# TETHYS ENGINEERING BLAST

# 29 January 2021

*Tethys Engineering* is an online knowledge base that facilitates the exchange and dissemination of information on the technical and engineering aspects of marine renewable energy (MRE). The bi-weekly *Tethys Engineering* Blast highlights new publications in the *Tethys Engineering* Knowledge Base; relevant announcements, opportunities, and upcoming events; and news articles of international interest. If you have specific content you would like circulated to the greater MRE community, please send it to tethys@pnnl.gov for consideration.

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## Announcements

PacWave Request for Information

The PacWave and Pacific Marine Energy Center (PMEC) team has released a Request for Information (RFI) to solicit feedback from wave energy technology developers and stakeholders on how the PacWave facility can best support testing needs. Responses are due by 2:00pm PST (10:00pm UTC) on 12 February 2021.

ETIPP Community Technical Assistance

The National Renewable Energy Laboratory (NREL) is now accepting community technical assistance applications for the Energy Transitions Initiative Partnership Project (ETIPP), a partnership among U.S. Department of Energy (DOE) offices, national labs, and community organizations that will provide resources and access to on-the-ground support for remote and island communities in the U.S. seeking to transform their energy systems and lower their vulnerability to energy disruptions. Applications are due by 15 February 2021.

Ocean Observing Prize

The U.S. DOE and National Oceanic and Atmospheric Administration (NOAA) are accepting applications for the DEVELOP Competition within the Ocean Observing Prize—a multi-stage

prize that challenges innovators to integrate MRE with ocean observation platforms. The DEVELOP Competition comprises three contests—Design, Build, and Splash. Submissions for the Design Contest close at 5:00pm EST on 16 February 2021.

Funding/Testing Opportunities

The European Commission has released a Blue Economy Call for Proposals to help advance market-readiness of new products, services, or processes, including MRE projects. Proposals are due by 5:00pm CEST (3:00pm UTC) on 16 February 2021.

The European Marine Energy Centre (EMEC) is looking to contract an MRE technology developer to act as an external advisor to the Ocean Energy Scale-up Alliance (OESA). Interested developers will need to deploy a wave or tidal energy technology at EMEC prior to March 2022, with learning from the preparations and deployment fed into the OESA project. The deadline for tenders is 19 February 2021.

Student/Employment Opportunities

Offshore Renewable Energy Catapult (ORE Catapult) is recruiting for a Senior Research Engineer to focus on energy systems and a Research Engineer to focus on electrical systems integration for offshore energy. Applications for both positions are due 31 January 2021.

Maynooth University is seeking two Senior Post-Doctoral Researchers to join its Centre for Ocean Energy Research. The roles will focus on the development of numerical optimization-based control strategies for the linear and nonlinear models of wave energy converter arrays. Applications are due 14 February 2021.

Maynooth University's Centre for Ocean Energy Research also has an opportunity for applicants interested in undertaking a funded PhD. The primary focus of the project will be the development of a small-scale wave powered data buoy.

Bombora Wave is seeking a Senior Electrical Engineer, Senior Mechanical Engineer, Membrane Engineer, and Finite Element Analyst to support the development of the company's wave energy technology. Applications for the Senior Electrical Engineer position are due 19 February 2021. Applications for the other positions are due 5 February 2021.

The Offshore Renewable Energy (ORE) Supergen Hub and University of Southampton are recruiting for a Research Fellow/Senior Research Fellow to analyze current and future sites and ORE systems around the UK. Applications are due 19 February 2021.

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## Upcoming Events

Upcoming Courses

WavEC Offshore Renewables will be hosting an online course entitled, "Computational Fluid Dynamics (CFD) for Sustainable Ocean Solutions: Course I", on 8-11 February 2021. The course is the first in a series sponsored by the University of Tokyo and the University of São Paulo, and will introduce several CFD crucial subjects. Register here by 4 February 2021.

The University of Strathclyde, in conjunction with the National Subsea Research Initiative and Subsea UK, have announced a new foundation-level course focusing on offshore renewable energy on 25-26 February 2021. The course will focus on the technical and business aspects of the offshore renewables sector, examining the full lifecycle. Register here.

Upcoming Webinars

NREL, Sandia, and PNNL will be hosting two webinars on new developments in the Marine and Hydrokinetic Toolkit (MHKiT), an open-source software package developed in Python and Matlab that includes modules for ingesting, quality controlling, processing, visualizing, and managing marine energy data. It is recommended that attendees preinstall MHKiT and its dependencies so they can follow along during the webinar.

- Register here for the webinar on 10 February 2021 at 12:00pm EST (5:00pm UTC), which will focus on MHKiT-Python, and include demonstrations in Python.
- Register here for the webinar on 18 February 2021 at 12:00pm EST (5:00pm UTC), which will focus on MHKiT-Matlab, and include Matlab demonstrations.

As part of its webinar series, the Selkie Project will be hosting a webinar on skills in the marine energy sector at 10:00am UTC on 23 February 2021. The webinar will outline the importance of a skilled workforce in coastal communities, highlight the skills shortages and the needs of the marine energy industry, and gather suggestions on how to address gaps. Register here.

The MHK Environmental Toolkit for Permitting and Licensing project team, led by Kearns & West, will be hosting a series of webinars and other engagement opportunities in February and March 2021 to demonstrate the toolkit, gather feedback, and share experts' understanding of potential impacts. Learn more about the Toolkit, register for the upcoming engagement opportunities, and view recordings of previous workshops here.

Event Update

Subsea Expo, the world's largest underwater engineering event, has been postponed to 2022. The three-day exhibition and conference, originally rescheduled for May 2021, is now scheduled for 22-24 February 2022 in Aberdeen, UK.

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## New Documents on *Tethys Engineering*

**On the impact of motion-thrust coupling in floating tidal energy applications – Brown et al. 2021**

Floating systems provide an opportunity to expand the available tidal stream energy resource and reduce the levelised cost of energy. However, the inevitable exposure to free

surface conditions raises questions over both the power delivery and the survivability of these systems, both due to the presence of waves and the associated excitation of the floating structures. Without addressing these concerns through scale modelling in laboratories and prototype deployments, the risk to investors is too high to gain significant support for the industry. Therefore, this paper presents physical modelling and analysis of a 1:12 scale model of the Modular Tide Generators floating tidal platform concept, a pseudo-generic design consisting of a catamaran-style platform, catenary mooring system and a submerged horizontal axis tidal turbine.

**Investigation on energy efficiency of rolling triboelectric nanogenerator using cylinder-cylindrical shell dynamic model – Gao et al. 2021**

The triboelectric nanogenerator (TENG) technology is rapidly becoming a promising candidate for harvesting wave energy from the ocean. In this paper, through an in-depth analysis of the working principle of spherical TENGs, for the first time, a dynamic model of this structure is proposed based on a cylinder-cylindrical shell configuration, and integrated into TENGs electric model. We verified the assumption that the motion of internal ball of the spherical TENGs is a small oscillation by comparing the V-Q-x relationship with experiments. The model reveals the influence of structural/material parameters, such as the radius of inner ball, density of material, and thickness of the shell on the energy output of TENGs.

**Framework for Identifying Cybersecurity Vulnerability and Determining Risk for Marine Renewable Energy Systems – de Peralta et al. 2020**

The advanced operational and information technology devices used in MRE systems create a pathway for a cyber-threat actor to gain unauthorized access to data or disrupt operation. To improve the resilience of MRE systems as a predictable, affordable, and reliable source of energy from oceans and rivers, the U.S. Department of Energy's Water Power Technologies Office funded Pacific Northwest National Laboratory to develop a guidance document that will assist MRE developers and end users with integrating security controls into the operational and enterprise networks of MRE systems. The cybersecurity guidance document was developed by assessing cyber threats and consequences of a cyberattack on typical MRE system assets (Focus 1) and determining industry best practices to protect from those threats (Focus 2).

**Gulf Stream Marine Hydrokinetic Energy Off Cape Hatteras, North Carolina – Muglia et al. 2020**

Multi-year measurements of current velocity, salinity, and temperature from fixed and vessel-mounted sensors quantify Gulf Stream (GS) marine hydrokinetic energy (MHK) resource variability and inform development off Cape Hatteras, NC. Vessel transects across the GS demonstrate a jet-like velocity structure with speeds exceeding 2.5 m/s at the surface, persistent horizontal shear throughout the jet, and strongest vertical shears within the cyclonic shear zone. Persistent equatorward flow at the base of the GS associated with the Deep Western Boundary Current (DWBC) produces a local

maximum in vertical shear where stratification is weak and is postulated to be a site of strong turbulent mixing.

**Frequency-Based Performance Analysis of an Array of Wave Energy Converters around a Hybrid Wind-Wave Monopile Support Structure – Gkaraklova et al. 2020**

In this paper, we investigate, in the frequency domain, the performance (hydrodynamic behavior and power absorption) of a circular array of four semi-immersed heaving Wave Energy Converters (WECs) around a hybrid wind–wave monopile (circular cylinder). The diffraction/radiation problem is solved by deploying the conventional boundary integral equation method. Oblate-spheroidal and hemispherical-shaped WECs are considered. For each geometry, we assess the effect of the array's net radial distance from the monopile and of the incident wave direction on the array's performance under regular waves. The results illustrate that by placing the oblate spheroidal WECs close to the monopile, the array's power absorption ability is enhanced in the low frequency range, while the opposite occurs for higher wave frequencies.

**Performance Optimization of a Condenser in Ocean Thermal Energy Conversion (OTEC) System Based on Constructal Theory and a Multi-Objective Genetic Algorithm – Wu et al. 2020**

Constructal optimization of a plate condenser with fixed heat transfer rate and effective volume in ocean thermal energy conversion (OTEC) system is performed based on constructal theory. Optimizations of entropy generation rate ($\dot{S}_g$) in heat transfer process and total pumping power ($P_{sum}$) due to friction loss are two conflicting objectives for a plate condenser. With the conventional optimization method, the plate condenser is designed by taking a composite function (CF) considering both $\dot{S}_g$ and $P_{sum}$ as optimization objectives, and employing effective length, width, and effective number of heat transfer plates as design variables. Effects of structural parameters of the plate condenser and weighting coefficient of CF on design results are investigated.

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## News & Press Releases

**Welsh national marine energy test centre secures marine license – Offshore Energy**

Marine Energy Test Area (META), Wales' national marine test centre, has obtained the marine license for the second phase of the project from Natural Resources Wales. This marks a significant step forward for the project, enabling META to support wave and tidal stream testing, as well as testing of floating wind components, and acting as a key innovation hub for research into wider blue economy activity. META Phase 2 offers sites for accessible, real-sea testing and provides a dedicated facility for research and innovation. With eight pre-consented test sites located within or adjacent to the Milford Haven Waterway, Pembrokeshire, META aims to help developers deploy, de-risk and develop their marine energy technologies.

**CorPower and OPS primed for 'industry advancing' wave energy project, following EEA Grant – CorPower**

> CorPower Ocean and OPS Composite Solutions are primed to deliver an 'industry advancing' wave energy project after securing close to €500,000 from EEA Grants. The Portuguese-Swedish wave energy developer and Norwegian engineering firm will join forces for the COMPACT (COMposite Pressure cAsing for CosT) Project, combining sector leading wave energy technology with low-cost composite design and fabrication processes from the offshore industry. The COMPACT Project aims to boost the performance and slash costs of CorPower's next generation wave energy converters, which will shortly enter the flagship HiWave-5 demonstration phase in northern Portugal.

**New Tidal Research Begins – Fundy Ocean Research Centre for Energy (FORCE)**

> As new tidal energy devices are expected in the Minas Passage over the next few years, new research is aimed at understanding potential risks tidal devices may pose to fish. Research partners that include FORCE, Ocean Tracking Network at Dalhousie University, the Mi'kmaw Conservation Group, Acadia University, and Marine Renewables Canada have begun work on a Risk Assessment Program (RAP) to gauge the probability that fish will encounter a tidal device. The RAP project is building a high-resolution radar network to map currents, eddies, and waves in the Minas Passage. At the same time, the RAP team is gathering the largest fish data set on fish movement in the Bay of Fundy, analyzing hydroacoustic tagging data for multiple species.

**Multi-Lab Collaboration Releases Groundbreaking High-Resolution, Long-Term Wave Resource Dataset – National Renewable Energy Laboratory (NREL)**

> Multi-decade, high-resolution wave data used to be hard to come by. Now, three national laboratories are working together to make the records easy to access and user-friendly. In collaboration with Pacific Northwest National Laboratory and Sandia National Laboratories, NREL has released a high-spatial-resolution, publicly accessible ocean surface wave hindcast dataset, improving our understanding of the nation's wave energy resources and providing an important tool for advancing marine renewable energy technologies. With funding from the U.S. Department of Energy's Water Power Technologies Office, NREL has made a 32-year high-resolution wave model hindcast dataset—spanning 1979 to 2010—publicly accessible via Amazon cloud services.

**Simec Atlantis' tidal turbine hits waters offshore Japan – Offshore Energy**

> The AR500 tidal energy generation system, designed and built by Simec Atlantis Energy, has been installed in the Naru Strait, off Japan's Goto Island chain. The turbine has already started power generation, according to Kyuden Mirai Energy, a Japanese company which contracted Simec Atlantis for the demonstration project. The project developers will now perform various tests ahead of the official start of the demonstration phase, scheduled for early February 2021. The turbine will initially be operating at a capped maximum generation output of 500kW, as performance and environmental data collection, and device validation are undertaken for the client and regulatory bodies.