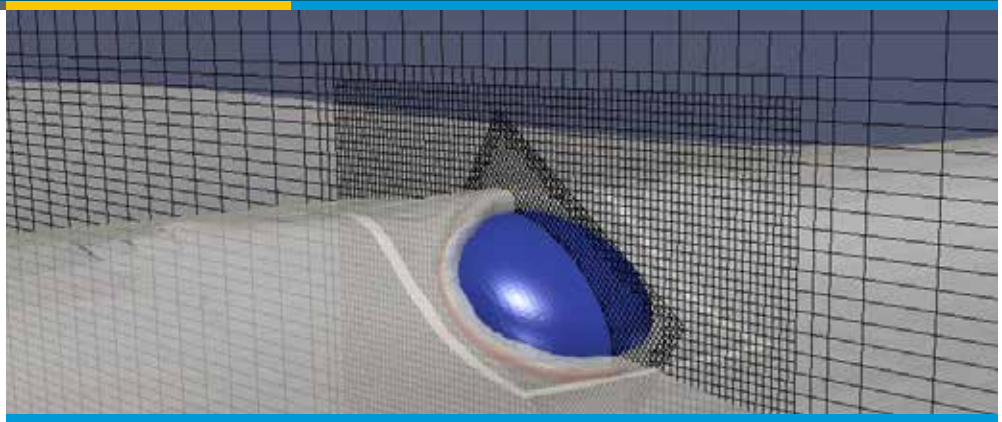
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Wave Energy Converter Extreme Conditions Modeling

Overview

The wave energy converter (WEC) extreme conditions modeling (ECM) project provides developers with improved means of predicting WEC design loads. WEC developers will use the ECM tools to reduce uncertainty and risk in the WEC design process. The ECM project is a collaboration between the National Renewable Energy Laboratory (NREL), Sandia National Laboratory (Sandia), and the U.S. Department of Energy.



Computational fluid dynamics simulation of a WEC in focused waves.

WEC State of the Art

The guidelines and engineering best practices developed for traditional offshore devices do not fully apply to WEC design. To produce energy, WECs must be designed to resonate in waves. The resulting large motions contrast with the limited motion that offshore oil and gas platforms, ships, and offshore wind turbines are designed to experience in open ocean environments.

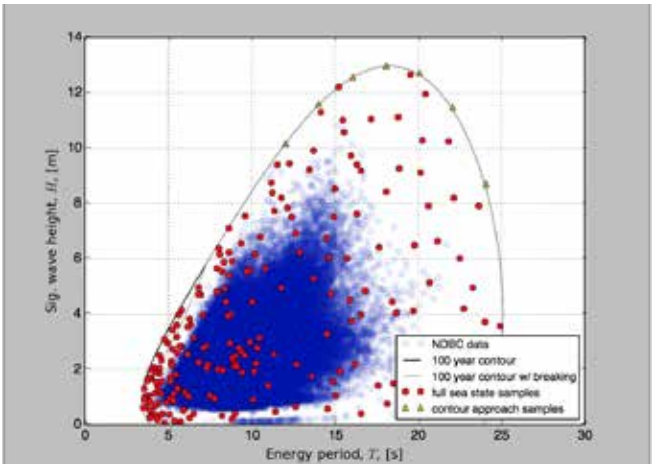
Potential Impacts of Extreme Conditions Modeling

- More accurate load predictions will lead to decreased structural and mechanical failures.
- Increased confidence in a WEC's ability to perform will reduce overly-conservative WEC designs, which unnecessarily increase levelized cost of energy.
- Streamlined process will enable analysis of WEC survival early and often in the design cycle, avoiding costly late-stage changes.
- Increased understanding of WEC design loads, uncertainties, and methodologies will lower capital and deployment costs while increasing insurer and investor confidence.

Strategy for Advancing Extreme Conditions Modeling

- **Develop and provide the tools necessary for the WEC ECM project**. Existing ECM methodologies have been adapted for application to WECs, verified, and publically provided in the form of the WEC Design Response Toolbox (WDRT).
- **Collaborate with the WEC industry to establish design loads and methodologies**. Partnering with commercial WEC developers to develop ECM methodologies will enable researchers to realize potential methodology pitfalls and validate the methodology with experimental data.
- **Create a design load case (DLC) best-practice document.** Based on a thorough review of existing ECM practices, experience gained via industry collaboration, and cooperation with international certification organizations, a preliminary WEC DLC best-practice document is being developed. The best-practice guide will clearly demonstrate a systematic DLC/ECM design process with a relevant case study.

This work was supported by the DOE Office of Energy Efficiency and Renewable Energy, Wind and Water Power Technologies Office. ■



Analysis of National Data Buoy Center (NDBC) wave data to give 100-year return contour and sampling of sea states for survival analysis performed with WEC Design Response Toolbox (WDRT).