TETHYS ENGINEERING BLAST

27 January 2023

Tethys Engineering is an online knowledge hub that facilitates the exchange and dissemination of information on the technical and engineering aspects of marine energy, as part of the *PRIMRE* universe. 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!

Announcements

Tethys Engineering Blast → *PRIMRE* Blast

In order to highlight more of the data, information, and resources available within the *Portal and Repository for Information on Marine Renewable Energy (PRIMRE)*, we will be rebranding the *Tethys Engineering* Blast as the *PRIMRE* Blast in the coming weeks. We will continue to include all the regular content but will expand the newsletter to include content from the other *PRIMRE* Knowledge Hubs as well. Please reach out to tethys@pnnl.gov if you have any questions.

FOSWEC Control Competition

Sandia National Laboratories, in conjunction with Oregon State University and Evergreen Innovations, is hosting the FOSWEC Digital-Twin ("FOSTWIN") Control Competition to develop an effective power absorption controller for a digital twin of the Floating Oscillating Surge Wave Energy Device (FOSWEC). An informational webinar will take place on 6 February 2023 from 9:00-10:30am MST (4:00-5:30pm UTC). Submissions are due 16 June 2023.

Calls for Abstracts

The Call for Abstracts for the 15th European Wave and Tidal Energy Conference Series (EWTEC 2023) is open through 28 January 2023. Full papers will be due 27 May 2023. EWTEC will take place on 3-7 September 2023 in Bilbao, Spain.

The Partnership for Research in Marine Renewable Energy (PRIMaRE) has opened the Call for Abstracts for the 10th PRIMaRE Conference through 10 March 2023. The conference will take place on 27-28 June 2023 in Bath, England.

Funding & Testing Opportunities

The European Commission has launched two new Calls for Proposals under the European Maritime, Fisheries and Aquaculture Fund aimed at supporting careers and regional projects for a sustainable blue economy in European Union sea basins. Proposals are due 31 January 2023.

The Basque Energy Agency has opened the Call for Tenders for its TurboWave Pre-Commercial Public Procurement program for the development of air turbines that will be implemented in the Mutriku wave power plant. An informational webinar will be held on 31 January 2023 at 9:00am UTC. Applications are due 16 February 2023.

The U.S. Testing and Expertise and Access for Marine Energy Research (TEAMER) program, sponsored by the U.S. Department of Energy's Water Power Technologies Office and directed by the Pacific Ocean Energy Trust (POET), is now accepting Request for Technical Support 9 applications until 3 March 2023. Open Water Support applications may be submitted at any time.

The European Commission has also launched the third call for large-scale projects under the European Union Innovation Fund. The call is open until 16 March 2023 for projects located in European Union Member States, Iceland, and Norway.

Student & Employment Opportunities

The European Marine Energy Centre (EMEC) is seeking a Project Manager to manage projects across EMEC's project portfolio, including wave, tidal, hydrogen, offshore wind, and integrated energy systems. Applications are due 31 January 2023.

The Environmental Research Institute (ERI) is recruiting for a Research Fellow in Renewable Energy and the Environment to advance understanding of the biophysical interactions of marine and offshore renewable energy with the environment. Applications are due 3 February 2023.

ERI is also recruiting for a Research Fellow in Marine Sensing to support design, development, and deployment of autonomous marine multi-sensor platforms to investigate the environmental effects of marine and offshore renewable energy. Applications are due 3 February 2023.

Net Zero Atlantic is seeking fulltime Project Managers to support the successful delivery of projects in our renewable energy research portfolio. Applications are due 10 February 2023.

EMEC is also seeking a Hydrogen Engineering Technician to assist our Operations Team with the specification, operation, and maintenance of EMEC's hydrogen assets. Applications are due 20 February 2023.

The National Renewable Energy Laboratory is seeking Undergraduate/Graduate (Summer) Interns to support water power technology and modeling analysis.

Swift Anchors, which develops anchors and subsea tooling for the floating wind, wave, and tidal industries, is seeking a Senior Geotechnical Engineer and a Mechanical Design Engineer.

Upcoming Events

Upcoming Conferences

Oceanology International Americas will take place 14-16 February 2023 in San Diego, California, U.S. Register here.

The 12th Annual North Carolina Renewable Ocean Energy Symposium will take place 20-21 March 2023 in Wanchese, North Carolina, U.S. Register here by 24 February 2023.

The Marine Energy Wales Conference 2023 will take place 21-22 March 2023 in Swansea, Wales.

New Documents on *Tethys Engineering*

What are the UK power system benefits from deployments of wave and tidal stream generation? – Pennock and Jeffrey 2023

> This study quantifies the potential power system benefits that the UK stands to gain through the deployment of marine energy technologies (wave and tidal stream) in domestic waters. This study focuses on a 2050 net-zero compliant scenario for the power system of Great Britain. System benefits from marine energy are quantified over a range of metrics: increased renewable dispatch, decreased peaking generation and fossil fuel dispatch, decreased storage requirements and decreased dispatch costs. This work is founded on deployment scenarios, where cost, performance, and systematic conditions are defined by the 2030 levelised cost of energy (LCOE) targets in the Strategic Energy Technology Plan for Ocean Energy.

A review of geographic information system (GIS) and techno economic (TE) software tools for renewable energy and methodology to develop a coupled GIS-TE software tool for marine renewable energy (MRE) – O'Connell et al. 2023

> Accurate and up-to-date Geographic Information System (GIS) and Techno Economic (TE) tools are pertinent to helping to develop the renewable energy sector. This paper reviews the state of the art in existing GIS and TE tools for renewable energy and proposes a methodology to develop a coupled GIS-TE software tool that is geared specifically to Marine Renewable Energy (MRE) applications and bespoke to Irish and Western UK waters. Methods for approaching GIS and TE analysis within existing tools

for renewable energy are presented and compared. Many existing tools of this nature have some interesting functionalities, but most are unsuitable for MRE; are limited by a lack of information on both the technology and the site; and focus solely either on GIS or TE aspects of analysis.

Deep Learning-Based Prediction of Unsteady Reynolds-Averaged Navier-Stokes Solutions for Vertical-Axis Turbines – Dorge and Bibeau 2023

The following study investigates the effectiveness of a deep learning-based method for predicting the flow field and flow-driven rotation of a vertical-axis hydrokinetic turbine operating in previously unseen free-stream velocities. A Convolutional Neural Network (CNN) is trained and tested using the solutions of five two-dimensional (2-D), foil-resolved Unsteady Reynolds-Averaged Navier-Stokes (URANS) simulations, with free-stream velocities of 1.0, 1.5, 2.0, 2.5, and 3.0 m/s. Based on the boundary conditions of free-stream velocity and rotor position, the flow fields of x-velocity, y-velocity, pressure, and turbulent viscosity are inferred, in addition to the angular velocity of the rotor. Three trained CNN models are developed to evaluate the effects of (1) the dimensions of the training data, and (2) the number of simulations used as training cases.

Thermodynamic performance of a radial-inflow turbine for ocean thermal energy conversion using ammonia – Zhang et al. 2023

Aiming at the high-efficiency ocean thermal energy conversion (OTEC) application, a 30 kW radial-inflow turbine using ammonia was constructed via the one-dimensional design. In addition, a 3D computational fluid dynamics (CFD) simulation was carried out to research the turbine performance. Furthermore, the effects of blade tip clearance on the flow characteristic in turbine were elucidated and the turbine performance under the off-design conditions was examined. It is indicated that the performance of the designed turbine is satisfactory with a theoretical isentropic efficiency of 85.2% under the design condition. The leakage flow encounters the scraping flow after leaving the tip clearance, forming the vortexes in the cross-section of the flow passage, which decreases the turbine efficiency.

Uncertainty estimation in wave energy systems with applications in robust energy maximising control – Farajvand et al. 2023

Under control action, wave energy devices typically display nonlinear hydrodynamic behaviour, making the design of energy maximising control somewhat onerous. One solution to approach the optimal performance for nonlinear control problem under model mismatches is to employ a linear control strategy, which can be robust to linear model mismatches. However, accurate characterisation of the uncertainty in the linear model is vital, if the controller is to adequately capture the full extent of the uncertainty, while not being overly conservative due to overestimation of the uncertainty. This paper describes a procedure, employing CFD-based numerical tank experiments, to accurately produce a nominal linear empirical transfer function model, along with an accurate estimate of the uncertainty bounds in that linear model, due to hydrodynamic uncertainty.

Status of Micro-Hydrokinetic River Technology Turbines Application for Rural Electrification in Africa – Awandu et al. 2022

> With majority of the rural population in Africa lacking electricity, there is need for a low-tech system that utilizes river flow to generate just enough energy for normal operation in these regions. Micro-hydrokinetic river turbine technology (μ-HRT), which offers less intermittency, can potentially contribute to sustainably electrifying Africa rural areas. The technology has been adopted by few countries worldwide, with limited comprehensive study in Africa even though the technology seems viable for use in African rivers. This paper reviewed the status of the μ-HRT applications in Africa and some of the barriers to its development. The study found out that the technology has not been vastly developed in Africa.

News & Press Releases

EVOLVE Project uncovers 70GW of viable ocean energy in GB, Ireland and Portugal, to unlock future net-zero energy systems – CorPower Ocean

> Official results from the pan-European EVOLVE project involving world-leading academics, research institutions and technology developers were recently released, providing a firm evidence base supporting the acceleration of ocean energy in Europe's future energy system. The spatial modelling study focused on three specific territories – Great Britain, Ireland and Portugal, identifying close to 60GW of practically viable wave energy and 10GW of tidal stream energy. More specifically, results show resources of 34.8GW in Great Britain, 18.8GW in Ireland and 15.5GW in Portugal. Projections further indicate that 10GW of ocean energy installed in Great Britain alone could save £1.46bn per year in power system dispatch costs.

OSU-led wave energy testing facility reaches key construction milestones – OSU

> The last major pieces of the contract to build the wave energy test facility PacWave South have been executed, paving the way for the completion of the Oregon State University-led (OSU) facility off the coast of Newport. PacWave South will be the first utility-scale, grid-connected wave energy test site in the United States. The facility will offer wave energy developers the opportunity to try different technologies for harnessing the power of ocean waves and transmitting that energy to the local electrical grid. PacWave project leaders recently authorized the procurement of more than 80 kilometers of cable that will deliver wave-generated energy to a shoreside facility where it can be fed to the local electrical grid.

WEDUSEA wave energy project makes design and engineering progress – Offshore Energy

> The partners in the €19.6 million Wave Energy Demonstration at Utility Scale to Enable Arrays (WEDUSEA) project have made significant progress in the engineering and

design scope of development, building on learnings from previous wave energy initiatives. All the design elements are currently in the process of being finalized by the project partners, with progress being made across all tasks in WEDUSEA's Front End Engineering Design and Procurement work package. The project will demonstrate OceanEnergy's grid-connected 1MW floating wave energy converter OE35 at EMEC's test site in Scotland. Being developed by 14 international partners, the project is ultimately expected to is to create a technology deployment pathway for a 20MW pilot farm by achieving a significant decrease in the levelized cost of energy for wave energy.

TIGER secures consent for two turbines at Morbihan site – Interreg France (Channel) England

The Interreg-funded Tidal Stream Industry Energiser (TIGER) project has secured consent for two new experimental turbines to be installed in the Gulf de Morbihan. TIGER is a game-changing project for the European tidal stream energy sector, driving collaboration and cost reduction through tidal turbine installations in the UK and France. The two D08-250 type tidal turbines, with a power capacity of 250kW, will be installed for 3 years providing a crucial opportunity to test the technology. The test site will also allow the project to carry out environmental monitoring and identify ways to reduce costs while exploiting local carbon-free energy. Turbine construction and deployment will take place toward the end of this year or early 2024.

Islands Growth Deal to Release £393 Million Investment – EMEC

An agreement to invest £100 million in the future economic prosperity of Orkney, Shetland and the Outer Hebrides has been signed in Orkney by UK and Scottish Government Ministers and the Council Leaders of the three island groups. Up to 1,300 jobs and £393 million of investment is anticipated to result from the signing of the transformative Islands Growth Deal between UK Government, Scottish Government, Comhairle nan Eilean Siar, Shetland Islands Council, and Orkney Islands Council. Over a ten-year period, the Deal will invest in 16 projects and programmes. The first year of the ten-year programme is anticipated to see investment across the islands, including in the pan-island Islands Centre for Net Zero, which is being led by EMEC in Orkney.

TidalKite breezes through preliminary trials ahead of deployment offshore Netherlands – Offshore Energy

Dutch company SeaQurrent has conducted first tests on its TidalKite tidal energy device as it prepares for upcoming deployment offshore the Netherlands. According to SeaQurrent, the focus of the first tests was to calibrate the TidalKite, check all its functions, and fine tune control systems, handling procedures and equipment. Demonstration of the TidalKite will continue throughout 2023, at SeaQurrent's grid connected test site, near Ameland in the Dutch Wadden Sea, after final preparational tuning, the company added. SeaQurrent is developing a full-scale multi-wing underwater kite that exploits the tides to produce electricity.