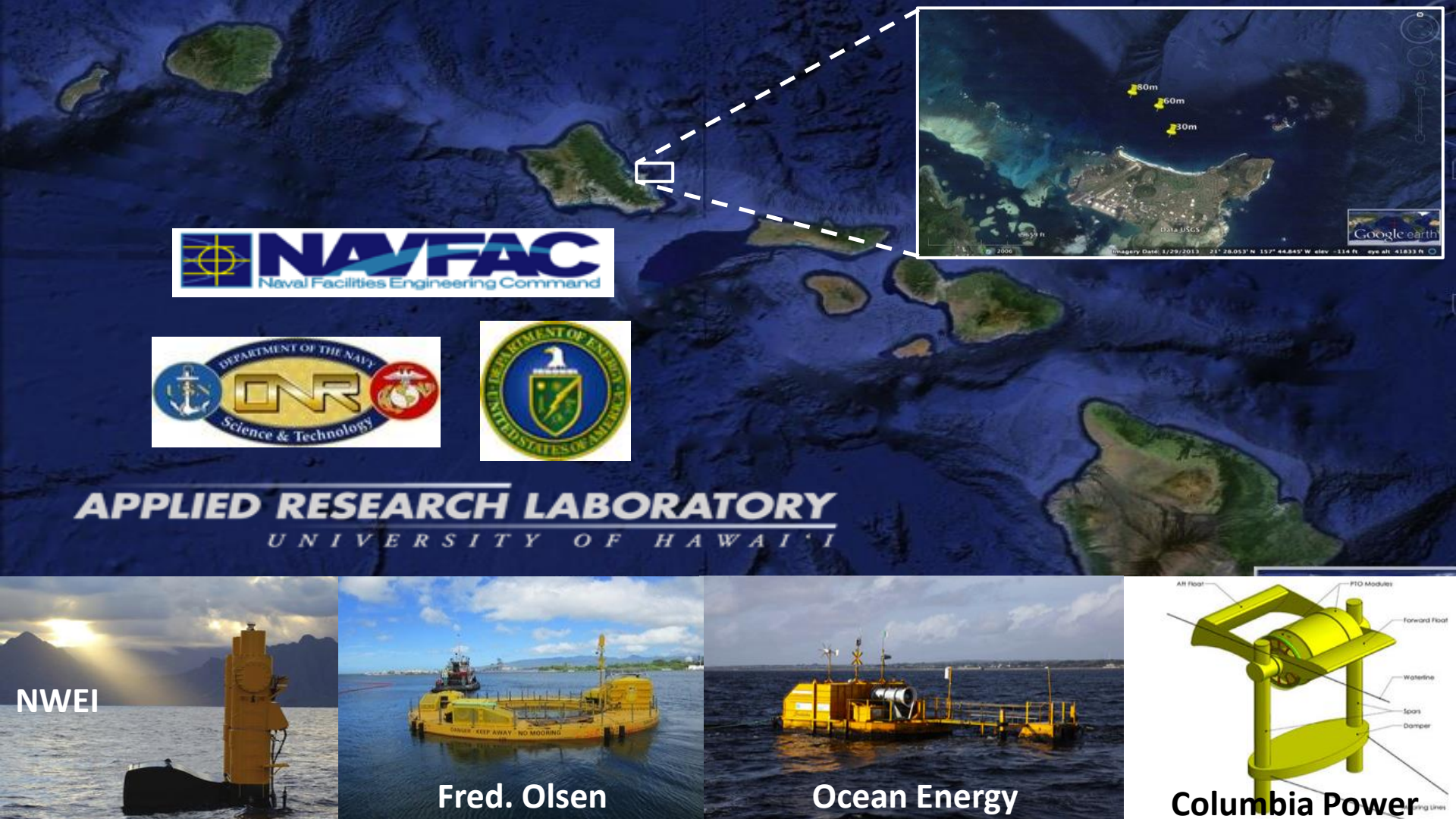
Ocean Testing at WETS – Ramping Up

Hyrdrovision 2018
Charlotte, NC
28 June 2018

Patrick Cross, Hawaii Natural Energy Institute
University of Hawaii


80m
60m
30m
Data USGS
Google earth
NAVFAC
Naval Facilities Engineering Command
DEPARTMENT OF THE NAVY
ONR
Science & Technology
APPLIED RESEARCH LABORATORY
UNIVERSITY OF HAWAI'I
NWEI
Fred. Olsen
Ocean Energy
Columbia Power

WETS Layout

80m

Waverider

Waverider

60m

30m

Bunker

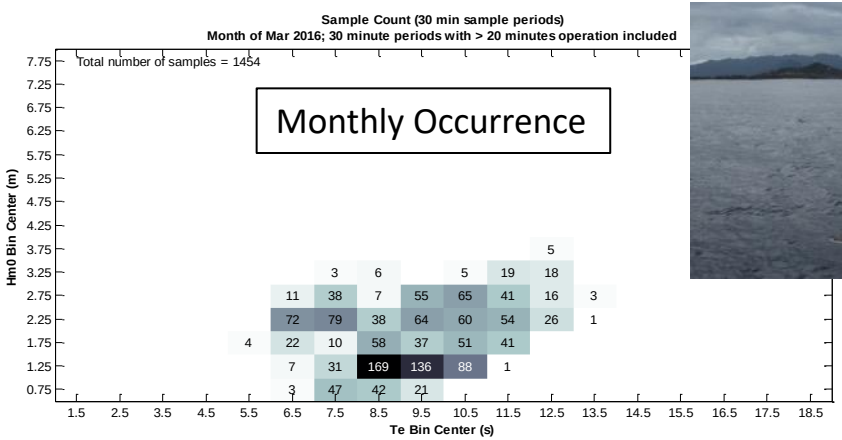
Cable Capacity
30m Berth – 250kW
60/80m Berths – 1MW

Legend
Splice Box
Mooring Anchor
WEC Device Mooring Point
Waverider Buoy
Surface Buoy (with WEC deployed)
Surface Buoy (vacant berth)
Work Boat Mooring
WET Existing Buoy
SubSeaCables
SubSeaCable_80mSite
SubSeaCable_60mSiite
Existing Cable (30m site)
MooringLegs
Terestial Cable Route
Contour 5m

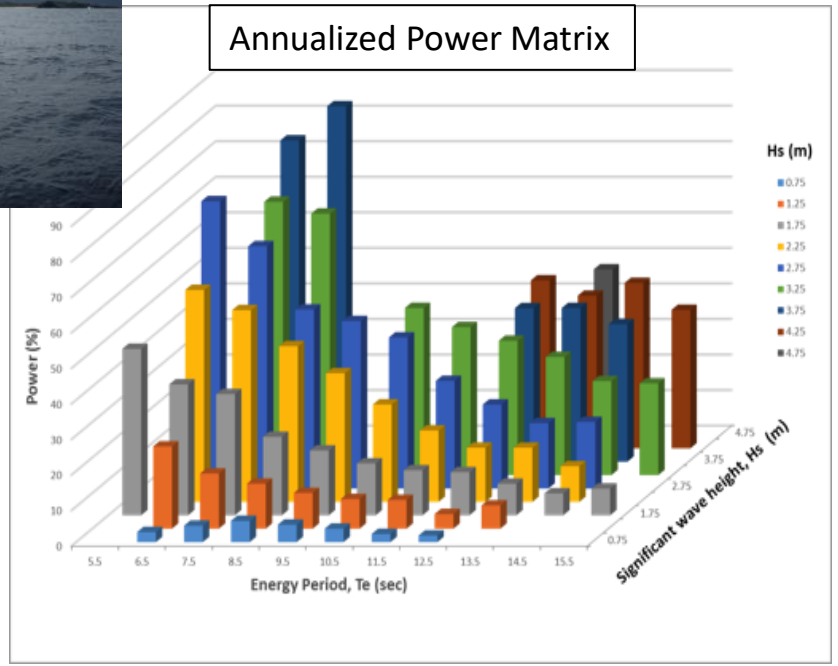
157°46'0"W 157°45'45"W 157°45'30"W 157°45'15"W 157°45'0"W 157°44'45"W 157°44'30"W
21°28'15"N 21°28'0"N 21°27'45"N 21°27'30"N
-175 -150 -130 -115 -100 -90 -80 -75 -70 -65 -50 -45 -35 -25 -20 -15 -10 -5

Coordinate System: UTM Zone 4 North - Depth/Elevation in Meters
Data Source: UofH, RSIMS, NOAA
Geovisualization by Sound & Sea Technology, Inc.
0 250 500 1,000
Meters
Isolines in Meters Depths
GIS Department
Sound & Sea Technology
gis@soundandsea.com 4/4/2014

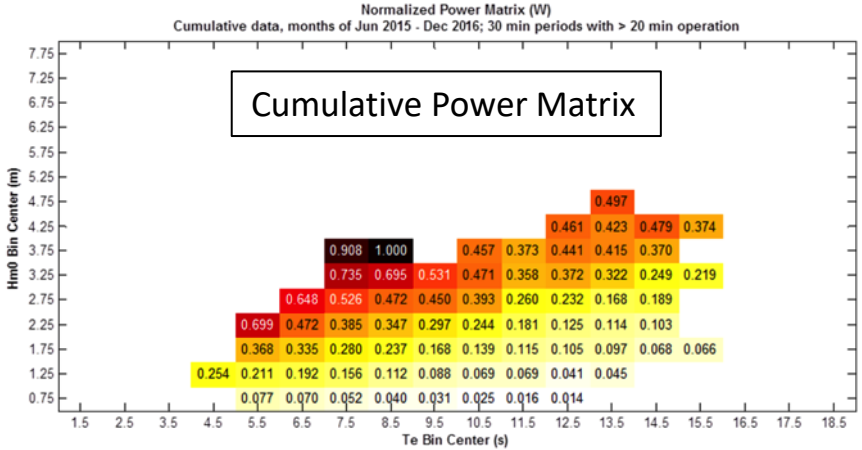
Power Performance Assessment



Monthly Occurrence



Annualized Power Matrix



Cumulative Power Matrix

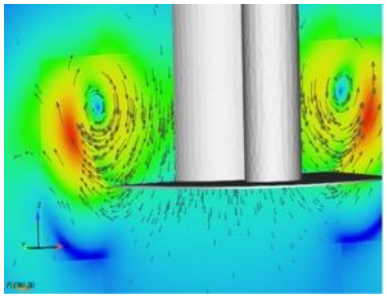
Performance assessed in accordance with IEC Technical Specification 62600-100

Numerical Modeling Efforts

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

Hydrodynamic Motion Analysis

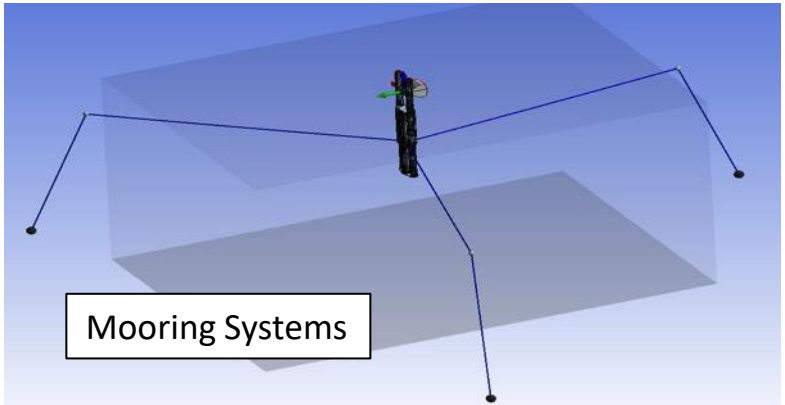
- WEC-Sim (Primary) & In-house code (Selected cases)
- Solution of equations of motion in time domain
- BEM: Estimation of hydrodynamic coefficients (Added mass, Wave damping)
- CFD : Estimation of viscous drag
- Predicted electric power, body motions
- Numerical model tuned with prototype trial data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



Dr. Kumar Rajagopalan

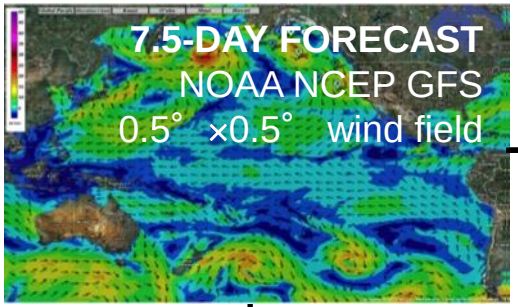
Modeling tools employed

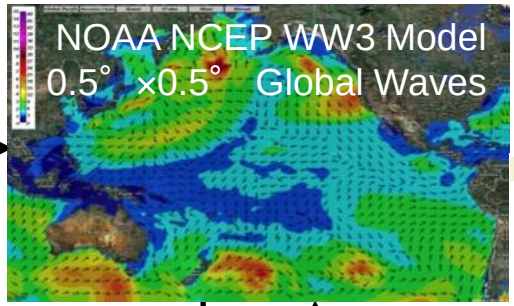
- WEC-Sim
- Flow3D
- OpenFOAM
- ANSYS SUITE
- In-house codes

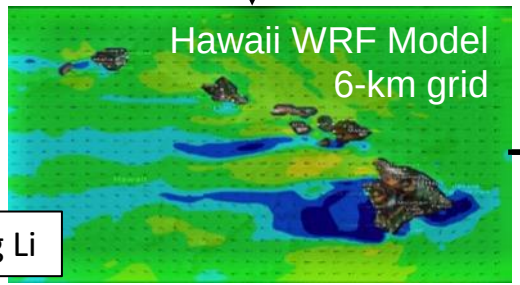


- Azura moored at 30m berth
- Mooring modeled in ANSYS AQWA

Daily 7.5-day Wave Forecast (oceanforecast.org)

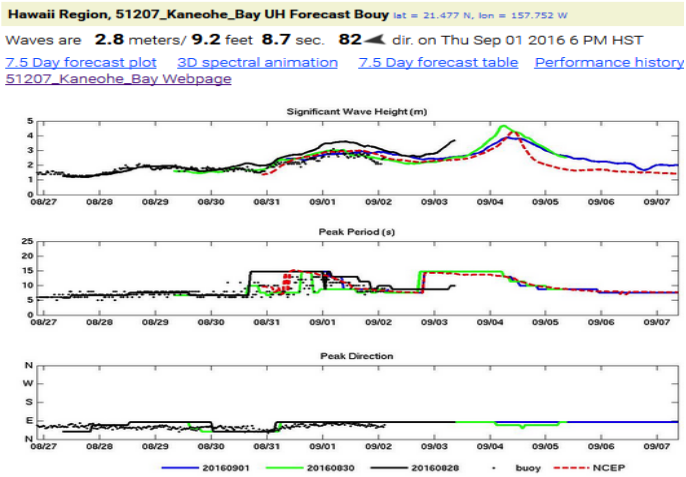


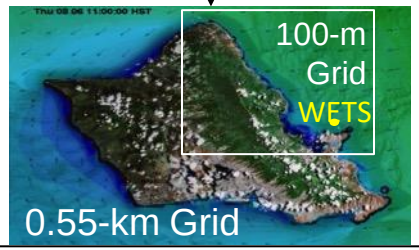


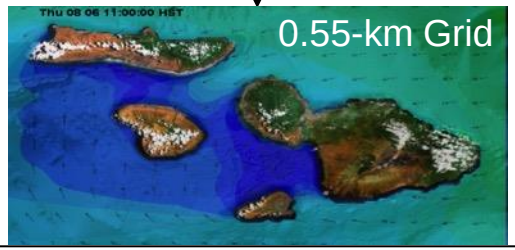


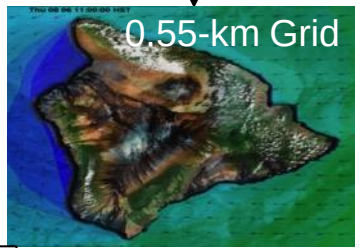
Dr. Ning Li

Real-time validation with measurements
- 30 buoys in the Pacific Basin
- Example on-line display for WETS



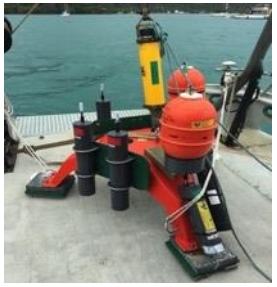




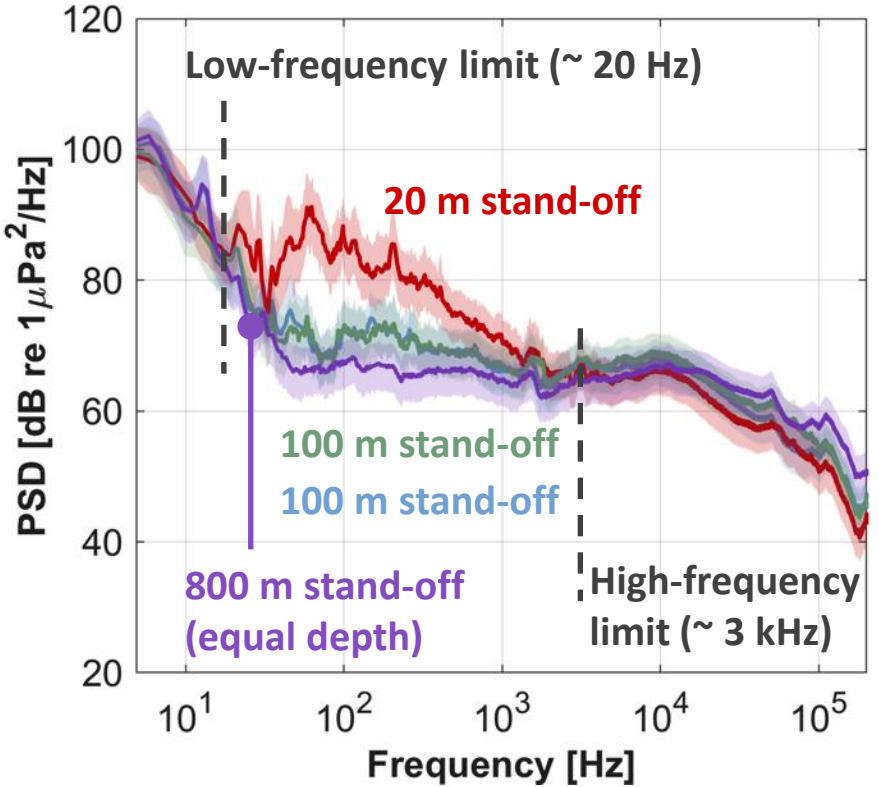


34-year Hindcast paper – N. Li, et al, *Ocean Modelling*, vol. 100, pp. 78-95, Feb. 2016.

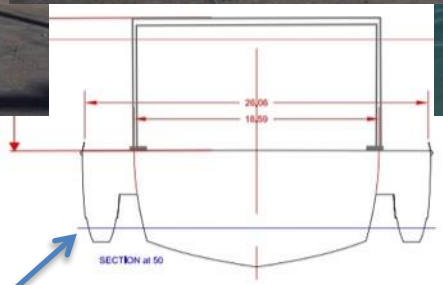
Environmental Data Collection



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



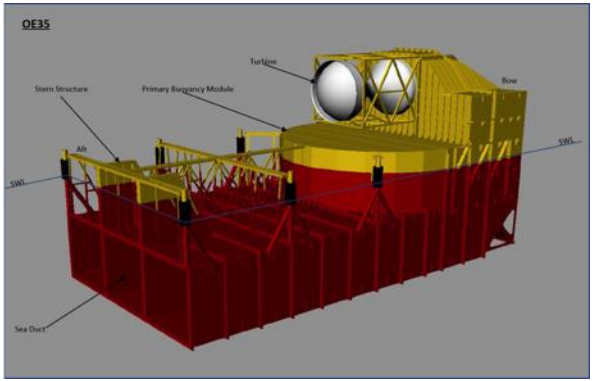
WETS Site-Dedicated Support Vessel – Sea Engineering, Inc.



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

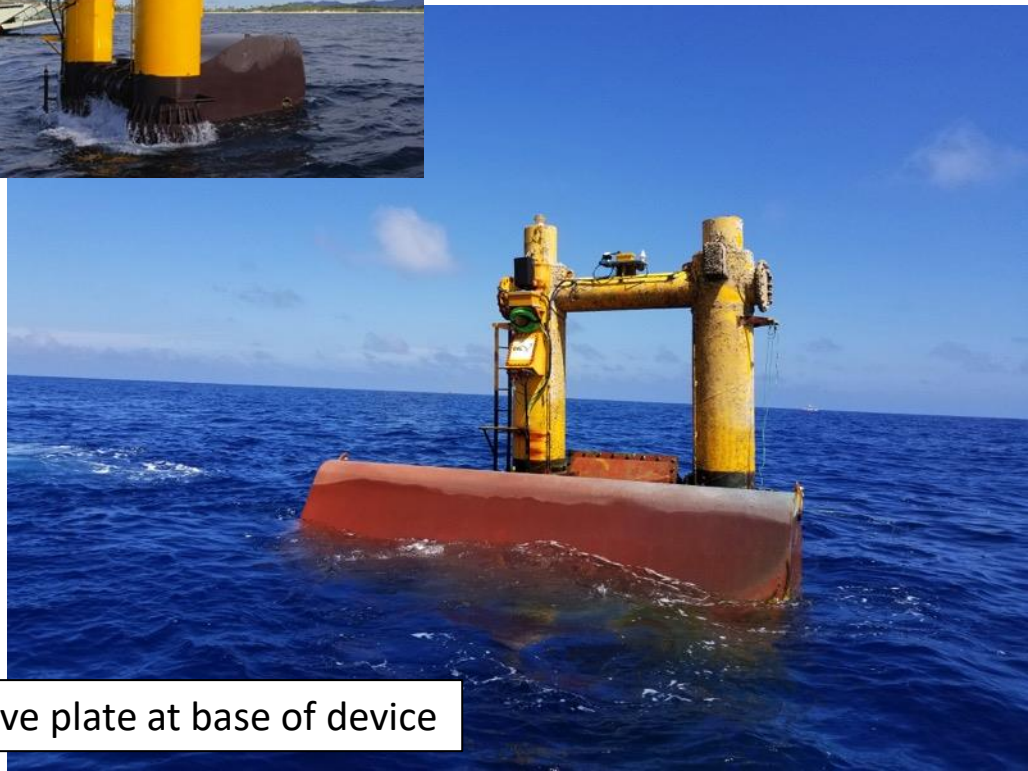
WEC Device Testing at WETS

• Northwest Energy Innovations (NWEI) Azura	Jun 2015 – Dec 2016
• Fred. Olsen BOLT Lifesaver	Mar 2016 – Apr 2017
• NWEI Modified Azura	Feb – Jul 2018
• BOLT Lifesaver Redeployment	Jul 2018 – Jan 2019
• Ocean Energy USA, LLC OE35	Dec 2018 – Dec 2019
• Columbia Power Technologies StingRay	Jun 2019 – Jun 2020
• NWEI (grid-scale device)	2020/2021
• Oscilla Power	Jul 2019 – Jul 2020
• California Wave Power Technologies	2020/2021
• Aquaharmonics	Late 2019 – late 2020



Projects receive support funding from Navy and/or DOE

Azura Modification

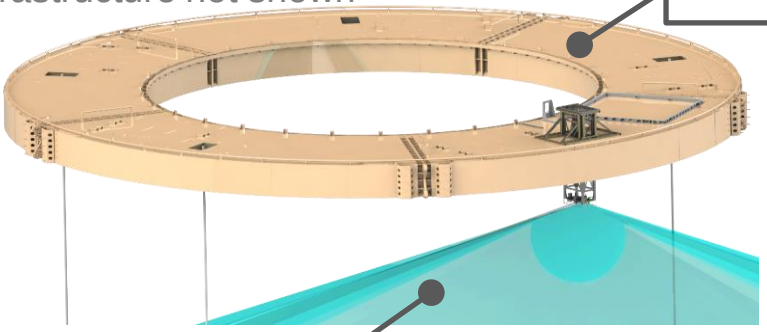


Also added heave plate at base of device

UW AMP Integrated w/Fred. Olsen Lifesaver

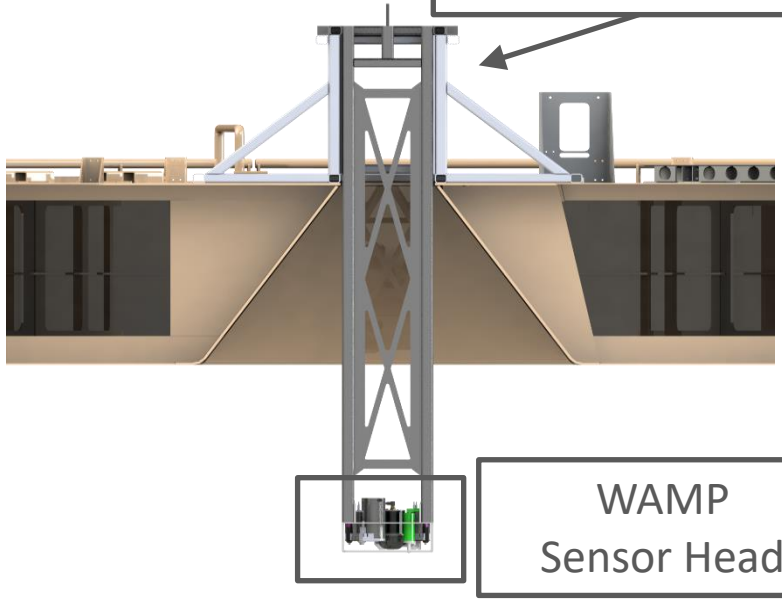
Power take-off infrastructure not shown

Fred. Olsen Lifesaver hull



WAMP Field of View

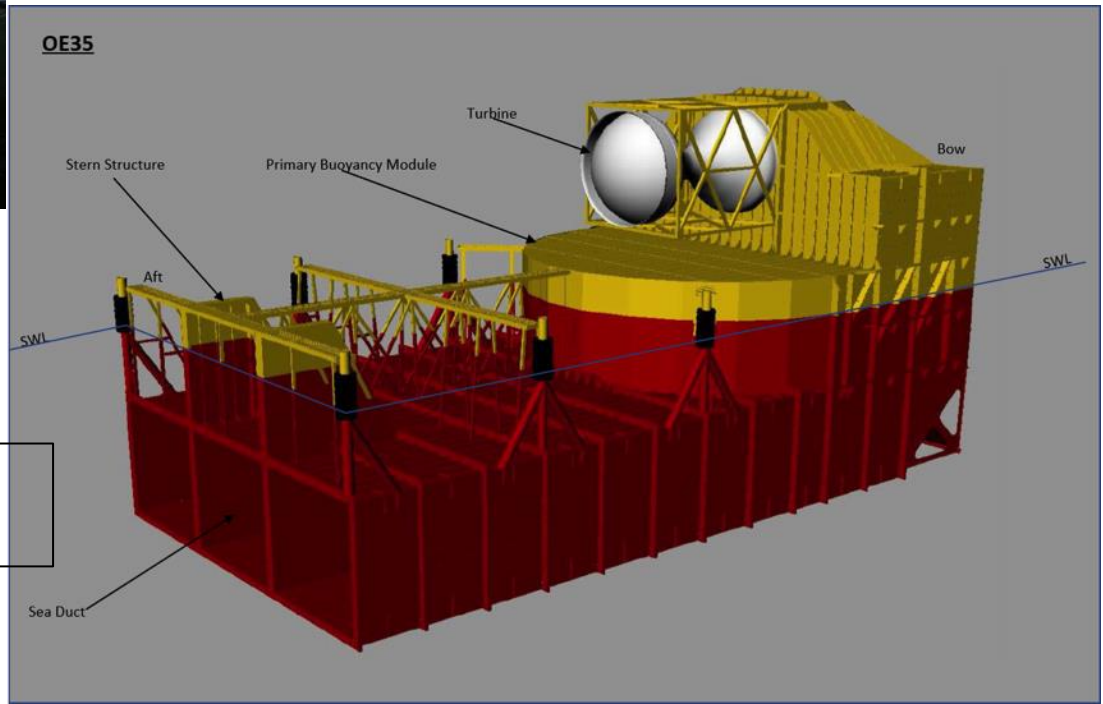
Adjustable-height Support Tower



WAMP Sensor Head

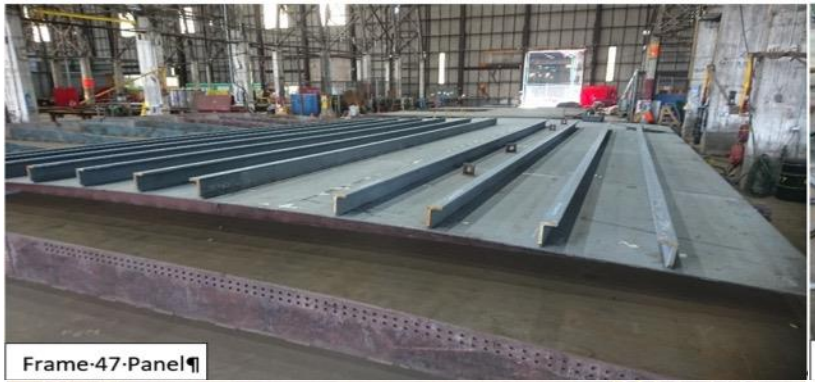
Ocean Energy OE35


Quarter-scale device in Galway Bay



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·

Vessels Available to Work at WETS


5-ton Lift Capacity

10-ton Lift Capacity

$ ≪


Healy Tibbits Crane Barge for Heavy Lift

Questions?