



Reduction of System Cost  
Characteristics through Innovative  
Solutions to Installation, Operations, and  
Maintenance

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## Reduction of System Cost Characteristics through Innovative Solutions to Installation, Operations, and Maintenance

### The Challenge:

Identify practical opportunities through innovative design and operational strategies to reduce the cost of wave energy converter (WEC) installation, operations, maintenance and recovery

### Partners:

U.S. Navy

RG Consulting

Ershigs

Siemens

Sea Engineering

DNV GL

## Technology Maturity

- Test and demonstrate prototypes
- **Develop cost effective approaches for installation, grid integration, operations and maintenance**
- Conduct R&D for Innovative MHK components
- Develop tools to optimize device and array performance and reliability
- Develop and apply quantitative metrics to advance MHK technologies

## Deployment Barriers

- Identify potential improvements to regulatory processes and requirements
- Support research focused on retiring or mitigating environmental risks and reducing costs
- Build awareness of MHK technologies
- Ensure MHK interests are considered in coastal and marine planning processes
- Evaluate deployment infrastructure needs and possible approaches to bridge gaps

## Market Development

- Support project demonstrations to reduce risk and build investor confidence
- Assess and communicate potential MHK market opportunities, including off-grid and non-electric
- Inform incentives and policy measures
- Develop, maintain and communicate our national strategy
- Support development of standards
- Expand MHK technical and research community

## Crosscutting Approaches

- Enable access to testing facilities that help accelerate the pace of technology development
- Improve resource characterization to optimize technologies, reduce deployment risks and identify promising markets
- Exchange of data information and expertise

## Safe and Cost-Efficient Installation, Operations and Maintenance (IO&M)

### Technology Maturity

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Design/Process Improvement	CapEx	OpEx	Availability	System Life
Serviceable seals	-65%	-90%	2%	0%
Simplified ascent & descent ballasting	0%	-50%	1%	0%
Hard ballast replacement	-80%	-25%	1%	0%
Mooring & umbilical modularity	10%	-50%	1%	0%
Transit ballasting optimization	-10%	-60%	2%	0%
PTO "lockout"	10%	-15%	5%	10%
Improved shipyard handling (primarily mass reduction)	-25%	-30%	0%	0%
Improved deployment logistics	0%	-20%	1%	0%
Optimized IO&M cost and strategy	-5%	-30%	1%	5%
Reduced shipping / transit costs*	TBD	TBD	TBD	TBD

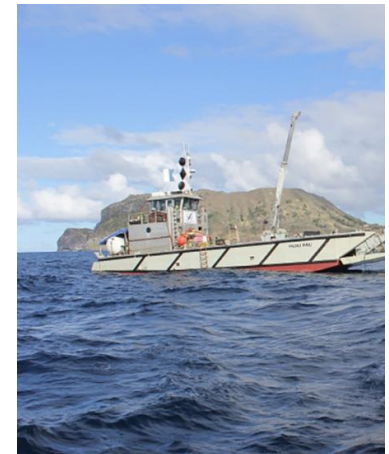
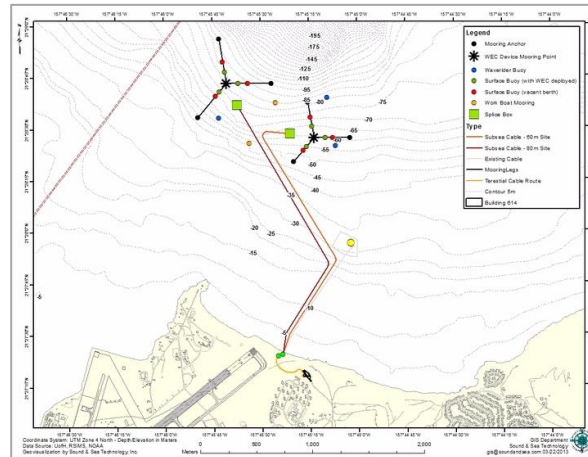
### Project Impact:

- Advances commercial readiness for CPower
- Supports full-scale open-ocean WEC test
- Delivers industry-relevant practical sub-system and operational cost reductions

- Study to establish confidence in the impact of the identified WEC design and IO&M process improvements
  - Capital cost
  - Operating cost and complexity
  - Risk
- Utilize experienced marine operations and component suppliers partners
- Demonstrate design and process improvements in 12-month open-water deployment



- Project initiated in May 2016
- Initial Risk Register compliance check and update complete
- Baseline IO&M costs established
- Initiated IO&M design and process improvement investigation



- Budget Period 1: 05/06/16 – 07/05/17
- Delay in initiation of design and process investigation due to resource constraints
- Project down select in FY 2017
- Full project = 40 months
- Budget Period 2 & 3 plans
  - Initiate certification activities
  - Integrate design and process improvements
  - Finalize permitting activities
  - Build, assemble, and commission StingRAY WEC
  - 12-month deployment at the Wave Energy Test Site (WETS) in 2018
  - Decommissioning

Budget History					
FY2014		FY2015		FY2016	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
				\$59K	\$41K

- 13% of BP1 budget expended to date. Total Budget Period 1 (BP1) DOE funding \$400K, Columbia Power cost share \$184K
- No other funding sources in BP1
- Total project budget (BP1-BP3) pending go/no-go decisions = \$13.2M
  - U.S. Navy funding \$3M
  - DOE funding \$4.1M



## Partners, Subcontractors, and Collaborators:

U.S. Navy – Test berth operator

RG Consulting – Marine operations consultant

Ershigs – Hull design and manufacture

Siemens – Electric plant manufacture

Sea Engineering – WETS Marine operations

DNV GL – WEC Certification

## Communications and Technology Transfer:

- International Marine Renewable Energy Conference 2016
- CPower-NREL Open House at National Wind Technology Center – November 2016
- Project data uploaded to the MHK-Data Repository and final report made publicly available

## FY17/Current research:

- Complete desktop study
- Integrate appropriate design and process improvements
- Build and test full-scale WEC in open water
- Demonstrate cost- and risk-reduction improvements
- Achieve Technology Readiness Level (TRL) 7/8

## Proposed future research:

Open-water demonstration in fully exposed resource to achieve TRL 8/9