Appendix C: Example WEC Device Technologies

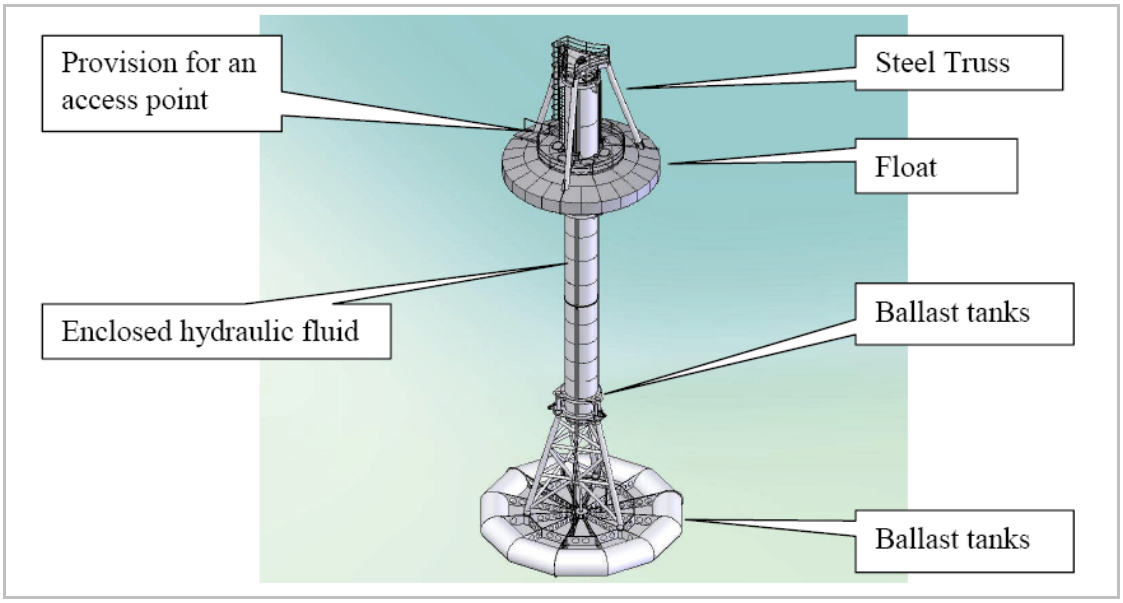
Introduction

Over the lifetime of the Northwest National Marine Renewable Energy Center's Wave Energy Test Project, (Proposed Project) a number of wave energy conversion devices are expected be tested. The specific WEC device prototypes and models that would be tested as part of the Proposed Project are not presently known, with the exception of the WET-NZ device, which has a planned deployment at the project site in August of 2012 and will undergo testing in 2012 and 2013. As described in Section 2.7 of the Environmental Assessment (EA) for the Proposed Project, general WEC device designs that are reasonably expected as part of this Proposed Project include pitching/surging/heaving/sway devices, point absorber devices, and oscillating water column devices capable of operating in water depths of approximately 55 meters (180 feet). Examples of these designs are provide in this Appendix and include the most probable types of devices that could be tested with the Proposed Project. These examples provide a basis for the analysis of effects of the Proposed Project that is included in the EA. Other WEC devices proposed for future tests would require authorization by the U.S. Army Corps of Engineers (Corps) pursuant to Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act prior to their deployment and would undergo environmental reviews under this process.

Ocean Power Technologies PowerBuoy®

The PowerBuoy® design, developed by Ocean Power Technologies (OPT), is one of the most widely deployed WEC device designs in the world. Presently, a 10-buoy test array of the PB150 PowerBuoy® is proposed for deployment in Reedsport, Oregon (Figure 1). The PB150 is a utility-scale 150 kilowatt (kW) buoy that—in the initial design—contains hydraulic fluid, which is cycled as the buoy moves up and down with the waves. The moving fluid or mechanical parts are used to spin a generator, which produces electricity. The buoy is approximately 35 meters (115 feet) tall (of which approximately 9 meters [30 feet] project above the water's surface) and 11 meters (36 feet) in diameter. It is held in place by a three-point mooring system (Reedsport OPT Wave Park 2010).

Figure 1. Ocean Power Technologies PB150 PowerBuoy®



Source: Reedsport OPT Wave Park 2010.

Embley Energy SPERBOY™

The SPERBOY™ (Figure 2), developed and patented by Embley Energy, is a floating oscillating water column device consisting of a buoyant structure with a submerged, enclosed column. Housed above the oscillating water column on top of the buoy is the plant: turbines, generators, and associated system facilities. Air displaced by the oscillating water column is passed through turbine generators above the water's surface. The device can be deployed in deep water to maximize energy production. The entire body floats and maintains optimum hydrodynamic interactions for the prevailing wave spectrum, maximizing energy capture. The total height of the device is approximately 50 meters (164 feet), with 35 meters (115 feet) of the device below water. The diameter of the SPERBOY™ is approximately 30 meters (98 feet[1]) (U.S. Department of Energy 2008).

[1] Dimensions represent maximum envisaged size of a full-scale commercial unit

Figure 2. Embley Energy SPERBOY™

Source: U.S. Department of Energy 2008.

Ocean Energy Ltd. OEBuoy

The OEBuoy device is a floating system with the mouth of the oscillating water column facing away from the wave direction that uses wave energy to compress air in a chamber and pump it through an air turbine system (Figure 3). The design isolates the power conversion system above and away from the seawater and also provides high-speed air flow to the turbine. The OEBuoy has undergone several years of development and testing. In 2006 and 2007, Ocean Energy Ltd. conducted a winter sea trial on the 25,401-kilogram (28-ton), 1:4-scale OEBuoy prototype at the Irish Marine Institute test site in the waters off of Galway, Ireland (U.S. Department of Energy 2008). OEBuoy is the only device of its kind to have undergone 2 years of rigorous testing and is now ready for market.

Figure 3. OEBuoy (1:4 Scale)

Source: U.S. Department of Energy 2008.

Floating Power Plant A/S FPP Poseidon

The Poseidon is based on a hydraulic power take-off system. It is designed for an offshore location in areas with considerable variation in wave activity levels and has a high efficiency and energy production. The Poseidon uses a float that absorbs the energy from incoming waves, and uses a piston pump to transform energy from the wave into water pressure. That water is then sent through a turbine to generate electricity. Poseidon was developed by the Danish company, Floating

Power Plant A/S (FPP). The Poseidon 37, a 327,000-kilogram (360-ton) and 37-meters (121-foot)-wide hybrid renewable energy demonstration plant (Figure 4), was launched in 2008 off the coast of Lolland in Denmark (Floating Power Plant 2011). Although the Poseidon 37 can be configured with wind turbines, any Poseidon device tested as part of the Proposed Project would include wave energy components only.

Figure 4. Poseidon 37 (Shown with Wind Turbine Configuration)

Source: Floating Power Plant 2011.

FPP has also developed and tested Poseidon models of the following sizes (Floating Power Plant A/S 2011):

- 2.4 meter (7.9-foot) wave front, system test
- 15 meter (49-foot) wave front, floater test
- 4 meter (13-foot) wave front, system test

References

Floating Power Plan A/S. 2011. Home of Poseidon. Available: <http://www.poseidonorgan.com/> Accessed May 9, 2011.

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U.S. Department of Energy. 2008. Marine and Hydrokinetic Technology Database. Last revised: November 25, 2008. Available: <http://www1.eere.energy.gov/windandhydro/hydrokinetic/default.aspx>. Accessed: February 24, 2010.