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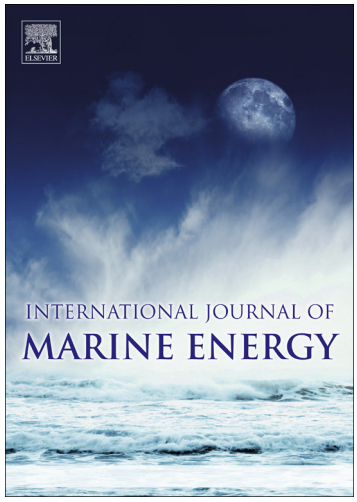

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ABSTRACT

The National Renewable Energy Laboratory and Ocean Power Technologies (OPT) conducted a collaborative code validation and design optimization study for OPT's PowerBuoy wave energy converter (WEC). NREL utilized WEC-Sim, an open-source WEC simulator, to compare four design variations of OPT's PowerBuoy. As an input to the WEC-Sim models, viscous drag coefficients for the PowerBuoy floats were first evaluated using computational fluid dynamics. The resulting WEC-Sim PowerBuoy models were then validated with experimental power output and fatigue load data provided by OPT. The validated WEC-Sim models were then used to simulate the power performance and loads for operational conditions, extreme conditions, and directional waves, for each of the four PowerBuoy design variations, assuming the wave environment of Humboldt Bay, California. And finally, ratios of power-to-weight, power-to-fatigue-load, power-to-maximum-extreme-load, power-to-water-plane-area, and power-to-wetted-surface-area were used to make a final comparison of the potential PowerBuoy WEC designs. The design comparison methodologies developed and presented in this study are applicable to other WEC devices and may be useful as a framework for future WEC design development projects.

Keywords:
Wave energy converter
Extreme condition modeling
Computational fluid dynamics
Design loads

1. Introduction

Ocean waves are a potentially vast renewable energy resource, with roughly 2 TW of power available globally [1]. Yet, wave energy technologies are less mature than other renewable energy technologies, such as wind and solar, with the majority of wave energy converters (WECs) still in the research and development stage. Although a wide range of WEC technologies and designs have been proposed [2], one of the obstacles to further progress is a lack of proven design methodologies and numerical modeling tools. The development of these tools would enable the design exploration and optimization necessary to mature WEC designs and create more cost-efficient solutions. This is similar to the early wind energy industry, in which the development of numerical modeling tools played a large part in moving the technology toward commercial viability by enabling the rapid development, analysis, and certification of turbine systems. Likewise, advancing the numerical modeling tools and design

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