Monty Worthington, ORPC Solutions (Subrecipient) on behalf of AlexAnna Salmon, Igiugig Village Council

Next Generation MHK River Power System, Optimized for Performance, Durability, and Survivability

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Project Overview

- Next Generation MHK River Power System, Optimized for Performance, Durability and Survivability:
  - IVC will collaborate with Ocean Renewable Power Company to significantly increase availability and reduce Installation, operation, and maintenance (IO&M) costs of the RivGen® Power System :
    - Integrated deployment and retrieval system design that drastically reduces expense associated with deployment and retrieval
    - Modular system component design that incorporates design features to reduce time to perform land-based integration and maintenance activities
    - Environment characterization, monitoring and mitigation to increase system availability with seasonal ice out and salmon smolt presence

Project Overview

The Challenge:

- Immediate need to reduce energy costs and offset diesel generation at Igiugig
- Improve reliability of installation, operation and maintenance logistics for remote communities
- Improve system availability
  - Determine effects of ice on hydrokinetic devices
  - Determine interactions between smolt and device

Partners:

- ORPC Solutions (Project Manager)
- University of Alaska – Fairbanks (UAF) (ice measurements)
- University of Maine School of Marine Sciences (fish interactions)
- Maine Marine Composites (mooring system and deployment analyses)

Program Strategic Priorities

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Technology Maturity

- Test and demonstrate prototypes
- **Develop cost effective approaches for installation, grid integration, operations and maintenance**
- Conduct R&D for innovative MHK systems & 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

Project Strategic Alignment

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

- Increase Availability to > 80%
  - Ice out
  - Annual Maintenance
- Reduce OpEx
  - Target of deployment time & resources
  - Three man-days per event
- Industry Impact
  - Low cost, reliable IO&M methods
- Project End
  - Demonstrated IO&M methods
    - Deployment
    - Inspection
    - Maintenance

Technical Approach

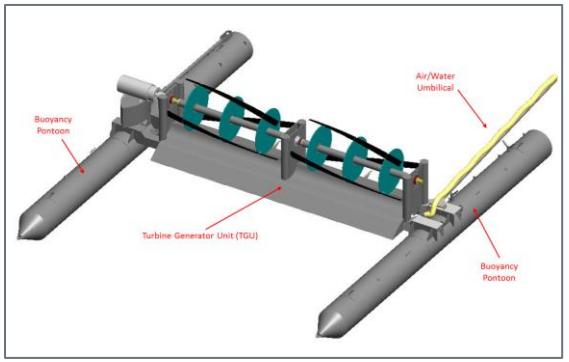
- Develop and evaluate designs to reduce retrieval and deployment, operation and maintenance costs.
  - A model incorporating the costs of installation, operations and maintenance has been completed to drive the design process.
  - Design exercises investigating multiple variants of the deployment system have been conducted, with inputs into the costing model providing economic guidance on the selection of an acceptable IO&M methodology.
  - Technical evaluation of different deployment strategies is 75% complete.
- Design validation plans for components and complete systems and open water tests
  - Test and validation plans for components and subsystems have started, with initial emphasis on driveline components.

Technical Approach

- Evaluation of increased system availability
  - Field work to evaluate the effect that ice will have on system availability has begun, with installation of shallow water ice profilers and an acoustic Doppler current profiler at the project site in Nov 2016
  - A probability of encounter with fishes model has been commenced
  - Complete out-of-water ice data collection
    - Under way
  - Complete in-water ice data collection
    - Under way

Accomplishments and Progress

- Technical Advisory Committee Meetings
  - August 26, 2016 and November 2, 2016
- System Design - Systems Requirements Analysis
  - Systems requirements complete
- Study of river ice conditions for over winter ice study
  - UAF completed a study plan
  - UAF deployed instrumentation
- Project Management Plan
  - Completed
- Project Management – IP and data management plan
  - Completed
- Baseline levelized cost of energy (LCOE) and Content Models
  - Completed



Project Plan & Schedule

- Budget Period 1: 05/06/2016 – 07/05/2017 (BP1)
- Total project duration: 36 months
- No slipped milestones
- Project down select in FY17
- Budget Period (BP) 2 and 3 Plan
  - Complete necessary permitting activities
  - System fabrication and deployment, with implemented IO&M improvements
  - 1-year testing campaign, providing electricity to the Village of Igiugig
  - Decommissioning

Project Budget

Budget History					
FY2014		FY2015		FY2016	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
				$86.1K	$21.3K

- There are no variances from planned budget and project plan has not been modified.

BP-1 (Current)		BP-2*		BP-3*		Totals	
DOE	Cost-Share	DOE	Cost-Share	DOE	Cost-Share	**DOE**	**Cost-Share**
$392.559k	$98.141k	$916.713k	$916.715k	$231.070k	$231.072k	**$1,540k**	**$1,245k**

*- Pending Down-Select and Go/No-Go at BP-1 Completion

Research Integration & Collaboration

Partners, Subcontractors, and Collaborators:

- ORPC Solutions
- University of Alaska – Fairbanks
- University of Maine School of Marine Sciences
- Maine Marine Composites

Communications and Technology Transfer:

- Publicly available project report delivered at project completion
- Project data to be uploaded to the MHK-Data Repository

Next Steps and Future Research

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FY17/Current research:

- Complete LCOE guidance for the improved system
- Salmon Smolt Characterization and Analysis
- Down-select Materials
  - Risk Management Plan
  - Risk Register
  - Deployment and Operations Plan
  - Data Collection and Environmental Monitoring Plans
  - Permitting Analysis for Open Water Tests

Proposed future research:

- Complete design work in BP1
- Complete subsystem validation in BP2
- Complete system validation in BP3
- Design refinements based on test work