

U.S. Navy Wave Energy Test Site



APPLIED RESEARCH LABORATORY
UNIVERSITY OF HAWAII

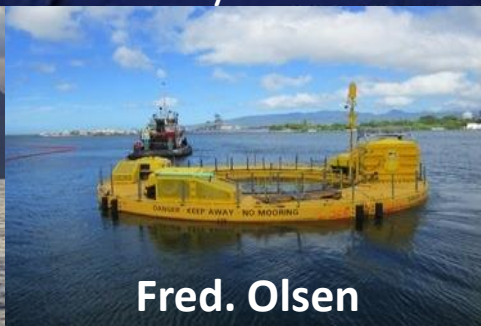


Update for International Marine Renewable Energy Conference
Washington, DC
2 May 2018

Patrick Cross, Hawaii Natural Energy Institute
University of Hawaii



NWEI



Fred. Olsen

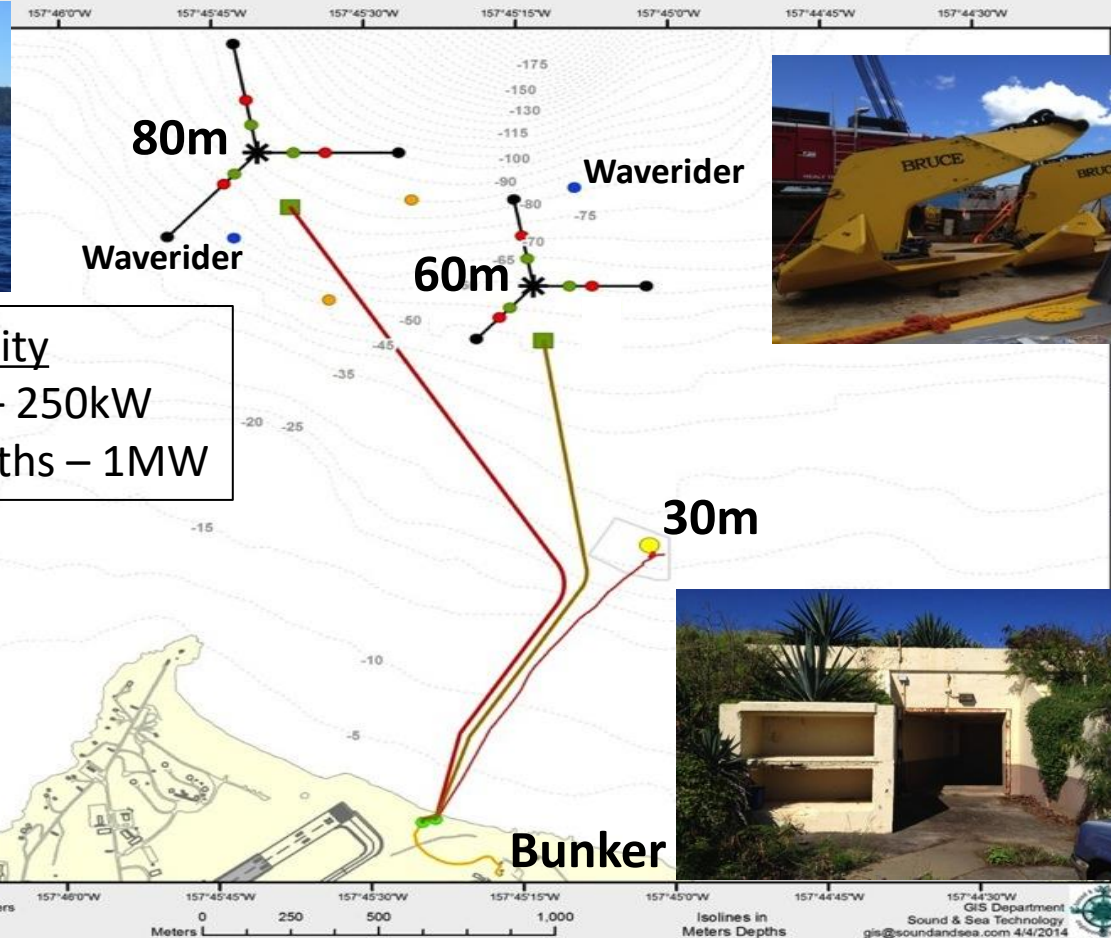


Ocean Energy

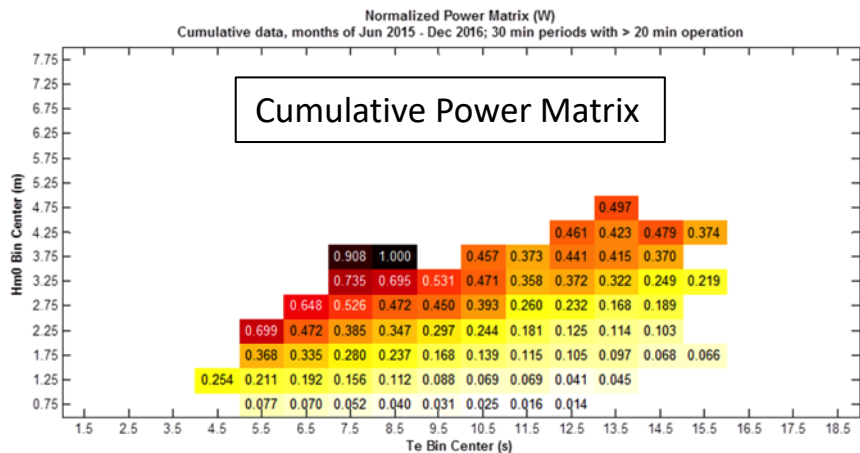
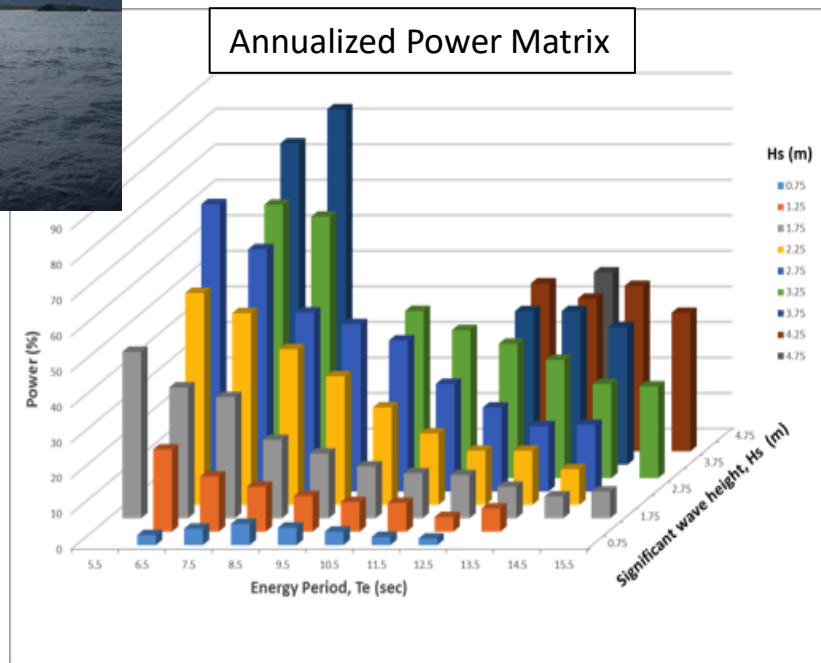
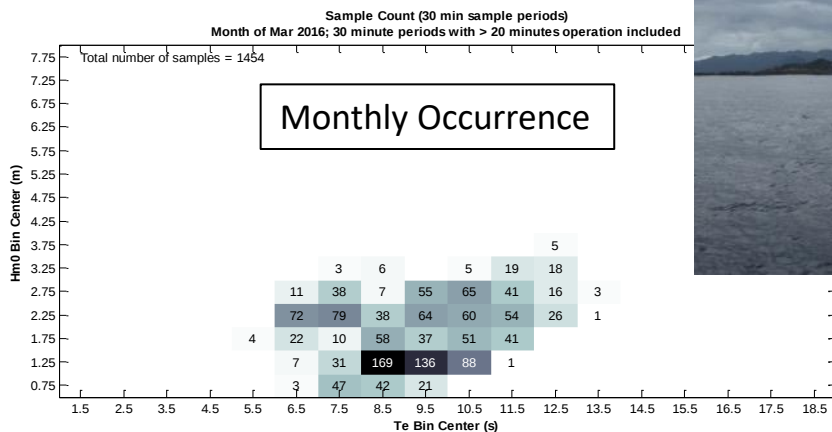


Columbia Power

WETS Layout

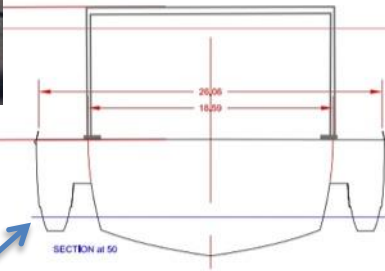


Power Performance Assessment



Performance assessed in accordance with
IEC Technical Specification 62600-100

WETS Site-Dedicated Support Vessel – Sea Engineering, Inc.



- 85 foot LOA
- 4-point mooring capability
- 10-ton A-frame lift capacity
- Knuckle-boom crane
- Deepwater dive spread
- ROV enclosure
- Reconfiguring w/added beam
- To be kept at boat harbor ~ 1hr away

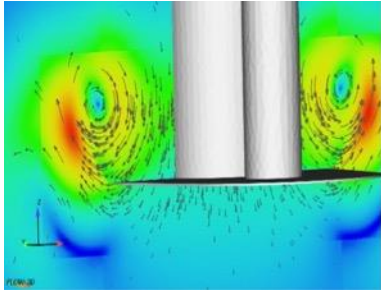


Numerical Modeling Efforts

- Develop numerical models to enhance independent assessment of WEC performance
- Model comparison with ocean test data

Hydrodynamic Motion Analysis

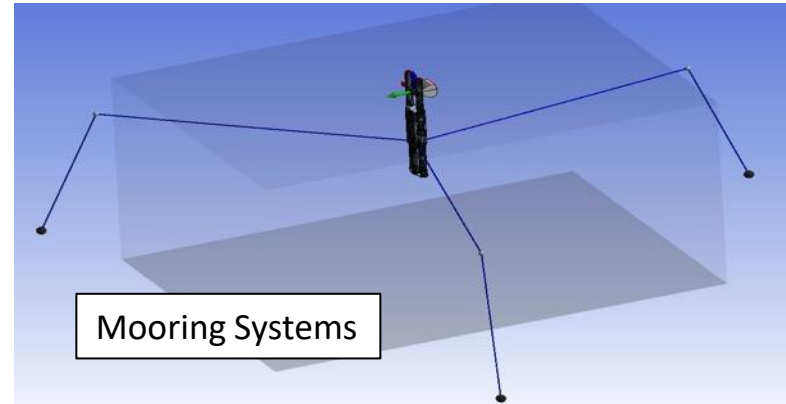
- WEC-Sim (Primary) & In-house code (Selected cases)
- Solution of equations of motion in time domain
- BEM: Estimation of hydrodynamic coefficients (Added mass, Wave damping)
- CFD : Estimation of viscous drag
- Predicted electric power, body motions
- Numerical model tuned with prototype trial data
- (Tuned) Num. model applied for comparative evaluation of versions 1 & 2 of Azura



Dr. Kumar Rajagopalan

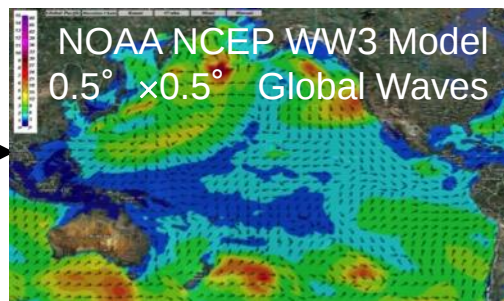
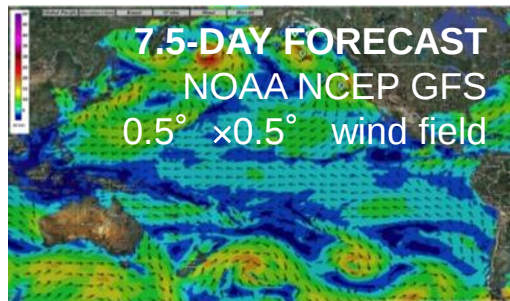
Modeling tools employed

- WEC-Sim
- Flow3D
- OpenFOAM
- ANSYS SUITE
- In-house codes



- Azura moored at 30m berth
- Mooring modeled in ANSYS AQWA

Daily 7.5-day Wave Forecast (oceanforecast.org)



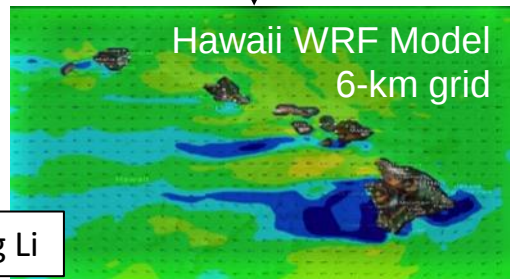
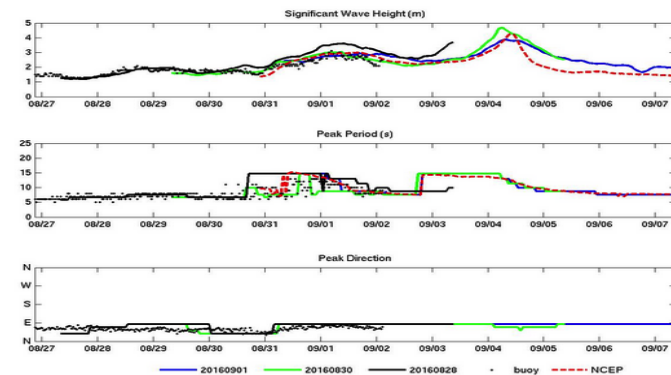
Real-time validation with measurements

- 30 buoys in the Pacific Basin
- Example on-line display for WETS

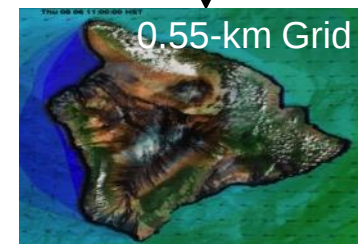
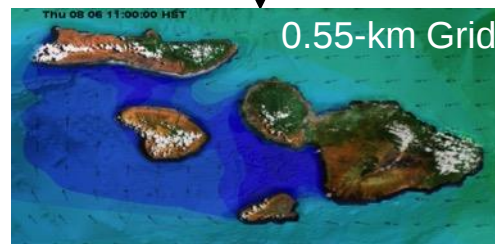
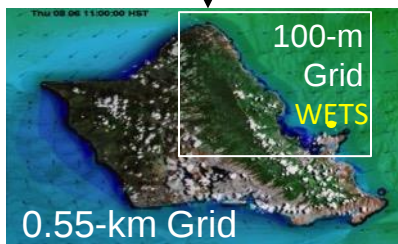
Hawaii Region, 51207_Kaneohe_Bay UH Forecast Bouy lat = 21.477 N, lon = 157.752 W

Waves are 2.8 meters/ 9.2 feet 8.7 sec. 82° dir. on Thu Sep 01 2016 6 PM HST

[7.5 Day forecast plot](#) [3D spectral animation](#) [7.5 Day forecast table](#) [Performance history](#)
[51207_Kaneohe_Bay Webpage](#)



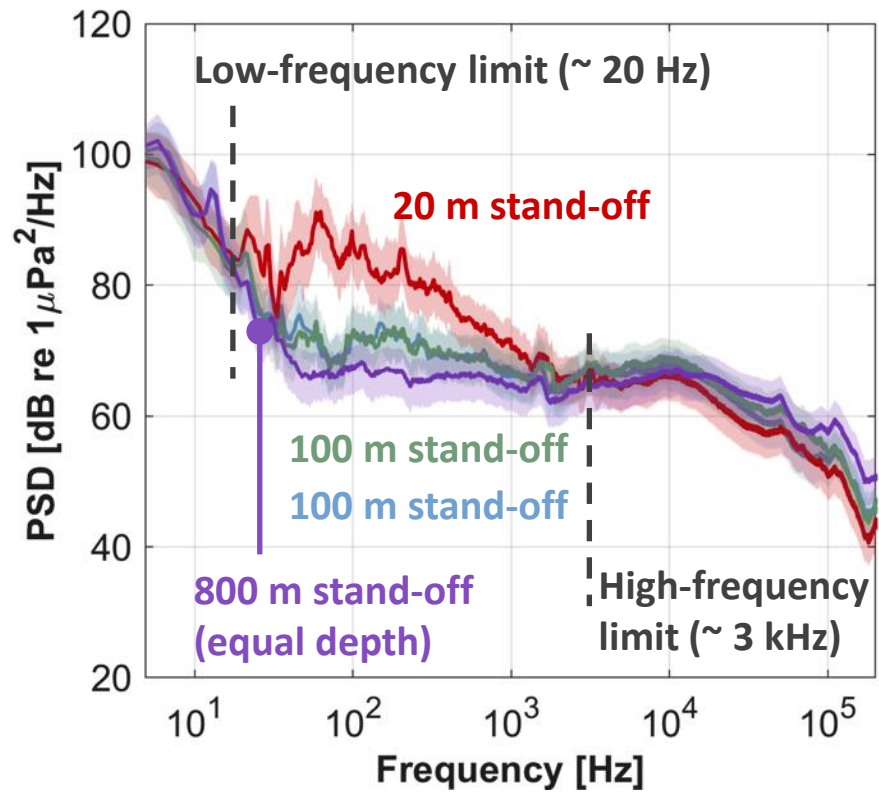
Dr. Ning Li



34-year Hindcast paper – N. Li, et al, *Ocean Modelling*, vol. 100, pp. 78-95, Feb. 2016.

Environmental Data Collection

- Device acoustic signatures
 - Bottom-mounted and drifting hydrophone systems
- Sediment transport
- Ecological surveys
- Protected marine species monitoring



WEC Device Testing at WETS

- Northwest Energy Innovations (NWEI) Azura

Jun 2015 – Dec 2016

- Fred. Olsen Bolt Lifesaver

Mar 2016 – Apr 2017

- NWEI Modified Azura

Feb – May 2018

- Bolt Lifesaver Redeployment

May – Nov 2018

- Ocean Energy USA, LLC

Nov 2018 – Nov 2019

- Columbia Power Technologies

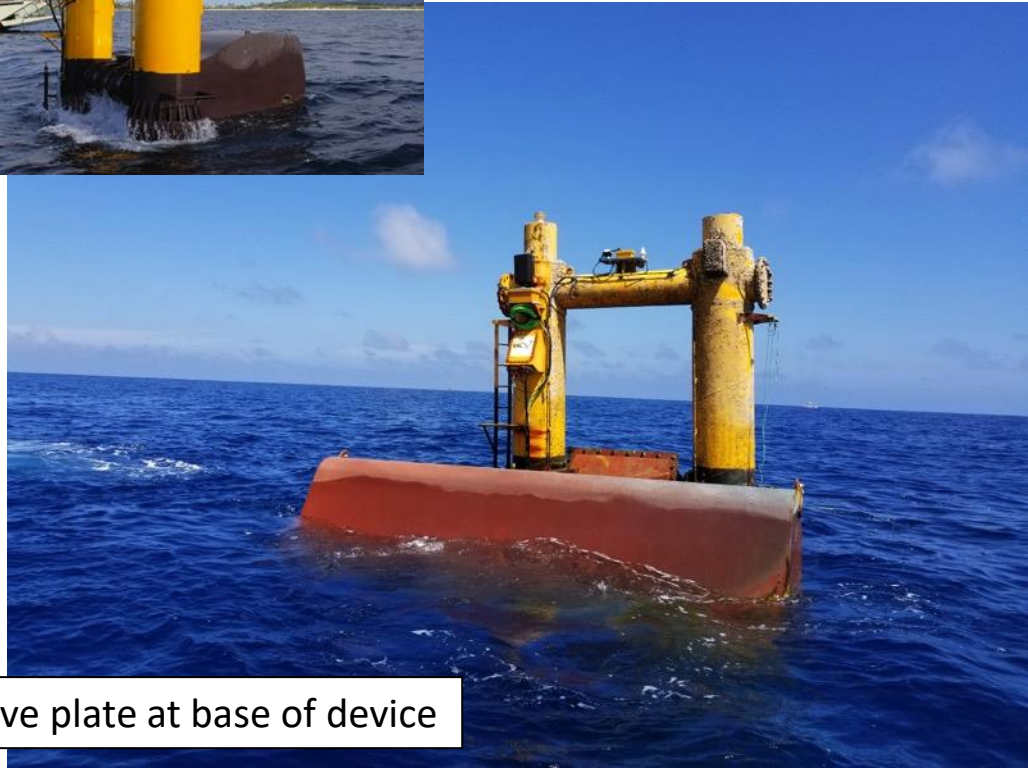
Apr 2019 – Apr 2020

- NWEI (grid scale device)



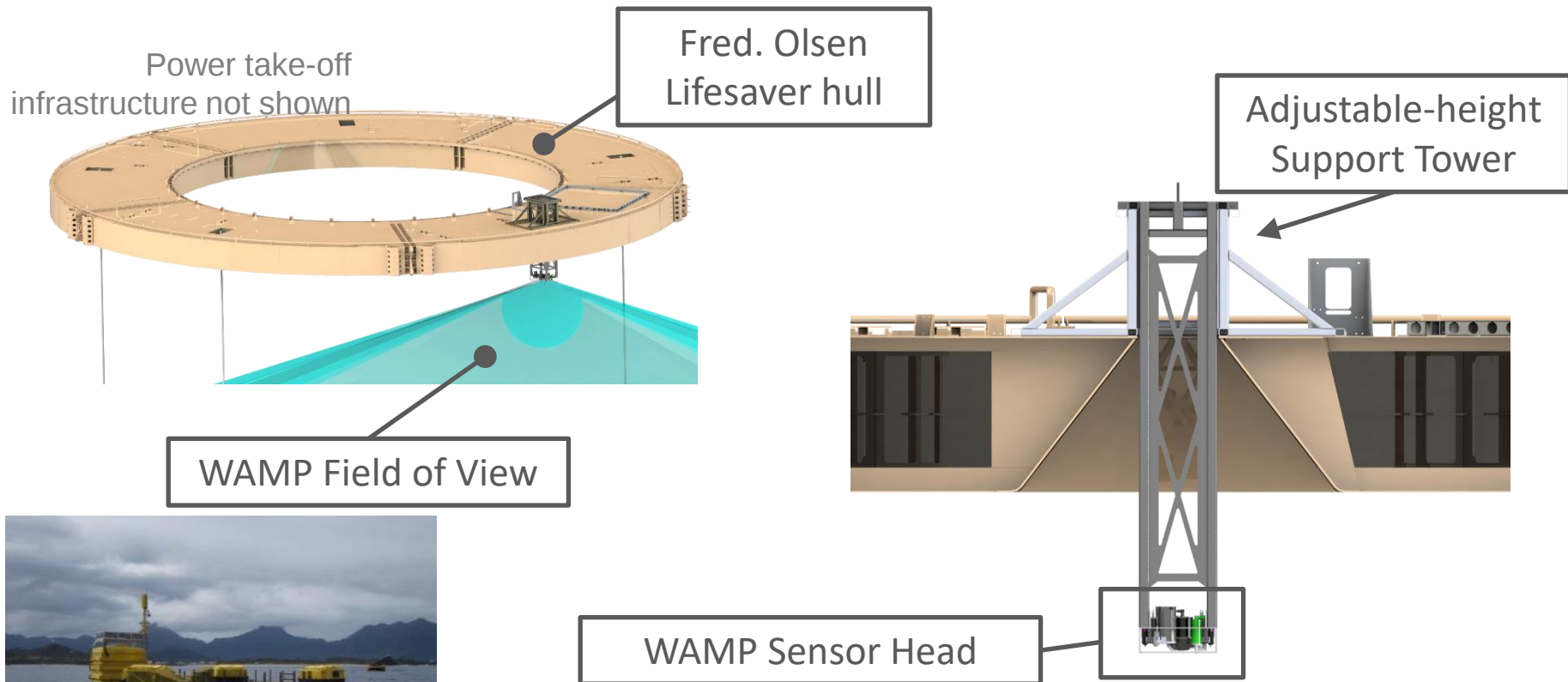
Projects receive support funding
from Navy and/or DOE

Azura Modification



Also added heave plate at base of device

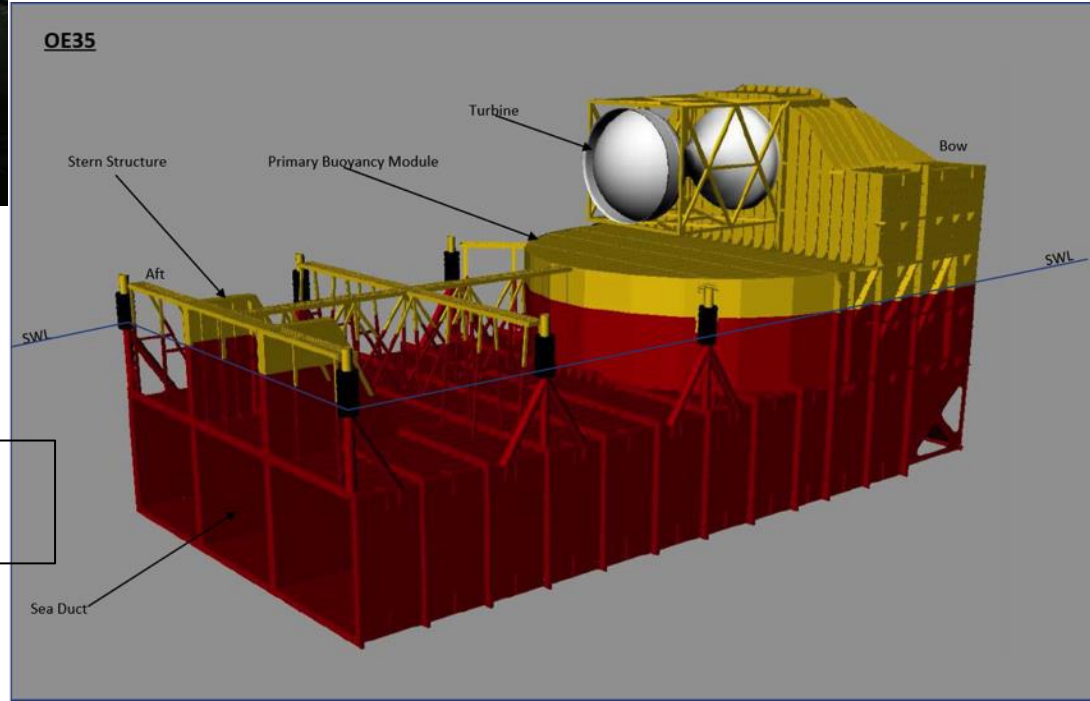
UW AMP Integrated w/Fred. Olsen Lifesaver



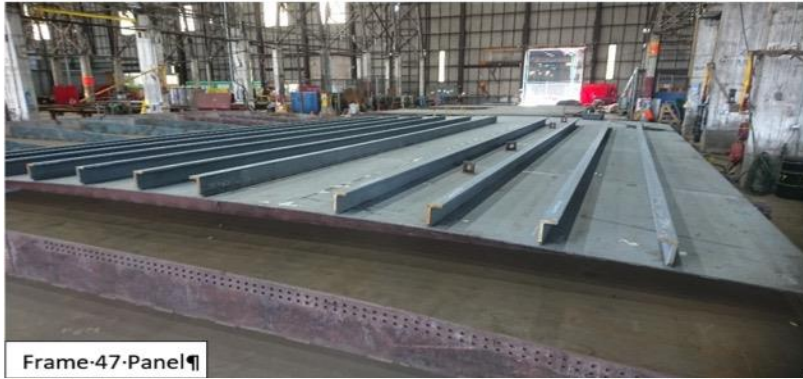
Ocean Energy OE35



Will deploy at WETS 60m berth late 2018 for 1 year



Ocean Energy's OE35



Frame-47-Panel



Forward-Towing-Padeye-Insert-Plates



Forward-Ballast-Tank-Assembly



Longitudinal-Bulkheads-Internal-Stiffening-Sub-Assembly

Questions?

