



U.S. DEPARTMENT OF
ENERGY

Office of ENERGY EFFICIENCY
& RENEWABLE ENERGY

WATER POWER TECHNOLOGIES OFFICE

Marine Energy & Ocean Observing

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WPTO Marine Energy Program Mission: *Harness energy from the world's oceans*



Oneka – Nags Head, North Carolina



CalWave – San Diego, California



NREL HERO WEC – Nags Head, North Carolina



Verdant Power – New York, New York

- Waves
- Tides
- Ocean/River Current
- Thermal Gradients
- Salinity Gradients
- Pressure Gradients

Near-term opportunities for marine energy

WPTO invests in utility scale & non-grid scale technologies (distributed and community).

Near-term Power at Sea opportunities include aquaculture, marine carbon dioxide removal (mCDR), and ocean observation.



Selected WPTO-supported ocean observing projects

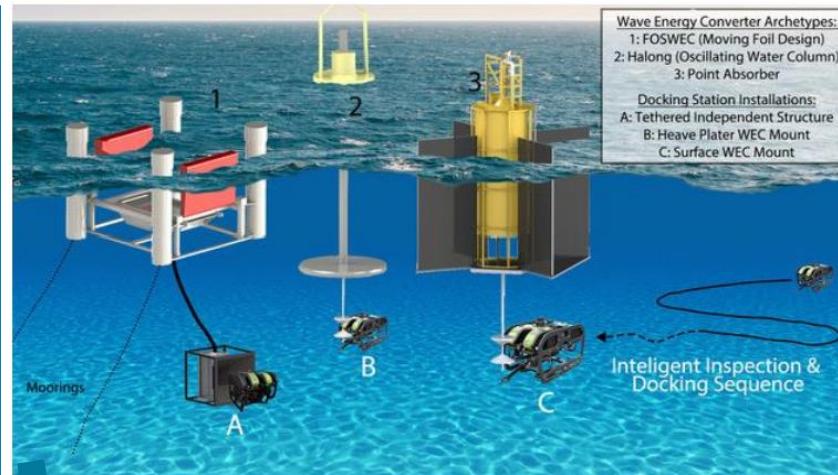


Lab project: **PNNL's Autonomous Surface Vehicle** is a testbed for remote docking and charging at marine energy devices, automated environmental monitoring of critical coastal habitats, and advanced autonomy and edge computing research.
<https://www.pnnl.gov/autonomous-surface-vehicle>



Industry project: **C-Power's SeaRAY** autonomous offshore power system (AOPS) provides in-situ power, energy storage, and real-time data and communications support that will advance the ocean economy toward a future of autonomous, connected and resident technologies. Will be paired with Saab's Sabertooth AUV to recharge the battery and offload data.
<https://www.energy.gov/eere/water/articles/searay-could-power-offshore-work-and-help-protect-oceans-energy-ocean-waves>

University project: **OSU's co-design of WECs for underwater vehicle docking and charging** has numerical modeling of coupled WEC-AUV system, experimental modelling of docking, vehicle dynamic perception and overall autonomy in challenging conditions, and will release completely open-source algorithm development and all data outputs.
<https://blogs.oregonstate.edu/marineautonomy/projects/>



Wave Energy Converter Archetypes:
1: FOSWEC (Moving Foil Design)
2: Halong (Oscillating Water Column)
3: Point Absorber

Docking Station Installations:
A: Tethered Independent Structure
B: Heave Plater WEC Mount
C: Surface WEC Mount

Intelligent Inspection & Docking Sequence

Project spotlight: adding a WEC to the OOI Pioneer Array Buoy

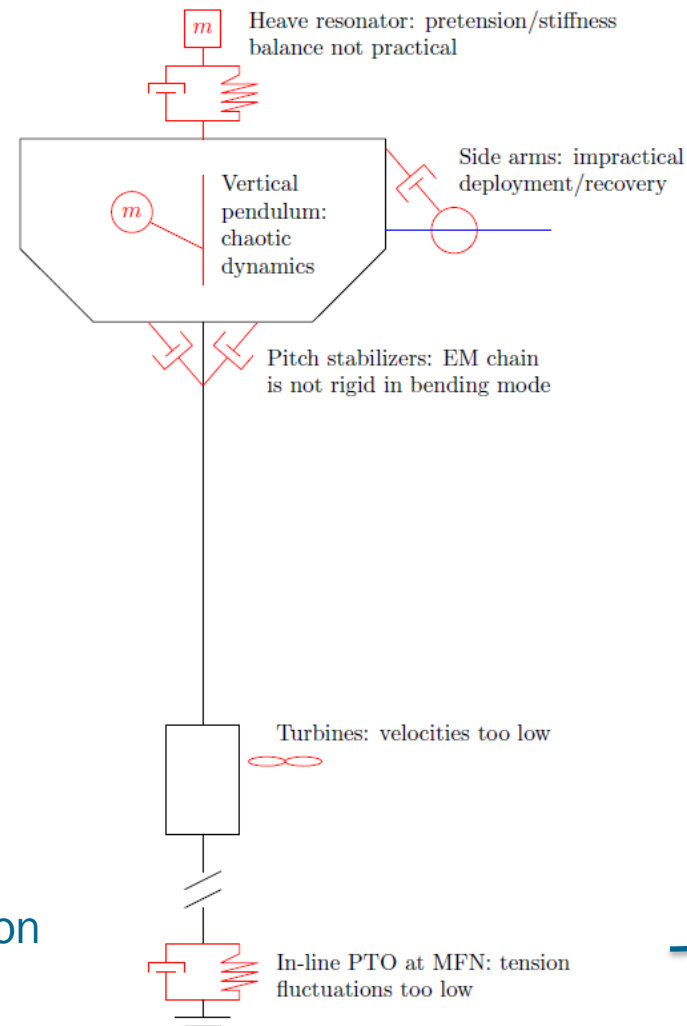


- The NSF OOI program presented an opportunity to integrate a WEC into a Pioneer Array buoy
- Buoy is currently powered by solar panels and wind turbines
 - Provide full power about 70% of the time (supplemented by include battery backup)
 - Power may be insufficient on cloudy or calm days (or when wildlife visits – *example photo from Endurance Array on the west coast*)
- Some sensors are temporarily shut down when power needs are not met
- Multiple days of full power needs not being met would initiate sampling rate reductions and selective shut down of some instruments



Requirements & initial ideas

- Generate power
 - 10-100W (no extra points for more)
- Avoid catastrophic failures
 - “don’t sink the ship”
- Include safe mode/fail-safe
 - passively prevent harm to equipment and personnel
- Don’t affect measurements
 - cannot ruin the science mission
- Maintain current operational requirements
 - already very costly and challenging
- Consider other important criteria
 - reliability, engineering challenges, size/weight/location restrictions, technical maturity

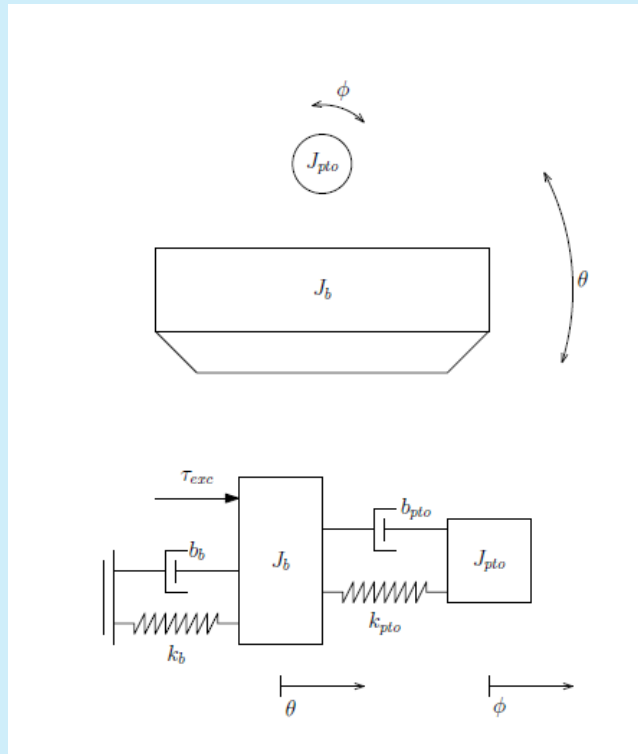


Concepts considered during the design process but ultimately not selected

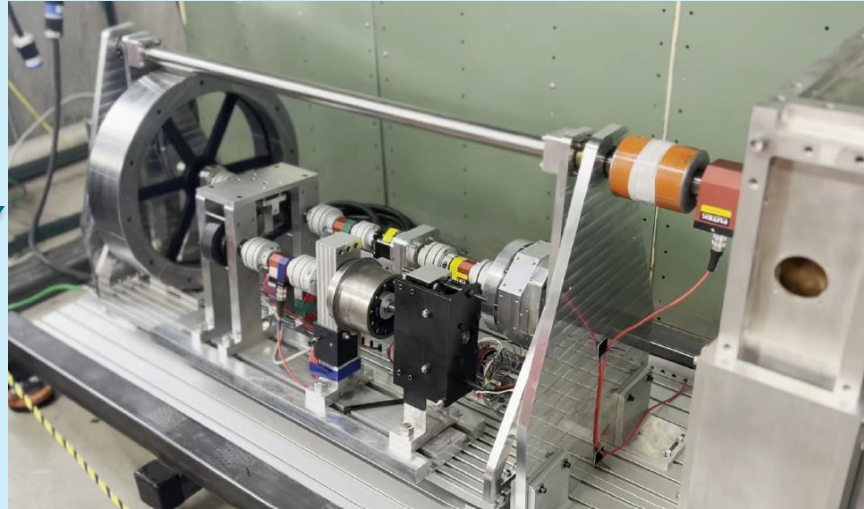
Detailed in design report



Now: testing and iterating on the pitch resonator concept



Pitch resonator concept

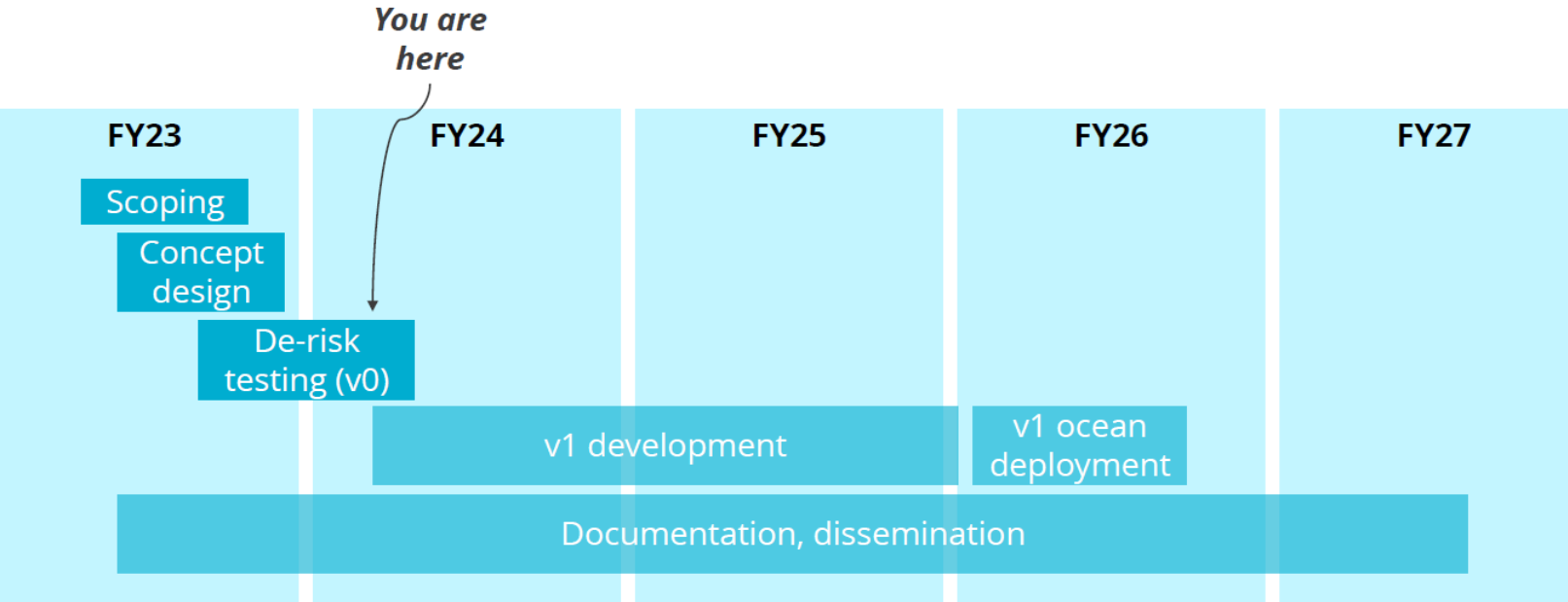


First test:
Sandia's testbed



Second test: NREL's
Large Amplitude Motion
Platform (LAMP)

Next Steps & Resources



Pioneer WEC Concept Design Report
<https://doi.org/10.2172/2280833>



Pioneer WEC WecOptTool tutorial
https://sandialabs.github.io/WecOptTool/examples/tutorial_4_Pioneer.html



Pioneer WEC intern YouTube video
<https://youtu.be/Tx8KqHqVaDk?si=O6s-Xtuxb07Z3IPM>



Thank you!



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