energetic and corrosive marine environment. The nascent commercial wave energy sector is thus critically dependent on available test infrastructure to advance development of wave energy conversion (WEC) devices and related technologies. For this reason, the U.S. Navy established the Wave Energy Test Site (WETS) in the waters off Marine Corps Base Hawai'i (shown below) as the United States' first grid-connected site, completing the buildout in mid-2015. WETS consists of test berths at 30m, 60m, and 80m water depths, and can host point absorber and oscillating water column (OWC) devices to a peak power of 1 MW.

HNEI provides key research support to this national effort in the form of environmental monitoring, independent WEC device performance analysis, and critical marine logistical support. The results achieved at WETS have far reaching impacts in terms of advancing wave energy globally.



BACKGROUND: Wave energy also has enormous potential to supply persistent power to small-scale or non-grid-connected applications, including ocean observation, charging of autonomous vehicles, aquaculture, at-sea mineral scavenging, and providing renewable power to remote or island communities. Through a cooperative effort between the Navy and the U.S. Department of Energy (DOE), WETS hosts companies seeking to test their pre-commercial WEC devices in an operational setting. HNEI works with the Navy and DOE to directly support WEC testing at WETS in three key ways: 1) *environmental impact monitoring* – acoustic signature measurement and protected species monitoring; 2) *independent WEC device performance*

analysis, including wave forecasting and monitoring, power matrix development (power output versus wave height and period), numerical hydrodynamic modeling, and a regimen of regular WEC and mooring inspections; and 3) *logistics support*, in the form of past funding to modify a site-dedicated support vessel for use at WETS, through local partner Sea Engineering, Inc., assisting WEC developers with deployment planning and through funding to developers for maintenance actions during their WEC deployments at the site.

In Summer 2022, NAVFAC granted HNEI an additional \$3.7M to continue this core support to WETS, and to expand research related to smaller-scale WECs for offshore, non-grid-connected applications of wave energy. Research continues in three primary areas: 1) development of a power generation and management system for a floating OWC device of UH design for applications such as ocean observation and AUV recharge; 2) advancement of a novel breakwater system with integrated OWC power generation; and 3) concept development and testing of a floating flap-type WEC.

Funding to support this research, as well as funds for all WETS support functions (including several major site infrastructure repairs and enhancements), has now totaled over \$34M.

PROJECT STATUS/RESULTS: Since mid-2015, the following major activities have occurred at WETS, with HNEI in both supporting and leading roles:

- June 2015 to December 2016: Northwest Energy Innovations deployed Azura device at 30m berth.



- March 2016 to April 2017: Sound and Sea Technology deployed Fred. Olsen Lifesaver at 60m berth. This project was not grid-connected.



- February to August 2018: HNEI led a second deployment of Azura, with modifications designed to improve power performance, including enlarging the float and adding a heave plate at the base.



- October 2018 to March 2019: HNEI led effort to redeploy Lifesaver at 30m with modifications to moorings and integration of UW sensor package and subsea charging capability, which drew its power from the WEC itself. This use of wave energy to power an offshore sensing suite was an important national first.



- May/June 2019: HNEI led a major redesign and reinstallation effort for the WETS deep berth moorings. 60m berth was reinstalled and 80m berth repairs held, subject to WEC developer demand.



- November 2019: Completion of site-dedicated support vessel Kupa'a by research partner Sea Engineering, Inc. This vessel adds significantly to our ability to perform various functions at WETS.



Issues stemming from COVID, funding, and technical challenges have substantially delayed planned WEC deployments over the past few years, but three deployments are currently happening, or are planned in the coming year:

1. Deployment of the Oscilla Power (Seattle) Triton-C community-scale WEC at the 30m berth. This device arrived in Hawai'i in October 2021. New anchors were deployed at the WETS 30m berth in support of this project, with work complete in August 2022, and a new electrical/data junction box was installed in

September 2023. The device is currently ready for deployment, pre-staged at Marine Corps Base Hawai‘i, and will deploy during the next weather window of less than 3-foot seas for 3 days, which is not a common occurrence.



2. Deployment of the C-Power SeaRay WEC. This is a stand-alone (not grid-connected) deployment of a small, 1 kW device designed to feed power to a subsea battery system that in turn provides power to an acoustic sensing system from Biosonics, as well a seafloor AUV docking station from Hibbard Inshore. The device was deployed at WETS in early October 2023 but suffered some early damage. It was redesigned and redeployed in June/July 2024, and successfully demonstrated wave power extraction and battery charging.



3. Deployment of the Ocean Energy (Ireland) OE35 WEC at the 60m berth. This device has been in Hawai‘i since December 2019, and underwent drydock repairs in August/September 2022, after extensive delays. A new generator was installed in April/May 2024, and it was deployed to WETS in July. However, it is not yet operational, as weather and logistics have not yet supported the operation to connect its umbilical cable to the WETS shore cable. It is hoped this will be achieved soon.



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