NATIONAL LABS EXTREME CONDITIONS MODELING CAPABILITIES

DE-FOA-0001310 webinar, June 2015
Design response/load analysis

- Search both operational and survival sea states that are likely to cause extreme loading to the WECs using linear frequency domain solutions or mid-fidelity numerical methods.
- Investigate the identified extreme conditions using experimental wave tank tests or CFD simulations.
Environmental characterization

- Characterize wave environment from buoy data
- Perform iFORM analysis to obtain joint probability distribution
- Contour sampling
  - Sample just on contour of interest (e.g. 100 year return period)
  - Must apply additional safety factor for variability
- Domain-wide sampling
  - Sample evenly across levels of occurrence
  - Can produce more complete story of design response/load
Mid-fidelity modeling

WEC-Sim

Aegir

- Nonlinear potential (can be run in "linear-mode")
- Developed for Office of Naval Research
- Modeling WECs
  - Limited multi-body capabilities
  - Basic mooring and PTO modeling

WEC device specification

Relevant numerical methods

Hydrodynamics

Multi-body dynamics

PTO & mooring

WEC performance

\[ \nabla^2 \phi = 0 \]

\begin{array}{cccccc}
H_s (\text{m}) & 0.75 & 1.75 & 2.75 & 3.75 & 4.75 \\
6.7 & 10.16 & 22.12 & 42.18 & 72.14 & 102.17 \\
8.7 & 22.49 & 45.98 & 81.47 & 126.97 & 182.48 \\
10.7 & 55.62 & 111.24 & 188.87 & 296.50 & 433.13 \\
12.7 & 107.75 & 215.50 & 348.25 & 540.00 & 732.75 \\
14.7 & 197.87 & 395.75 & 698.50 & 1001.25 & 1404.00 \\
16.7 & 367.99 & 735.98 & 1268.75 & 1901.50 & 2634.25 \\
\end{array}

Electrical Power Matrix (kW)

Energy Peak Period (s)
High-fidelity numerical modeling

- Response conditioned wave profiles
  - Construct an ensemble of short design wave profiles
  - Evaluate how applicable these methods are and their computational efficiencies
- Validate CFD against experimental study (Weller et al. 2013)
Conclusion

The ECM team from Sandia and NREL will support selected project teams up to 750 labor hours. The specifics of this collaboration/support will finalized throughout the application and selection process.

Questions?: email MHKFOA1310@ee.doe.gov

All Q&As related to this FOA will be posted on EERE Exchange
- You must select this specific FOA Number in order to view the Q&As
- EERE will attempt to respond to a question within 3 business days, unless a similar Q&A has already been posted on the website

Capabilities:
- Low/mid-fidelity dynamics modeling (WEC-Sim, Aegir, ...)
- High-fidelity modeling (CFD)
- Environmental characterization and sampling
- Response statistics

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This work was supported by the U.S. Department of Energy under Contract No. DE-AC36-08GO28308 with the National Renewable Energy Laboratory. Funding for the work was provided by the DOE Office of Energy Efficiency and Renewable Energy, Wind and Water Power Technologies Office. Sandia National Laboratories is a multiprogram laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy’s National Nuclear Security Administration under contract DE-AC04-94AL85000.