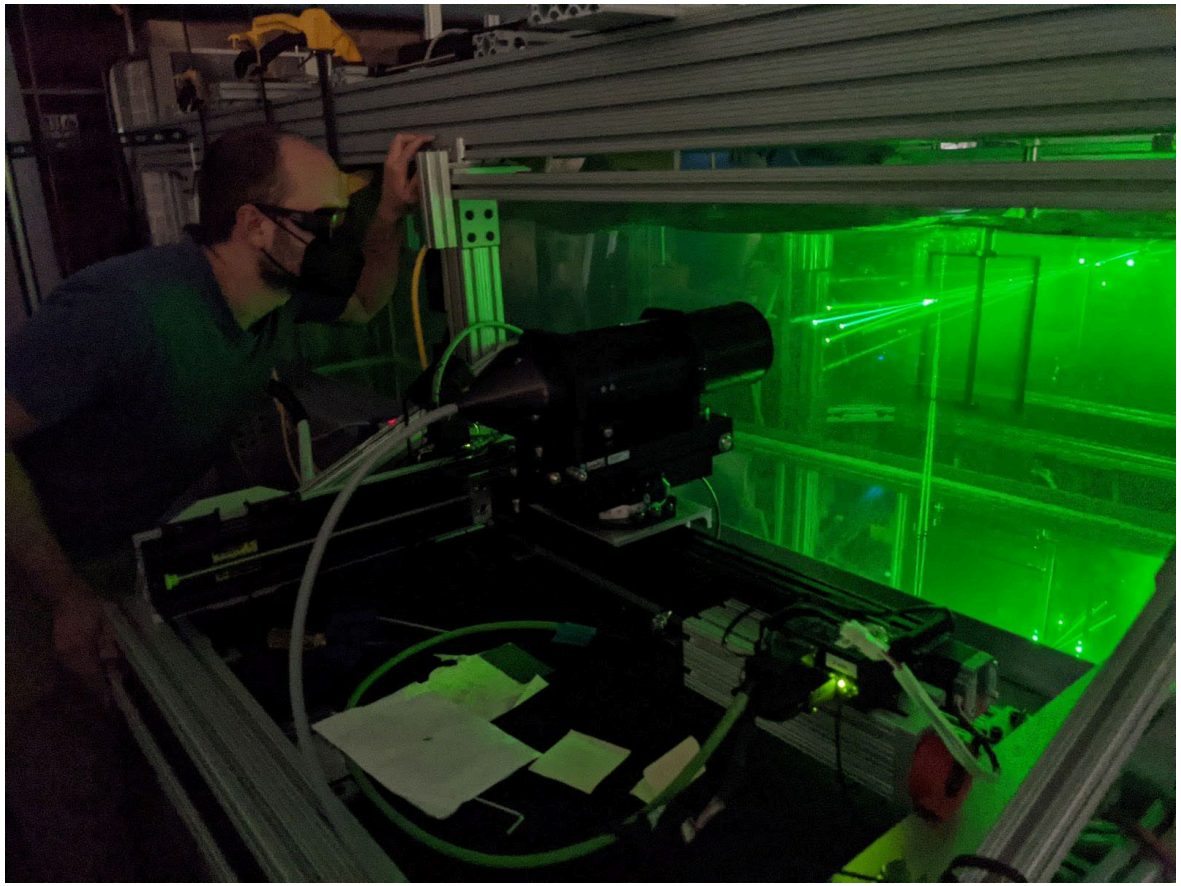
DE-EE0008955 – National Marine Renewable Energy Center Infrastructure Upgrades



Brian Polagye
University of Washington

bpolagye@uw.edu
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Project Overview

Project Summary

- Renew and enhance the research & development infrastructure at institutions affiliated with National Marine Renewable Energy Centers
  - *UW Focus*: Laboratory-scale WEC and current turbine testing
  - *OSU Focus*: Laboratory-scale WEC
  - *UAF Focus*: Current turbines at the Tanana River Test Site
  - *FAU Focus*: Onshore and offshore current turbine testing
  - *UH Focus*: Offshore test bed at Kilo Nalu Observatory

Intended Outcomes

- Increased capacity for NMRECs to engage in collaborative research and development to advance marine energy
  - **Enhanced laboratory testing capabilities**: wave generation, flow field visualization, motion tracking
  - **Research marine energy converters**: point absorber, oscillating surge, and oscillating water column WECs; cross-flow river turbine
  - **Field testing capabilities**: river, tidal, and ocean current turbine test beds; blue economy integration site

Project Information

Principal Investigator(s)

- Williams, Chickadel, Derakhti

Project Partners/Subs

- Oregon State University (Robertson)
- University of Alaska Fairbanks (Kasper)
- Florida Atlantic University (Alsenas)
- University of Hawai'i (Cross)

Project Status

Ongoing

Project Duration

- April 1, 2020
- March 31, 2023

Total Costed (FY19–FY21)

- $1832k (of $5000k)

Project Objectives: Relevance

Relevance to Program Goals:

- Enabling foundational R&D with new capabilities
  - Research MECs, advanced flow visualization, and simulation tools to better understand fluid-structure interactions and test implications of new control strategies
- Reducing barriers to testing by maintaining and expanding capabilities
  - Wider range of laboratory and open water conditions for system testing
  - Enhanced capabilities to characterize environment and systems under test
  - Component test beds for power electronics
- Powering the Blue Economy test bed
  - Foundational infrastructure for combined testing of WECs, underwater vehicle recharge, and distributed sensing in an realistic environment

Project Objectives: Approach

Approach:

- In response to 2019 FOA, the five universities affiliated with National Marine Renewable Energy Centers (NMRECs) collaborated to identify infrastructure priorities
- Range of motivations for proposed upgrades:
  - Gaps in capabilities requested by industry (e.g., deep water waves for O.H. Hinsdale Wave Research Laboratory, offshore tow testing)
  - Gaps in R&D capabilities (e.g., experimental WEC hydrodynamics)
  - End of life renewal for existing infrastructure (e.g., Tanana River Test Site)
  - Adapting existing infrastructure for marine energy use (e.g., Kilo Nalu Observatory)
  - Recurring “pain points” (e.g., software licenses, field measurements)

Project Objectives: Expected Outputs and Intended Outcomes

Outputs:

- Multiple research MECs
- Upgrades to laboratory capabilities
  - Hydrodynamics, power electronics
- New computational capabilities
  - Moorings, hydrodynamics
- Upgrades to field capabilities
  - Lift and tow capacity, MEC sensing
- Virtual equipment pool of environmental sensors

Outcomes:

- Utilization of research MECs in R&D projects
  - UW and OSU WECs being used to study sub-surface WEC hydrodynamics for NAVFAC
- Utilization of new capabilities in collaborative R&D projects
  - UAF TRTS utilization by Water Horse (WPTO), SHARKS (ARPA-E), and PNNL
- New capabilities available through TEAMER network

Project Timeline

FY 2020

Contracting

Initiation of long-lead procurements

COVID-19

FY 2021

Completion of procurement milestones

Delays associated with COVID, supply chain, and NEPA

FY 2022-2023

Steady progress towards completion of fabrication milestones

Management and mitigation of delays

- Distributed nature of tasks has simplified risk management - most significant remaining risk lies with serial tasking

Project Budget

Total Project Budget – Award Information		
DOE	Cost-share	Total
$5000k	$1370k	$6370k

FY19	FY20	FY21	Total Actual Costs FY19–FY21
Federal Costed	Federal Costed	Federal Costed	Total Federal Costed
$0	$264k	$1568k	$1832k

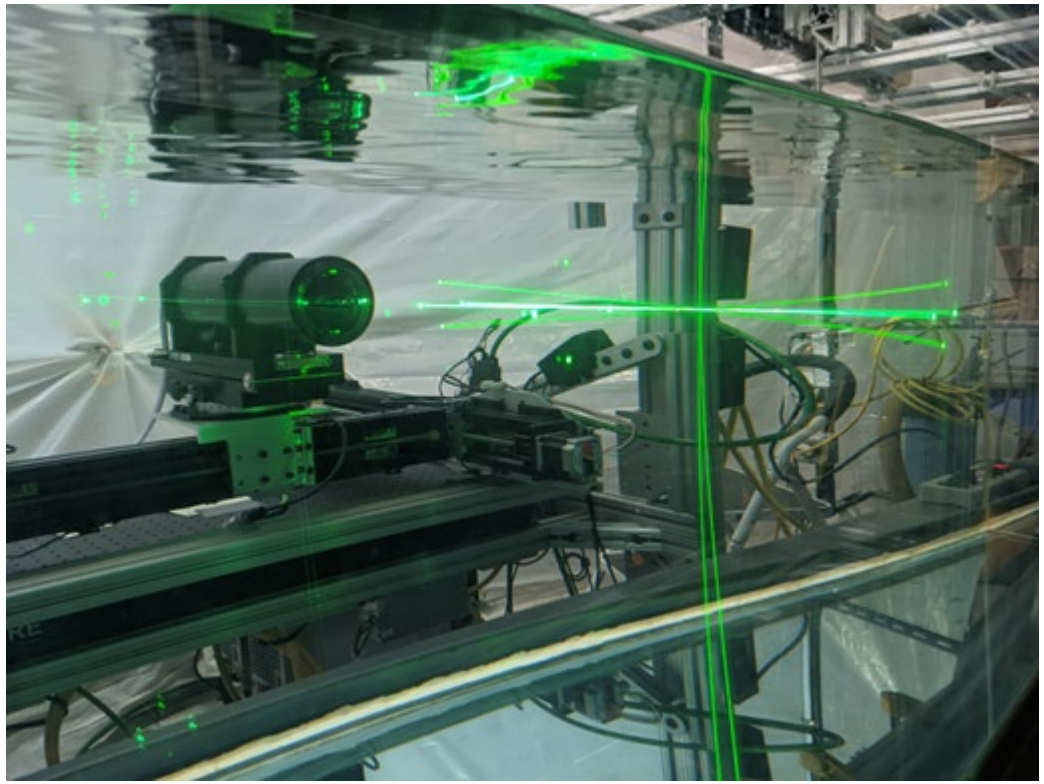
- Under-spend primarily associated with larger fabrication and procurement activities with delays
- UH activities delayed due to unique procurement challenges (HI state tax clearance) and NEPA review for an active field site that had been through state, but not federal, review
- Minor scope modifications (e.g., change in type of load bank, new procurement vs. refurbishment) and financial accounting (e.g., OSU procurement of software license, fabrication vs. supplies)

End-User Engagement and Dissemination

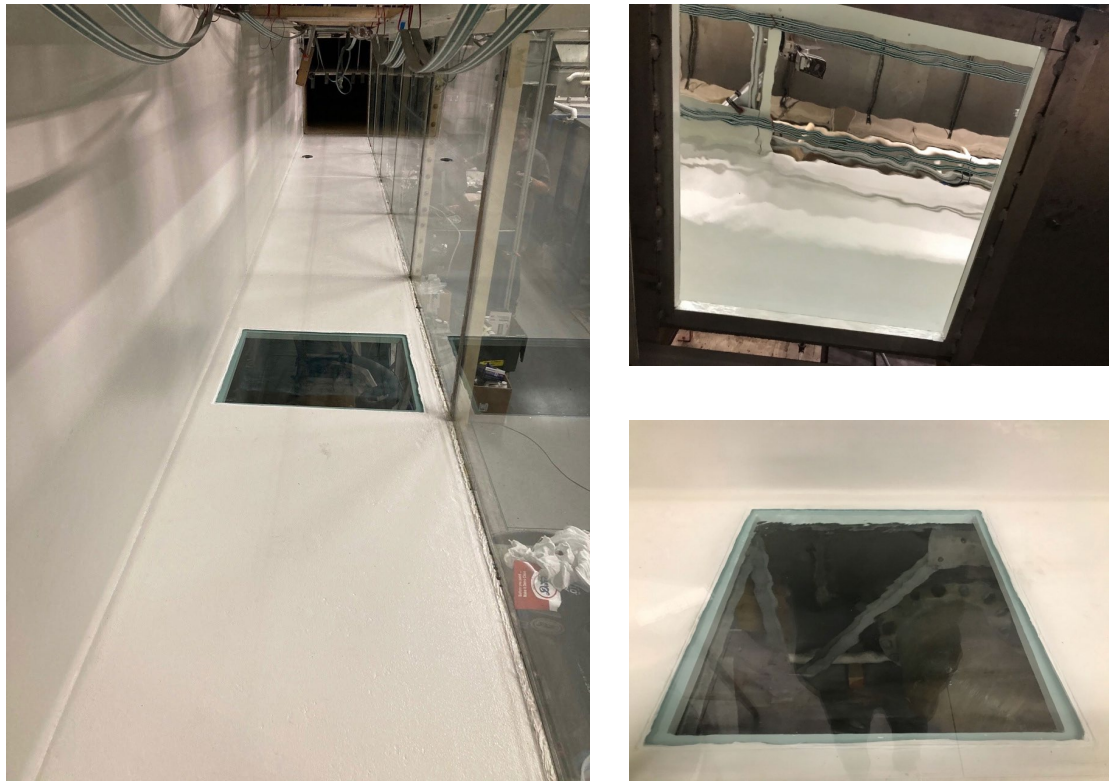
- Upgrade priorities shaped by limitations of existing infrastructure identified by internal and external users over multi-year period
- **Internal capacity building**
  - Draw in faculty on periphery of marine energy with new capabilities
  - Attract diverse, high-quality graduate students with state-of-the-art infrastructure
  - Enabling dialogue between NMREC institution leads
- **External user engagement**
  - Advertise availability of new capabilities through TEAMER
  - Showcase infrastructure in conference presentations
  - Present preliminary results through webinars (e.g., point absorber design review)
- Data dissemination in progress, pending completion of upgrades
  - MHK-DR data sets for “research MEC” performance

Performance: Accomplishments and Progress

- Flow Field Visualization (UW)



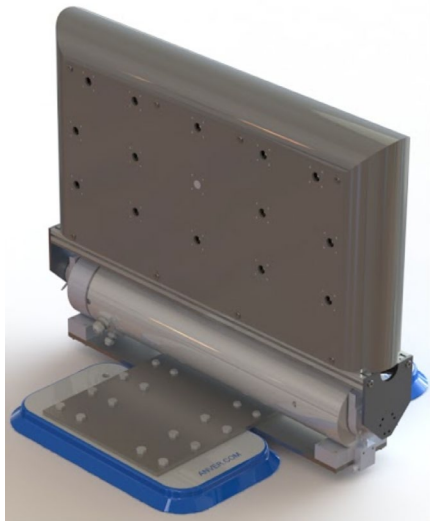
Commissioning of Laser Doppler Velocimeter

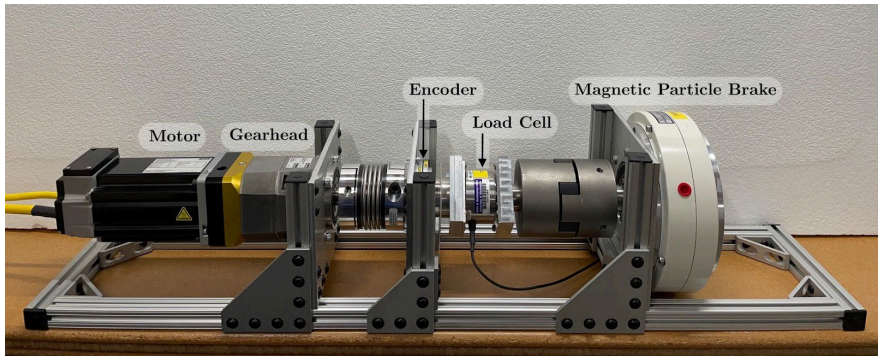


New optical access for wind/wave/current flume

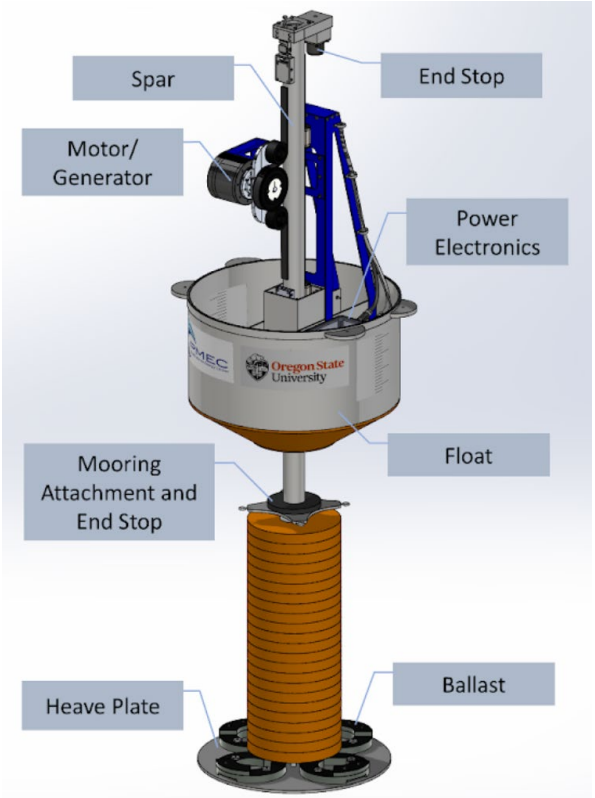
Performance: Accomplishments and Progress

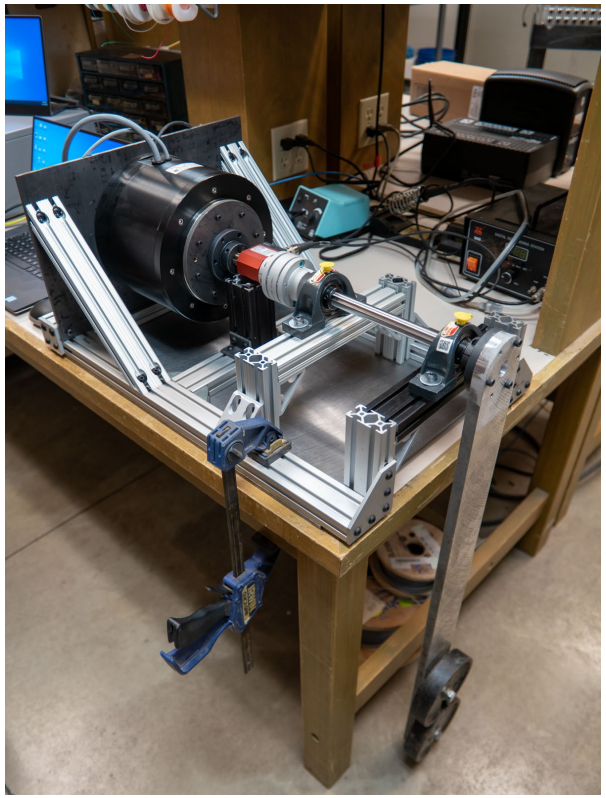
- Research MECs (UW & OSU)





Oscillating Surge Wave Energy Converter (UW)





Point Absorber Wave Energy Converter (OSU)

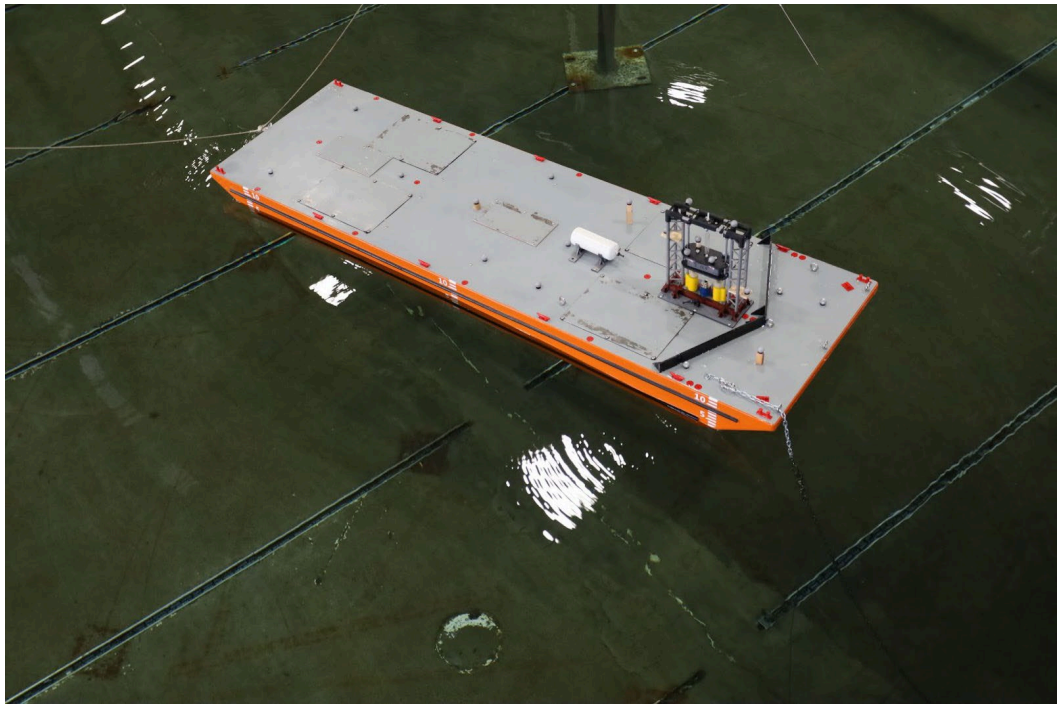
Performance: Accomplishments and Progress

- Deep Water Wave Maker (OSU)

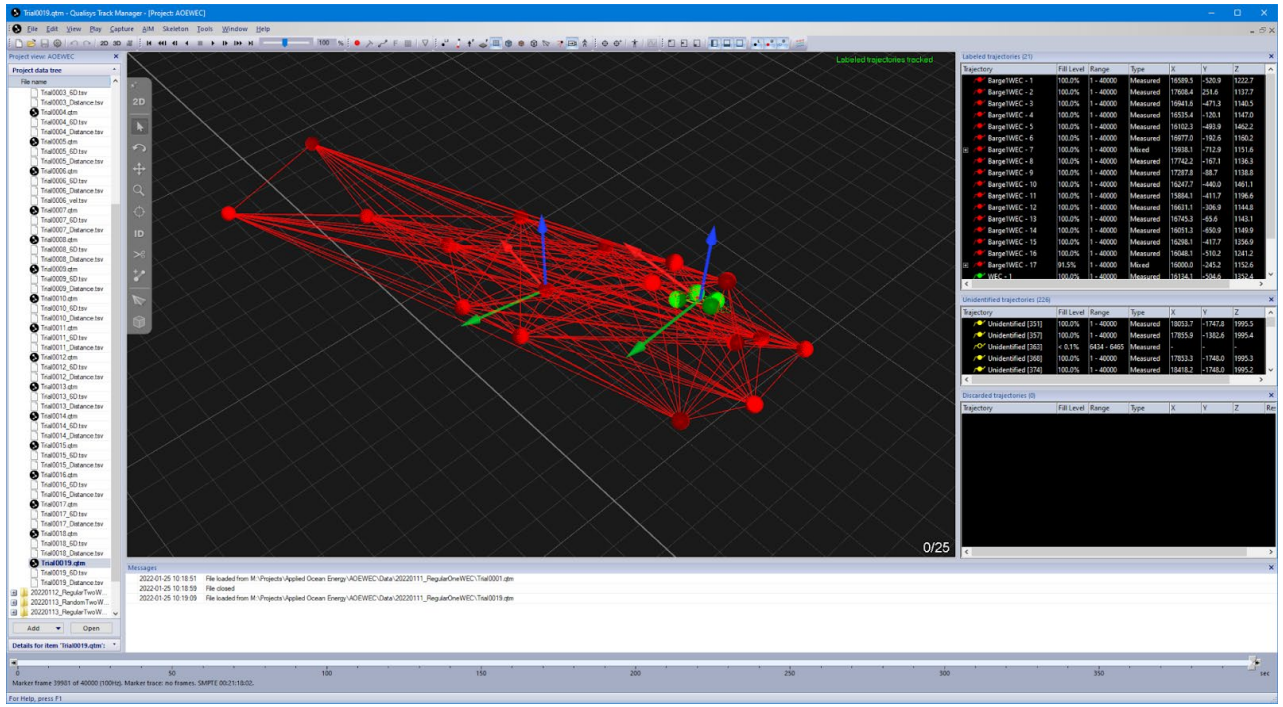
Fabrication process at Edinburgh Designs

Performance: Accomplishments and Progress

- Qualisys Motion Tracking Capability (OSU)



Barge with vertical pendulum WEC in O.H. Hinsdale directional wave basin



Motion capture post-processing

Performance: Accomplishments and Progress

- Tanana River Test Site Upgrades (UAF)

New anchor deployed in fall 2020

6 kW DC Load Bank used during Water Horse (WPTO) and SHARKS (ARPA-E) testing in 2021

Performance: Accomplishments and Progress

- Tanana River Test Site Upgrades (UAF)

Deep Fishing Platform during fabrication (currently being moved to TRTS for first deployment)

New debris diverter under construction

Future Work

- Overall, on track for completion by March 2023, but a few major activities remain
- **Major Activity 1**: Commissioning of O.H. Hinsdale wave maker
  - Once at OSU, need to schedule installation (missed original window due to COVID-19 delays by supplier, shipping delays, and shipping errors)
  - Necessary precursor to point absorber commissioning and testing
- **Major Activity 2**: Deployment of infrastructure at Kilo Nalu Observatory
  - NEPA determination requires resource agency concurrence
  - Weather windows can occur any time of year (largest swell in summer)
- **Major Activity 3**: Receive offshore tow infrastructure
  - Contingent on raw material availability for cable fabrication

Q&A