TETHYS ENGINEERING BLAST

25 February 2022

Tethys Engineering is an online knowledge hub that facilitates the exchange and dissemination of information on the technical and engineering aspects of marine energy. 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. Email tethys@pnnl.gov to contribute!

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Announcements

Marine Energy R&D Needs Survey

Pacific Northwest National Laboratory, National Renewable Energy Laboratory, and Sandia National Laboratories are conducting a survey to help prioritize marine energy testing infrastructure upgrades at national laboratories. Please submit responses by 25 February 2022.

Biofouling Survey

As part of the GloFouling Partnerships Project, the World Ocean Council is conducting a survey to identify challenges, priorities, trends, and management practices related to biofouling and invasive species in various ocean industries, including offshore renewable energy. The deadline to submit responses is 28 February 2022.

Call for Abstracts

The Call for Abstracts for the International Conference on Ocean Energy (ICOE) and Ocean Energy Europe (OEE)'s annual event is now open until 31 March 2022. The Basque Energy Cluster and OEE will host ICOE-OEE 2022 on 18-20 October 2022 in San Sebastián, Spain.

Calls for Papers

The *Journal for Marine Science and Engineering* is accepting submissions for several Special Issues, including "New Frontiers in Marine Energy Conversion Technologies" (due 10 March 2022) and Renewable Energy Applications: Wind turbines, Marine Current Turbines, Hybrid Generation Systems, and Smart Grids (due 10 April 2022).

The American Society of Mechanical Engineers' *Journal of Offshore Mechanics and Arctic Engineering* is accepting submissions for a Special Issue on Advanced Numerical Methods and Applications in Marine Hydrodynamics through 31 March 2022.

Energies is accepting submissions to several Topical Collections, including "Modeling and Design of Offshore Renewable Energy Systems", "Progress on Offshore Wind and Marine Energy", and "Women's Research in Wind and Ocean Energy".

Funding & Testing Opportunities

The US DOE recently launched the Inclusive Energy Innovation Prize, which will provide cash prizes of up to $250,000 to groups and organizations that support entrepreneurship and innovation in communities historically underserved in climate and energy technology funding. Phase One submissions are due by 5:00pm EST (10:00pm UTC) on 25 February 2022.

The US Testing Expertise and Access for Marine Energy Research (TEAMER) program, sponsored by DOE and directed by Pacific Ocean Energy Trust, is offering open water support for marine energy testing. Open Water Support applications may be submitted at any time, while applications for its 6th Request for Technical Support are now available and due 17 March 2022.

The Oceanic Platform of the Canary Islands (PLOCAN) recently announced the launch of its Winter Access Call for the use of its facilities and services by public research groups and by the private sector, both national and international communities. Applications are due 20 March 2022.

Student & Employment Opportunities

The University of Queensland is advertising a PhD scholarship to study the mechanics of the M4 wave energy converter using experimental and numerical modelling, with a focus on identifying optimization options for offshore aquaculture applications. Applications are due 1 March 2022.

The Environmental Research Institute, part of North Highland College, is recruiting an Energy Research Associate to join its multidisciplinary group working at the forefront of the energy transition across Scotland and internationally. Applications are due 2 March 2022.

Aarhus University is inviting applicants for a PhD scholarship in connection with the research project *Physical Principles and Commercial Aspects of the Crestwing Wave Energy system* at the PhD Programme Business Development and Technology. Applications are due 4 March 2022.

The University of Tasmania is inviting applicants for a PhD scholarship to join a project that seeks to investigate the influence that scale effects have on assessing performance of a wave energy converter. Applications are due 7 March 2022.

Pacific Northwest National Laboratory is recruiting multiple Undergraduate Technical Interns from diverse backgrounds to join its Coastal Sciences Division and work in one of three focus areas, including marine energy and coastal resilience. Applications are due 11 March 2022.

WavEC Offshore Renewables is recruiting an Electrical Engineer, with experience or training related to offshore electrical systems and infrastructures with special focus on the Portuguese legislation. Applications are due 15 March 2022.

CalWave is currently advertising several open positions, including a Senior Mechanical Design Engineer, a Systems Modeling and Controls Engineer, an Electrical Engineer Lead, and a Naval Architect. Visit CalWave's Careers page to see more positions coming soon.

Virigina Tech's Center for Energy Harvesting Materials and Systems is seeking two Postdocs to conduct research on the hydrodynamics, design, and control of marine renewable energy devices.

Upcoming Events

Upcoming Workshops

OES-Environmental is hosting a two-part Innovation Session on the future of wave energy in Hawaii as part of the 2022 Ocean Sciences Meeting (OSM) from 11:30am-1:30pm PST (7:30-9:30pm UTC) on 1-2 March 2022. The interactive event will use online breakout sessions, engaging marine scientists to brainstorm what it would take to extract power sustainably and efficiently from waves in Hawaii. Register here.

The Ocean Power Innovation Network is hosting an online masterclass on dynamic cables on 15-16 March 2022. The training will provide developers, operators, and technology providers with a background knowledge in dynamic cables for offshore renewables. Register for free here.

The US DOE's Water Power Technologies Office (WPTO) and National Renewable Energy Laboratory are hosting a free, two-day Marine Energy Data and Instrumentation Workshop on 16-17 March 2022 to bring together industry, university, and laboratory experts in marine energy data collection and instrumentation. Participants will identify instrumentation and measurement needs, and discuss best practices for data collection. Register for Day 1 here and Day 2 here.

Upcoming Webinars

Open Communications for the Ocean is hosting a webinar on a new tool for assessing the ecological risks of wave energy converters at 12:00pm EST (5:00pm UTC) on 1 March 2022. Developed by AZTI, the WEC-ERA Tool is a new open-access tool for managers, decision makers, industry, and others to assess environmental impacts of new projects. Register here.

The RESOURCECODE project is hosting a webinar from 10:00-11:30am UTC on 10 March 2022 to introduce a new Marine Data Toolbox that provides developers with a set of standards and functions for resource assessment and operations planning. Register here.

The US DOE's WPTO is hosting its WPTO Semiannual Stakeholder Webinar from 1:00-2:00pm EST (6:00-7:00pm UTC) on 10 March 2022. During the webinar, WPTO leadership will review accomplishments, preview what's yet to come, and discuss investments that will come from the Bipartisan Infrastructure Law. Register here.

The US DOE's WPTO is also hosting the next webinar in its *R&D Deep Dive Webinar Series* from 3:00-4:00pm EDT (7:00-8:00pm UTC) on 16 March 2022. During the webinar, Oregon State University and the Pacific Marine Energy Center will present the latest design and testing program for the Laboratory Upgrade Point Absorber (LUPA), a robust, open-source wave energy converter designed for deployment in the O.H. Hinsdale Wave Basin Register here.

The Portal and Repository for Information on Marine Renewable Energy (PRIMRE) is hosting a webinar on the Marine and Hydrokinetic Toolkit (MHKiT) from 1:00-2:00pm EDT (5:00-6:00pm UTC) on 31 March 2022. During the webinar National Renewable Energy Laboratory, Sandia National Laboratories, and Pacific Northwest National Laboratory will present introduce new functionality in the open-source package and give demonstrations in Python. Register here.

Upcoming Conferences

The Marine Energy Wales Conference will take place 22-23 March 2022 in Llandudno, Wales. Program details, sponsorship and exhibition packages, and registration will be available soon.

The All-Energy & Dcarbonise Exhibition and Conference will take place 11-12 May 2022 in Glasgow, Scotland. Register for both events for free here.

New Documents on *Tethys Engineering*

Wave energy extraction from a floating flexible circular plate – Michele et al. 2022

> We present a theoretical model to investigate the hydrodynamics of a floating flexible circular wave energy converter (WEC). Decomposition in rigid and bending elastic modes of the plate allows us to investigate power extraction efficiency in monochromatic incident waves. We show that plate elasticity increases the number of eigenfrequencies, which has a positive beneficial effect on power output. We also show how plate radius and power take-off (PTO) distribution affect the response of the system and the consequent absorbed energy. This work highlights the need to extend theoretical studies and experimental investigations on flexible devices, currently seen as the future of WEC technology.

Modelling marine turbine arrays in tidal flows – Stansby & Ouro 2022

> Tidal stream turbines operate in the harsh marine environment, subjected to turbulence, wave action and wakes from upstream devices when deployed in arrays. Numerical models are invaluable to study individual and array performance and their interaction with environmental flows. To date, shallow water models and three-dimensional Reynolds averaged Navier–Stokes (RANS) simulations predominate the simulation of turbine arrays, while large-eddy simulation (LES) is becoming more widely used due to availability of high-performance computing resources. In this Vision Paper, we provide a perspective on the numerical approaches currently used for modelling tidal flows and marine turbines, suggesting future challenges envisaged in this field.

Performance and parameter optimization of a capacitive salinity/heat engine for harvesting salinity difference energy and low grade heat – Lin et al. 2022

> A novel cycle model of the capacitive salinity/heat engine mainly consisting of nano-porous super-capacitors is established for harvesting mixed free energy caused by salinity difference between the river water and the seawater, and the thermal energy due to the temperature difference. The heat engine is charged and discharged in the cycle of a low temperature brine and a high temperature fresh water, respectively. The analytical expressions of the cyclic work output and efficiency are given. General performance characteristics of the capacitive salinity/heat engine are analyzed. The temperature of the heat reservoir and salt concentration of seawater are optimized to improve the efficiency of the capacitive salinity/heat engine. The optimal selection ranges of several main parameters are provided.

Wave Power Density Hotspot Distribution and Correlation Pattern Exploration in the Gulf of Mexico – Gu & Li 2022

> Wave energy has been studied and explored because of its enormous potential to supply electricity for human activities. However, the uncertainty of its spatial and temporal variations increases the difficulty of harvesting wave energy commercially. There are no large-scale wave converters in commercial operation yet. A thorough understanding of wave energy dynamic behaviors will definitely contribute to the acceleration of wave energy harvesting. In this paper, about 40 years of meteorological data from the Gulf of Mexico were obtained, visualized, and analyzed to reveal the wave power density hotspot distribution pattern, and its correlation with ocean surface water temperatures and salinities. The collected geospatial data were first visualized in MATLAB.

Influence of blade numbers on start-up performance of vertical axis tidal current turbines – Sun et al. 2022

> To alleviate the energy crisis, the tidal energy extraction has become a hot topic in recent years. As a commonly utilized energy converter, a primary concern of vertical axis tidal turbines (VATTs) is the incapability to self-start. Previous studies have found that the starting performance has a great correlation with the number of blades. However, the

detailed effects of blade number on starting characteristic are not fully understood. Therefore, it is necessary to further assess the influences of the number and azimuthal angle of blades on starting characteristics. In this study, we investigate the effects of the blade number on start-up performance of VATTs by means of the commercial Computational Fluid Dynamic (CFD) software CFX.

A Novel Ocean Thermal Energy Driven System for Sustainable Power and Fresh Water Supply – Ma et al. 2022

The ocean thermal energy conversion (OTEC) is a potential substitute for traditional power plants in tropical islands and coastal regions. However, the OTEC power generation cycle has low thermal efficiency and the integrated utilization is imperative, in which an OTEC coupled with seawater desalination is the most attractive option. Membrane distillation (MD) has distinct advantages making itself a competitive process for seawater desalination, especially the feature that the drained warm seawater from the OTEC power plant can be recycled, improving the integrated output of the OTEC system. In this study, an innovative OTEC system coupling a power generation sub-cycle (PGC) and a water production sub-cycle (WPC) was proposed, composed of the upstream organic Rankine cycle and the downstream membrane distillation modules.

News & Press Releases

Eco Wave Power Finalizes the Production of 10 Floater Units and Commences Installation of the Floaters in the Port of Jaffa, Israel – Eco Wave Power

Eco Wave Power recently announced that it had finalized the production of all floaters required for the EWP-EDF One Project, and commenced installation of the floaters to the sea wall in the Port of Jaffa, Israel. The project's next steps are the installation of all 10 floater units, a test run in real conditions and the official connection of the power station to the grid. The system functionality and capacity tests are expected to be conducted by the end of the second quarter of this year. The installation of the floaters is all made from the land side, as opposed to the traditional use of expensive ships and divers for equipment installation in offshore wave energy installations. This further emphasizes the simplicity of the onshore nature in the work programming of Eco Wave Power's floaters shipment and installation technology.

Nova Innovation gets clearance to install five 100kW tidal turbines in Canada – Offshore Energy

Scottish tidal energy company Nova Innovation has received authorization from Fisheries and Oceans Canada (DFO) to install five 100kW in-stream tidal turbines in Petit Passage in Nova Scotia. The approval is related to the first phase of the larger 1.5MW tidal energy array project, which received approval from Nova Scotia's Department of Energy and Mines late in 2019. The latest authorization from DFO covers the development and operation of a 500kW in-stream tidal energy array, that will be conducted in two distinct

phases – Phase 1a and Phase 1b. The five turbines to be used in this phase are Nova M100-D – 2-bladed, bi-directional, horizontal axis turbines rated at 100kW each. Nova believes the smaller profile of its M100-D turbines, at 100 kW, will enable them to withstand the Fundy tide and operate without endangering marine life.

UMACK anchor ready for deployment – CorPower Ocean

The first commercial scale UMACK (Universal Mooring, Anchor & Connectivity Kit) anchor has completed pre-deployment checks at CorPower's facility in Viana do Castelo port, northern Portugal. Developed in a European consortium, the innovative UMACK technology represents a geotechnical breakthrough allowing 4-5 times higher vertical load capacity compared to a standard monopile of the same size. This may enable efficient low-cost anchoring for offshore structures across sectors such as wave & tidal energy, floating wind and aquaculture. The pioneering anchor solution will first be deployed with CorPower's C4 Wave Energy Converter at the Agucadoura site, part of the flagship HiWave-5 Project.

TU Delft researchers tackling power variability in hybrid marine energy parks – Offshore Energy

Researchers from Delft University of Technology, also known as TU Delft, have started exploring the interactions between different renewable energy sources to reduce the variability in electricity supplied to households as part of €45 million EU-SCORES project. The TU Delft team is developing a reliable modelling framework that can be the basis for any type of renewable energy, power generation and market analysis, with accurate long-term climate descriptions. To demonstrate that hybrid energy parks at sea make a sustainable, resilient, reliable and commercially viable energy supply possible, the partners in the EU-SCORES project are jointly building two hybrid energy demonstration projects in Portugal and off the Belgian coast.

How PSU Will Put $4.5 M to Work Advancing Wave Energy – Portland State University

With a $4.5 million grant from the U.S. Department of Energy (DOE)'s Water Power Technologies Office, Portland State University (PSU) researchers will test and validate a new type of electromagnetic device that turns ocean waves into a source of renewable energy. This novel technology will be able to harness more power from waves—possibly 10 times more—than currently available technology. The project is part of a $25 million initiative through DOE to advance the commercial viability of wave energy through open water testing at the PacWave site on the Oregon Coast. At PSU, Jonathan Bird and his group will focus on refining the design of the electromagnetic component parts. The Portland-based startup AquaHarmonics will integrate the components into the buoy-like wave energy converter, which will be tested in a wave tank and then at the PacWave site.