TETHYS ENGINEERING BLAST

30 July 2021

Tethys Engineering is an online knowledge base 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. If you have specific content you would like circulated to the greater marine energy community, please send it to tethys@pnnl.gov for consideration.

Announcements

Frequently Asked Questions

Do you have questions about *Tethys Engineering*? Check out the Frequently Asked Questions page to learn more about *Tethys Engineering* content, features, and how to contribute!

DOE Request for Information

The United States (US) Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy recently released a Request for Information to understand the current barriers and actions needed to make its funding opportunities and innovation and entrepreneurship activities more inclusive, just, and equitable. Responses are due by 5:00pm EDT (9:00pm UTC) on 6 August 2021.

Calls for Abstracts

The American Geophysical Union (AGU) is accepting abstracts for the AGU Fall Meeting 2021, which will take place online and in New Orleans, Louisiana (US) on 13-17 December 2021. Session GC074 - Renewable Energy: Marine and Hydrokinetic will focus on the science, technology, and policy issues of renewable marine-, wave-, current-, and tidal-energy resources and conversion technologies. Abstracts are due by 4 August 2021.

The Marine Technology Society and Oceanic Engineering Society are now accepting abstracts for OCEANS 2022 Chennai. The conference and exposition will take place in Chennai, India on 21-24 February 2022. Abstracts are due by 15 August 2021.

The Call for Abstracts for Oceanology International, which includes a conference track on offshore energy development, is now open. The conference and exhibition will take place in London, United Kingdom (UK) on 15-17 March 2022. Abstracts are due by 31 August 2021.

Funding & Testing Opportunities

The Offshore Renewable Energy (ORE) Catapult's Marine Energy Engineering Centre of Excellence (MEECE) has launched an Innovation Challenge to support UK-based applicants developing monitoring methodologies for tracking underwater species behavior in and around tidal stream turbines. Applications are due 11 August 2021.

The US DOE has issued a Funding Opportunity Announcement (FOA) titled "Advancing Wave Energy Technologies through Open Water Testing at PacWave" to support research and development (R&D) at PacWave South and advance wave energy technologies toward commercial viability. Concept papers are due 13 August 2021 and full applications are due 5 October 2021. View the FOA for more details here.

The Oceanic Platform of the Canary Islands (PLOCAN) has opened its Summer Access Call for 2021. Applicants interested in accessing PLOCAN facilities and services are encouraged to contact PLOCAN before submitting their proposal. Applications due 20 September 2021.

Student & Employment Opportunities

The University of Edinburgh is seeking a Research Associate in the Fluid Mechanics of Morphing Blades. The position will contribute to experimental and theoretical research on the fluid-structure interaction of morphing blades for wind and tidal turbines. Applications are due by 9 August 2021.

The Delft University of Technology is seeking candidates for a PhD in Variable Wave Energy Converter Farms. This position will investigate wave structure interactions in large scale wave energy converter farms with different geometries, leading to the design of tools and methodologies. Applications are due by 1 September 2021.

Upcoming Events

Upcoming Webinar

As part of its *R&D Deep Dive Webinar Series*, the US DOE Water Power Technologies Office (WPTO) is hosting "Seeding Water Power Innovation: An R&D Showcase" from 1:00-5:00pm EDT (5:00-9:00pm UTC) on 11 August 2021. During the webinar, WPTO will host a showcase of different projects funded by their novel National Lab Seedlings Program. Register here.

Upcoming Conferences

The Offshore Technology Conference (OTC 2021) will take place 16-19 August 2021 in Houston, Texas (US) and virtually. Register here.

Seanergy 2021, an international forum dedicated to offshore renewable energy, will take place 21-24 September 2021 in Nantes and Saint-Nazaire, France. Register here.

New Documents on *Tethys Engineering*

Development and calibration of a high-resolution model for the Gulf of Mexico, Puerto Rico, and the U.S. Virgin Islands: Implication for wave energy resource characterization – Nabi Allahdadi et al. 2021

> A high-resolution, unstructured Simulating WAves Nearshore (SWAN) model with a resolution of 200 m within 20 km of the coast was developed to provide a reliable setting for a long-term wave energy characterization of the Gulf of Mexico, Puerto Rico, and the U.S. Virgin Islands. A thorough model parameter sensitivity analysis, as well as a calibration process for selecting the whitecapping dissipation formulation, were conducted. Sensitivity analyses for the simulation timestep and number of iterations highlighted the less-studied interplay between these parameters in SWAN, which can substantially affect simulation accuracy and cost and is vital for the next step long-term simulation of the wave energy resources.

Tidal turbine performance and near-wake characteristics in a sheared turbulent inflow – Vinod et al. 2021

> Turbulent non-homogenous flow environments at high-energy tidal sites lead to variation in power performance of tidal stream turbines. In addition, non-uniform loading due to combined effects of shear and elevated inflow turbulence affects device survivability. In the current study, an active-grid turbulence generator is used to mimic sheared-turbulent inflow representative of the flood (low shear) and ebb tides (high shear). The performance and near-wake characteristics of a turbine model measured in the sheared-turbulent inflow conditions are compared to conditions where the flow velocity is uniform with low and elevated turbulence intensities (T_i). The sheared-turbulent inflows were observed to result in a 5–15% drop in maximum power coefficient when compared to the low T_i case.

Numerical simulation of salinity gradient power generation using reverse electrodialysis – Jin et al. 2021

> Reverse electrodialysis (RED) is a promising technology that directly converts salinity gradient energy into electrical energy through the directional permeation of ions across the ion exchange membranes (IEMs). Fundamental understanding of the multi-physical RED process requires a reliable description of all the related phenomena involved in the

process. In this work, a two-dimensional RED model based on the Nernst-Planck framework was developed. The fluid dynamics and ion transport were modelled in a full-length cell pair domain by employing the continuity, Navier-Stokes and Nernst-Planck equations complemented by the Donnan exclusion theory and local electroneutrality. The experimentally inaccessible IEM diffusion coefficients were analytically determined using the counterion condensation theory incorporating the tortuosity effect.

Comparison and Validation of Hydrodynamic Theories for Wave Energy Converter Modelling – Leary et al. 2021

Dynamic Wave Energy Converter (WEC) models utilize a wide variety of fundamental hydrodynamic theories. When incorporating novel hydrodynamic theories into numerical models, there are distinct impacts on WEC rigid body motions, cable dynamics, and final power production. This paper focuses on developing an understanding of the influence several refined hydrodynamic theories have on WEC dynamics, including weakly nonlinear Froude-Krylov and hydrostatic forces, body-to-body interactions, and dynamic cable modelling. All theories have evolved from simpler approaches and are of importance to a wide array of WEC archetypes. This study quantifies the impact these theories have on modelling accuracy through a WEC case study.

Assessing Hydrokinetic Energy in the Mexican Caribbean: A Case Study in the Cozumel Channel – Graniel et al. 2021

This paper presents a techno-economic assessment of hydrokinetic energy of Cozumel Island, where ocean currents have been detected, but tourist activities are paramount. The main objective of this research is to identify devices that have been used to harvest hydrokinetic power elsewhere and perform an economic analysis as to their implementation in the Mexican Caribbean. First, the energy potential of the area was evaluated using simulated data available through the HYCOM consortium. Then, for four pre-commercial and commercial turbines, technical and economic analyses of their deployments were performed. Socio-environmental constraints were reviewed and discussed. Three optimal sites were identified, with an average annual hydrokinetic energy density of 3–6 MWh/m2-year.

Three-Dimensional Performance Analysis of a Radial-Inflow Turbine for Ocean Thermal Energy Conversion System – Chen et al. 2021

Turbine is one of the key components of the ocean thermal energy conversion system (OTEC), and its aerodynamic performance and geometric dimension affect the performance of the system directly. This paper proposes a design method for the radial inflow turbine suitable for the ocean thermal energy conversion based on the parameter optimization of the ocean thermal energy conversion system. Aiming at the application characteristics of marine thermal energy conversion in a small temperature difference environment and the special thermophysical properties of the organic working fluid in this environment, one-dimensional design and three-dimensional CFD analysis of the turbine is separately done, of which the results were compared.

News & Press Releases

Spanish Mutriku plant sets record for continuous wave power production – Offshore Energy

> The Mutriku wave power plant, located in the Basque Country in northern Spain, has reached a ten-year milestone of uninterrupted clean power generation, becoming the longest operating commercial plant of its kind in the world. Owned by the Basque energy agency, Ente Vasco de la Energia, and inaugurated in 2011, the plant boasts 16 turbines that exploit the movement of the waves to produce clean power that is fed directly to the public electricity grid of the Basque Country. Sited on the breakwater protecting the entrance to the harbour at Mutriku, a coastal village after which the facility was named, Mutriku plant also holds a record for a wave energy plant with the longest operating hours. Equipped with oscillating water column units with a total installed capacity of 296kW, the plant is said to produce approximately 300MWh annually.

World's most powerful tidal turbine, the O2, starts exporting clean power – Orbital Marine Power

> Orbital Marine Power's O2, the world's most powerful tidal turbine, has commenced grid connected power generation at the European Marine Energy Centre (EMEC) in Orkney. The innovative, floating turbine is anchored in the Fall of Warness where a subsea cable connects the 2MW offshore unit to the local onshore electricity network. Manufactured and launched in Dundee earlier in the year before being towed up to Orkney, the O2 is Orbital's first commercial turbine and represents the culmination of more than 15 years of world leading product development in the UK. The 74m long turbine is expected to operate in the waters off Orkney for the next 15 years with the capacity to meet the annual electricity demand of around 2,000 UK homes with clean, predictable power from the fast-flowing waters.

Wello is transforming Basque energy as they deploy their wave energy converter off coast of Bilbao – Wello

> Sustainable wave energy has just arrived at the Basque Country. After the trials and tribulations of the global pandemic, Wello's 600 kW Wave Energy Converter has been deployed at the Biscay Marine Energy Platform off the coast of Armintza. Wello's Wave Energy Converter sets to continue the successes of its predecessor, continuing to generate direct to grid energy. The device will be undergoing 2 years of real-world ocean conditions, during this period Wello is holding several tests and trials to enable full validation of its wave energy conversion technology. Inspired by the natural movement of waves, the shape and power take of principle of The Penguin is rotation. It's simple design and operating principle means it's low maintenance while still producing huge amounts of energy.

Major £10M project aims to unlock untapped potential of ocean renewable energy fuels – University of Strathclyde

An innovative £10M research project will investigate the potential of harnessing offshore wind and marine renewable energy to produce zero carbon hydrogen and ammonia fuels. The University of Strathclyde will lead the multi-disciplinary Ocean-REFuel: Ocean Renewable Energy Fuels project, which will explore ways of converting ocean energy into fuels for use in heating, energy storage and difficult to decarbonise transport applications. The consortium includes world-leading research teams from the Universities of Nottingham, Cardiff, Newcastle and Imperial College London. The project is funded by the Engineering and Physical Sciences Research Council, industry, and the partner universities, who have also pledged a total of nine linked PhD studentships.

C-Power autonomous offshore power systems promise to unlock new marine applications through efficient energy delivery – Vicor Power

Columbia Power Technologies, Inc. (C-Power), a global leader in wave energy systems based in Corvallis, Oregon, is helping to expand the marine economy by providing reliable, cost-effective energy generation and storage, data and communication services for offshore assets. C-Power Autonomous Offshore Power Systems (AOPS) capture mechanical wave energy and convert it into usable power for a wide range of oceanic applications such as offshore oil and gas exploration and production, offshore carbon sequestration, oceanographic research, aquaculture and homeland defense. To achieve its goals at the lower end of the power spectrum, C-Power created a SeaRAY AOPS design with a high power-to-weight ratio using power conversion technology from Vicor Corporation.