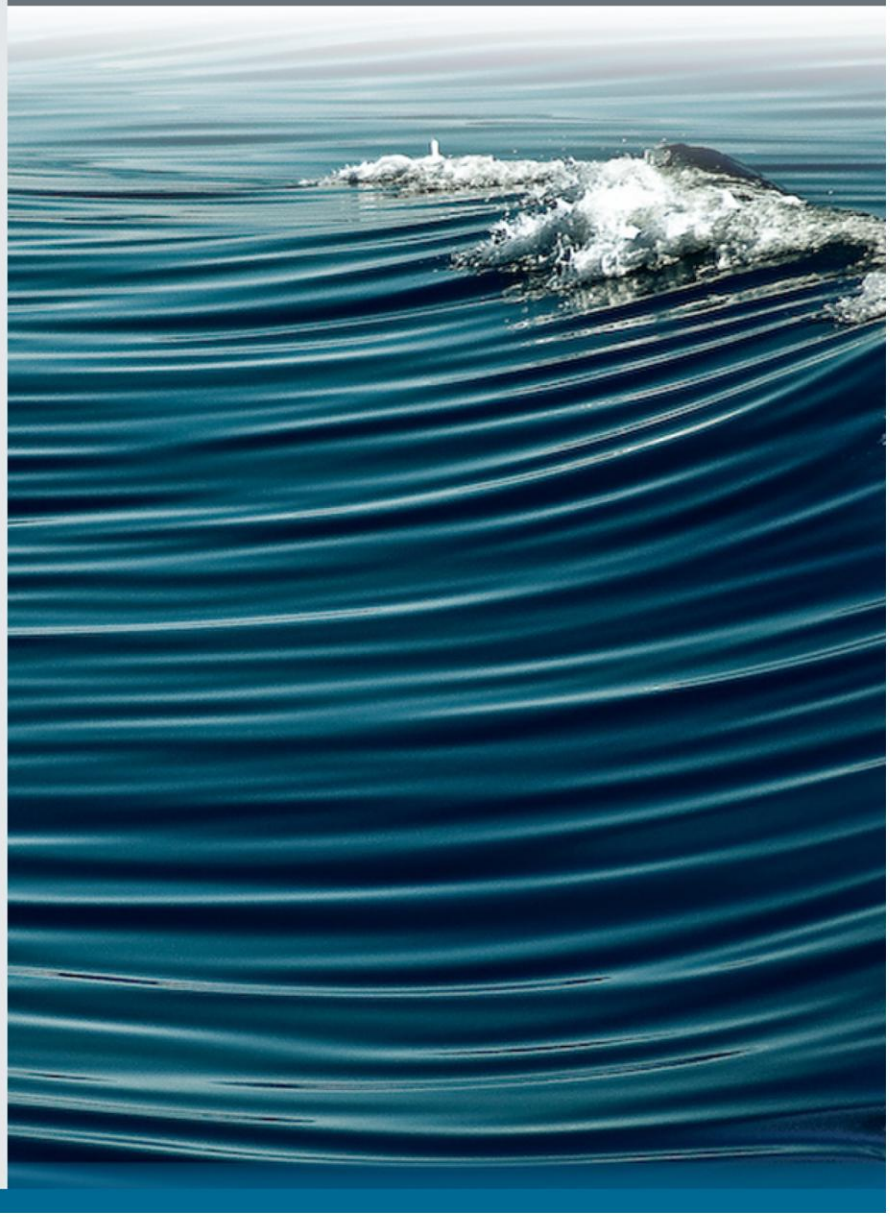
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Wind and Water Power Program

Water Power

2009 Peer Review Report

November 2009
Lakewood, CO



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2009 Peer Review Report
November 2009

U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
Wind and Water Power Program
2009 Water Power Peer Review Report
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2009 Water Power Peer Review Panel

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Table of Contents

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Executive Summary

Dear Colleague:

This document summarizes the comments provided by the peer reviewers at the U.S. Department of Energy (DOE) Wind & Water Power Program Fiscal Year (FY) 2009 Water Power Annual Peer Review meeting, held on November 17-18, 2009 in Lakewood, CO. In response to direction from the Under Secretary of Energy, this review process provides evaluations of the Program's projects in applied research, development and demonstration, and analysis of marine and hydrokinetic (MHK) water power technologies.

We on the DOE Water Power Team have thoroughly studied the recommendations of the reviewers, and they will be taken into consideration in the generation of future work plans. The tables below list the projects presented at the review, the final evaluation scores, and a summary of major actions to be taken by the Program during the upcoming fiscal. The projects have been grouped according to Program Element (Technology Development or Market Acceleration) and then by the four evaluation criteria. The weighted scores are based on a 4-point scale. To furnish all principal investigators (PIs) with direct feedback, all evaluations and comments are provided to each presenter; however, the authors of the individual comments remain anonymous. The PI of each project is instructed to fully consider these summary evaluation comments, as appropriate, in their FY 2010 plans.

I would like to express my sincere gratitude to the reviewers. You make this report possible, and we rely on your comments to help make project decisions for the new fiscal year. I would also like to express my admiration and appreciation of the tremendous efforts on the part of the PIs, their partners, and all of their colleagues in the marine and hydrokinetic industry. It is your dedication and commitment that will allow these technologies to succeed.

We look forward to the participation of many of you in the FY 2010 Wind & Water Power Program Annual Peer Review meeting, which is presently scheduled for the week of October 18 in Denver, Colorado. Thank you for participating in the FY 2009 Peer Review meeting.

Sincerely,

Mike Reed
Water Power Technologies Lead
U.S. DOE Wind & Water Power Program

Marine and Hydrokinetic Technology Development Projects

Project Title	Final Score	Cont	Dis-Cont	Other	Summary Comment	Program Response
WaveConnect Wave Energy In-Water Testing and Development (PG&E)	3.0	X			The WaveConnect project is well planned, utilizes critical state and private partnerships, and will be useful in moving the entire industry forward. However, this general approach appears to be technology agnostic and does not provide specific R&D pathways upon which the project would focus. The panel recommended the project should articulate specific deliverables as it relates to reliability of offshore connection for wave energy projects.	The Program's design for test centers is that they be technology agnostic – that is, they be available to demonstrate and test a variety of devices rather than provide a pathway for the development of a specific device.
Development and Demonstration of OWC (Concepts ETI)	3.3	X			The project is well planned and has been well executed in accomplishing optimization of turbine components necessary to improve OWC generation. The project scope is clearly focused on cost reduction and improved reliability. This project should have more active engagement with potential manufacturers, and should develop a clearer information sharing approach.	The program will work with Concepts to encourage engagement with manufacturers.
Puget Sound Tidal Energy In-Water Testing (Snohomish PUD)	4.0	X			This project has been well executed to date, and displays well defined task plans, good progress in completing baseline studies and excellent outreach with all levels of stakeholders. The panel did not find any weaknesses with the SnoPUD project.	
Verdant-NREL/SNL CRADA: Rotor Design and Modeling Tools	2.9	X			The project utilizes a strong well-qualified team that will benefit other tidal turbines of this type through better understanding of design parameters. Details were unclear, but the project should ultimately produce a generic software tool to design and optimize a rotor for various marine conditions. The project would be even more valuable if a report on the fatigue behavior of Aluminum/Magnesium alloy blade and other composite materials were made available; and what the operational loads on hydrokinetic turbines were as well as what flow characteristics were found using ADCP and ADV. Finally, the project should have clearer definition on how it fits in with the Verdant rotor improvement project.	Program will investigate increasing publically available data on rotor performance/survivability and flow characteristics.
Improved Structure and Fabrication of Rotors (Verdant Power)	3.0	X			Project is critical for better survivability of tidal turbines, and shows strong verification of methods. However, there needs to be a stronger tie-in with the NREL/SNL CRADA work, and there needs to be more clarity of when redeployment will take place. Additionally, it was unclear how this project would benefit the entire industry.	CRADA work has since been completed. Redeployment is scheduled for February, 2011.
Advanced Composite OTEC Cold Water Pipe Project (Lockheed Martin)	3.4	X			The project is focused on one of the three main cost-drivers for OTEC plants – the cold-water pipe being the most important technological barrier. The project leverages past R&D in this area as well as a team with strong technical expertise. The Lockheed team should develop partnerships to actually facilitate ocean deployment of a pipe (but this is obviously a separate effort from the DOE-funded project).	
Global MHK Technology and Project Database (DOE)	3.4	X			This project allows for increased public access to valuable data on the hydrokinetic industry. However, data retrieval from industry is inconsistent and the survey approach may limit some participation. The project should consider interfacing closer with IEA OES to work in collaboration with other organizations in both Europe and Asia to make	The Program has increased the frequency and comprehensiveness of data collection, although recognizes that information sharing from

Project Title	Final Score	Cont	Dis-Cont	Other	Summary Comment	Program Response
					the scope of this database more manageable. Additionally, it may be useful to also include projects that have applied (NOI/PAD) for a preliminary permit but have yet to receive one.	private companies can only be done on a voluntary basis. The Program has begun work with the IEA to encourage more detailed data collection from publically funded demonstrations and tests across the world.
Hydrodynamic Testing Facilities Database (DOE)	3.3	X			The database provides a valuable tool for industry and the public. It would be worthwhile to expand the database to include other types of relevant testing facilities that would be needed for technology development and market acceleration activities. This would include – for example - (a) Coastal Engineering test facilities to enable sediment transport and other ecological studies, (b) marine science laboratories to study various impacts, (C) Specialized mechanical and/or /structural and/or electrical laboratories to evaluate structural, mechanical and electrical performance of conversion systems in laboratory conditions, (d) any specialized offshore sea keeping facilities to assess installation methods etc.	The program will investigate expanding the database to include additional types of facilities.
Northwest National Marine Renewable Energy Center (OSU/UW)	3.3	X			The NNMREC demonstrated very good collaboration with other relevant research institutions and stakeholders – e.g., the SnoPUD project. Graduate students were also deeply involved in a number of activities at the Center. However, communication with NMREC of Hawaii and National labs should be increased in order to avoid duplicative work where possible. Additionally, there has not been a market study done for the discussed UW tidal test site, and it was not clear what the overall objective was for OSU to mainly focus on the mobile wave energy test berth.	The Program agrees with the need for more NMREC-National Laboratory collaboration and has begun that process. The focus on mobile test berths reflects the most effective testing system that can be realized with the available funding.
National Marine Renewable Energy Center of Hawaii (Univ. of Hawaii)	2.9	X			Having a National test center hosted at University of Hawaii seems to make sense given the resource and the fact that not many other locations will be viable for OTEC R&D. Similar to the above center, there seems to be some duplication in efforts and no current engagement with the National Labs or OSU/UW was mentioned. U of H should consider scaling back on getting four sites permitted in order to expedite the remaining sites and focus more resources on them. The Center should also consider switching more R&D resources to focus on OTEC.	As with OSU-UW, the Program agrees with the need for more UH-National Laboratory collaboration, as well as more direct coordination between the two centers, and has begun that process. DOE will consider working with Hawaii to focus test efforts on fewer sites.

Marine and Hydrokinetic Market Acceleration Projects

Project Title	Final Score	Cont	Dis-Cont	Other	Summary Comment	Program Response
Wave Energy Resource Assessment and GIS Database for U.S. (EPRI/VT)	**3.4**	X			This project has a well-defined schedule and process for achieving proposed objectives. The project team should utilize ten years worth of empirical wave height/period data versus five years. Additionally, DOE needs to have a plan for long term hosting of this database on the Program or NREL website.	The Program will be developing an integrated plan for long term hosting of all its resource assessments. Data used is based on availability and timeframes of project, but program will investigate potential of using 10-year wave data.
Assessment of Energy Potential from Tidal Streams in the U.S. (GTRC)	**2.5**	X			The database will be useful in filtering tidal areas that are appropriate based on specific device dimensions. However, the project is unclear in whether it is going to provide total energy potential for specific regional locations or total resource for the U.S. Modeling tidal resources in such areas as Florida may have little utility for project developers. This project needs to engage other stakeholders who have been conducting this type of work for validation purposes. DOE needs to have a plan for long term hosting of this database on the Program or NREL website. Where applicable (e.g., Puget Sound), the project should layer other site specific pieces of data generated from ongoing modeling by universities and/or federal labs.	The Program agrees that the final product of this assessment must provide total resource for the US, as well as for specific regional locations where appropriate. The Program will engage with the PIs to ensure this outcome.
Siting Protocol for MHK Projects (PEV)	**3.1**			X	The project is a necessary step to outlining the prerequisite regulatory process for deployment of MHK devices. Although the project conducted many stakeholder interviews, there should have been more strategic engagement and collaboration with WA/OR/CA projects that are already in progress. The project needs more integration with the PCCI and Re Vision projects.	The Program agrees fully with the need for direct coordination with projects in progress, and that process has already begun.
Identification of Potential Navig Impacts and Mitigation Measures (PCCI)	**2.4**			X	The project does a poor job at explaining how generic navigation regulations can be applied to site specific navigational issues. The resulting report should be more focused on the necessary requirements that developers will have to complete, as opposed to the "like to haves." The project could have also done a better job at engaging stakeholders that could be affected by these projects. This report should be rolled up into PEV's report as it is a subset of their work.	The report was designed to be part of the larger scope of the work coordinated by PEV, and as such will be rolled up into that project. While the period of performance of this project has ended, the Program will investigate ways to improve the communications of its findings.
Best Siting Practices for MHK Projects (Re Vision Consulting)	**3.0**	X			The project is more useful to larger planning efforts like marine spatial planning than to individual developers. The project should have used more real world project examples. Similar to the PCCI project, Re Vision's final product should be rolled into one report combining it with PEV's report.	Like PPCI's work, the ReVision project was designed as part of the larger scope of the work led by PEV.
Technical Support and General Environmental Studies (PNNL)	**2.7**	X			The knowledge and expertise of the PI is strong for this project. However, the exact deliverables of this support work is unclear, which makes it difficult to determine project success. Going forward, PNNL's work on developing a risk-based environmental impact framework would connect this work with industry R&D efforts.	The Program agrees with the need to connect this work with PNNL's Environmental Risk Evaluation System (ERES) and has since done so.

Project Title	Final Score	Cont	Dis-Cont	Other	Summary Comment	Program Response
EISA Report – Environmental Effects of MHK Energy (ORNL)	**2.5**			X	The report was dated when it finally came out, and it may not be representative of the state of the industry. On a content level, the report seemed to focus on negative environmental impacts, and the validity of some of the impacts and their respective mitigation measures was questionable. The Program should consider whether producing a second edition of the report with more contextual real world examples would be worthwhile. Additionally, the report should be revised to focus on potential environmental impacts that are specifically related to a statutory or regulatory permitting standard that must be met.	While the Program recognizes that a report focused on the effects related to statutory or regulatory permitting would be a useful tool for developers, the mandate of this report to Congress was to focus on all potential environmental effects. As the report acknowledges, there is little hard data from which to extrapolate potential effects, and much of the Program's environmental portfolio is directed at improving the quality of data to be able to evaluate the significance of potential effects and provide tools to mitigate them.
International Standards Development for MHK Renewable Energy (SAIC)	**3.3**	X			The project is key to international industry development as a whole, and utilizes qualified technical experts on the IEC panels. There needs to be more involvement by National lab personnel as well as personnel from the National Marine Renewable Energy Centers in order to provide the foremost experts in the state of the US industry to these panels. Additionally, it seems to make sense to run this effort through a lab or Center so it won't be perpetually addressed as an ad hoc effort. In the mean time, extending this effort by SAIC in recognition that this is an important long term effort.	The Program has increased lab and DOE representation to the Commission, but is at the moment satisfied with the work SAIC has done to lead the U.S. delegation.
Market Development and Transformation (NREL)	**3.2**	X			NREL has done a good job with staying involved and providing feedback in a number of different venues. The funding leverages the experience of the PI, which brings lots of technological experience from the wind industry's development. The Program should consider having NREL absorb the SAIC-led standards development efforts.	

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1.0 Introduction

Objective review and advice from peers—"peer review"—provides Department of Energy (DOE) managers, staff, and researchers with a powerful and effective tool for enhancing the management, relevance, effectiveness, and productivity of all Office of Energy Efficiency and Renewable Energy (EERE) research, development, demonstration, deployment, and supporting business management programs. The 2004 EERE Peer Review Guide[1] defines a peer review as:

> *A rigorous, formal, and documented evaluation process using objective criteria and qualified and independent reviewers to make a judgment of the technical/ scientific/business merit, the actual or anticipated results, and the productivity and management effectiveness of programs and/or projects.*

This definition is drawn from definitions used by the U. S. Department of Energy (DOE), National Academy of Sciences (NAS), the White House Office of Management and Budget (OMB), the U.S. General Accounting Office (GAO), and other federal agencies and institutions. It clearly distinguishes in-progress peer review from other types of peer review, such as merit review to select winners of competitive solicitations or readiness (stage gate) reviews to determine when a technology is ready to move to the next phase of development, as well as from other management activities such as quarterly milestone reviews or budget reviews.

The Wind and Water Power Program mission is the responsible stewardship of national resources to increase the development and deployment of reliable, affordable, and environmentally sustainable wind and water power technologies to realize the benefits of domestic renewable energy production. The Program supports research and development on a wide range of advanced water power technologies, with the objective of better understanding their potential for energy generation, and identifying and addressing the technical and nontechnical barriers to achieving this potential.

Advanced water power technologies include:

- Marine and hydrokinetic technologies, which capture energy from waves, tides, ocean currents, the natural flow of water in rivers, and marine thermal gradients without building new dams or diversions; and
- Conventional hydropower, which uses dams, diversionary structures, or impoundments to generate electric power from water resources.

Congress has supported research and development (R&D) for both conventional and new emerging water power technologies through the Energy Policy Act of 2005 and the Energy Independence and Security Act, which authorized substantial new funding to conduct R&D on marine and hydrokinetic technologies. FY2008 Congressional appropriations allowed for the program to fund $7.3 million in research projects for advanced water power technologies. In FY2009 Congress increased appropriations for these water power technologies to $40 million.

The inaugural DOE Water Power Peer Review, conducted on November 17-18, 2009 at the Sheraton Denver West Hotel in Lakewood, Colorado, focused exclusively on Technology Development and Market Acceleration activities currently underway in the Marine and Hydrokinetic technologies program focus area. Conventional Hydropower activities were not included in the 2009 Water Power Peer

[1] Peer Review Guide, Based on a Survey of Best Practices for In-Progress Peer Review, August 2004

Review. The findings from the Peer Review will be considered by program managers, staff, and researchers in setting priorities, conducting operations, and improving projects.

The objectives of the 2009 meeting were to:

- Review and evaluate FY 2008 and 2009 accomplishments;
- Provide an opportunity for Program partners to help shape the DOE-sponsored R&D program in order that the highest priority technical barriers are addressed;
- Serve to facilitate knowledge and technology transfer;
- Review and evaluate Program structure and approach; and
- Foster interactions among the national laboratories, industry, and academic institutions conducting the R&D.

A rigorous Peer Review was conducted as a two-day event. The first day focused on reviewing and evaluating the 19 Technology Development and Market Acceleration projects. On the second day, the reviewers convened in a separate location to provide an initial summary of their findings to the Water Power Technologies Lead and other program staff, and to discuss their initial impressions of the reviewed projects. The panel evaluated 15 of the 19 projects on the second day. A follow-up conference call was held on Friday, November 20, 2009 to discuss the remaining projects. Due to conflicts of interest with certain panel members, the following projects were evaluated by an alternate third expert reviewer: 1) Puget Sound Tidal Energy In-Water Testing; and 2) Siting Protocol for MHK Projects.

The following document represents the Peer Review Panel's observations and findings, the response from the Water Power Technologies Lead to these findings, and the supporting meeting materials, including an agenda and list of participants. In accordance with the DOE Peer Review Guide Section 6.0[2], peer reviewers provided both quantitative and narrative evaluations of the materials and projects presented at the Peer Review. The comments herein are the most direct reflection of reviewers' written evaluations, and where possible have been included verbatim.

1.1 Peer Review Panel

Peer Review Panel members (hereafter called Reviewers or Panel Members) are peer experts from a variety of water power-related backgrounds and organizations, including laboratories, industry, and academia. Reviewers were screened to ensure no conflicts of interest with regard to the specific projects for which they submitted reviews. Reviewers recused themselves if they worked on projects, had other relationships with project team members, or if they had a financial interest in the matter at issue. Where conflicts were identified, an alternate expert reviewer was selected, as identified below.

[2] Peer Review Guide, Based on a Survey of Best Practices for In-Progress Peer Review, August 2004

Table 1: Peer Review Panel Members

Name	Affiliation
Michael Murphy (Chair)	HDR Engineering Incorporated
Roger Bedard	Electric Power Research Institute (EPRI)
Gouri Bhuyan	Powertech Labs, Incorporated
Craig Collar	Snohomish Public Utilities District
Cherise Oram	Stoel Rives, LLC
Richard Cool*	PCCI, Incorporated
Brendan Dooher*	Pacific Gas & Electric (PG&E) Company

**Reviewed one project due to panel conflicts*

Reviewers received briefing materials one week prior to attending the meeting to aid in the program review process. This information included a 2009 Water Power Peer Review Plan (reviewer instructions), an agenda, the PowerPoint presentations for the 19 projects to be reviewed, project narratives and statements of proposed objectives (SOPOs), a review of the overall goals of the Program, conflict of interest forms, nondisclosure agreement forms, honorarium and travel reimbursement forms, and the MS Excel Evaluation Workbooks (electronic format) for technology development projects, market acceleration projects, and an overall programmatic review. Programmatic plans such as a Multi-Year Program Plan or Strategic Program Plan were not available prior to the peer review.

1.2 Analysis Methodology

In accordance with DOE EERE Peer Review Guide Section 6.0[3], the Peer Review Panel chose to submit both quantitative (i.e., numerical scores) and qualitative (i.e., narrative accounts) evaluations as part of their review of the materials and projects presented. The comments herein are the most direct reflection of their written evaluations, and where possible have been included verbatim. The project evaluation forms were distributed to the Peer Review Panel members prior to the meeting, along with detailed guidance on how to complete the forms.

The panel was asked to rate the projects in the following weighted categories:

1. **Relevance to Overall DOE Objectives**: the degree to which the project supports the goal and pathways of the Water Power Technology Development and Market Acceleration activities. (Weight = 40%)
2. **Approach to Performing the RD&D**: the degree to which technical barriers are addressed, the project is well-designed and technically feasible; and the degree to which future research has been planned - including consideration of contingencies, built-in optional paths or off-ramps, etc. (Weight = 30%)
3. **Technical Accomplishments and Progress**: advancement towards overall project and DOE goals; the degree to which research progress is measured against performance indicators and to which the project elicits improved performance (effectiveness, efficiency, cost, and benefits). (Weight = 20%)
4. **Research Integration and Collaboration:** relationships with industry/universities/other laboratories; the degree to which the project interacts, interfaces, or coordinates with other institutions and projects. (Weight = 10%)

[3] Peer Review Guide, Based on a Survey of Best Practices for In-Progress Peer Review, August 2004

Additionally, the Program Evaluation forms were designed to capture input regarding the following criteria:

1. **Relevance to Program Mission**: How well do Program funded projects accomplish the Water Power Program Mission?
2. **Approach**: Program's methodology to determining industry priorities and selecting relevant RD&D projects to achieve those industry goals.
3. **Communication & Collaboration:** Degree and impact that Program interaction has on industry, universities, Federal agencies, as well as comparable international actors.

Numerical scores were based on a four point scale, with the following qualitative descriptors given for the numerical scoring index:

- **4 - Outstanding**. Excellent progress toward objectives; suggests that barrier(s) will be overcome.
- **3 - Good**. Significant progress toward objectives and overcoming one or more barriers.
- **2 - Fair**. Modest progress in overcoming barriers; rate of progress has been slow.
- **1 - Poor**. Little or no demonstrated progress towards objectives or any barriers.

The individual criterion scores for the projects are reflected in the bar graphs in Section 4.1 and Section 5 .1. Additionally, the formula listed below was used to calculate the overall weighted average score in order to provide a means for comparing a project's final overall score equivalently to other projects:

*Final Project Score = [Reviewer 1 (Score1*0.40 + Score2*0.30 + Score3*0.20 + Score4*0.10) + Reviewer 2 (Score1*0.40 + Score2*0.30 + Score3*0.20 + Score4*0.10) + Reviewer 3 (Score1*0.40 + Score2*0.30 + Score3*0.20 + Score4*0.10) + Reviewer 4 (Score1*0.40 + Score2*0.30 + Score3*0.20 + Score4*0.10) + Reviewer 5 (Score1*0.40 + Score2*0.30 + Score3*0.20 + Score4*0.10)]/5*

A maximum final overall score of 4 signifies that the project satisfied the above mentioned four criteria to the fullest possible extent, while a minimum score of 1 implies that the project did not satisfactorily meet any of the requirements of the five criteria mentioned above.

The Reviewers were asked to provide qualitative comments indicating specific strengths or weaknesses of the project, along with recommendations for additions/deletions to the work scope. These comments, along with the quantitative scores, were placed into a database for easy retrieval and analysis. These comments are summarized in the following sections of this report.

The qualitative analyses provided in this report are individual comments made by the Reviewers, as consolidated by the U.S. DOE for brevity and merging comments with commonalities, and do not represent consensus opinion on the subject matter. The Principal Investigators were allotted 15 minutes to give their presentations.

The following sections of this report provide:

- an overview of the Peer Review Meeting Agenda,
- an overall review of the 2009 Water Power activities,
- key findings of the Peer Review Panel,
- quantitative and qualitative analyses of the Marine and Hydrokinetic Technology Development and Market Acceleration activities that were reviewed. Analyses include a summary of qualitative reviewer comments as well as graphs and tables showing overall scores for each of the projects,
- quantitative and qualitative analysis of the Peer Review Panel's overall evaluation of the

Program,

- a letter from the Chairperson to the Program Director,
- an meeting attendee list, and
- general project and program evaluation forms.

1.3 Peer Review Agenda

Wind & Hydropower Technologies Program
Water Program Peer Review Meeting
November 17-18, 2009 • Lakewood, CO

Tuesday, November 17, 2009

7:30 am	**Continental Breakfast & Registration**	**City Lights I**
8:00	**Welcome & Introductions**	Megan McCluer

MHK TECHNOLOGY DEVELOPMENT AND TESTING

8:20	**Water Power Program Introduction**	Alejandro Moreno
8:30	**Technology Development Overview**	Alejandro Moreno
8:50	**Wave Technologies**	
	• WaveConnect Wave Energy In-Water Testing and Development (PG&E)	Brendan Dooher
	• Development and Demonstration of OWC (Concepts ETI)	Frank DiBella
9:50	**Current Technologies**	
	• Puget Sound Tidal Energy In-Water Testing (Snohomish PUD)	Craig Collar
10:20	**BREAK (15 min)**	
10:35	**Current Technologies (continued)**	
	• Verdant-NREL/SNL CRADA: Rotor Design and Modeling Tools	Scott Hughes/ Josh Paquette
	• Improved Structure and Fabrication of Rotors (Verdant Power)	Dan Costin
11:35	**Ocean Thermal Energy Technology (OTEC)**	
	• Advanced Composite OTEC Cold Water Pipe Project (Lockheed Martin)	Dennis Cooper
	Technology Assessment	
	• Global Marine and Hydrokinetic Technology and Project Database (DOE)	Robert Whitson
	• Hydrodynamic Testing Facilities Database (DOE)	
1:05	**National Marine Renewable Energy Centers**	
	• Northwest National Marine Renewable Energy Center (OSU/UW)	Meleah Ashford/ Merrick Haller/ Brian Polagye
	• National Marine Renewable Energy Center of Hawaii (U. of Hawaii)	Rick Rocheleau

MHK MARKET ACCELERATION		
2:05	**Market Acceleration Overview**	Alejandro Moreno
2:20	**Resource Assessments**	
	• Wave Energy Resource Assessment and GIS Database for U.S. (EPRI/VT)	Paul Jacobson/ George Scott
	• Assessment of Energy Potential from Tidal Streams in the U.S. (GTRC)	Kevin Haas
3:20	**BREAK (15 min)**	
3:35	**Siting & Environmental Effects**	
	• Siting Protocol for MHK Projects (Pacific Energy Ventures)	Steve Kopf
	• Identification of Potential Navig. Impacts and Mitigation Measures (PCCI)	Richard Cool
	• Best Siting Practices for MHK Technologies (Re Vision Consulting)	Mirko Previsic
	• Technical Support and General Environmental Studies (PNNL)	Andrea Copping
	• EISA Report - Environmental Effects of Marine & Hydrokinetic Energy (ORNL)	Glenn Cada
5:15	**International Standards Development**	
	• International Standards Development for Marine and Hydrokinetic Renewable Energy (SAIC)	Neil Rondorf
	• Market Development and Transformation (NREL)	Bob Thresher
6:15	**Adjourn**	

Wednesday, November 18, 2009

8:00 am	**Breakfast**	**City Lights II**
9:00	**Review Program Goals and Priorities** ***Meeting Room: City Lights II***	Peer Review Panel CLOSED ROOM MEETING
10:30	**BREAK (15 min)**	
10:45-12:15	**Peer Review Panel**	Peer Review Panel CLOSED ROOM MEETING
12:15-1:45	**WORKING LUNCH – Box Lunch Delivered**	Peer Review Panel CLOSED ROOM MEETING

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2.0 Water Power Peer Review Panel Recommendations and Key Findings

The following is a summary list of the Water Power Peer Review Panel's overall recommendations and key findings and comments from the 2009 Water Power Peer Review meeting. More detailed, technical comments on specific projects are provided in Section 4.1 and Section 5.1.

Recommendations to the Program

- The Program priorities, pathways, and approaches are generally well-aligned with industry needs and are supportive of industry growth and development. However, some projects could be better aligned regarding these elements. Most of the program activities further the goals of the Program.
- The Program is well-balanced among four main categories: 1) pure technology testing, 2) supporting getting projects permitted and deployed so that they can be tested, 3) determining energy capacity, and 4) analyzing and synthesizing regulatory challenges.
- The approach to research and development should include verification that the issues being researched are being done to a level of rigor acceptable to the regulatory/scientific community so that the results will be applicable for industry to reference and utilize as appropriate in project and policy development.
- Projects could be more sharply focused on reducing barriers. Some projects focus on issues that do not directly address barriers, or do not directly facilitate the efforts of leading projects that are already in progress.
- The greatest value at this stage of the industry is to focus on furthering efforts to get real world projects in the water with appropriate monitoring programs to ensure necessary data is effectively gathered. The data and experience gained from these efforts will be invaluable, and will contribute greatly to optimizing the overall MHK program going forward.
- Program resources could be applied to work directly with NOAA Fisheries to develop criteria for when baseline/pre-license studies are absolutely necessary for short-term demonstration projects (as distinguished from long-term commercial projects) and when post-deployment monitoring is sufficient and appropriate.
- System deployment, testing, and validation should be of the highest priority, as results from these efforts will inform all other priorities and approaches. Without information and data from these real world projects, other/current (desktop study) efforts related to environmental effects, stakeholder analysis, etc. may not be optimally focused or may not result in value-added efforts.
- Existing resource assessments and baseline impact studies:
    - Funding resource impact studies for OTEC. Rather than waiting, we should identify environmental challenges now so that technology developers can plan for or avoid those impacts.
    - Focusing on project monitoring efforts/technology, particularly with respect to environmental impacts, will be an important element for project/industry success.
    - Increased support on addressing specific environmental issues that industry is facing with permitting efforts is required. The Program should approach this in a way that industry can use and that regulatory agencies will accept to support permitting efforts as best can be accomplished.
- The development of a framework for what adaptive management means, in terms of commercial development and who pays for this work, is important.

- The Program should distinguish between studying and minimizing impacts for the sake of doing so vs. studying and minimizing impacts that are directly linked to a statutory or regulatory standard that a project must meet to be permitted, the latter being the appropriate subject for DOE-funded studies.
- Construction impacts are not unique to ocean energy, and those that are, are the types of impacts that the agencies seem to understand sufficiently to be able to permit; therefore using DOE resources to identify such impacts is not a critical path for this industry.

Issues Regarding Duplicative Efforts and Dilution of Resources

- There are too many projects and associated dilution of resources given current funding levels.
- There needs to be some attention on the centers that are working on the same areas.
- In order to avoid duplication and dilution of Program resources, the following specific issues need to be addressed:
    - Developing a well-defined role for each of the U.S. DOE national laboratories - for the water program delivery, there should be measurable deliverables - at this point there are too many soft deliverables and it is very difficult to measure the value;
    - Improving coordination between the two marine centers for prioritization of their future tasks and encouraging them to leverage federal R&D resources from other sources to maximize the DOE investment; and
    - DOE water power activities are currently focused on addressing barriers associated with enabling in water demonstrations, with no significant focus on developing new conversion technologies or further developing existing conversion technologies. The Program needs to enable a staged technology improvement process.

Measurable Goals and Outcomes Issues

- The goal to reduce cost of energy (COE) by 2030 to 7 cents/kWh for the technology development projects is not an effective, measurable goal.
- A quantitative cost of electricity goal without specifying the financial assumptions behind the goal is pretty much meaningless.
    - One recommendation is to replace the "7 cents/kWh" goal with a cost reduction goal and possibly a statement that the Program strives to make Marine and Hydrokinetic (MHK) technologies cost comparable with land-based wind technologies.
- Some of the activities could have better defined, measurable, and trackable goals and objectives.
- The development of short-term goals, with a focus on reliable demonstration of technologies, would be beneficial to the Program. Short-term goals should include measurable values such as: a) "x" number of current wave and tidal projects in the U.S., and b) demonstration of reliable (50% of availability) generation of electricity for a 12-month period with minimum environmental impact by 2020) for example.

The Energy Independence and Security Act (EISA) of 2007 Report to Congress Issues[4]

- The EISA report is now a dated document and may not reflect the current state of industry and understanding of environmental issues. This may lead to a step backwards and perhaps hamper development.
- The report mainly focuses on the negative aspects, and publishing this report could cause major problems and negatively impact the entire industry.
- The Panel questioned the validity of some of the identified impacts and mitigation measures listed in the EISA report.

[4] Report to Congress: Potential Environmental Effects of Marine and Hydrokinetic Energy Technologies, 2009.

Technology Process – roadmap, regulatory spending

- A Technology Roadmap should be completed, and the Program should complete and publish this document as soon as possible.

Technology Transfer Issues

- DOE staff should decide which projects require information sharing and which do not, and make that information sharing a requirement of funding.

International

- The Program should follow up on efforts undertaken in 2009 during the "Clean Energy Dialogue" between the U.S. and Canada regarding synergistic activities underway along both coasts of the continent.
- The Program currently has some good communication and collaboration with European countries and the International Energy Agency (IEA).

Integration – other initiatives, ongoing private efforts, and permitting issues

- The Program's coordination with NOAA, FERC, MMS and other agencies has been and will continue to be useful in coordinating the missions and goals of those agencies.
- The Program needs to incorporate additional coordination between award recipients, especially and if the recipients are comprised of multiple team members require strong project management /communication procedures within their teams to assure efficiency and organized/coordinated approach. It was evident in presentations that this area could be improved.
- Coordination is required between the Program DOE Water Power Program-funded marine centers, DOE national laboratories, and other national funding agencies for basic research and development at the centers.
- Rather than asking several grant recipients to coordinate and merge their work, it may be more efficient and effective for the Program to choose one entity that appears to have the capability to take on a broader scope, and empower that entity to choose who will sub to it on various subjects.

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3.0 Water Power Activities

To take this country in a new direction, the President is working with Congress to pass comprehensive legislation to protect our nation from the serious economic and strategic risks associated with our reliance on foreign oil and the destabilizing effects of a changing climate. Policies to advance energy and climate security should promote economic recovery efforts, accelerate job creation, and drive clean energy manufacturing by:

- Investing in the Clean Energy Jobs of the Future,
- Creating new Jobs in the Clean Energy Economy, and
- Investing in the Next Generation of Energy Technologies.

The U.S. Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE) works to strengthen the United States' energy security, environmental quality, and economic vitality through public-private partnerships. The goals of the EERE Office are to support the development of clean, affordable, reliable, and domestic energy resources and technologies.

The Office of Energy Efficiency and Renewable Energy supports this goal through:

- Enhancing energy efficiency and productivity,
- bringing clean, reliable and affordable energy technologies to the marketplace, and
- making a difference in the everyday lives of Americans by enhancing their energy choices and their quality of life.

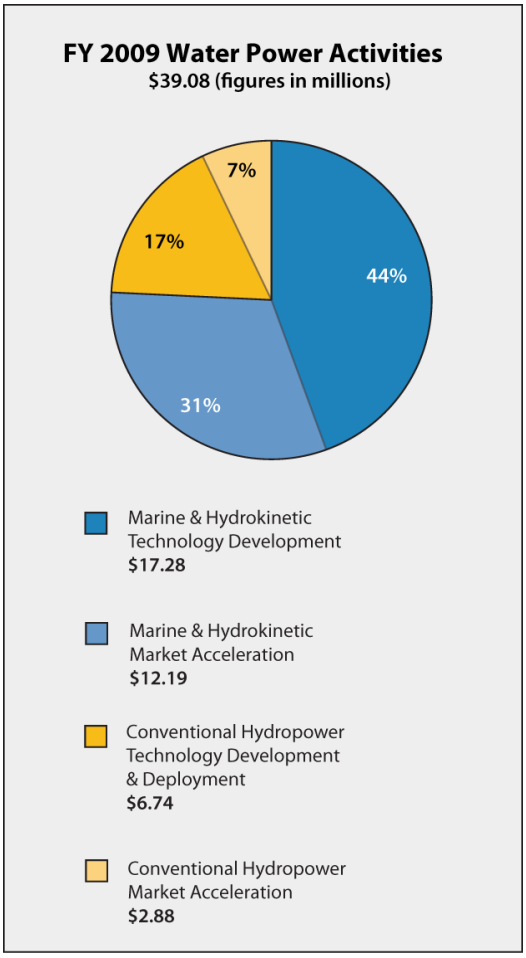


Figure 3.1 FY 2009 Water Power Activities

The Wind and Water Power Program is one of ten programs within EERE and includes the Water Power Activities. The mission of the Wind and Water Power Program is the responsible stewardship of national resources to increase the development and deployment of reliable, affordable, and environmentally sustainable wind and water power technologies to realize the benefits of domestic renewable energy production.

The mission of the U.S. DOE Water Power activities is to develop and employ novel technologies, improved operational procedures, and rigorous analysis to assess the potential extractable energy from domestic rivers, estuaries and coastal waters and help industry harness this renewable, emissions-free resource through environmentally sustainable ad cost-effective electric generation.

Figure 3.1 illustrates the budget breakdown for water power activities for FY2009. The 2009 Peer Review focused on Technology Development and
Market Acceleration activities that were currently underway in the Marine and Hydrokinetic (MHK) program area. Conventional Hydropower activities were not included in the 2009 Peer Review.

The priorities of the MHK Program are:

- System Deployment, Testing and Validation
  - Facilitate the deployment and testing of full scale MHK prototypes and components
  - Support the development of integrated test centers
  - Generate data on performance, reliability and impacts
- Cost Reduction and System Performance/Reliability
  - Support design and development of scale systems and components in order to reduce technology costs and improve performance and reliability
  - Develop design and testing protocol, support developers who follow it
  - Develop numerical and physical tools to assist industry in device and system design and operation
- Understand Environmental Effects
  - Generate and disseminate data to assess and evaluate environmental impacts and prioritize further research
  - Collaborate with industry, regulators, and stakeholders to reduce siting and permitting burden while minimizing impacts
- Resource Modeling
  - Determine the available, extractable, and cost-effective water resources in the US by location and resource type
- Develop Evaluation and Performance Standards
  - Characterize, evaluate and compare the wide variety of MHK technologies; continue IEC/IEA standards development.

The following sections of this report provide summaries and analyses of the Marine and Hydrokinetic Technology Development and Market Acceleration activities that were reviewed during the 2009 Water Power Peer Review meeting. Analyses include a summary of qualitative reviewer comments as well as graphs and tables showing overall scores for each of the projects. The qualitative analyses provided in the following sections are individual comments made by the Reviewers, as consolidated by the U.S. DOE for brevity and merging comments with commonalities, and do not represent consensus opinion on the specific project or presentation.

4.0 MHK Technology Development Activities

The goal of Marine and Hydrokinetic (MHK) Technology Development activities is to reduce the cost of energy (COE) generated from MHK technologies to $0.07/kWh by 2030. To achieve this goal, Technology Development activities will follow specific strategic pathways including: 1) increasing device efficiency, 2) improving device availability and reliability, 3) optimizing array efficiency, and 4) reducing development, deployment and O&M costs.

The key barriers facing MHK Technology Development are:

- Lack of cost and performance data,
- Prototype deployment is costly and time-consuming,
- O&M is difficult and costly in rough marine environments,
- Lack of common technical standards,
- Lack of fundamental data on device and resource interaction, and
- Numerous disparate competing design types.

The technical approaches to addressing the MHK Technology Development key barriers and achieving the COE goal of $0.07/kWh by 2030 are:

- Industry partnerships supporting the design, manufacture, and deployment of MHK components and systems,
- Support for facilities to test devices at all technology stages,
- Computational tools and models to identify cost and performance drivers and technology improvement opportunities, and
- Integrate models and test data to evaluate technologies and refine program goals and strategy.

The main topic areas addressed by 2008 MHK Technology Development Program solicitations were (a) Advanced Water Power Renewable Energy In-Water Testing and Development and (b) National Marine Renewable Energy Centers. In 2009, MHK Technology Development Program solicitations concentrated on (a) Marine and Hydrokinetic Energy Conversion Device or Component Design and Development and (b) Supporting Research and Testing for Marine and Hydrokinetic Energy.

Table 4.1 below lists the MHK Technology Development projects reviewed during the 2009 Peer Review meeting, including the Principal Investigator and budget for each project.

Table 4.1 MHK Technology Development Projects

Project Name	Principal Investigator	FY08 (DOE Funds)	FY09 (DOE Funds)	Total Funding	Duration (Years)
Wave Technologies					
WaveConnect Wave Energy In-Water Testing and Development (PG&E)	Brendan Dooher	$600,000	$600,000	$5,850,000	**2**
Development and Demonstration of OWC (Concepts ETI)	Frank DiBella	$597,116	$598,340	$2,951,000	**2**
Current Technologies					
Puget Sound Tidal Energy In-Water Testing (Snohomish PUD)	Craig Collar	$550,000	$600,000	$3,099,000	**2**
Verdant-NREL/SNL CRADA: Rotor Design and Modeling Tools	Scott Hughes/ Josh Paquette	$500,000	NA	$955,000	**1**

Project Name	Principal Investigator	FY08 (DOE Funds)	FY09 (DOE Funds)	Total Funding	Duration (Years)
Improved Structure and Fabrication of Rotors (Verdant Power)	Dean Corren	$329,544	$593,286	$922,830	**2**
Ocean Thermal Energy Technology (OTEC)					
Advanced Composite OTEC Cold Water Pipe Project (Lockheed Martin)	Dennis Cooper	$602,000	$594,221	$1,196,221	**2**
Technology Assessment					
Global Marine and Hydrokinetic Technology and Project Database (DOE)	Robert Whitson	$110,000	NA	$110,000	**Ongoing**
Hydrodynamic Testing Facilities Database (DOE)	Robert Whitson	NA	$6,000	$6,000	**Ongoing**
National Marine Renewable Energy Centers					
Northwest National Marine Renewable Energy Center (OSU/UW)	Meleah Ashford/ Merrick Haller/ Brian Polagye	$1,250,000	$1,250,000	$13,545,000	**5**
National Marine Renewable Energy Center of Hawaii (Univ. of Hawaii)	**Rick Rocheleau/ Luis Vega**	**$978,000**	**$1,204,500**	**$11,055,000**	**5**

4.1 MHK Technology Development Project Evaluations

Table 4.2 below lists the average score per category and the averaged weighted score for each Technology Development project that was evaluated by the Peer Review Panel.

Table 4.2 Technology Development Project Scores

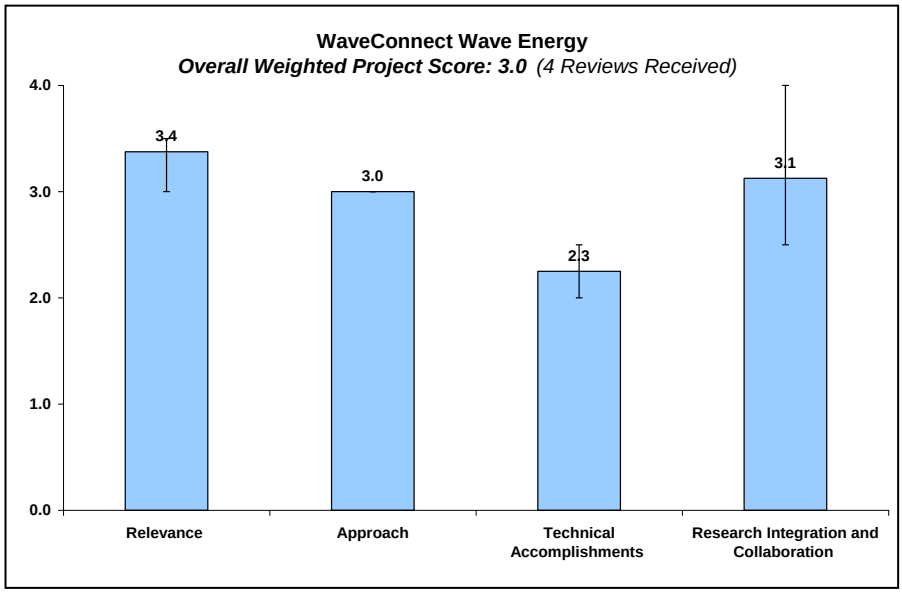
Peer Reviewer Project Evaluation Form Scores - Average Scores

Numerical Scoring Index	1	2	3	4
Qualitative Descriptors	Poor	Fair	Good	Outstanding

	Technology Development Projects									
Scoring Category \ Projects	WaveConnect Wave Energy (PG&E)	Development and Demonstration of OWC (Concepts ETI)	Puget Sound Tidal Energy (Snohomish PUD)	Verdant-NREL/SNL CRADA	Improved Structure and Fab. of Rotors (Verdant Power)	OTEC Cold Water Pipe (Lockheed Martin)	Global MHK Technology and Project Database (DOE)	Hydrodynamic Testing Facilities Database (DOE)	Northwest National Marine REC (OSU/UW)	National Marine REC of HI (Univ. of Hawaii)
1. Relevance to Overall DOE Objectives (degree to which the project supports the goal and pathways of the Water Power Program. (Weight = 40%)	3.4	3.3	4.0	3.1	3.3	3.6	3.4	3.3	3.7	3.5
2. Approach to Performing the RD&D (degree to which technical barriers are addressed, the project is well-designed and technically feasible; and the degree to which future research has been planned. (Weight = 30%)	3.0	3.6	4.0	3.0	3.1	3.6	3.2	3.2	3.0	2.7
3. Technical Accomplishments and Progress (toward overall project and DOE goals – the degree to which research progress is measured against performance indicators and to which the project elicits improved performance. (Weight = 20%)	2.3	3.1	3.8	2.6	2.6	3.0	3.4	3.5	3.0	2.2
4. Research Integration and Collaboration (with industry/universities/other laboratories – the degree to which the project interacts, interfaces, or coordinates with other institutions and projects). (Weight = 10%)	3.1	2.3	3.8	2.6	2.1	2.8	3.5	3.2	3.2	2.9
Average Weighted Score	**3.0**	**3.3**	**4.0**	**2.9**	**3.0**	**3.4**	**3.4**	**3.3**	**3.3**	**2.9**

WaveConnect Wave Energy In-Water Testing and Development Project
Brendan Dooher, Pacific Gas and Electric Company

Brief Summary of Project



The objective of the four-phase PG&E WaveConnect Demonstration Project is to conduct in-water testing and evaluation of commercial/near-commercial WEC technology representative of what would be expected to be used in a commercial-scale wave power plant (40 MW or more rated capacity). This will enable the PG&E team to make an informed evaluation of WEC technology as to whether, and to what extent, wave energy should be included in PG&E's energy portfolio, while simultaneously facilitating the commercial development of this new industry.

The specific objective of this Phase II project is to conduct all work necessary to complete engineering design, conduct baseline environmental studies, and submit all license construction and operation applications required for a pilot wave energy demonstration plant for the two WaveConnect sites in Northern California.

The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.

Question 1: Relevance to overall DOE objectives

- Provides location for WEC testing, allows for array and other related assessments.
- The project is the first project in U.S. that would enable demonstration of multiple wave energy technologies.
- The project has the opportunity to demonstrate availability and reliability of wave energy conversion process.
- Project has the potential to notably advance progress towards DOE objectives.
- Will force the issue in terms of regulatory agencies taking formal positions regarding permitting requirements.
- Developing wave test facilities is very important to the goal to allow testing of new technologies that would otherwise have difficulty getting in the water. For different reasons, it is also important to get commercial projects through the regulatory process and into the water.
- Getting demonstration and commercial projects in the water is critical to demonstrate that these projects are both technologically feasible and can get over the regulatory hurdles.

Question 2: Approach to performing the RD&D

- Includes academia and provides a location for research and development.
- Provides a good potential for future R&D on relevant issues.

- The project is well designed and technically feasible.
- Though the approaches to deliver the project are defined well, the project does not specifically identify or discuss specific R&D component of the project.
- Not clear how 50% of resources focused on environmental efforts will be prioritized and deployed.
- Not clear how the longevity of a test facility fits with the business of a utility.
- For the commercial project, moving projects like this forward is invaluable to show that it can be done, to assist resource agencies in understanding how to permit these types of projects.

Question 3: Technical Accomplishments and Progress

- Issues identification and monitoring plans are currently being developed with stakeholders, however at this point not yet finalized and uncertainty exists on final acceptance of all monitoring requirements.
- Modest progress has been made for the project.
- DLA going in to FERC in March 2010.
- Difficult to determine progress without seeing DLA or some additional information.

Question 4: Research Integration and Collaboration

- Includes academia, broad involvement.
- Though the project presenter suggested potential coordination with EMEC and other organization, the project is lacking on details of the research integrations and collaboration.
- Strong technical and consultant team.
- Large group of relatively costly consultants.
- There may be internal opportunities to support within PG&E.
- Appears to be limited interaction with National Labs and the Marine Energy Center.
- The testing facility provides a great opportunity for collaborating with technology developers to advance the industry.
- Commercial projects do not lend themselves well to this category - intent is to showcase that a particular technology is feasible and capable of being permitted, not necessarily to integrate and collaborate.

Project Strengths

- Two locations, pilot and commercial demonstration provides an opportunity to assess technical and environmental aspects of project development.
- The project is well designed in coordination with utility commission, and other government stakeholders.
- Given the scope of the project, it has potential to contribute technology development associated with the reliability of the offshore connection of multiple wave energy networks.
- Some strong partnerships have been developed.
- Good current support from PUC, risk is how enduring this will be in the future.
- It is critical to provide opportunities to test new technologies. It is also critical to get commercial or demonstration projects permitted and in the water.

Project Weaknesses

- Considering the project involves multiple technologies, the work program of the project does not provide a clear indication on what specific R&D pathways the project would focus.
- It is also not clear how this project, after completion, would be available for enabling one of the DOE's pathways to reduce the cost of energy.

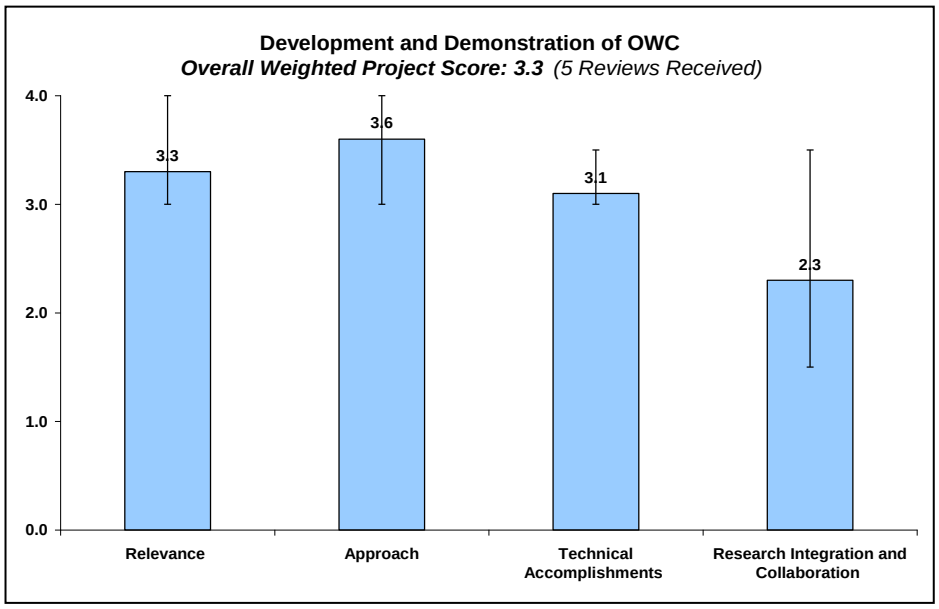
- More integration with OSU would seem beneficial.
- The degree of consultation is not clear.
- Overall strategy for the two sites was not clear.

Recommendations for Additions/Deletions to Project Scope

- The project needs to establish more specific R&D collaboration and integrations, and the partners and their roles in this collaboration.
- The project needs to articulate what specific deliverables would enable the projects to achieve the goals of the Program. The project has an opportunity to focus on reliability of offshore connection for wave energy project.
- The role and strategy for both sites needs to be clarified.

Development and Demonstration of OWC
Frank DiBella, Concepts ETI

Brief Summary of Project
The objective of this DOE effort is to finalize the engineering design of turbine and diffuser assembly, conduct scaled mechanical testing of the new blade articulation control mechanism and other critical components, assist Oceanlinx in completion of the final detailed design of their Mark3 nominal 300 kWe Oscillating Water Column Wave Energy Converter System, and proceed to (in Phase 2) ocean water testing of the complete system.



The successful deployment of this next generation system will provide a significant boost to the industry in terms of identifying and resolving critical engineering details, while simultaneously verifying the economic viability for this energy resource.

The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.

Question 1: Relevance to overall DOE objectives

- Supports the goals of improving device reliability and efficiency.
- Good reduction in manufacturing cost and O&M cost for this variable pitch turbine is critical.
- The project scope is very well defined to: 1) increase reliability and device efficiency of the Oceanlinx type of OWC, and 2) to reduce manufacturing cost for the link design of the component.
- Activities are appropriate and seem well considered.
- Strong focus on efforts to reduce costs and enhance manufacturability.
- This project is well focused on a technical engineering effort to increase efficiency, decrease costs of OWC device, which is an important to DOE's goals
- Some of the important components of this project are: (1) making the device "sloppy" to allow development at any machine shop, not just one unique shop; (2) reducing O&M costs for blade design considering ocean conditions failure modes will be published.

Question 2: Approach to performing the RD&D

- Overall seems like a very strong, appropriate, and focused approach.
- Approach appears to be well designed, organized and executed.
- Seems to have a clear path forward.

- The design for manufacturing and low O&M via testing in a lab test rig is right on target.
- Various tasks of the project are well designed, through targeted activities, to address the barriers.
- Utilizing two test rigs.
- Blade articulation mechanism simplification is key.
- Focused work to determine the necessary tolerances.
- Fatigue and Failure Modes and Effects Analysis (FMEA) determinations.

Question 3: Technical Accomplishments and Progress

- The project has finished assembly of the blade articulation system and is ready for testing.
- The progress has been good up to this point. The prototypes have been constructed and are being prepped for installation in test rigs.

Question 4: Research Integration and Collaboration

- Very little collaboration outside of the team was mentioned, but maybe that is because they are focusing on a limited scope.
- Recommend a defined information sharing approach that without would be only one beneficiary of this work - Oceanlinx of Australia.
- Would like to see more regarding how the learning and benefits from this project will be applied to the industry at large.
- This is being done in collaboration with Oceanlinx to be used in their projects.
- Requires clarification on issues regarding intellectual property. Results should be pushed into the public domain.

Project Strengths

- Well designed, organized, and executed to solve a particular issue that is important for OWCs and may help support development of projects with this technology in the U.S.
- Looking at a common challenging aspect of power generation. Will publish results of failure and O&M experiences.
- The project scope is very focused to reduce cost and improve reliability of a wave energy conversion system that is being considered for one of the early stage projects in U.S.
- Very detailed and thorough efforts.

Project Weaknesses

- No engagement with potential manufacturers of the components.
- Focuses exclusively on blade linkage and articulation, which is a narrow cross section of the turbine assembly. However, this may be entirely appropriate for the scope of this project.
- Very specific to the OWC technology.

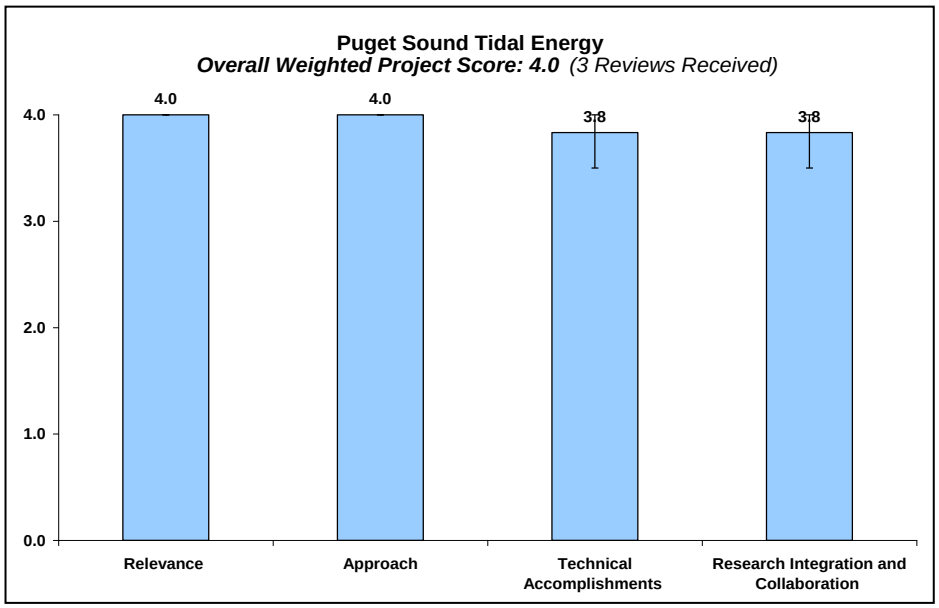
Recommendations for Additions/Deletions to Project Scope

- Develop clearer information sharing approach.
- Information should be shared broadly if possible.

Puget Sound Tidal Energy In-Water Testing

Craig Collar, Snohomish Public Utility District

Brief Summary of Project



The overarching goal of the multi-phase Snohomish PUD Tidal Energy Demonstration Project (outside the scope of DOE assistance) is to conduct in-water testing and evaluation of commercial/near-commercial tidal in-stream energy conversion (TISEC) technology representative of what would be expected to be used in a commercial-scale power plant. This will enable the District team to make an informed evaluation as to whether, and to what extent, tidal energy should be included in the District's energy portfolio, while simultaneously facilitating the commercial development of this new industry.

The specific objective of this phase of the project (DOE assistance phase) is to conduct all work necessary to complete preliminary engineering design, ensure effective plans to evaluate environmental considerations, and submit all license applications required for a pilot tidal energy demonstration plant in the Admiralty Inlet of Puget Sound.

The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.

Question 1: Relevance to overall DOE objectives

- This is a first utility scale tidal current project that will be built in U.S. with the assistance of the DOE program.
- The project objective to generate relevant scientific data on environmental, mechanical and electrical performance of the first unit is a very critical DOE program goal of deployment as well as the DOE technology development goal of long-term cost reduction.
- The project would provide relevant cost information for a demonstration tidal current project for utility scale and would also provide relevant information on reliability, availability and environmental impact, if any. These are some of the pathways to achieve DOE objectives.
- It is critical that DOE support getting projects like this in the water in order to demonstrate both the technical feasibility and that the projects can overcome the regulatory hurdles. The latter will be invaluable in facilitating financing, additional funding options, and the industry as a whole.
- Killer whale, salmon and rockfish studies are expected to decrease the need for similar baseline studies in the future which will help projects move forward more quickly and with fewer associated costs.

Question 2: Approach to performing the RD&D

- The project approach for site selection, technology selection, environmental characterization and the outreach activities are very well defined.
- The technology choice is smart - it is already deployed in several other areas which should minimize the potential for failures.
- SnoPUD is addressing shipping and military vessel issues through outreach to U.S. Coast Guard and U.S. Navy to make sure these agencies are satisfied with the project approach.
- SnoPUD is working closely with NOAA on baseline studies and delaying the DLA to specifically address NOAA request to incorporate agreement on studies into DLA, which is a smart approach to minimize future potential delays.

Question 3: Technical Accomplishments and Progress

- The project progress has been very good. The site has been selected and baseline environmental and other geophysical data have been characterized. The tidal current technology has been selected for the site.
- Focus is appropriately on the initial permitting and development stage.
- Excellent progress being made to address regulatory hurdles with NOAA.
- Tug cable between tugs and barges is an issue to be addressed in the future.

Question 4: Research Integration and Collaboration

- The project collaboration and coordination with various stakeholders, research organizations including the University of Washington (one of the partners of the Northwest National Marine Renewable Energy Center), are well defined and have been great so far.
- Considering an adjacent tidal current initiative by U.S. Navy, the project team proactively coordinating with the U.S. Navy and the U.S. Coast Guard for enabling synergy.
- At SnoPUD's initiation, collaborating with Navy/Verdant project to reduce costs of studies, e.g. joint consultation meetings.
- Excellent work with NOAA to develop studies/monitoring to address NOAA's concerns.

Project Strengths

- Overall the project is outstanding considering the objective. Very well defined task plans, good progress has been made, and SnoPUD is collaborating with various stakeholders.
- The future plan of the project is well defined.
- Focus on getting technology in the water.
- Works through regulatory hurdles, particularly with NOAA, to both illustrate that these projects can be permitted and to work through the study issues with NOAA to both define appropriate studies and obtain key information for future projects.

Project Weaknesses

- N/A

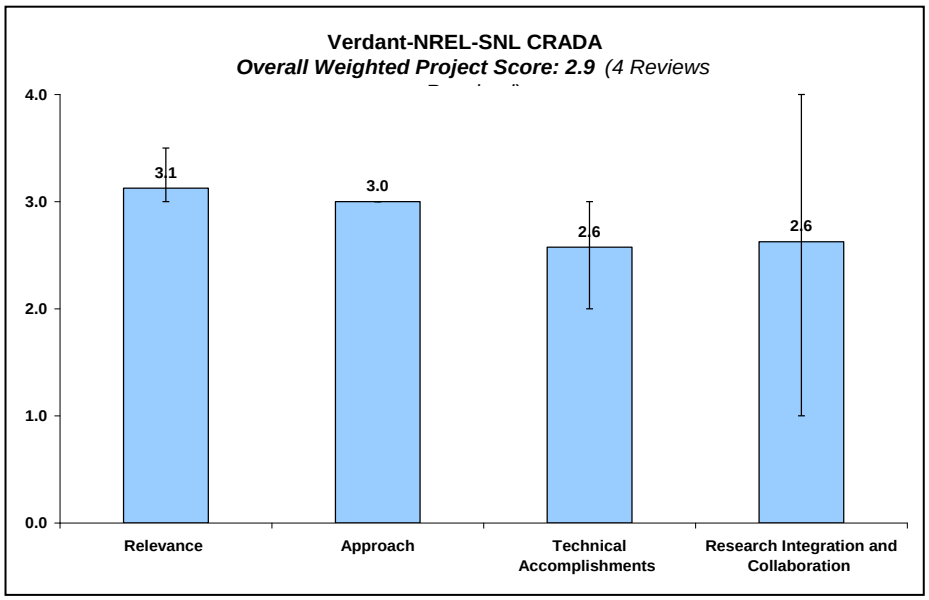
Recommendations for Additions/Deletions to Project Scope

- N/A

Verdant-NREL/SNL CRADA: Rotor Design and Modeling Tools

Scott Hughes, National Renewable Energy Laboratory (NREL)
Josh Paquette, Sandia National Laboratories

Brief Summary of Project



NREL is working with Verdant Power to develop a new rotor design that will allow higher current flows (> 4m/s) and greater swept area (6-11m), and, in the process, will maximize performance and energy capture. The work embodied in this CRADA complements the work that will be conducted under an award granted under Topic Area 1 of the FY08 FOA.

The NREL-Verdant CRADA will enable more refined rotor designs and will help develop tools and methodologies, including hydrodynamic modeling and load calculation methods, which can be directly applied to the Verdant rotor design. The improved structure must optimize the cost, durability and longevity of the blades and rotors to meet commercial cost of energy objectives. The needed changes will be significant enough to entail revisiting the fundamental blade design and a complete blade hydrodynamic design cycle. The new design cycle will require multidisciplinary collaboration, including hydrodynamic and structural modeling, analysis and design along with design for manufacture and fabrication technique development. This design process must be followed by extensive strength and fatigue testing and full or near full-scale hydrodynamic testing. This CRADA was signed in October 2008 and a kickoff meeting was held on November 18, 2008.

Sandia National Laboratories (SNL) will perform structural analysis for this same project under a separate SNL CRADA.

The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.

Question 1: Relevance to overall DOE objectives

- Supports work on device availability and reliability, and efficiency.
- Good program idea, however, unclear how project success is measured.
- Turbulence intensity is characterized at too low a frequency (1 hz) as compared to what is needed (10 hz).
- This project intends to develop an advanced tool for design and validation through product development to improve reliability of marine current turbine and also to reduce O&M cost.
- This project is very specific to Verdant technology. How will this work be made applicable to other developers?
- This project should have the potential to provide useful and valuable insight and information to the industry overall.

- The project lacks discussion regarding scalability for different sites.
- Lack of clarity as to how this work integrates into Verdant's plans going forward and the work of the separate Verdant blade and structure project.

Question 2: Approach to performing the RD&D

- Working with two different national labs. Water testing data has been incorporated.
- The scope of the project has been designed to: 1) understand operational load at the East River site, fundamental linear dynamic behavior of the Al/Mg material used for Verdant power turbine at the East River site under various operating condition; 2) evaluate composite material as an alternate material, and 3) develop a software tool to design composite blade for marine turbine.
- The project seems to look into various non-liner dynamic behavior (such as, turbulence that could cause overloading) as well as other complex dynamic behavior, such as, cavitations,) on the material performance with a very limited budget.
- Estimation of operational load for the blades for the east river site is one of the key tasks.
- Requires more clarity as to how this work will be leveraged in Verdant's overall design efforts.
- Importance of ADV data and plans to resolve are unclear.

Question 3: Technical Accomplishments and Progress

- Has performed hydraulic loading and edge fatigue testing on turbine blades. However, presenter mentioned potential need to use a different approach for determining hydraulic conditions at site.
- Analytical tools need to be pushed out to industry and assist vendors other than Verdant.
- The exact status was not clear from the presentation, though the "accomplishment" slide reflected a code has been developed to optimize hydrofoil for best performance of a hydrokinetic design considering cavitations.
- Fatigue testing completed on blade and a piece of the hub. Largely focused on the blade itself, less on the hub.
- Not clear if there is an envisioned upper limit on scalability.

Question 4: Research Integration and Collaboration

- The team consists of two national labs. However, the presentations indicated a need for increased communication within the team.
- Recommend that the DOE brings these three groups together to assure that they are coordinated in terms of work plans and schedules. There needs to be a single leader for this work.
- Research collaboration with others particularly with Verdant Power for understanding operation load is good.
- Interaction with a real world project/developer.

Project Strengths

- Provides support to further understanding tidal turbine design parameters.
- Strong team and good technical analysis.
- Should be of tremendous value to Verdant-- potentially translates directly to commercial success.
- Enables lab participation – the ability to test in real world demonstrations.

Project Weaknesses

- Challenging to bring team and information together. Apparently the ADCP data may not be appropriate for this type of analysis.
- It is not clear whether the developed design tool would be of generic design tool or it would be linked to specific Verdant power technology.

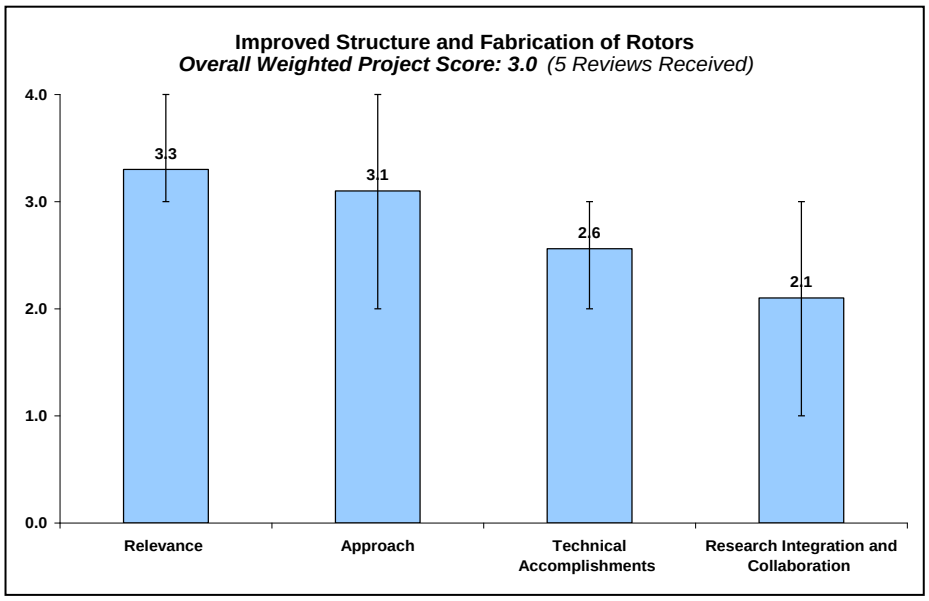
- Apparent lack of integration between this project and the Verdant rotor improvement project.

Recommendations for Additions/Deletions to Project Scope

- Make decision on ADCP/ADB needs.
- The remaining tasks of the project should be refocused to deliver a generic software tool to design and optimize a rotor for marine environment considering hydrodynamic and structural loads.
- The project could be valuable to stakeholders if the following specific outputs from the project are available without any proprietary restriction:
  - (a) fatigue behavior of the Al/Mg alloy blade and other composite materials that would be accessed by various stakeholders; and
  - (b) Operational load on a hydrokinetic turbine, and (c) flow characterization using ADCP and ADV.
- Combine this project with the Verdant rotor improvement project and resolve integration concerns.

Improved Structure and Fabrication of Rotors
Dean Corren, Verdant Power

Brief Summary of Project



The objective of this project is to design, analyze, develop for manufacture, fabricate and thoroughly test an improved blade structure and concomitant blade design for Kinetic Hydropower System (KHPS) turbine rotors. This new rotor technology will allow for larger, higher-power and more cost-effective KHP systems and will enhance the commercial viability, cost-competitiveness, and market acceptance of the KHPS technology and KHP overall as a viable renewable energy source in the United States and worldwide. It will also help secure the U.S. position as a technology provider to this growing market.

The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.

Question 1: Relevance to overall DOE objectives

- Works towards increasing efficiency and availability and array efficiency.
- Have a success criterion - 20 year life.
- Would improve reliability and reduce O&M cost based on the experience from the operation of Al/Mg blade design hydrokinetic device.
- Very specific to Verdant technology. How will this work be made applicable to other developers?
- Limited to no discussions regarding scalability for different sites and device sizes.
- Unclear how this work integrates into Verdant's plans going forward and the work of the separate Verdant blade and structure project.
- Need confidence that design will work for the industry to advance.
- Rotor design from this project will be used for 30-turbine project under pending FERC license application.

Question 2: Approach to performing the RD&D

- Utilizing concepts from the wind industry regarding hub and root mass, however not clear if integration efforts are sufficient.
- Using CRADA tools and building and testing - verifies these methods.
- Various tasks of the project are well thought out and designed to achieve the objective of developing a composite based blade design for different applications of Verdant hydrokinetic rotors.

- The focus is on the root/hub designs. Several have been considered, but few details provided as to the evaluation process.
- Not clear how the CRADA work is being leveraged or integrated with this project.
- Lack of clarity regarding importance of ADV data and how this will be addressed.

Question 3: Technical Accomplishments and Progress

- Progress towards establishing design parameters for a composite rotor design has been good.
- Not clear to what degree of technical work has been completed and in what level of detail.
- Delays in schedule due to DOE objection to Ricardo's rates (not Verdant's fault).
- Planning to be ready for construction by fall 2010.

Question 4: Research Integration and Collaboration

- Working with NREL and Sandia to resolve issues with Ricardo so rest of project is not affected.
- This work needs to be coordinated with NREL and Sandia with work flows, schedules, and dependencies defined. Their needs to be a single leader for this project.
- Research integration with NREL and other has been good; however, a better clarity on role of various project partners is required.
- Focused on testing, modeling, candidate design development. Verdant AWPP is focused on finalizing that design, analysis, design for manufacture, fabrication of prototype and both lab and in-water testing.

Project Strengths

- Verification of methods.
- Connection with a real world project.
- It is critical to conduct both lab and in-water testing to demonstrate technical feasibility.

Project Weaknesses

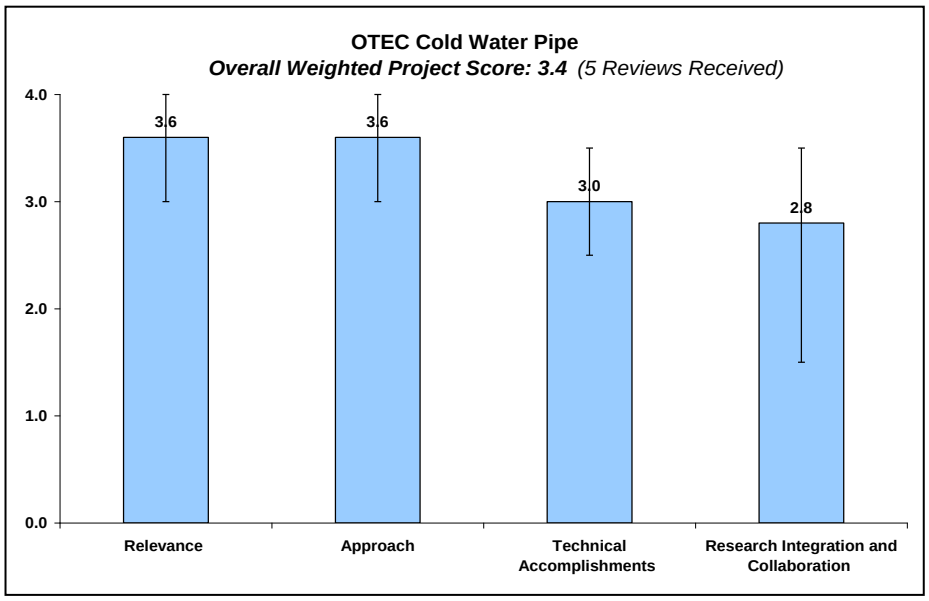
- Reliance on Ricardo relationship. If not resolved then what is the next step?
- Effort is also based on the CRADA work which during that presentation indicated concern with ADCP data for flow conditions, although presenter indicated he did not see as a concern.
- In general, presentation could have provided more details on how three partners work together.
- Does not appear to be well coordinated with the CRADA project. Some elements seem duplicative with the CRADA work.
- Lack of clarity regarding timing of redeployment.
- ADV data seems critical to meeting project objectives, but it is not clear how this will be accomplished.

Recommendations for Additions/Deletions to Project Scope

- Stronger coordination with Sandia and NREL is needed**.**
- Recommendation to DOE: various tasks of this project and the project "Verdant-NREL-SNL CRADA" are interlinked and it is very difficult to assess whether or not there is a duplication of the efforts in these projects. Some difficulty in pinpointing specific deliverables from each of these projects, particularly the CRADA project.
- Deliverables that benefit the entire industry/sector should be developed for any project that national labs are leading.
- Combine this project with the NREL CRADA blade design project and resolve integration concerns.

Advanced Composite Ocean Thermal Energy Conversion (OTEC) Cold Water Pipe Project
Dennis Cooper, Lockheed Martin

Brief Summary of Project
The Lockheed Martin team is investigating commercializing OTEC and is therefore focused on reducing the cost of critical system components such as the cold water pipe (CWP).The objectives of the Advanced Manufacture & Deployment of Composite OTEC Cold Water Pipe Project are to:



1. Validate the LM CWP design at prototype and Pilot Plant scale associated projected cost savings, and
2. Validate the simultaneous construction and deployment concept for a 70m length of 4m diameter CWP into the marine environment.

The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.

Question 1: Relevance to overall DOE objectives

- Works to improve reliability for a base load source of renewable energy.
- OTEC is a viable resource. It is a given that DOE believes it can be economical and be permitted.
- The project proposes to validate composite CWP design and fabrication method and to establish cost parameters for the fabrication process.
- These project objectives align with the DOE program goals for the deployment target as well as achieving cost of energy goal by improving reliability and reducing deployment as well O&M cost.
- The project is very relevant to overall DOE objectives considering: 1) the potential of OTEC to generate electricity to meet the base load and other energy utilization such as, cooling; and 2) reliability of CWP is one of the key barriers to realize OTEC maturity.
- Directly addressing the cold water pipe, which is a critical component to the success of the OTEC.
- Design and manufacturability are appropriate focuses.
- Scope does not include the actual manufacture of a project pipe, but will test all components.
- Cold water pipe is primary challenge for OTEC systems because of cost and past failures when being installed.
- Steel telescope-styled prior design would be 100 million (illustrates how important cost is - Lockheed's coldwater pipe cost estimate is 1/3 of that, however this needs to be validated).

Question 2: Approach to performing the RD&D

- The project scope is very focused on addressing one of the well identified technical barriers for OTEC, i.e. manufacturing and deploying a reliable and cost effective cold water pipe.
- The tasks of the projects, involving developing a design of a prototype CWP and acquiring necessary pultrusion apparatus for fabricating a 15 ft long pipe are well planned.
- This takes approach of building on site, lowering as it is built; machine-based wide fabric placement to lower costs, and improved durability and reliability due to one-piece face sheet construction.
- Use of composite material (fiberglass) and VARTM process.
- Focusing on 4m pipe for proof of principle including physical apparatus.
- Essentially aiming at one continuous pipe with no macro joints, which are typically the point of failure.

Question 3: Technical Accomplishments and Progress

- Completed conceptual design and ordered equipment.
- The pultrusion design, set up, preliminary material performance evaluation, has been completed and the key apparatus for fabrication has been ordered. The project progress has been modest.
- Seems well organized and managed.
- The 4-meter pipe is currently being built (goal of 12-meter).

Question 4: Research Integration and Collaboration

- Related efforts with NAVFAC.
- Is there collaboration? Does there need to be collaboration? Should this work collaborate with Florida Atlantic University and the University of Hawaii?
- Research collaborations with West Virginia University, Owens Corning, Janicki industry have been good.
- Good industrial partners.
- Collaboration with specific projects involves the U.S. Navy and U.S. Department of Defense.
- Collaborating with the Hawaii Center to site their project.

Project Strengths

- This is the only project related to OTEC technology development, and a successful project delivery could have a significant contribution towards a reliable demonstration of OTEC plant in Hawaii.
- Focused on the most important technological barrier.
- Strong technical expertise.
- Very deliberate focus on cold water pipe deployment methodology and elimination of joints.
- Organization and past experience and other related funded efforts.

Project Weaknesses

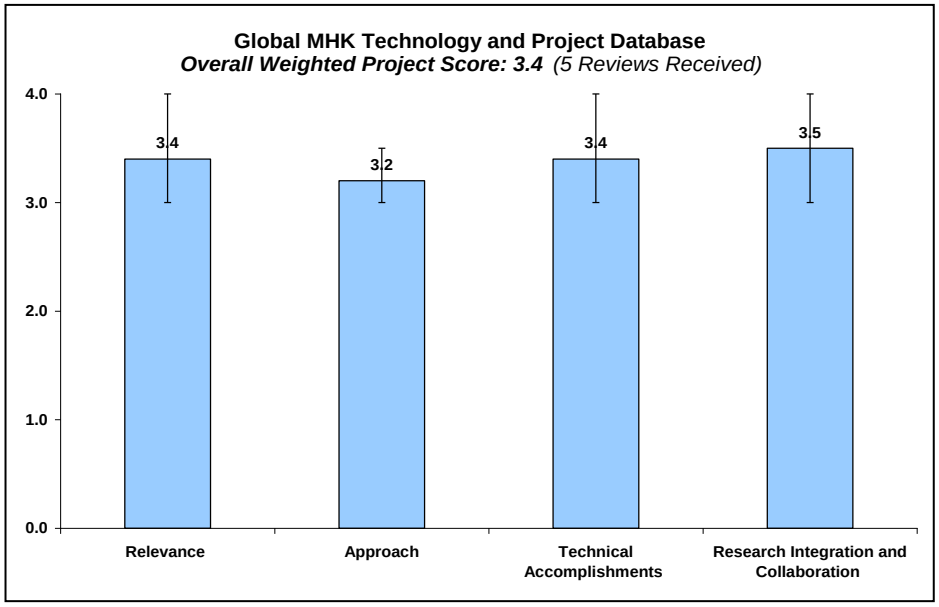
- Some contact with associated global work, but there is the opportunity for more.

Recommendations for Additions/Deletions to Project Scope

- Develop partnerships to actually facilitate ocean deployment of a pipe for a real project.
- Realize this will be a separate effort.

Global Marine and Hydrokinetic Technology and Project Database
Robert Whitson, Sentech, Inc., U.S. Department of Energy

Brief Summary of Project



The Global Marine and Hydrokinetic Technology and Project Database is a new, web-based database designed and maintained to provide up-to-date information on marine and hydrokinetic renewable energy technologies and projects in the U.S. and around the world. The database includes wave, tidal, current, and ocean thermal energy technologies. It contains information on various energy conversion products, companies active in the field, and development of projects in the water. Depending on the needs of the user, the database can present a snapshot of projects in a given region, assess the progress of a certain technology type, and provide a comprehensive view of the entire marine and hydrokinetic energy industry.

The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.

Question 1: Relevance to overall DOE objectives

- Supports increased access to information on existing testing centers.
- Though the project is important for dissemination of relevant information to U.S. stakeholders, there is no direct link to any of the four specific pathways to achieve the DOE's goal could be made.
- Very necessary and worthwhile. Will require ownership and ongoing updating going forward.
- This database is useful for the industry in identifying sites where developers are investigating sites, as well as for governmental officials and the public in understanding the extent of interest in hydrokinetics.

Question 2: Approach to performing the RD&D

- Good approach to obtain R&D testing facilities information.
- It is a big job to maintain this database.
- The database should include marine technologies/projects that are being developed for utilization of additional ocean renewable resources other than electricity production, such as, for desalination, cooling and heating, aquaculture, etc.
- The database needs to be periodically updated with information, particularly on the status of the projects listed based on preliminary FERC permits.
- The database should also include some relevant technologies being developed and/or demonstrated in countries like Korea, India, Brazil, etc.

- Counting projects once they have received a FERC preliminary permit will likely include some unrealistic projects, but providing a link to the associate FERC docket would be useful.
- Interactive GPS mapping capability and technical glossary are good elements.
- It would be helpful to have not only preliminary permits but also designate those projects for which a developer has submitted an NOI/PAD, since the NOI/PAD signifies that a project proponent is moving forward to develop the project.

Question 3: Technical Accomplishments and Progress

- Prepared database consolidating information.
- Significant progress.
- The database progress has been good.
- Seems like very good progress to date.

Question 4: Research Integration and Collaboration

- Inherently good interactions as surveys are being distributed to academic institutions.
- This is by definition a task that requires integration with hundreds (maybe soon to be thousands) of entities in the world.
- Recommend working some kind of arrangement (maybe through the IEA OES) to link to a database maintained by someone in Asia, and this could be extended to Europe as well, maybe an arrangement wherein each region maintains there own thus creating a more reasonable scope for the task.
- The database should make reference/retrieve information from IEA OES 2009 Report# T0104.
- Working with NAVFAC was an excellent approach.
- Participation was voluntary on the part of companies. Received approximately 80 surveys which is a very good response.
- Engagement with IEA is also positive.
- The key purpose is to allow industry members to leverage existing information so that they don't have to redo that work.

Project Strengths

- Increased access to information to the public.
- Nice survey interface that made it easy for folks to respond.
- Good collaboration.
- Information is very accessible.

Project Weaknesses

- Inconsistent data retrieval from industry.
- Survey approach may limit some participation.
- Preliminary permit filter misses some projects and includes some that may not be "real" projects.

Recommendations for Additions/Deletions to Project Scope

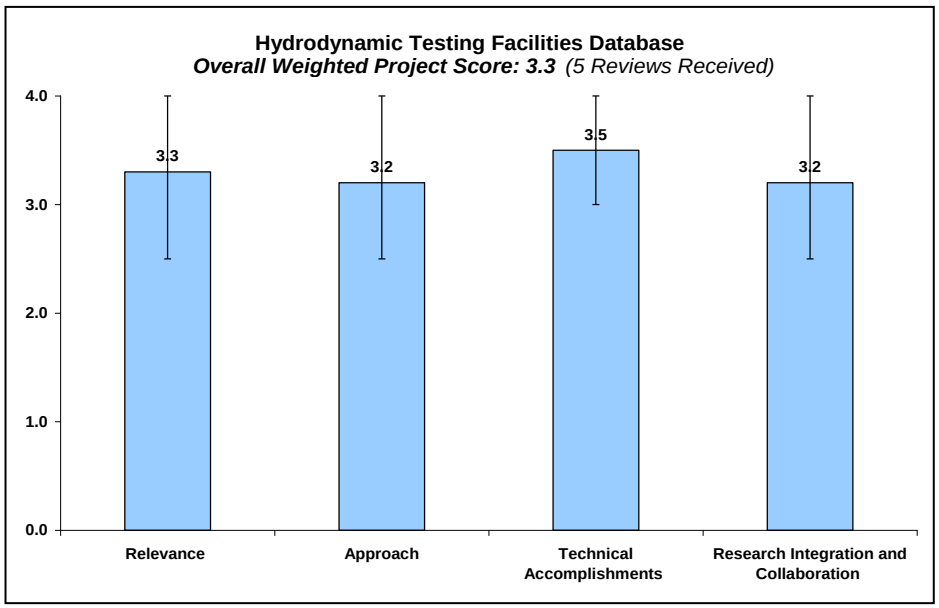
- May need to determine another way to identify projects other than by FERC preliminary permit.
- The database needs to be expanded to cover the technologies associated with wave, tidal, OTEC, salinity and barrage type for electricity production as well as for other utilizations.
- The database should cover all countries when it comes to technologies to reflect technology developmental stages, but may focus of U.S.-based project only.
- It is important that the database be periodically updated once every two year.
- Include information regarding whether or not an NOI/PAD has been filed for the project -- link to

FERC docket could address this.

- Recommend that the database be expanded to include not only preliminary permits but also, separately, designate those projects for which a developer has submitted an NOI/PAD.
- Confirm that the database is updated to remove or otherwise indicate which preliminary permits have been revoked, surrendered, or expired and a new permit not requested.

Hydrodynamic Testing Facilities Database
Robert Whitson, Sentech, Inc., U.S. Department of Energy

Brief Summary of Project



The U.S. Hydrodynamic Testing Facilities Database is a searchable website of U.S. hydrodynamic testing facilities designed to widely distribute this informant ion to technology developers. Users are able to find specifications on a range of test capabilities and service s available at commercial, academic, and government facilities.

The U.S. Hydrodynamic Testing Facilities Database:

- Includes 27 operators and 84 different test facilities,
- Is designed to serve as an interface between technology developers and closed/open-water test facilities/berths - includes actual email addresses of real facility operator,
- Provides data on basic specifications (e.g., dimensions and capabilities on towing, wave making, channel/tunnel/flume, and wind capabilities); control and data acquisition; data generation capability; test services/available personnel; special miscellaneous, and
- Provides technology developer with geographically proximal or affordable test services to validate device performance.

The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.

Question 1: Relevance to overall DOE objectives

- Good tool for the industry and public.
- Though the project is important for listing hydrodynamic facilities to U.S. stakeholders, no direct link to any of the four specific pathways to achieve the DOE's goal could be made.
- Potentially a very valuable tool that should provide significant utility for the industry.
- Helps industry identify all test facilities over one foot.

Question 2: Approach to performing the RD&D

- Adequate approach to establishing the database. May want to consider viewing a broader institution base that provides similar facilities for different reasons.
- The database should also link to international some key test facilities that would be complimentary and would be useful to U.S. stakeholders, i.e., Canada's Institute of Marine Technology facilities in St. John's.

Question 3: Technical Accomplishments and Progress

- Already includes 84 different test facilities -- this seems like a great start and good progress.

- Interface looks to be good and very usable.
- Still waiting on feedback from some, but 95% have responded.

Question 4: Research Integration and Collaboration

- Interacts with facilities.
- In this case, the scope is limited to U.S. test facilities and per my earlier comment, maybe the device database ought to be limited to U.S. devices with links to other regional databases.
- The database could link to IEA-OES Annex 2 report, published in 2003, listing some relevant facilities in other countries.
- No specific comments captured.
- Complements IEA Annex IV.

Project Strengths

- Valuable information for the industry and the public.

Project Weaknesses

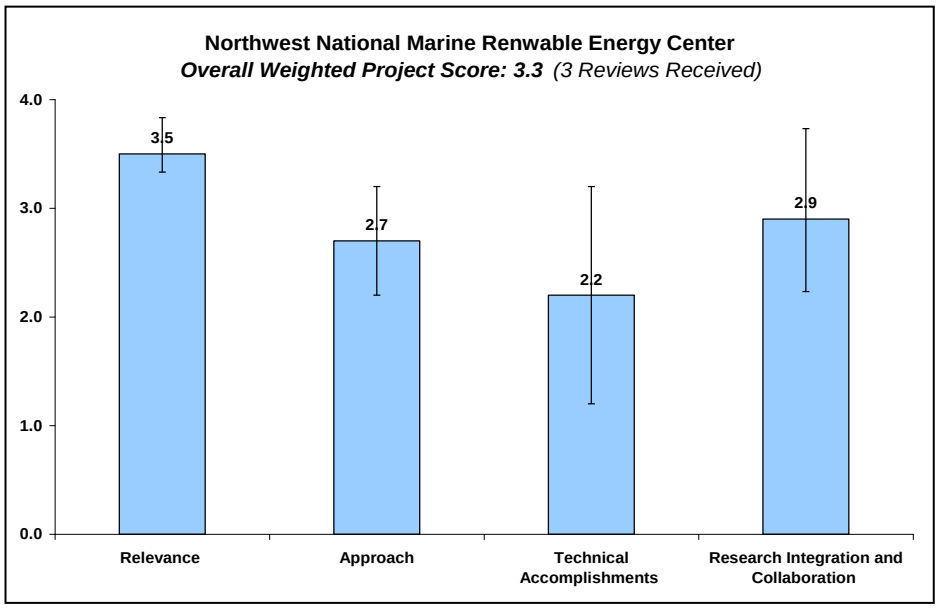
- N/A

Recommendations for Additions/Deletions to Project Scope

- This database currently list only U.S. based hydrodynamic testing facility (wave tank and flume tank, etc.).
- It would be worthwhile to expand this testing facility database to incorporate other type of relevant testing facilities that would be needed for enabling developing and evaluating hydrokinetic technologies in U.S. The other type of testing facilities could be: (a) Coastal Engineering test facilities to enable sediment transport and other ecological, (b) marine science laboratories to study various impact, (C) Specialized mechanical and/or /structural and/or electrical laboratories to evaluate structural, mechanical and electrical performance of conversion systems in laboratory condition, (d) any specialized offshore sea keeping facilities to assess installation methods etc.
- Potentially could branch out to include global facilities.
- Potentially include other types of capabilities (vessels, equipment, etc.).

Northwest National Marine Renewable Energy Center
Meleah Ashford and Dr. Merrick Haller, Oregon State University
Dr.Brian Polagye, University of Washington

Brief Summary of Project
Oregon State University (OSU) and University of Washington (UW) are partnering to develop the *Northwest National Marine Renewable Energy Center* (*NW Center*) with a full range of capabilities to support wave and tidal energy development for the United States. Center activities are structured to: facilitate device commercialization, inform regulatory and policy decisions, and close key gaps in understanding.



The following topic areas will be addressed:

- Development of facilities to serve as an integrated, standardized test center for U.S. and international developers of wave and tidal energy,
- Evaluation of potential environmental and ecosystem impacts, focusing on the compatibility of marine energy technologies in areas with sensitive environments and existing users,
- Device and array optimization for effective deployment of wave and tidal energy technologies,
- Improved forecasting of the wave energy resource, and
- Increased reliability and survivability of marine energy systems.

Results of key findings and research programs will be disseminated to all stakeholders and interested parties through workshops, conferences, publications, and an on-line portal.

The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.

Question 1: Relevance to overall DOE objectives

- Supports R&D and creates a testing facility to test devices.
- Establishment of the Northwest National Marine Renewable Energy Center at OSU and WSU with a focus on wave and tidal current energy will play a critical role in achieving the stated overall DOE goal through various activities associated with all the four pathways.
- Both efforts should provide substantial value to achieving DOE objectives.
- The UW work represents the only marine energy center tidal-centered effort and is directly related to furthering the success of a real world project (the SnoPUD project).
- The OSU work is similarly important, but is not directly facilitating a real world project and may represent some duplication of effort with the Hawaii energy center work and other wave energy projects on the west coast.

Question 2: Approach to performing the RD&D

- Working on key issues such as near shore effects from arrays.
- The RD&D topics need to be prioritized in consolation with the other National center for Marine Energy at the University of Hawaii.
- The research topics need to priories considering the knowledge gaps to enable the technology development and deployment and must consider the development and information available from other industries.
- Ratio of graduate student to faculty ratio for the center is low, and must be increased to enable development of a larger number of professionals for the emerging industry.
- The efforts for the relevant basic research and development activities at the center through the DOE resources must be leveraged with the activities through the National Science Foundation and other available national and state level resources.
- The UW RD&D approach is directly contributing to the success of a real world project.
- The OSU approach is largely focused on the permitting and development of the mobile test berth.
- Would like to see the results of the industry survey (relative to the likely use of the test berth).

Question 3: Technical Accomplishments and Progress

- OSU and UW are doing varying efforts with OSU focused on wave and UW on tidal.
- Project staged deliverables should be better defined to assess the outcome from the center.
- The initial research activities are very much focused on testing of material and coatings in marine environment and wave forecasting.
- The objective of the testing considering corrosion and bio-fouling behavior of typical materials and coatings is unclear.
- The research activities associated with wave forecasting could be better coordinated with the effort at Hawaii.
- Both teams seem to be making good progress; thought the UW team had conducted much more field work to date.

Question 4: Research Integration and Collaboration

- Appears to have good coordination with academic institutions, but would benefit from increased coordination with other DOE funded efforts for similar topics to reduce potential for duplication.
- Would benefit better coordination and collaboration with other National Marine Labs.
- Would benefit from better coordination with some specific wave energy project initiative in Oregon and California.
- Both teams seemed to have a vigorous approach to collaboration.

Project Strengths

- A number of task accomplishments have occurred but because of time constraints the presenters did not have much time to go over all they had accomplished.
- The activities associated with tidal current are better focused and some activities are aligned with the demonstration project.
- UW collaboration with the SnoPUD project.
- Both programs are building capability for the future.
- Graduate student involvement is significant.

Project Weaknesses

- Is there overlap with some other efforts currently Hawaii? Increase communication and coordination to reduce potential for duplication.
- Resources seemed skewed towards the Oregon/wave work.
- No market study has been conducted for the discussed UW tidal test site.

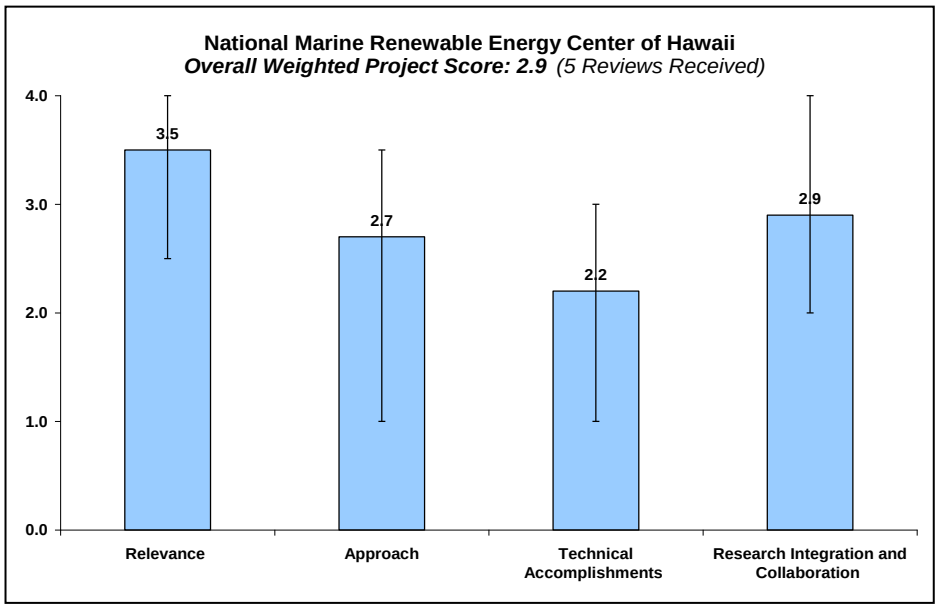
Recommendations for Additions/Deletions to Project Scope

- Assure coordination with other similar efforts.
- There is duplication of certain effort with the University of Hawaii center.
- Evaluate for duplication of efforts between OSU and other wave energy efforts. Reduce potential for duplication.
- It is not clear what the overall objective is for focusing on a mobile wave energy test berth. The reviewers question the effective utilization of DOE resources by the center for the NEPA permitting and other stakeholder engagement activities.
- Would like to see all Marine Energy Center efforts directly connected to real world projects.

National Marine Renewable Energy Center of Hawaii

Dr. Rick Rocheleau and Dr. Luis Vega, University of Hawaii at Manoa

Brief Summary of Project



The primary objective of the National Marine Renewable Energy Center (NMERC) in Hawaii is to facilitate the development and implementation of commercial wave energy systems for use in Hawaii and elsewhere in the world. For validation, the target is for one or more of these systems to be supplying power to the local grid at >50% availability before the end of the 5-year period of performance of the Center. The Center will assist in completing necessary environmental studies and help industrial partners acquire required permits. It will provide engineering support to developers and will work with industrial partners to monitor the performance of deployed systems. The Center also will coordinate information exchange. Wave energy field test facilities developed under this program will offer opportunities for component optimization and testing of complete systems. National and international partnerships will be leveraged to assess the potential for the export of technologies to other markets.

A second objective of the Center is to assist the private sector move ocean thermal energy conversion (OTEC) systems beyond proof-of-concept to pre-commercialization through long-term testing of an OTEC plant with gross power generating capacity of at least 5 MWe. The timeline for construction of such a plant depends on the success of commercial developers to secure funding. The technical role of the Center in this endeavor will focus on system and component engineering and local and global environmental studies. Presuming that sufficient funding for a pre-commercial plant can be raised by developers, a reasonable target at the end of the 5 year period of performance would be to have completed or be in the process of finishing the design of a plant, to have secured major permits, to have prepared, as required, either a draft Environmental Assessment (EA) or Environmental Impact Statement (EIS), and to have in place a power purchase agreement between the local utility company and the OTEC developer.

The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.

Question 1: Relevance to overall DOE objectives

- Supports device reliability, efficiency, and array interests.
- Establishment of the Marine Renewable Energy Center at the University of Hawaii with a focus on wave and OTEC will play a critical role in achieving the stated DOE overall goal through various activities associated with all the four pathways.
- Work is directly focused on helping industry establish in-water projects.

- Significantly focus on deploying funding towards execution of environmental studies.
- Should get strong support from the state and the U.S. Navy.
- Projects like this are critical to reducing cost and time to in-water demonstrations, technology development and testing.
- Focus on studies necessary to meet NOAA and FERC needs is excellent.

Question 2: Approach to performing the RD&D

- Good opportunity to develop R&D efforts coordinated with other institutions, national labs, and industry.
- Needs a better defined plan. Activities are sort of scattered and it is unclear as to whether specific goals have been established.
- The approach to facilitate partnerships among various stakeholders to carry out the RD&D activities is good.
- The RD&D topics need to be prioritized in consolation with the other National Center for Marine Energy at the OSU/WSU, considering that center has also focus on wave.
- The research topics need to be prioritized considering the knowledge gaps to enable the technology development and deployment and must consider the development and information available from other industries, particularly for the material performance, wave modeling and forecasting.
- Ratio of graduate student to faculty ratio for the center is low and must be increased to enable development of a larger number of professionals for the emerging industry.
- The center has identified 50% of the DOE funding for basic research.
- The DOE funding must be leveraged with the activities through the National Science Foundation and other available national and state level funding sources.
- Intends to assist with funding to address the environmental hurdles and are engaging with FERC and NOAA to accomplish.
- Have access to valuable sites and facilities (subsea cable, U.S. Navy, etc.).
- Half of the DOE funds are being used to "buy down" cost of doing surveys, environmental review, etc. Ultimately, companies will apply for their own permits.
- Question whether each of the four test sites are necessary or whether permitting would be simpler if they were folded into a consolidated one or two sites.
- They are meeting with FERC and NOAA to ensure studies will meet their needs.

Question 3: Technical Accomplishments and Progress

- Efforts have just started.
- NDAs with Oceanlinx, OPT and Lockheed Martin have been signed.
- This project is in its initial stages but appears to be moving forward well.
- Rate of expenditure and progress have been slowed.

Question 4: Research Integration and Collaboration

- Working with industry and other stakeholders to determine focus areas of the study.
- Recommend communicating with the HECO offices that control the discretionary R&D.
- The center activities are well planned and integrated with industries and basic sciences better.
- The center's plan for allocating 50 % of the DOE fund for basic R&D activities within the university to address longer-term needs and other 50% of fund towards collaborating industries project activities for addressing their short term needs is a good plan.
- Engaged with UK, Norway and France.
- Good engagement with the State and U.S. Navy.

- Strong industry participation and collaboration.
- Partnerships with U.S. developers would like to see more information exchange on international side and more coordination with NNMREC.

Project Strengths

- OTEC R&D.
- The center has a good interaction and collaboration with relevant industries and stakeholders.
- Strong support to industry. Half of the center's funding is going to industry.
- Strong U.S. Department of Defense interest.
- Good/viable regional wave and OTEC resources.

Project Weaknesses

- There seems to be potential for duplication of effort for some topics with other national labs and institutions.
- Certain efforts associated with wave energy prediction and material testing seem to be similar to those of the Northwest Marine Center.
- No current engagement with the National Labs.
- Finding projects with money and permits to utilize some of the center's wave capabilities may be an uncertainty.
- Lack of engagement with OSU to date.
- The four sites may be important from a technological perspective, but if having four sites will cause significant delays in permitting, it might not be the best strategy.

Recommendations for Additions/Deletions to Project Scope

- Increase coordination with other programs funded by the U.S. DOE in these areas potential for some duplicity with OSU on wave.
- The Center should explore in expanding activities with more emphasis in OTEC.
- Need coordination with the Northwest Marine Renewable Energy Center for RD&D prioritization.

5.0 MHK Market Acceleration Activities

The goal of Marine and Hydrokinetic (MHK) Market Acceleration activities is to facilitate the deployment of 20 GW capacity of MHK systems in the U.S. by 2030. To achieve this goal, Market Acceleration activities will follow specific strategic pathways including: 1) understanding the total quantity, locations and characteristics of all MHK resources in the U.S.; and 2) reducing the costs, time, and potential environmental effects associated with deployment of MHK systems.

The key barriers facing MHK Market Acceleration are:

- Lack of refined and comprehensive resource estimates,
- Lack of data on environmental, navigational, and competing use impacts,
- Complex and lengthy regulatory process not designed to accommodate small, scalable projects,
- Lack of public acceptance of MHK technologies,
- Renewable energy incentives discourage investment in the newest technologies, and
- Financing is extremely costly or unavailable.

The technical approaches to addressing the MHK Market Acceleration key barriers and to facilitating the deployment of 20 GW capacity of MHK systems in the U.S. by 2030 are to:

- Study and validate estimates of extractable energy by resource and technology type,
- Support the generation of site-specific environmental data,
- Improve the prediction, monitoring, and evaluation of environmental impacts,
- Collect, synthesize, evaluate, and disseminate existing impact information,
- Build consensus among stakeholders on a framework to minimize and mitigate potential impacts, and
- Develop and disseminate information policies that directly affect the MHK industry.

The main topic area addressed by 2008 MHK Market Acceleration Program solicitations was Marine and Hydrokinetic Renewable Energy Market Acceleration Projects. The 2009 MHK Market Acceleration Program solicitations concentrated on Marine and Hydrokinetic Site-specific Environmental Studies/Information, Advanced Water Power Market Acceleration Projects/Analysis and Assessments, and Environmental Assessment and Mitigation Methods for Marine and Hydrokinetic Energy.

Table 5.1 below lists the MHK Market Acceleration projects reviewed during the 2009 Peer Review meeting, including the Principal Investigator and budget for each project.

Table 5.1 MHK Market Acceleration Projects

Project Name	Principal Investigator	FY08 (DOE Funds)	FY09 (DOE Funds)	Total Funding	Duration (Years)
Resource Assessments					
Wave Energy Resource Assessment and GIS Database (EPRI/VT)	Paul Jacobson/ George Scott	$394,500	$105,100	$499,600	**2**
Assessment of Energy Potential from Tidal Streams in the U.S. (GTRC)	Kevin Hass	$320,900	$148,600	$469,500	**2**
Siting & Environmental Effects					
Siting Protocol for MHK Projects (Pacific Energy Ventures)	Steve Kopf	$350,000	$500,000	$850,000	**2**

Project Name	Principal Investigator	FY08 (DOE Funds)	FY09 (DOE Funds)	Total Funding	Duration (Years)
Identification of Potential Navig. Impacts and Mitigation Measures (PCCI)	Richard Cool	$165,300	NA	$165,300	**1**
Best Siting Practices for MHK Technologies (Re Vision Consulting)	Mirko Previsic	$350,000	NA	$350,000	**1**
Technical Support and General Environmental Studies (PNNL)	Andrea Copping	$50,000	$249,530	$299,530	**Ongoing**
EISA Report - Environmental Effects of MHK Energy (ORNL)	Glenn Cada	$292,000	NA	$292,000	**1**
International Standards and Development					
International Standards Development for MHK Renewable Energy (SAIC)	Neil Rondorf	NA	$401,300	$401,300	**1**
Market Development and Transformation (NREL)	**Bob Thresher**	**$300,000**	**$399,530**	**$699,530**	**2**

5.1 MHK Market Acceleration Project Evaluations

Table 5.2 below lists the average score per category and the averaged weighted score for each Market Acceleration project that was evaluated by the Peer Review Panel.

Table 5.2 Market Acceleration Project Scores

Peer Reviewer Project Evaluation Form Scores - Average Scores

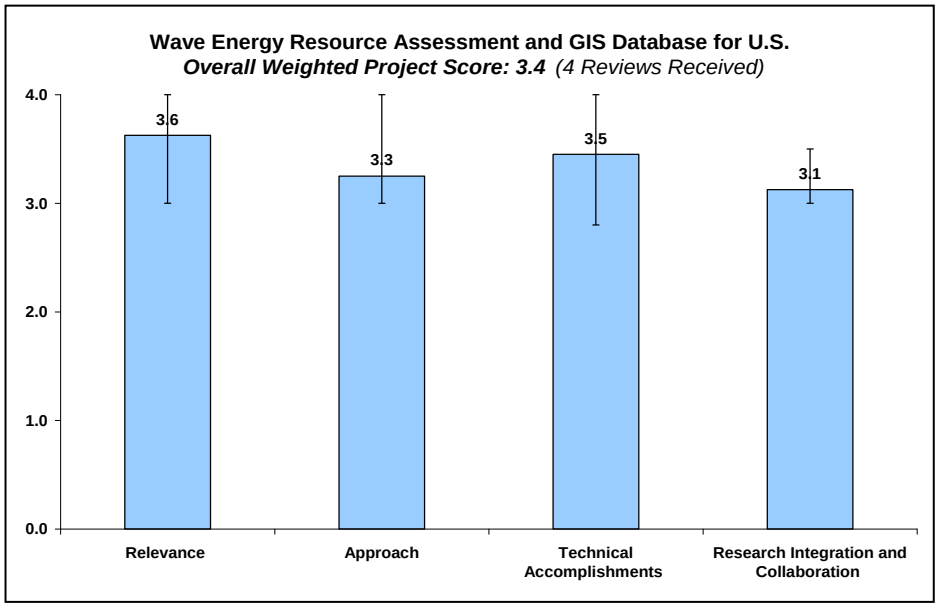
Numerical Scoring Index	1	2	3	4
Qualitative Descriptors	Poor	Fair	Good	Outstanding

	Market Acceleration Projects								
Scoring Category \ Projects	Wave Energy Resource Assess and GIS db (EPRI/VT)	Assess. Of Energy Potential from Tidal Streams (GTRC)	Siting Protocol for MHK Projects (PEV)	Identification of Potential Navig Impacts (PCCI)	Best Siting Practices for MHK Projects (Re Vision Consulting)	Technical Support and Environmental Studies (PNNL)	EISA Report (ORNL)	International Standards Development (SAIC)	Market Development and Transformation (NREL)
1. Relevance to Overall DOE Objectives (degree to which the project supports the goal and pathways of the Water Power Program. (Weight = 40%)	3.6	2.8	2.8	2.4	2.9	2.7	2.8	3.7	3.4
2. Approach to Performing the RD&D (degree to which technical barriers are addressed, the project is well-designed and technically feasible; and the degree to which future research has been planned. (Weight = 30%)	3.3	2.2	3.0	2.1	3.0	2.6	2.1	3.1	3.0
3. Technical Accomplishments and Progress (toward overall project and DOE goals – the degree to which research progress is measured against performance indicators and to which the project elicits improved performance. (Weight = 20%)	3.5	2.8	3.7	2.6	3.3	2.5	2.4	2.9	3.1
4. Research Integration and Collaboration (with industry/universities/other laboratories – the degree to which the project interacts, interfaces, or coordinates with other institutions and projects). (Weight = 10%)	3.1	1.7	2.8	2.5	2.8	3.0	2.5	3.2	3.3
Average Weighted Score	**3.4**	**2.5**	**3.1**	**2.4**	**3.0**	**2.7**	**2.5**	**3.3**	**3.2**

Wave Energy Resource Assessment and GIS Database for U.S.

Paul Jacobson, Electric Power Research Institute (EPRI)
George Scott, Virginia Tech
Walt Musial, NREL

Brief Summary of Project



The objective of this project is to determine the maximum practicable extractable wave energy along the coastlines of the United States. The expected users of this product include policymakers, project developers, wave energy device developers, investors and universities. Policymakers will be able to use the outputs of this project to estimate the total available and extractable wave energy resources on a state by state basis, as well as regional and national totals. The overall goal is to accelerate the nation's serious investigation of the degree to which U.S. wave energy resources can contribute to a national portfolio of energy supply alternatives.

The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.

Question 1: Relevance to overall DOE objectives

- Supports identification of wave resources in U.S. Will present results in a figure similar to the wind resource maps from NREL thereby seeing results in a manner familiar with many users.
- The deliverable from the project will facilitate the long-term deployment targets in the U.S.
- Should provide useful information to the industry, however it was a little unclear as to if the level of detail and resolution will be sufficient to meet the intent of the project.
- Determining recoverable resource will be device specific.
- Project will provide total resource estimate which is critical to illustrating the benefit of wave energy to meeting the U.S. DOE goals and renewable energy goals.

Question 2: Approach to performing the RD&D

- Provides additional information to the public on resource potentials.
- Will look at different energy devices to get potential extraction per device type.
- The activities and the approaches of the project are designed based on the feedback from a user group workshop.
- The tasks and the methodologies for establishing available wave energy resources are well defined.
- Challenging to estimate "technically recoverable resources" based on device specific

characteristics such as, absorption efficiency, spacing, etc. and perhaps require further discussion on the merit of establishing such information considering uncertainty on the types of conversion devices that would be deployed.
- Intent is to estimate available and recoverable energy resource.
- Geospatial database has been prepared and independently verified.
- Will include annual and monthly outputs.
- Utilizing hind cast archived information to develop models -- designing around defined distance from shore and depth contours.
- NREL will construct a GIS database similar to approach used for wind.
- Overall approach seems quite thorough.
- Well organized, methodology appears well considered and executed.

Question 3: Technical Accomplishments and Progress
- Has held workshop with experts to discuss the area of knowledge and approach.
- Clear step by step process towards meeting objectives.
- Modest progress towards the objectives has been made.
- Expert and users need workshops conducted--good cross section of participants.
- Regression analysis conducted and revealed good fit.
- GIS map not yet developed.
- Appears to be progressing well.

Question 4: Research Integration and Collaboration
- Has collaborated by way of expert workshop and there is a good potential in future.
- Various tasks of the project are well coordinated.
- Leverages NREL wind experience and existing resource databases.
- Need to tie in to international efforts.

Project Strengths
- Clear process.
- Methodology to determine total resource is well defined.

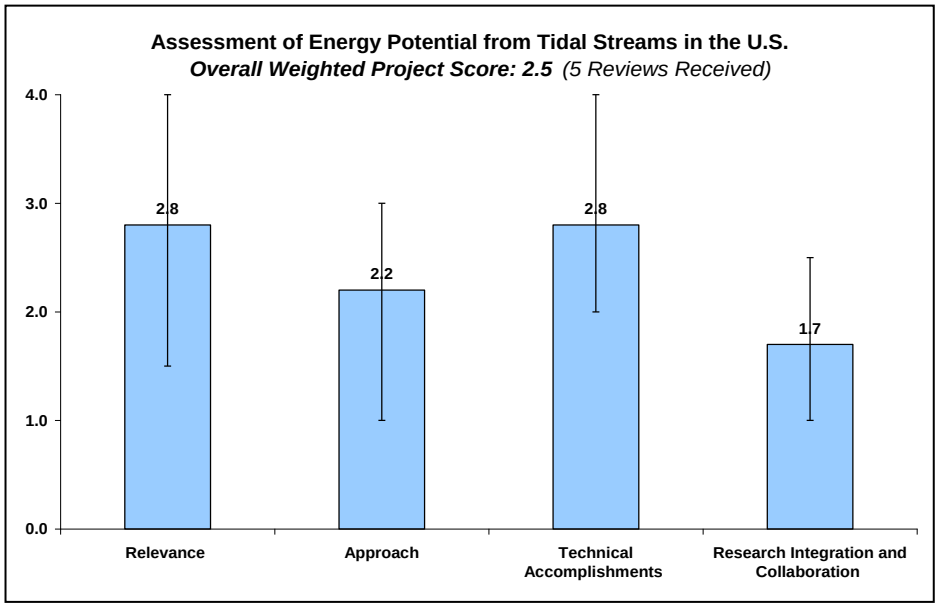
Project Weaknesses
- A little unclear as to how the database/web site will be managed in the future.
- Extent of database used to date may not be sufficient to meeting objectives.
- There is a need for 10 years of data versus the 5 years that is currently available to the team.
- As already discussed, extractable energy is device/technology specific.

Recommendations for Additions/Deletions to Project Scope
- Confirm that someone has committed to supporting this on a public web site over the long term or that it can be moved to DOE web site.
- Determine practical level of extraction (add additional key constraint filters).
- Make sure underlying data are available to developers and others to use later for project specific feasibility studies.

Assessment of Energy Potential from Tidal Streams in the U.S.

Dr. Kevin Hass and Dr. Hermann Fritz, Georgia Institute of Technology, Savannah Campus
Dr. Steven French, Georgia Institute of Technology, Atlanta Campus
Brennan Smith, Oak Ridge National Laboratory

Brief Summary of Project



The research program will advance the state of the art and market penetration in tidal energy resource assessment via contributions on numerous topics, including: (1) numerical modeling of the entire US coastlines to resolve detailed tidal current variations both in spatial (location and depth) and temporal (lunar months) domains; (2) development of numerical simulation and GIS tools and their use to facilitate the critical site selection process for energy converters; (3) the efficacy of innovative energy converter techniques in maximizing efficiency in power production at various locations, scales and time domains; (4) the optimization of tidal energy converter arrays and networks; (5) acceleration of the tidal energy market; (6) increased public awareness and acceptance of the tidal energy resource and technology.

The specific objectives are as follows:

1. Utilize an advanced ocean circulation numerical model Regional Ocean Modeling Systems (ROMS) to predict tidal currents.
2. Compute the tidal harmonic constituents for the tidal velocities and water levels.
3. Validate the velocities and water levels predicted by the model with available data.
4. Build a GIS database of the tidal constituents.
5. Develop GIS tools for dissemination of the data.
    a. A filter based on depth requirements.
    b. Compute current velocity histograms based on the tidal constituents.
    c. Compute the available power density (W/m2) based on the velocity histograms.
    d. Use turbine efficiencies to determine the effective power density.
    e. Compute the total available power within arrays based on turbine parameters.
    f. Compute the velocity histogram at specified elevations.
6. Develop a web based interface for accessing the GIS database and using the GIS tools.

The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.

Question 1: Relevance to overall DOE objectives

- Provides a high level tool to determine at a high level potential energy related to tides in U.S. However, there are likely steps to be able to get to the next level that will need to be taken to predict total energy resource.
- Modeling tidal passages most likely will not be economically viable, and the focus on all this modeling limits the resources available to Georgia Tech to estimate the regional and national tidal hydrokinetic energy potential.
- The deliverable from the project will facilitate the long-term deployment targets in the U.S.
- Concerned that the data from this project will be too high level and general to meaningfully facilitate tidal energy development.
- Should however help meet the first specific U.S. DOE pathway noted above, but only at a very high level -- not clear that this project will meet the overall objectives of the effort.
- Creating a database for tidal energy potential in areas where it is thought to be important will be useful to demonstrating the resource.
- It would be more helpful if this work resulted in an estimate of the total energy potential from tides.

Question 2: Approach to performing the RD&D

- Project is currently utilizing existing data. Has there been a robust information exchange outreach for development of the model?
- How does the DOE know that experts will agree that approach is accurate and that users will be able to use the output?
- What is the plan for maintaining the GIS database after the project is done?
- It is not clear from the tasks whether the methodology being used to compute current power density is acceptable by the relevant experts. The project team did not make any reference to similar work that has been carried out in Canada and elsewhere.
- Advisable to organize an expert workshop to get relevant feedback on the acceptable methodology, format of data presentation, and the assumptions made for the assessment.
- Reasoning for establishing minimum depth criteria for the resource assessment must be clearly established.
- It is a little unclear from the project scope whether the project will be able deliver total available tidal current power for U.S.
- Utilizing the ROM ocean circulation model.
- Building a GIS database and associated accessibility and filter tools -- this should provide value at a high level.
- Focus validation activities to higher energy areas (this should be a very significant area of focus, but was not clear from the presentation).
- This project is appropriately focusing more of its resources on areas where energy potential is most interesting.
- Utilizes bases resolution for modeling anticipated flows, but utilized higher resolution for more promising areas.

Question 3: Technical Accomplishments and Progress

- Seems to be progressing in an organized way.
- Have run 32-day simulations on the east coast of the U.S. Modeling will be completed
- Currently working on a web page.
- Project seems potentially behind given the very large scope of modeling that is envisioned.

Question 4: Research Integration and Collaboration

- Seems that there could have been more outreach in specific locations where known tidal projects are occurring to increase the rigor of the database.
- Very little if any research regarding integration and collaboration.
- Recommend expert and user group workshops be held on the methodology and user needs. The methodology used for modeling and the approach for power quantification should be acceptable by the relevant experts.
- Oak Ridge National Lab providing independent verification.
- Did not appear to engage experts in developing approach and selection of the ROM model.
- Coordination with other similar assessments before embarking on this would have been beneficial; recommend doing so moving forward.

Project Strengths

- Will have GIS tools on line for public use; can put in depth criteria to eliminate areas that are too deep for user's technology. Sounds very user friendly.

Project Weaknesses

- Unclear to the Panel if this task will provide total energy potential in specific regional locations.
- Unclear to the Panel whether the project will establish total available tidal current power for U.S.
- Output of project may be too generic.
- Modeling of southern sites (such as Florida) may not be worthwhile.
- Little evaluation of other modeling programs (besides ROMs) seems to have occurred.
- Little engagement so far with others who have been conducting similar work.
- Admitted it is not clear who will maintain this website after end of project.
- This work is important precursor to, but does not accomplish, estimating the total potential.

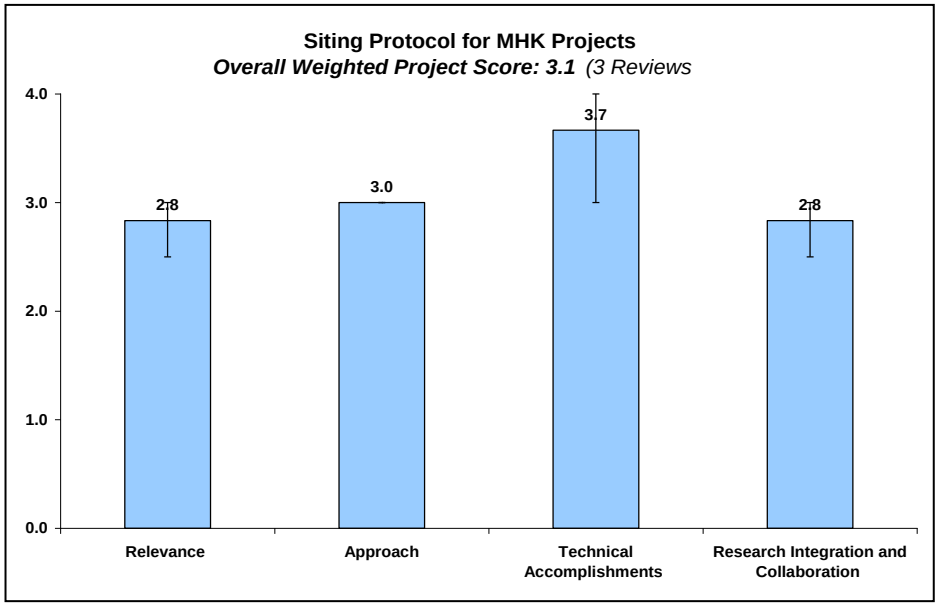
Recommendations for Additions/Deletions to Project Scope

- Include additional site specific information in locations where there is other ongoing modeling by universities and/or federal labs.
- Database should be created to hand over to DOE, or project scope should require a commitment that someone will host and maintain the web site over the long term.
- The generated GIS-based database should be located at NREL along with the other U.S. national resource database for better access by the end-users.
- Project should be re-scoped to focus on sites for which there is a reasonable expectation for tidal energy development, with minimal effort necessary on the large scale resource.
- Require coordination with similar projects elsewhere.

Siting Protocol for MHK Projects
Steve Kopf, Pacific Energy Ventures

Brief Summary of Project
The purpose of this project is to identify and address regulatory issues that affect the cost, time and the management of potential effects as it related to siting and permitting advanced water power technologies.

The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.



Question 1: Relevance to overall DOE objectives

- Some tasks support the DOE goals by producing a comprehensive document on necessary regulatory needs for building wave and current projects in U.S.
- Useful work, but some concern that the views expressed in associated agency/stakeholder meetings may not necessarily be the same as what those same folks express when they are eventually faced with a real project requiring their sign off.

Question 2: Approach to performing the RD&D

- The project approach for delivering the task is effective.

Question 3: Technical Accomplishments and Progress

- The progress has been good.
- Process handbook nearing completion, regulatory roadmap, etc.
- Website going live in December in WIKI format.
- Report has been submitted for the stakeholder engagement process.
- Seems like good progress towards project objectives, but difficult to ascertain without seeing products.

Question 4: Research Integration and Collaboration

- The collaboration with Rising Tide, Kearns & West and Stoel Rives is good.
- Perhaps a better coordination with the PCCI's navigational impact and revision could have been made to produce a unified product.
- Strong, well qualified team members.
- Need more strategic engagement and collaboration with WA/OR/CA projects that are already in progress.

Project Strengths

- N/A

Project Weaknesses

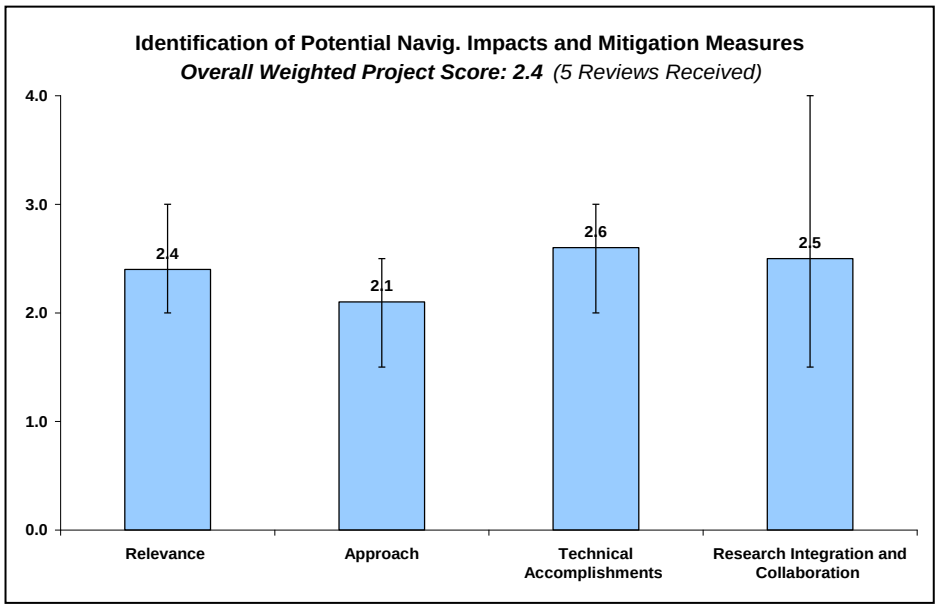
- It is unclear how the output from this project would be used by wave and tidal current project developers.
- Need closer engagement and collaboration with related projects that are already in progress (SnoPUD, OPT, etc.).

Recommendations for Additions/Deletions to Project Scope

- Perhaps DOE should make an effort to produce a single report based on the deliverable from this project and the outputs from PCCI and Re Vision.
- If this work is to move forward it should be conducted as a clearly integrated effort with the Re Vision and PCCI efforts with a single project point of contact who will interface effectively with other ongoing projects (SnoPUD, OPT, etc.).

Identification of Potential Navig. Impacts and Mitigation Measures
Richard Cool, PCCI

Brief Summary of Project



The objectives of this project are to:

- Accelerate the deployment of marine and hydrokinetic renewable energy installations by providing a technical manual to assist developers and regulators in obtaining the information needed, as part of the permit application process to the lead permitting agency, to address potential navigational impacts and mitigation measures. The information needs to be addressed include:
  - Identification of all potential navigational impacts on traditional waterway uses through a rigorous navigational risk assessment
  - Mitigation measures including example mitigation strategies to prevent adverse impacts
- Provide improved guidance, consistent with that already provided in NVIC 02-07, for use by project developers to help expedite the review process, and assist the U.S. Coast Guard (USCG) in the review process through development of a comprehensive checklist. The improved guidance will:
  - Identify gaps in the Navigation and Vessel Inspection Circular and other regulatory guidance
  - Provide narrative for potential use in closing gaps in the regulatory guidance
  - Include a checklist for use by project developers and the USCG to expedite the application and review processes.
- Provide, and help distribute to project developers, a brochure summarizing the information contained in the NVIC and technical manual
- Work cooperatively with awardees in Topic Area 2, Application Area 4: Streamlined Best Siting Protocols, to provide best practice recommendations on navigational impacts as they affect siting practices of marine and hydrokinetic renewable energy installations.

The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.

Question 1: Relevance to overall DOE objectives

- Supportive of getting devices in the water.
- Will provide a checklist for developers to use when getting approvals.
- Does a general handbook make any sense since this is a very site specific issue?

- The deliverables from this project could be useful for inputs to risk assessments for navigational impact, hence the project does support DOE's goal by enabling producing a comprehensive document on identifying navigational impacts and mitigation measures.
- Some concern that this project was just delivering a laundry list of potential issues, and was very U.S. Coast Guard oriented. The Coast Guard will not necessarily represent the views of all navigational issues that are relevant (even if the belief is that they should, the reality is that this is not the case).
- Issues are likely to be very site specific – some skepticism whether the information from this project will be helpful to individual developers.
- Much of this would be best handled case by case given the site specific nature of navigational issues.
- Some of this may already exist in the NAVIC.

Question 2: Approach to performing the RD&D

- Based on presentation project seems to have had little R&D component except for consultation with USCG.
- The approaches used for carrying out the project is good, however there is a risk in producing separate document fro this project as compared to the document from PEV and Re Vision.
- Approach seemed to pretty much just consider Coast Guard guidance.
- No other outreach to other marine users was evident.
- Concerned that PCCI is simply developing a laundry list of concerns rather than a clear analysis of what is necessary versus what the USCG would like to have.
- Questions being asked by the U.S. DOE on the regulatory side should be closely tied to regulatory issues that must be determined in order to become permitted.

Question 3: Technical Accomplishments and Progress

- Significant progress has been made in the project.
- Completed draft report for USCG comment.
- Completion date is mid-December for final report.
- Few details provided as to actual progress.
- Seems to be progressing in a timely manner, but ultimate product does not appear to be as helpful as hoped.

Question 4: Research Integration and Collaboration

- There has been collaboration with other DOE contractors but seems to have had little outreach to other navigation interests except for USCG.
- Though there is coordination with PEV for this project, there is no need to produce separate project reports from this.
- Attempt has to be made also coordination with other relevant work that is currently underway through OWET and others.
- Appears to be primarily engagement with the Coast Guard.
- No interaction with current project developers to get feedback from actual experience.
- Coordinated with PEV and Re Vision results - will provide navigation information for incorporation into PEV framework, etc.
- Working closely with U.S. Coast Guard.

Project Strengths

- N/A

Project Weaknesses

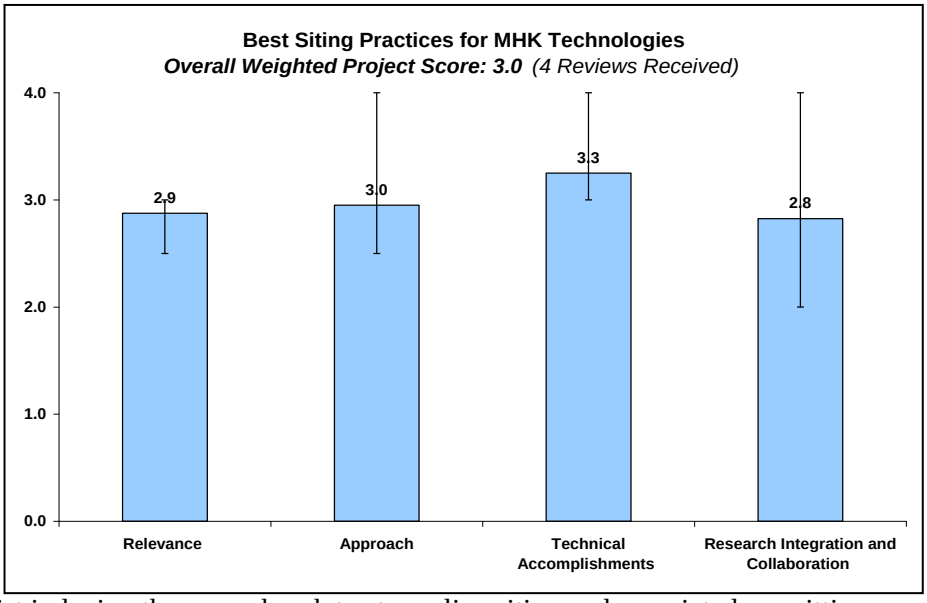
- Navigation issues can be very site specific. It is currently unclear how that aspect has been captured in this project.
- There appears to be a lack of engagement with broad cross section of entities concerned with marine navigation issues.
- Should be directed toward understanding which issues must be addressed to get the aid to navigation permit, rather than on the USCG's "like to haves" that would be provided as comments on NEPA and recommendations to FERC.
- This work could have been included in the PEV's roadmap focused on the Aid to Navigation permit.

Recommendations for Additions/Deletions to Project Scope

- This could be a piece of the overall siting report presented with a focused discussion. Consider placing the siting efforts into one project and one project leader for siting so easier for industry interaction and communication of results.
- This recommendation is for the DOE: It is better to produce comprehensive guidelines considering the output from the PEV, PCCI, and Re-vision, and other similar work.
- Navigation issues and constraints are likely to be very site specific and may be best resolved on a case by case basis.
- This effort should perhaps just be one chapter or element of the PEV Siting Protocol, rather than separate project/effort.
- Providing information to PEV to roll into its framework report would be beneficial rather than providing separate reports that could potentially result in a laundry list of concerns unrelated to regulatory authorities/standards.

Best Siting Practices for MHK Technologies
Mirko Previsic, Re Vision Consulting

Brief Summary of Project



In order to accelerate the adoption of emerging hydrokinetic and marine energy technologies, navigational and environmental issues and concerns must be identified and addressed.

By identifying and addressing these concerns in the early stages of the industry's development, serious mistakes that could potentially derail industry-wide technology development can be avoided. This project will assist in laying the groundwork to streamline siting and associated permitting processes, which are currently considered key hurdles for the industry's development in the U.S.

The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.

Question 1: Relevance to overall DOE objectives

- In concept this project supports development; however there are a number of aspects that are currently being performed also by industry as well to permit specific projects.
- Though the project lead provided a good presentation on the output from the project particularly the tool, it is not clear how this type of tool will be effectively used by the wave energy and tidal current project developers for siting individual projects and would facilitate the U.S. DOE goals.
- Largely focused on educating and gaining support from stakeholders.
- Should provide a good template for new developers to follow when combined with Pacific Energy Ventures and PCCI efforts.
- Does seem to duplicate the work already being done by projects like SnoPUD and OPT with some potential to impact those projects (this impact could be positive or negative).
- Re Vision has focused on siting from a technical perspective, as compared to PEV from a regulatory perspective.
- It appears this could be very valuable information for developers.

Question 2: Approach to performing the RD&D

- Addresses some of the environmental challenges in siting, however not sure how much interaction with industry has taken place where similar efforts through permitting process has occurred.
- If one part of the scope of this project is to consider a realistic deployment scenario - then this type of tool would be useful for planning development for a larger geographical reason, not for a single project specific.

- It is unclear whether the deployment scenarios consider other usage of the ocean space, such as, fishing zone, or recreational area, etc. in the tool.
- Approach is thorough, well developed, and leverages the experience the team has had on other projects.
- Re Vision is aware of the need to create a readable report to ensure information is used.
- Conducted scenario studies, but there is a question regarding whether that information is transferable to other sites, or how it will be used by developers in considering a particular site or sites.
- Re Vision is encountering several unanticipated issues (e.g., site developers' sensitivity to information sharing, underestimated technical complexities of several tasks).

Question 3: Technical Accomplishments and Progress

- Prepared draft reports that will soon be distributed for review at the U.S. DOE.
- The progress of the project has been good.
- Draft reports written for multiple sites and development scenarios. If typical of previous efforts, this will be of good quality, but difficult to judge without seeing.
- Appears to be progressing well.

Question 4: Research Integration and Collaboration

- Collaborates with other DOE contractors PCCI and PEV. Due to the similarity of efforts currently being undertaken by industry/applicants within the permitting process, it seems that there would be room for reaching out to these developers to understand what has been done, issues identified etc.
- Requires coordination with others such as the OWET-funded project on development analytical framework for cumulative impact assessment having some similar component.
- The information from the PCCI and PEV needs to be integrated with the outputs from this project.
- It was not clear, whether there has been coordination with some project initiatives, such as, by PG&E in California with this project.
- Collaborated with a number of technology developers and consultants.
- Need closer engagement and collaboration with related projects that are already in progress (SnoPUD, OPT, etc.).
- Coordinating with PEV and PCCI efforts.
- Nature of project involves integrating information from developers.

Project Strengths

- The tool has option to consider uncertainty in the next phase and could be used as long-term planning tool for larger geographical areas.

Project Weaknesses

- Not sure what this effort will add to help projects already in the cue and if this could create some confusion regards to issues being identified in this report with ongoing projects being permitted that have also identified issues but within the regulatory process.
- Need closer engagement and collaboration with related projects that are already in progress.

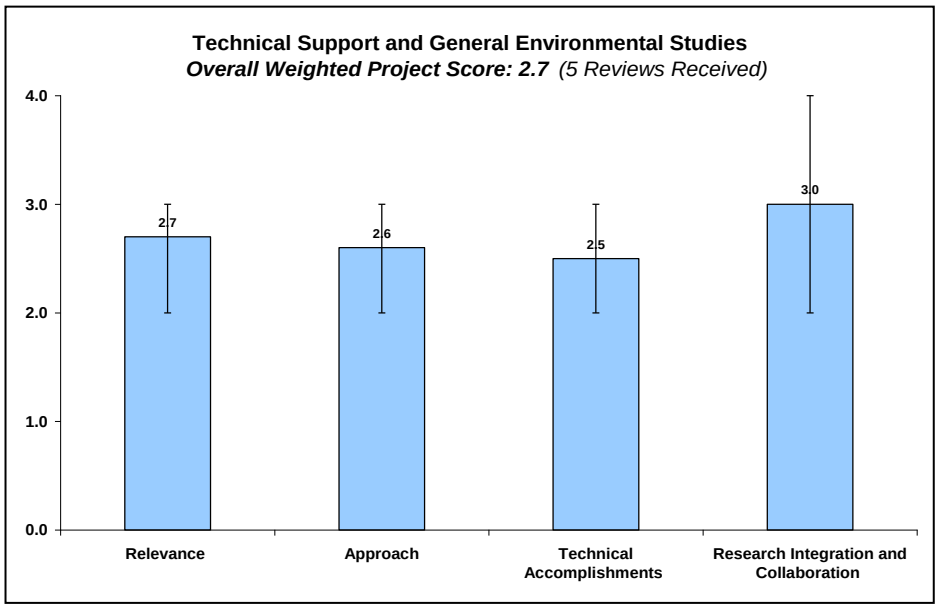
Recommendations for Additions/Deletions to Project Scope

- Consider placing the siting efforts into one project and one project leader for siting so easier for industry interaction and communication of results.

- If this work is to move forward it should be conducted as a clearly integrated effort with the PEV and PCCI efforts with a single project point of contact who will interface effectively with other ongoing projects (SnoPUD, OPT, etc.) which could be effected.

Technical Support and General Environmental Studies
Andrea Copping, PNNL

Brief Summary of Project
PNNL provides program support, strategic planning, and coordination and outreach for marine hydrokinetic energy. To increase the viability of ocean energy generation, the PNNL program assesses and has begun to address major barriers that include environmental and socio-economic impacts of facilities, regulatory uncertainly for permitting and siting, and the general lack of coordination among the important players in the field.



Tasks of this project include**:**
Coordination and Outreach to Industry and Stakeholders. PNNL works to increase information flow among industry groups, regulators, and stakeholders on ocean power technology, development needs, regulatory issues, impact analysis, siting, etc.

Coordination with US Navy. PNNL staff coordinates with Navy Northwest staff and contractors as the Navy moves towards installing a tidal power mooring in Admiralty Inlet in northern Puget Sound. As of February 2009, Navy NW is in the initial stages of planning a deployment of three to six Verdant Power tidal generators on the west side of Admiralty Inlet, a (relatively) shallow swift moving body of water separating the main basin of Puget Sound from the Straits of Juan de Fuca. At the same time, Snohomish PUD is planning for a pilot installation of tidal devices on the east side of Admiralty Inlet.

Coordination with Northwest National Marine Renewable Center. PNNL collaborates with University of Washington (UW) faculty and staff on tidal power investigations in Pacific Northwest waters, specifically Puget Sound, and with Oregon State University (OSU) faculty and staff on wave power projects along the Pacific.

The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.

Question 1: Relevance to overall DOE objectives:

- Provides general support to R&D and industry interested parties.
- This project, with a scope of technical support and addressing generic studies, aligns very well with one of the DOE pathways to achieve the program goal.
- In general, providing information to the public and facilitating coordination are all important
- It is extremely difficult to grade a project that does not have established deliverables and where

the little information on specific activities and accomplishments was provided.

Question 2: Approach to performing the RD&D

- Working to support increasing relevant information and data gathering efforts. However, it is not clear how this work is coordinated with other R&D and industry efforts.
- The future plan on having PNNL on developing risk-based environmental impact assessment and the principal organization leading the IEA-OES Annex IV activities on behalf of DOE would provide a focus to the R&D D approach.
- Primarily outreach and dialogue with a wide variety of stakeholders, as well as review of existing information globally.
- Seems to be doing good things but again, difficult to ascertain what is actually being done.

Question 3: Technical Accomplishments and Progress

- Providing some support to various interested parties and key projects. Specific goals/milestones were not identified in presentation so difficult to measure progress.
- The accomplishments have been primarily outreach activities.
- For the future deliverables, specific goals and deliverables need to be established.
- Preparing to publish report. No information really provided relative to progress.
- It appears there are many activities ongoing.

Question 4: Research Integration and Collaboration

- Working with other national labs and universities.
- PNNL has a marine component to their lab makes, which makes collaboration interesting.
- Some coordination exists with various stakeholders and primarily these are more outreach types of coordination and interaction.
- PNNL must design their program in coordination with other key stakeholders, national marine centers, regulatory bodies, key project developers and the international organizations to prioritize their activities.
- Significant coordination across multiple stakeholder groups at many levels.

Project Strengths

- Provides access to environmental expertise.
- Principal Investigator's technical knowledge and credibility.

Project Weaknesses

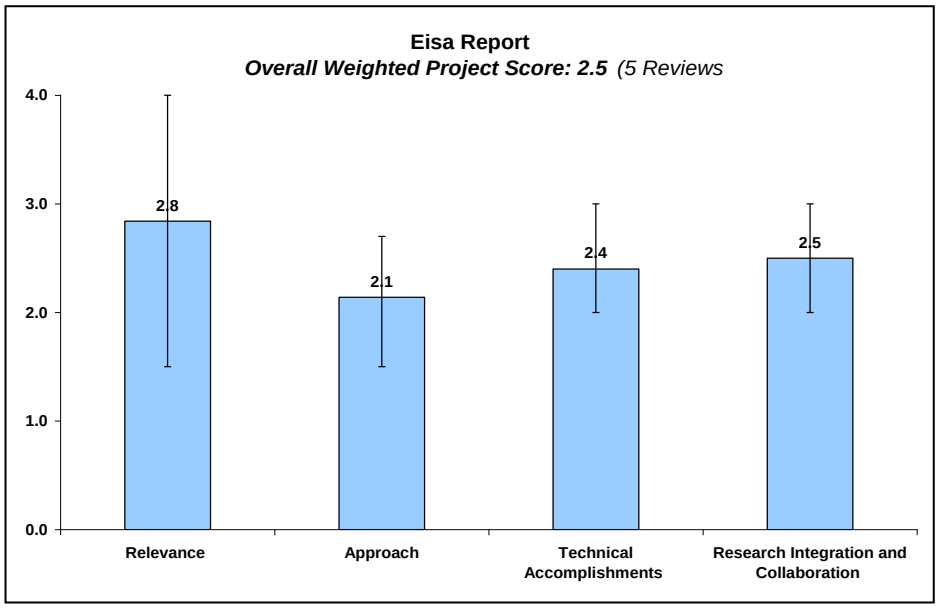
- Approach needs to be better defined-- not clear how these efforts are coordinated with other RD and industry efforts.
- Scope of work is a little vague and unclear.
- This type of work is very important, but the absence of a deliverable makes it difficult to determine whether this has been a useful project.

Recommendations for Additions/Deletions to Project Scope

- Coordinate with other R&D programs to reduce potential for duplication of efforts. PNNL could increase their awareness of ongoing industry outreach efforts.
- Any effort of this type should have a clear mission and direct focus to facilitate the success of real world projects.
- Add deliverable and describe successes.

EISA Report – Environmental Effects of Marine & Hydrokinetic Energy
Glenn Cada, ORNL

Brief Summary of Project



Section 633(b) of the Energy Independence and Security Act (EISA) of 2007 (Public Law 110-140) called for DOE to prepare a Report to Congress that addresses the effects of marine and hydrokinetic energy projects. The report covers: potential environmental impacts of marine and hydrokinetic energy projects, options to prevent adverse impacts, potential roles for environmental monitoring and adaptive management in mitigating impacts, and necessary components in adaptive management. As directed by EISA, the report is a cooperative effort with the Departments of Commerce (working though NOAA) and the Interior. ORNL environmental staff led responsibility for producing the report, supported by SENTECH, Inc. The final report was to be completed and sent to Congress in June 2009.

The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.

Question 1: Relevance to overall DOE objectives:

- Identifies areas of potential environmental impacts; however the effort is now over a year old and may not reflect current state of industry and available relevant information.
- The project is very valuable towards identifying potential environmental effects associated with deployment.
- Understood this is a requirement in terms of providing information to Congress, but somewhat duplicative with other efforts.
- Recognizing that this effort was driven by congressional request, the focus of this project is premature and appears to have focused in on the negative impacts of these projects in a manner that could be very damaging to the industry's efforts to move forward and focus on environmental issues that are specifically related to a statutory or regulatory standard that must be met.
- Focusing on mitigation for all environmental impacts is not appropriate - rather than reducing environmental impacts, we should be focused on identifying regulatory and statutory standards that these projects do not meet or legitimately may not meet, and describe methods to study and minimize those impacts to permitted levels.
- Reduction of effects for reduction's sake is not a good use of DOE funds, and therefore not an appropriate purpose of this report.

Question 2: Approach to performing the RD&D

- Report was based on existing information, however there was very limited time provided for public and industry input.
- A compendium of existing reports without an original assessment of what is important or not and too light on the potential environmental benefits.
- The project primarily focused on identifying potential negative impacts, role of adaptive management.
- The report failed to discuss the socioeconomics benefits of the future developments, including potential contribution that the available renewable wave, tidal and OTEC and other marine renewable resources in U.S. could make towards climate change mitigation.
- Feedback from NMFS and DOI.
- Conducted webinar to discuss draft reports.
- Public input was provided for a three week period during the holidays. Question whether that was sufficient time for the public, and in particular the industry, to review, digest, and provide meaningful input. Conversely, it appears that federal agencies (both headquarters and regional staff) appear to have had significant opportunities to provide feedback at multiple points during the project's development. Concerned that it may include comments or thoughts that are not consistent with where consensus is moving this effort.
- At no fault of the report's developers, OMB has taken significant time to review this report.

Question 3: Technical Accomplishments and Progress

- Prepared a draft report that is currently being reviewed at OMB. Presenter indicated additional input has been provided by resource agencies. However, the report is over a year old now and may not reflect current state of industry or available information on issues.
- Could have focused more on positive effects statements.
- The project has not made any significant progress to address any barriers.
- Draft report completed and shared for comment and feedback.

Question 4: Research Integration and Collaboration

- Performed research on existing information for technologies and environmental effects, however there was little time provided for public and industry input.
- Including public discussion/inputs in the early stage of the project would have been beneficial.
- Limited time for public and developer input.
- As explained above, while the coordination with agencies appears good, critical public review was short and therefore I question whether it was meaningful, and significant additions on adaptive management have not had public review. For a document like this, public input is very important.

Project Strengths

- N/A

Project Weaknesses

- Draft report could have focused more on the benefits rather than the negative impacts.
- Report is also somewhat dated at this point as draft was prepared over a year ago.
- The project deliverable did not include socio-economic benefits considering long-term deployment scenario for harnessing this emerging renewable resource in the U.S. and its contribution to climate change mitigation.
- Exceptionally difficult to qualify/quantify potential environmental effects given the dearth of

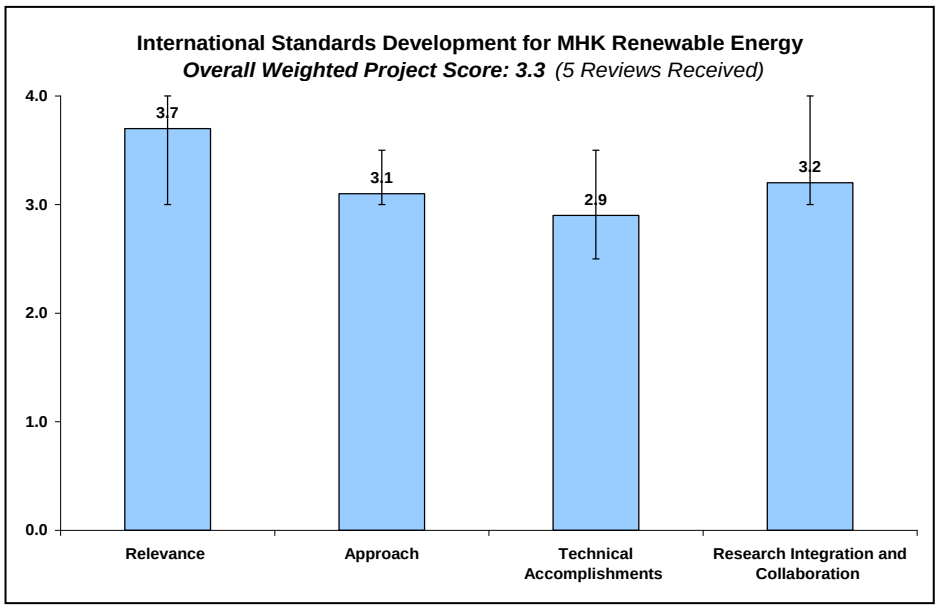
currently available data

Recommendations for Additions/Deletions to Project Scope

- The report must be placed into context of other activities in marine environment, update document to current state of industry.
- It is understood that this project is essentially now completed.
- This report should be revised to focus on potential environmental impacts that are specifically related to a statutory or regulatory permitting standard that must be met, and to fully emphasize benefits of hydrokinetics.
- This report should be re-released for a 60-day minimum comment period and revised as appropriate in response to those comments.
- If issued as is, this report should reflect a March or April 2009 date to reflect that the information is not up to date.

International Standards Development for Marine and Hydrokinetic Renewable Energy
Neil Rondorf, Science Applications International Corporation (SAIC)

Brief Summary of Project



The objectives and features of this project are to:

- Establish US credibility and economic parity with European and Asian Counterparts through increased US participation in standards development,
- Determine the critical staffing to support the IEC standards,
- Funding is managed by the US TAG,
- Report to DOE
  - The status of the IEC standards development for Marine Energy
  - Guidance to industry members
  - The relevant sections are Tidal Energy Converters and Wave Energy Converters
- Perform outreach to inform the public of the progress of the TC114 committee, and
- Recruit industry / government / academia to staff the US Mirror Committee.

The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.

Question 1: Relevance to overall DOE objectives

- Moving forward the effort for standards development, key for industry to have this.
- The project enables necessary effort from the U.S. towards development of relevant international standard and guidelines for assessing performances of the conversion technologies to harness the marine renewable resources.
- The project enables engagement of different relevant organizations representing a wider U.S. supply chain, towards development of necessary guidelines for enabling development and deployment of MHK technologies domestically as well as for the export market.
- Clearly a key element of positioning the US industry for future success and influence in the marine energy industry.
- It is very important that the U.S. be involved in IEC technology standards development to avoid being shut out of future technology development because of standards biased toward other countries.

Question 2: Approach to performing the RD&D

- Standards provide some level of certainty in the technology which is a positive effect, increases general knowledge of technology which can lead to public acceptance.

- Working with IEC is a good approach.
- The approach so far in participating some of the working group of the IEC TC 114 is good; however, the U.S. needs to take more proactive role for bringing new work program and leading some existing and/or new activities.
- Strong focus on ensuring for effective engagement with the global standards community.
- Recruitment of U.S. experts to participate on focused areas of standards development has been successful.
- Although the IEC process has caused standards development to go slowly, the wave group is unofficially moving forward due in significant part, it appears, to SAIC's efforts.

Question 3: Technical Accomplishments and Progress

- Working to support wave and initiating efforts on the tidal resource.
- Completion of some key frameworks.
- Participation in global working group meetings.
- The work will not be done by end of grant period of performance but that reflects the reality that this is a long-term effort that DOE should support.

Question 4: Research Integration and Collaboration

- Working closely with international members of the industry.
- This is by definition a task requiring integration and collaboration.
- Primarily with key U.S. experts and global standards groups, but this seems appropriate for this effort.
- This is necessarily a collaborative effort with representatives from many countries.

Project Strengths

- Important effort to set standards and interact with international community.
- Strong involvement by qualified individuals.

Project Weaknesses

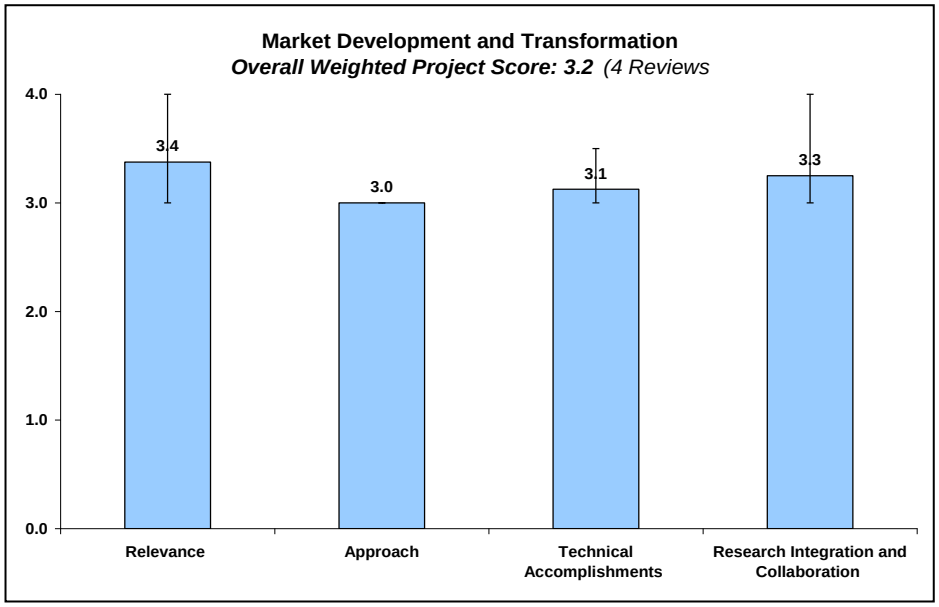
- Limited involvement of people, however project organizers are working to increase visibility within U.S. industry to increase involvement.
- Requires ongoing engagement to realize benefits.

Recommendations for Additions/Deletions to Project Scope

- The U.S. tag should include representation from all the U.S. DOE labs coordinating different marine R&D&D themes; the two national centers representing wave, tidal and OTEC interest, and the key technology developments and project developers and the regulatory stakeholders.
- Seems as if this activity will have to be transferred to an enduring organization so it won't be perpetually addressed as an ad hoc effort. Marine energy centers or NREL would seem to be a logical choice.
- Recommend renewing or extending grant in recognition that this is an important long term effort.

Market Development and Transformation
Bob Thresher, NREL

Brief Summary of Project



DOE contracts with NREL to serve as the secretary of the United States Technical Advisory Group (TAG) to the International Electrotechnical Commission's (IEC) Technical Committee 114 (TC 114) on marine energy. TC 114 is charged with developing international standards for the marine energy industry worldwide, and the US TAG coordinates US experts and develops the US position and input into the international body. Through the FY 2008 FOA, DOE also supports SAIC as the leader of the US TAG - specifically their activities to coordinate U.S. marine energy experts and lead the development of U.S. positions and their communication to the international committee.

The U.S. DOE will continue its participation under the International Energy Agency Ocean Energy Systems (IEA-OES) Implementing Agreement.

The bullets below are a compilation of comments made by individual panel members during the evaluation of this project.

Question 1: Relevance to overall DOE objectives

- In general supports information dissemination, standards, involved in numerous areas of technical support and information exchange through conferences.
- Provides support to standards, which are being identified as a key RDD&D need.
- Certain tasks (standardization) of this project are in duplication as that of the project on "International standards."
- A wide and disparate variety of industry activities, but all seemed value added, and the Principal Investigator certainly brings a wealth of important insight and experience to the effort.

Question 2: Approach to performing the RD&D

- Involved in numerous R&D efforts and interacts and gains broader insight through involvement with standards development.
- NREL wind technology experience is directly related to the Waterpower program and they are in a great position to provide technical support to the Program.
- The approach has been effective.
- Essentially this project seemed to apply experience and expertise on a somewhat ad hoc basis wherever/whenever it can best be deployed.

Question 3: Technical Accomplishments and Progress

- Has supported standards development.
- Support DOE on SBIR proposal reviews.
- Supports conferences by sponsorship and participation.
- All support activities provided by NREL have been accomplished in a good to outstanding manner.
- Progress has been good.
- Variety of activities…all as noted in the presentation. Appears that has done a nice and effective job of participating in various industry activities.

Question 4: Research Integration and Collaboration

- Performs work with input from numerous interests.
- NREL does an outstanding job of integrating and collaboration with others as required.
- Collaboration and integration with other US stakeholders have been good.
- Good engagement with a wide variety of groups, conferences, workshops, etc.

Project Strengths

- Leverages the experience of the Principal Investigator and other key experts, as well as that from NREL's wind experience.

Project Weaknesses

- None

Recommendations for Additions/Deletions to Project Scope

- Should this effort absorb the currently SAIC-led standards development efforts?
- The Roadmap should be completed as soon as possible.

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6.0 Overall Program Evaluation

As part of the 2009 Water Power Peer Review process, the Panel Members were asked to evaluate the performance of Wind and Water Power Program in the focus areas of Technology Development and Market Acceleration. Panel Members provided both quantitative and narrative evaluations based on the following criteria:

- Relevance to the Program Mission,
- Approach, and
- Communication & Collaboration.

Specifically, Panel Members were asked to evaluate: 1) how well the Program funded projects to accomplish the Wind and Water Power Program Mission, 2) the Program's methodology to determining industry priorities and selecting relevant RD&D projects to achieve those industry goals, and 3) the degree and impact that Program interaction has on industry, universities, Federal agencies, as well as comparable international actors. This section represents the Peer Review Panel's quantitative and qualitative analysis of the Wind and Water Power Program.

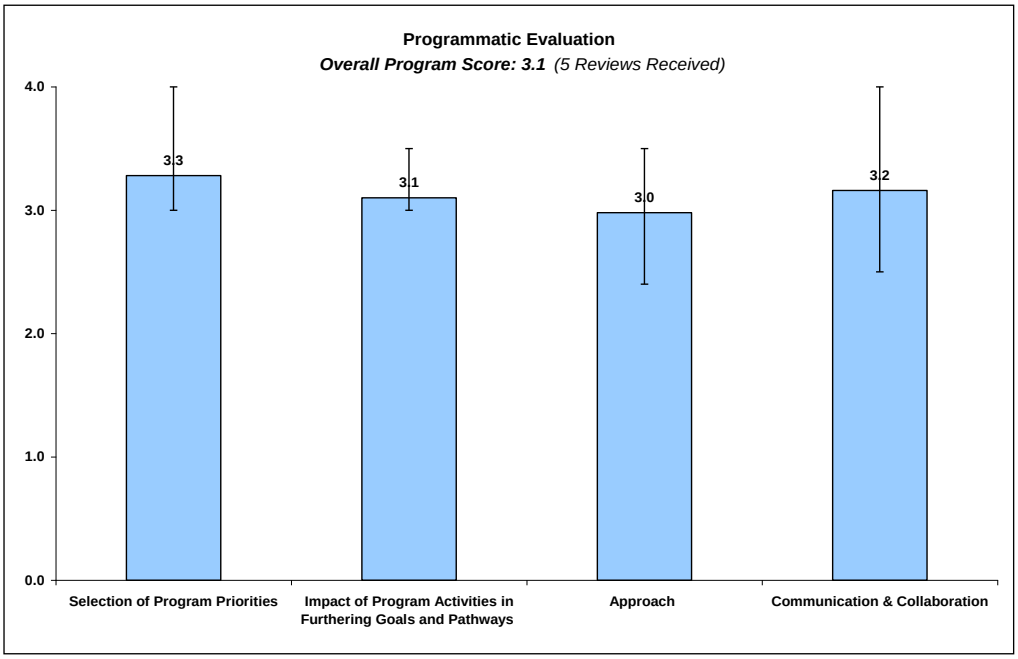

Figure 6.1 Peer Reviewer Program Evaluation Results

Question 1: Selection of Program Priorities

- The activities are supportive of industry growth and development efforts.
- Industry needs may be met more quickly by incorporating additional support on specific, early pilot/commercial project developments.
- Increase support on addressing specific environmental issues that industry is facing with permitting efforts. Approach in a way that industry can use and that regulatory agencies will accept to support permitting efforts as best can be accomplished.
- A quantitative cost of electricity goal without specifying the financial assumptions behind the goal is pretty much meaningless.
- The goal to reduce COE by 2030 for the technology development projects is not an effective

measureable goal.
- There could be some short-term goals with a focus on "reliable demonstration of technologies" with some measurable quantities.
- The program priorities, pathways, and approaches are generally well aligned with industry needs, however some projects could be better aligned with these program elements (please see comments in individual project reviews).
- Greatest value at this stage of the industry is to focus on furthering efforts to get real world projects in the water with appropriate monitoring programs to ensure necessary data is effectively gathered.
- A focus on project monitoring efforts/technology, particularly with respect to environmental impacts, is an important element for project/industry success.
- The program is supporting research and analysis of critical technological and regulatory challenges that will help move the industry forward. This support is absolutely necessary to ensure this industry gets off the ground as quickly as possible.
- The program priorities are well balanced between four categories - pure technology testing, supporting getting projects permitted and deployed so that they can be tested, determining energy capacity, and analyzing and synthesizing regulatory challenges.

Question 2: Impact of Program Activities in Furthering Goals and Pathways
- Activities in general work towards furthering goals and pathways.
- There appears to be some scheduling issues with getting work initiated.
- The EISA report is now a dated document and may not reflect the current state of industry and understanding of environmental issues. This may lead to a step backwards and perhaps hamper development.
- The Program should consider an equivalent to the National Wind Technology Center.
- Requires more activities aimed at getting hardware in the water.
- Requires more work on standards. Need to develop a framework for what adaptive management means in terms of commercial development and who pays for this work.
- Highest priority should be focused on System Deployment, Testing, and Validation, as results from these efforts will inform all other priorities and approaches. Without information and data from these real world projects, other/current (desktop study) efforts related to environmental effects, stakeholder analysis, etc. may not be optimally focused or not result in value-added efforts.

Question 3: Approach
- Approach could transition more towards also providing opportunities for shovel ready projects or those within the permitting process that could use DOE support for performing studies or monitoring effects after construction.
- Approach to R&D should include verification that issues being researched are being conducted to a level of rigor acceptable to regulatory/scientific community so results will be applicable for industry to reference and utilize as appropriate in project and policy development.
- Increase effort on coordination between goals/objectives/effort to reduce the potential for duplicity.
- Need to increase the amount of hardware in the water. Need to support more projects that actually put hardware in the water.
- There is still opportunity for DOE to improve the program by more precisely identify the barriers to achieving the long term goal.
- It needs to be recognized that not having a reliable (demonstrated) conversion technology (wave

as well as tidal current) is a major barrier. Certain component of the DOE program has to address this barrier.

- Better coordination between DOE-funded efforts at the National DOE Labs, National Marine Centers as well as by the industries (including DOE funded projects) in the area of project permitting & regulatory, environmental issues, as well as generic R&D activities would be beneficial. Some effort is necessary to avoid duplication and a better utilization of DOE resources.
- Could be more sharply focused on reducing barriers. Some projects address issues that do not directly address barriers, or do not directly facilitate the efforts of leading projects that are already in progress.

Question 4: Communication and Collaboration

- Good high energy team working with broad representation of industry interests.
- Engagement with industry, labs, etc. overall is very good. The visibility of the program and program leadership is excellent.
- Good communication and collaboration with European countries and the IEA.
- The Program should follow up on efforts undertaken in 2009 during the "Clean Energy Dialogue" between the U.S. and Canada regarding synergistic activities underway along both coasts of the continent.
- Considering U.S. and Canada energy dialogue, and very synergistic activities underway along both coasts of the continent, perhaps the U.S. DOE should encourage a better collaborative approach among key industrial players.
- Coordination is required between DOE Water Power-funded marine centers, national labs, and other national funding agencies for basic research and development at the centers, such as, NSF and others.
- Would be beneficial if there could be more engagement/influence with federal resource agencies with respect to gaining resource agency support and reducing barriers, at least to the degree possible.
- DOE has done an excellent job communicating with and receiving input from industry.
- It appears based on the programs chosen by DOE that it is having a significant impact on universities working in this field and national labs.
- DOE's coordination with NOAA, FERC, MMS and other agencies as a sort of neutral agency has been and will continue to be useful in coordinating those agencies' missions and goals.

Program Strengths

- The DOE team understands this industry very well, and that has translated into a set of draft goals that are strategic and appropriately focused. The team should be applauded for their effort in determining what this young industry needs and how to achieve it.
- Program is focused on the right things - developing technology, supporting project development in order to test and prove that technology in the marine environment, determining overall energy capacity in the US, and identifying and analyzing regulatory challenges. Each of these is critical to moving the industry forward.
- In overall, the current DOE program is strong considering the early stage of implementation.
- Strong, competent leadership and a well organized program and diverse recipients in initial offerings.
- Many projects strongly support DOE's objectives.
- Marine energy centers and university engagement are very valuable and set the stage for the future.

Program Weaknesses

- The program could benefit from an increase in support for some of the first projects to test hardware in the water. This would allow for collecting information and R&D while at same time support goal of getting devices in the water.
- There seems to be a potential for duplicity in some of the recipients tasks/efforts. Incorporate clear goals and objectives as well as coordination at the task/recipient level.
- In order to avoid duplication and dilution of the resources, the following specific issues needs to be considered:
    - (a) a better well defined role for each of the national labs for the Water Program delivery - well measured deliverables should be established;
    - (b) better coordination between the two marine centers for prioritization of their future tasks and encouraging then to leverage other federal R&D funding from sources to maximize the U.S. DOE investment; and
    - (c) the Program needs to enable a staged technology improvement process. A more significant focus on developing new conversion technologies or further developing existing conversion technologies is required.
- A Water Power Roadmap should be completed in less than a year.
- If DOE is tasked with forwarding this industry then there may need to be additional outreach with NOAA/MMS/FERC to identify and help to resolve challenges and issues to meeting this goal.
- Greatest value will be realized by focusing resources to facilitate real world projects. The data and experience gained from these efforts will be invaluable, and will contribute greatly to optimizing the overall MHK program going forward.
- Recommend that DOE clarify the extent to which resulting information shall be public. Suggest that DOE staff decide which projects require information sharing and which do not, and make those decisions a requirement of funding.
- Program should focus on studying and minimizing impacts that are directly linked to a statutory or regulatory standard that a project must meet to be permitted.
- Program should focus on discrete areas where additional information is necessary to confirm that project impacts are within legally acceptable thresholds, and any minimization measures analyzed or studied should also directly relate to a legal requirement to minimize impacts.
- DOE should consider issuing an RFP for projects specifically aimed at (1) identifying a statutory or regulatory standard that the industry is having difficulty meeting or that requires a confirmation of impacts to assure regulatory agencies that presumed impact levels are indeed correct, and then (2) studying that impact, providing publicly available information on the study results, and finally (3) perhaps takes the third step of identifying minimization measures.
- DOE should include as part of the testing facility grant contracts a requirement that they coordinate to ensure they are not performing redundant functions - both on a day to day basis as well as each university's overarching goals.
- DOE should immediately focus on funding resource impact studies for OTEC. Rather than waiting, we should identify environmental challenges now so that technology developers can plan for or avoid those impacts.
- In the future, rather than asking several grant recipients to coordinate and merge their work, it would be more efficient and effective to choose one entity that appears to have the capability to take on a broader scope, and empower that entity to choose who will sub to it on various subjects.

7.0 Lessons Learned from the 2009 Water Power Peer Review Meeting Process

November 17-18, 2009 marked the Water Power peer review meeting in Lakewood, Colorado. The Peer Review Panel was comprised of five main experts, with two alternate experts reviewing those projects with conflicts of interest. Overall, 19 projects were reviewed: ten Technology Development project and nine Market Acceleration projects. The following is a list of comments and actionable recommendations aimed at improving the process for future Water Power Peer Review Meetings:

- The entire Peer Review Panel was satisfied with the efforts put-forth in all phases of the review process, including planning, coordinating, facilitating, and report writing.
- The schedule was compressed on the second day for the Peer Review Panel, and not enough time was allotted for the panel to complete their discussions regarding the project evaluations.
- The Panel recommends two full days for the peer review process; one day for principal investigators and Program Managers to present, and one day for the Panel to review program goals and priorities and to discuss the project evaluations.
- The Conflict of Interest issues required more attention prior to the review meeting.
- The Review Panel reimbursement process needs to be finalized in advance, and better direction/instruction regarding the reimbursement process should be provided to the reviewers.
- Detailed guidelines that better explain and define the role of the Panel Chair should be provided.
- Some panel members suggest distributing the information packets (presentations, SOPOs, evaluation forms, etc.) to the reviewers earlier in the peer review process. This would enable the reviewers to perform initial qualitative and quantitative analyses prior to attending the meeting and observing the presentation by the principal investigator (PI). Reviewers would then be able to more easily focus on and capture additional key points that they may otherwise miss when trying to comment on and evaluate the projects during the presentations. Evaluations would be modified after the presentations from the PIs.

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APPENDICES

Appendix A. Meeting Attendee List

Appendix B. General Project Evaluation Forms (Technology Development and Market Acceleration.

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Appendix A: Meeting Attendee List

U.S. Department of Energy, Wind and Water Power Program (WWPP) Water Power Peer Review, November 17 & 18, 2009 Lakewood, Colorado		
Last Name	**First Name**	**Organization**
Ashford	Meleah	Northwest National Marine Renewable Energy Center at Oregon State University
Battey	Hoyt	Department of Energy, WWPP
Bedard	Roger	Electric Power Research Institute (EPRI)
Bevelhimer	Mark	Oak Ridge National Laboratory
Bhuyan	Gouri	Power Tech Labs
Cada	Glenn	Oak Ridge National Laboratory
Collar	Craig	Snohomish County Public Utilities District
Cool	Richard	PCCI, Inc.
Cooper	Dennis	Lockheed Martin
Copping	Andrea	Pacific Northwest National Laboratory
Corren	Dean	Verdant Power
DiBella	Frank	Concepts/NREC
Dooher	Brendan	Pacific Gas & Electric
Eugeni	Ed	SENTECH, Inc.
Gasper	John	Argonne National Laboratory
Geerlofs	Simon	Pacific Northwest National Laboratory
Haas	Kevin	Georgia Tech Research Corporation
Haller	Merick	Northwest National Marine Renewable Energy Center at Oregon State University
Hughes	Scott	National Renewable Energy Laboratory
Jepsen	Rich	Sandia National Laboratories
Johnson	Jesse	SENTECH, Inc.
Kopf	Steve	Pacific Energy Ventures
Mauer	Erik	Navarro Research & Engineering, Inc.
McCluer	Megan	Department of Energy, WWPP
Moreno	Alejandro	Department of Energy, WWPP
Moreno	Alejandro	Department of Energy, WWPP
Murphy	Mike	HDR, Inc.
Neary	Vincent	Oak Ridge National Laboratory
Nowakowski	Gary	Department of Energy, Golden Field Office
Oram	Cherise	Stoel Rives LLP
Paquette	Josh	Sandia National Laboratories
Polagye	Brian	Northwest National Marine Renewable Energy Center at Oregon State University
Previsic	Mirko	Re Vision Consulting
Quinn	Samantha	Navarro Research & Engineering, Inc.
Reed	Michael	Inspired Systems
Rieks	Jeff	Navarro Research & Engineering, Inc.
Rocheleau	Rick	National Marine Renewable Energy Center of Hawaii
Rondorf	Neil	Science Applications International Corporation

U.S. Department of Energy, Wind and Water Power Program (WWPP) Water Power Peer Review, November 17 & 18, 2009 Lakewood, Colorado		
Scott	George	National Renewable Energy Laboratory
States	Jennifer	Pacific Northwest National Laboratory
Tasca	Coryne	SENTECH, Inc.
Thresher	Robert	National Renewable Energy Laboratory
Toman	Bill	Pacific Gas & Electric
Whitson	Robert	SENTECH, Inc.
Winkenwerder	Laurel	BCS, Inc.
Zayas	Jose	Sandia National Laboratories

Appendix B. General Project and Program Evaluation Forms

The evaluation forms were the only means by which Reviewers documented their quantitative and qualitative project evaluations. Separate evaluation forms were used to document reviewer scores and comments regarding: 1) Technology Development projects, 2) Market Acceleration projects, and 3) an overall evaluation of the Program.

The Technology Development and Market Acceleration evaluation forms were designed to capture input regarding the following criteria:

1. **Relevance to Overall DOE Objectives**: the degree to which the project supports the goal and pathways of the Water Power Technology Development and Market Acceleration activities. (Weight = 40%)
2. **Approach to Performing the RD&D**: the degree to which technical barriers are addressed, the project is well-designed and technically feasible; and the degree to which future research has been planned - including consideration of contingencies, built-in optional paths or off-ramps, etc. (Weight = 30%)
3. **Technical Accomplishments and Progress**: advancement towards overall project and DOE goals; the degree to which research progress is measured against performance indicators and to which the project elicits improved performance (effectiveness, efficiency, cost, and benefits). (Weight = 20%)
4. **Research Integration and Collaboration:** relationships with industry/universities/other laboratories; the degree to which the project interacts, interfaces, or coordinates with other institutions and projects. (Weight = 10%)

The Program evaluation forms were designed to capture input regarding the following criteria:

1. **Relevance to Program Mission**: How well do Program funded projects accomplish the Water Power Program Mission?
2. **Approach**: Program's methodology to determining industry priorities and selecting relevant RD&D projects to achieve those industry goals.
3. **Communication & Collaboration:** Degree and impact that Program interaction has on industry, universities, Federal agencies, as well as comparable international actors.

Numerical scores were based on a four point scale for each evaluation form, with the following qualitative descriptors given for the numerical scoring index:

- **4 - Outstanding**. Excellent progress toward objectives; suggests that barrier(s) will be overcome.
- **3 - Good**. Significant progress toward objectives and overcoming one or more barriers.
- **2 - Fair**. Modest progress in overcoming barriers; rate of progress has been slow.
- **1 - Poor**. Little or no demonstrated progress towards objectives or any barriers.

Additionally, all three evaluation forms were designed to capture reviewer input regarding the strengths and weaknesses for a specific project or the Program as a whole.

The following templates represent the Technology Development, Market Acceleration, and Program evaluation forms.

DOE Water Power Program 2009 Peer Review
Project Evaluation Form - Technology Development

Project Name: _____ **Reviewer:** _____

Presenter Name: _____ **Presenter Org:** _____

Provide specific, concise comments to support your evaluation -- and, write clearly please.

1. Relevance to overall DOE objectives – the degree to which the project supports the goal* and pathways* of the Water Power Program Technology Development activities. **(Weight = 40%)**

Goal	*Reduce the cost of energy generated from marine and/or hydrokinetic technologies to $0.07/kWh by 2030*	
Pathways	● *Increase device efficiency*	● *Improve device availability and reliability*
	● *Optimize array efficiency*	● *Reduce development, deployment and O&M costs*

4 - Outstanding. Project is critical to Program goal and fully supports DOE RD&D pathways.
3 - Good. Most project aspects align with the Program goal and DOE RD&D pathways.
2 - Fair. Project partially supports the Program goal and DOE RD&D pathways.
1 - Poor. Project provides little support to the Program goal and the DOE RD&D pathways.

score _____

Comments

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2. Approach to performing the RD&D. **(Weight = 30%)**

● Degree to which technical barriers are addressed, the project is well-designed and technically feasible.

● Degree to which future research has been planned - including consideration of contingencies, built in optional paths or off ramps, etc.

Barriers	● *Lack of cost and performance data*	● *Prototype deployment is costly and time-consuming*
	● *O&M is difficult and costly in rough marine environments*	● *Lack of common technical standards*
	● *Lack of fundamental data on device and resource interaction*	● *Numerous disparate competing design types*

4 - Outstanding. Sharply focused on technical barriers; difficult to improve approach significantly.
3 - Good. Generally effective but could be improved; contributes to overcoming some barriers.
2 - Fair. Has significant weaknesses; may have some impact on overcoming barriers.
1 - Poor. Not responsive to project objectives; unlikely to contribute to overcoming the barriers.

score _____

Comments

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3. Technical Accomplishments and Progress toward overall project and DOE goals – the degree to which research progress is measured against performance indicators and to which the project elicits improved performance (effectiveness, efficiency, cost, and benefits). **(Weight = 20%)**

4 - Outstanding. Excellent progress toward objectives; suggests that barrier(s) will be overcome.
3 - Good. Significant progress toward objectives and overcoming one or more barriers.
2 - Fair. Modest progress in overcoming barriers; rate of progress has been slow.
1 - Poor. Little or no demonstrated progress towards objectives or any barriers.

score

Comments

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4. Research Integration & Collaboration with industry/universities/other laboratories – the degree to which the project interacts, interfaces, or coordinates with other institutions and projects. **(Weight = 10%)**

4 - Outstanding. Close, appropriate coordination with other institutions; partners are full participants.
3 - Good. Some coordination exists; full/needed coordination could be accomplished easily.
2 - Fair. A little coordination exists; full/needed coordination would take significant effort.
1 - Poor. Most work is done at the sponsoring organization with little outside interaction.

score

Comments

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Project Strengths

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Project Weaknesses

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Recommendations for Additions/Deletions to Project Scope

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DOE Water Power Program 2009 Peer Review
Project Evaluation Form - Market Acceleration

Project Name: | **Reviewer:**

Presenter Name: | **Presenter Org:**

Provide specific, concise comments to support your evaluation -- and, write clearly please.

1. Relevance to overall DOE objectives – the degree to which the project supports the goal* and pathways* of the Water Power Program Market Acceleration activities. **(Weight = 40%)**

Goal	*Facilitate the deployment of 20 GW capacity of marine and hydrokinetic systems in the United States by 2030.*	
Pathways	● *Understand the total quantity, locations, and characteristics of all marine and hydrokinetic resources in the United States*	● *Reduce the costs, time, and potential environmental effects associated with deployment of marine and hydrokinetic systems*

4 - Outstanding. Project is critical to Program goal and fully supports DOE RD&D pathways.
3 - Good. Most project aspects align with the Program goal and DOE RD&D pathways.
2 - Fair. Project partially supports the Program goal and DOE RD&D pathways.
1 - Poor. Project provides little support to the Program goal and the DOE RD&D pathways.

score

Comments

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2. Approach to performing the RD&D. **(Weight = 30%)**

● Degree to which technical barriers are addressed, the project is well-designed and technically feasible.

● Degree to which future research has been planned - including consideration of contingencies, built in optional paths or off ramps, etc.

Barriers	● *Lack of refined and comprehensive resource estimates*	● *Lack of data on environmental, navigational, and competing use impacts*
	● *Complex and lengthy regulatory process not designed to accommodate small, scalable, projects*	● *Lack of public acceptance of marine and hydrokinetic technologies*
	● *Renewable energy incentives discourage investment in the newest technologies*	● *Financing is extremely costly or unavailable*

4 - Outstanding. Sharply focused on technical barriers; difficult to improve approach significantly.
3 - Good. Generally effective but could be improved; contributes to overcoming some barriers.
2 - Fair. Has significant weaknesses; may have some impact on overcoming barriers.
1 - Poor. Not responsive to project objectives; unlikely to contribute to overcoming the barriers.

score

Comments

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3. Technical Accomplishments and Progress toward overall project and DOE goals – the degree to which research progress is measured against performance indicators and to which the project elicits improved performance (effectiveness, efficiency, cost, and benefits). **(Weight = 20%)**

4 - Outstanding. Excellent progress toward objectives; suggests that barrier(s) will be overcome.
3 - Good. Significant progress toward objectives and overcoming one or more barriers.
2 - Fair. Modest progress in overcoming barriers; rate of progress has been slow.
1 - Poor. Little or no demonstrated progress towards objectives or any barriers.

score

Comments

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4. Research Integration & Collaboration with industry/universities/other laboratories – the degree to which the project interacts, interfaces, or coordinates with other institutions and projects. **(Weight = 10%)**

4 - Outstanding. Close, appropriate coordination with other institutions; partners are full participants.
3 - Good. Some coordination exists; full/needed coordination could be accomplished easily.
2 - Fair. A little coordination exists; full/needed coordination would take significant effort.
1 - Poor. Most work is done at the sponsoring organization with little outside interaction.

score

Comments

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Project Strengths

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Project Weaknesses

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Recommendations for Additions/Deletions to Project Scope

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DOE Water Power Program 2009 Peer Review
Program Evaluation Form

Reviewer:

Presenter Name: _____ **Presenter Org:** **U.S. Department of Energy**

Provide specific, concise comments to support your evaluation -- and, write clearly please.

1. Selection of Program Priorities - How well do Program priorities, pathways, and approaches align with industry needs? (reference Attachment: "*Tentative Program Goals, Pathways, and Technical Approaches*")

4 - Outstanding. All Program priorities fully support industry.
3 - Good. Most Program priorities support industry.
2 - Fair. Some Program priorities support industry.
1 - Poor. Very few Program priorities support industry.

score

Comments

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2. Impact of Program Activities in Furthering Goals and Pathways - (reference Attachment: "Tentative Program Goals, Pathways, and Technical Approaches"

4 - Outstanding. All Program activities further goals and pathways.
3 - Good. Most Program activities further goals and pathways.
2 - Fair. Some Program activities further goals and pathways.
1 - Poor. Very few Program activities further goals and pathways.

score

Comments

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3. Approach - Program's methodology to determining industry priorities and selecting relevant RD&D projects to achieve those industry goals.

4 - Outstanding. Sharply focused on technical barriers; difficult to improve approach significantly.
3 - Good. Generally effective but could be improved; contributes to overcoming some barriers.
2 - Fair. Has significant weaknesses; may have some impact on overcoming barriers.
1 - Poor. Not responsive to project objectives; unlikely to contribute to overcoming the barriers.

score

Comments

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4. Communication & Collaboration - Degree and impact that Program interaction has on industry, universities, Federal agencies, as well as comparable international actors and other stakeholders.

4 - Outstanding. Close, appropriate coordination with other institutions.
3 - Good. Some coordination exists with other institutions.
2 - Fair. A little coordination exists with other institutions.
1 - Poor. Little to no outside interaction occurs with other institutions.

score

Comments

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Program Strengths

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Program Weaknesses

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