Business Plan for NNMREC's Mobile Ocean Test Berth

Revised, April 5

2011

The following document is a DRAFT Business plan for the Mobile Ocean Test Berth at Oregon State University's Northwest National Marine Renewable Energy Center.

Northwest National Marine Renewable Energy Center (NNMREC)

OSU Oregon State University

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Section 1 Plan Objective

The purpose of this plan is to guide the development and continued funding of the Mobile Ocean Test Berth (MOTB) at the Northwest National Marine Renewable Energy Center (NNMREC). This plan is intended to be updated on a regular basis to reflect the needs and interests of customers and realities of funding. Conceptually, the MOTB is a small business with the need to define a development, operational, revenue and marketing strategy.

This business plan will form the foundation to:

1. Provide focus for the internal efforts at Oregon State University (OSU) to support wave energy development;
2. Attract wave energy device developers to use the MOTB to test their devices;
3. Develop comprehensive project specifics that meet test requirements;
4. Plan for project development and execution of current (MOTB) and future phases (Grid Connected Ocean Test Berth (GCOTB)); and
5. Leverage additional Department of Energy and third-party funding.

1.1 MOTB Status Update and General Summary (as of July 1, 2010)

Objectives

- Provide a permitted test berth and site for testing and demonstration of prototype and full scale wave energy devices.
- Improve understanding of environmental effects.
- Obtain consistent, comparable performance data for devices.
- Support development of renewable energy resources.

Concept

As an integrated test facility, we address:

Environment: effects, impacts, monitoring technology, mitigation
Device Technology: power take-off, controls, modeling, mooring, materials
Outreach and Human Dimensions: Community Engagement
Cost effectiveness: performance, reliability, survivability, optimized procedures

Progress

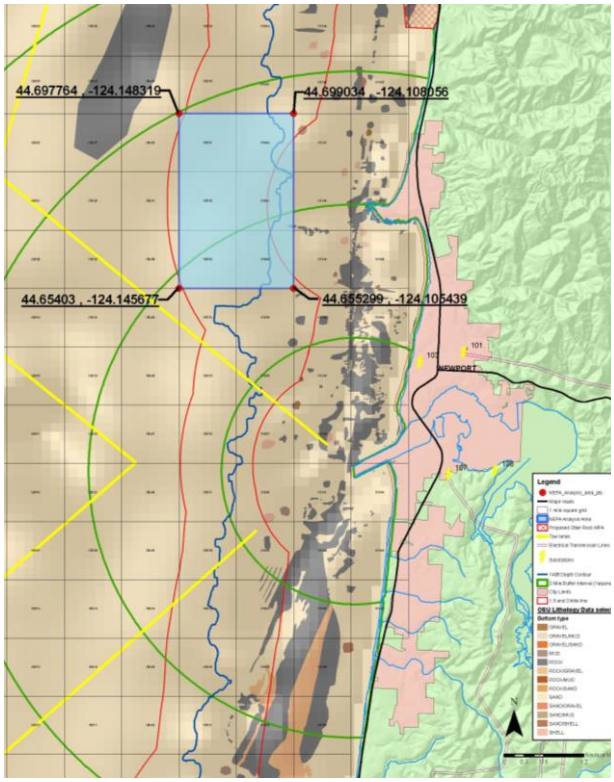
- One year design followed by one year build on US west coast.
- Design began Jan-2010.
- Pre-design is underway for 1st MOTB using SAIC design team.
- Site characterization underway.
- NEPA analysis underway.
- Permit discussions underway.
- First test planned for late 2011/early 2012.

Infrastructure

Wave Energy Ocean Test berths

- 1st Phase is mobile, with primary site off Newport, Oregon
- Power and performance data, with load bank to emulate the grid
- Device health monitoring
- Environmental monitoring
- Facility permitted to operate under adaptive management framework
- Future plans for grid connection

Location



Physical Characteristics

Test Berth Site Characteristics

- Water depth 40-50m
- Sandy bottom
- Waves: 1-4m,
  Periods: 6-12s
- Proximity to maritime industry, Hatfield Marine Science Center, Oregon State University

The MOTB is being established to test devices in the technology readiness levels (TRL) of 6 – 9, near full-scale devices just prior to commercialization. NNMREC also has exiting capabilities in the TRL 1-5 ranges, conceptual to small-scale prototypes. These facilities include the Wallace Energy Systems Renewable Facility (WESRF) with its renewables testing capabilities, and two wave tanks at the Hinsdale Wave Research Laboratory. All of these facilities have been successfully utilized to test devices in the 1:33 (TRL 4/5) through 1:15 (TRL 4/5) scale.

Section 2 Mission Statement

The mission of the Mobile Ocean Test Berth (MOTB) at the Northwest National Marine Renewable Energy Center (NNMREC) will be *an accredited test facility that will allow WEC developers to ocean testing of subscale and full-scale systems to support technology demonstration and validation, optimization, and certification by a third party organization.* NNMREC will not act as a certification agency, but rather support the testing of devices for certification by others.

The MOTB will leverage other efforts of the NNMREC such as advanced modeling, wave forecasting and environmental effects analysis. Although related to NNMREC, the MOTB will serve as a standalone facility housed under the umbrella of NNMREC.

The mission of NNMREC is to provide full range of capabilities to support wave and tidal energy development for the United States. NNMREC is structured to:1) FACILITIES - Development of facilities to serve as an integrated, standardized test Center for U.S. and international developers of wave and tidal energy technology;

2) ENVIRONMENTAL EFFECTS - Evaluation of potential environmental, ecosystem and social impacts, focusing on compatibility of marine energy technologies within sensitive environments and existing users;

3) OPTIMIZATION - Device and array optimization for effective deployment of wave and tidal energy technologies; and

Section 9 'Supporting Services' provides additional details on other services that NNMREC is able to offer to wave energy technology developers. Note that these services will be provided independently of testing services offered as part of the MOTB.

The focus of this business plan is on the development of the MOTB. However, at times, the document references the Ocean Test Berth (OTB), which is intended to imply a complete facility that will include both mobile (MOTB) and grid connected capabilities.

Section 3 Offering

3.1 Ocean Test Berth

Currently, the U.S. marine energy industry is challenged by the lack of proper and standardized infrastructure to test and deploy WEC devices in the ocean. NNMREC aims to solve this industry problem by developing the Nation's first MOTB off the coast of Newport, Oregon. The MOTB will provide the critical infrastructure to test and validate WEC devices and allow developers to demonstrate the commercial viability of their technology.

OSU has established the need for such a test center by conducting an initial industry market research (as detailed in Section 4.1) and working directly with potential users of the test berth to assist with design specifications and technical details. Ocean energy test facilities exist in Europe, but nothing currently exists in North America. This necessary infrastructure will allow Oregon to serve as the Nation's leading and only test facility capable of testing a full range of WEC devices.

The development of the full scale OTB will occur in two phases (mobile and grid connected facilities) to meet the needs of wave energy system developers. The full scale OTB will:

- Serve as an integrated (with other OSU capabilities), independent test Center for U.S. and international developers of wave and tidal energy;
- Assist wave and tidal technology providers in optimizing device performance;

- Enable all ocean stakeholders to develop levels of confidence and acceptance through the successful demonstration of wave energy research and testing;
- Enable technology developers to improve reliability and survivability of marine energy systems; and
- Serve as a location for conducting environmental research

Phase I – Mobile Ocean Test Berth (MOTB) – The MOTB is designed to allow testing and analysis of a WEC device without a connection to the electrical grid. The MOTB system has four major infrastructure segments, each of which contains sub-systems with technical elements, as described below. The four major infrastructure segments are:

- Sea-Based Infrastructure (SBI), which includes monitoring sensors for the marine environment, navigational markers and notifications, and the MOTB hull sub-system;
- Anchoring and Mooring Infrastructure (AMI), which includes the mooring, recovery and release, and anchors;
- Power Interconnect Infrastructure (PII), which includes electrical power conversion, conditioning, distribution, and protection elements of the System, and command and control elements of the electrical sub-system;
- Data Acquisition and Telemetry Infrastructure (DATI), which includes data collection, transport, and local storage elements, data topology and encryption, the network interface to external elements and the shore monitoring station.

Provided there is sufficient budget, NNMREC will fabricate up to five complete test berths. The first system will be a MOTB primarily deployed to test at a fixed site off the coast of Newport, Oregon ('Test Site'). The Test Site location is being developed in conjunction with State and Federal resource agencies, a local fishing group (FINE), and the local community. This MOTB will be designed as a plug-and-play device fully contained within a vessel hull and will have the capability to be transported to test a WEC developer's system at their project site ("Client Site"). It is anticipated that the MOTB will be home ported in Yaquina Bay at Newport either at a dock or on a trailer. The MOTB will be deployed from Newport and towed into position.

Figure 1: MOTB Technical Schematic

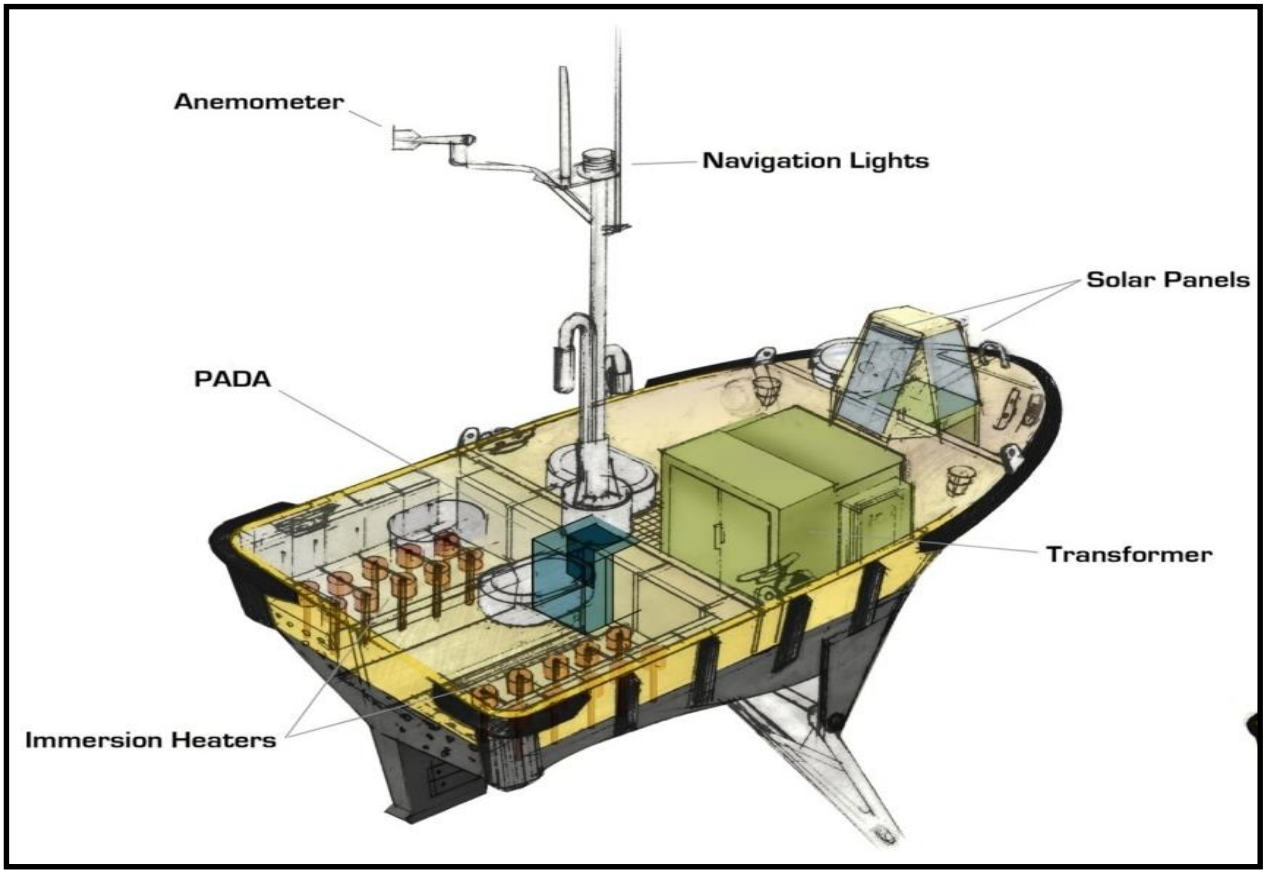
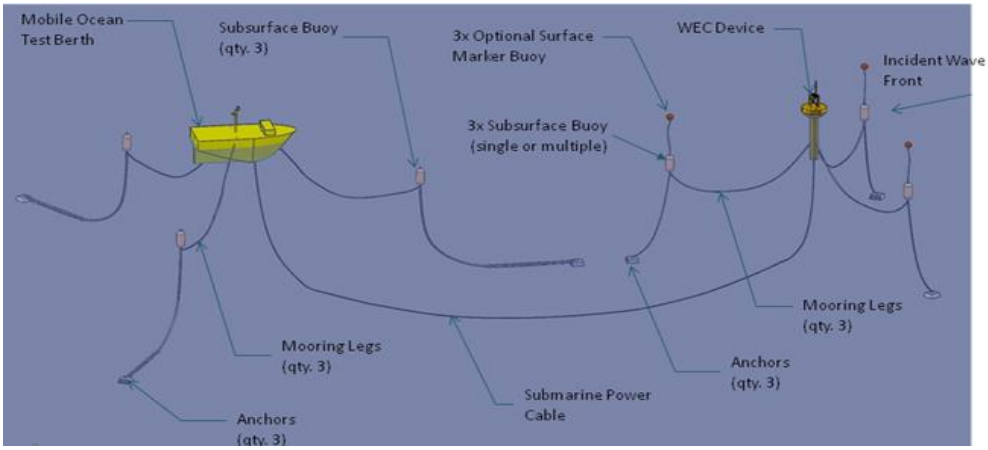


Figure 1.1: MOTB Mooring Schematic



Phase II – Grid-Connected Ocean Test Berth (GCOTB) – The GCOTB is designed to allow ocean testing at a fixed location with a connection to the electric utility grid via a subsea cable. The GCOTB will allow WEC devices to be certified to IEEE and other international standards. The location of the GCOTB is assumed to be the same as the MOTB, but additional customer surveys and discussions may result in a different location. The GCOTB will consist of up to five berths to allow the concurrent testing and demonstration of different technologies. The GCOTB will be

located in proximity to minimize infrastructure costs, but may be sited in different water depths to accommodate a wide range of WEC devices. When built out, the test berths will be connected to a single subsea cable via the Central Junction Box (CJB).

3.2 Services

The following services will be available to WEC device developers as a result of the development of the MOTB:

- Testing and analysis of the client's WEC system using the MOTB at the Test Site, including wave measurement.
- Testing and analysis of the client's WEC system using the PADA and/or ALB at a pre-permitted Client Site within 100 nautical miles of Newport, OR.
- Lease or sale of the PADA and/or ALB to support testing of a WEC or tidal energy device at a site not able to be serviced by NNMREC.

Additional testing services available through the NNMREC include:

- Analysis of WEC device output and device efficiency;
- Assessment of wave resources;
- Modeling and simulations of WEC device and/or array;
- Assessment of potential environmental effects;
- In situ measurement of wave attenuation;
- Device and array optimization; and
- Licensing and Permitting assistance for test devices.

3.3 MOTB Technical Specifications

The following specifications will be developed to support the development, siting, and permitting of the MOTB:

- Power Analysis/Data Acquisition System (PADA)
- Adjustable Load Bank (ALB)
- Central Junction Box (CJB)
- Mooring Systems for MOTB
- MOTB Site
- Client's WEC

Future Specifications for GCOTB

- Subsea cabling for GCOTB
- Grid interconnection for GCOTB
- GCOTB Site (Location TBD)
- Client's WEC

3.4 Guidance Documents

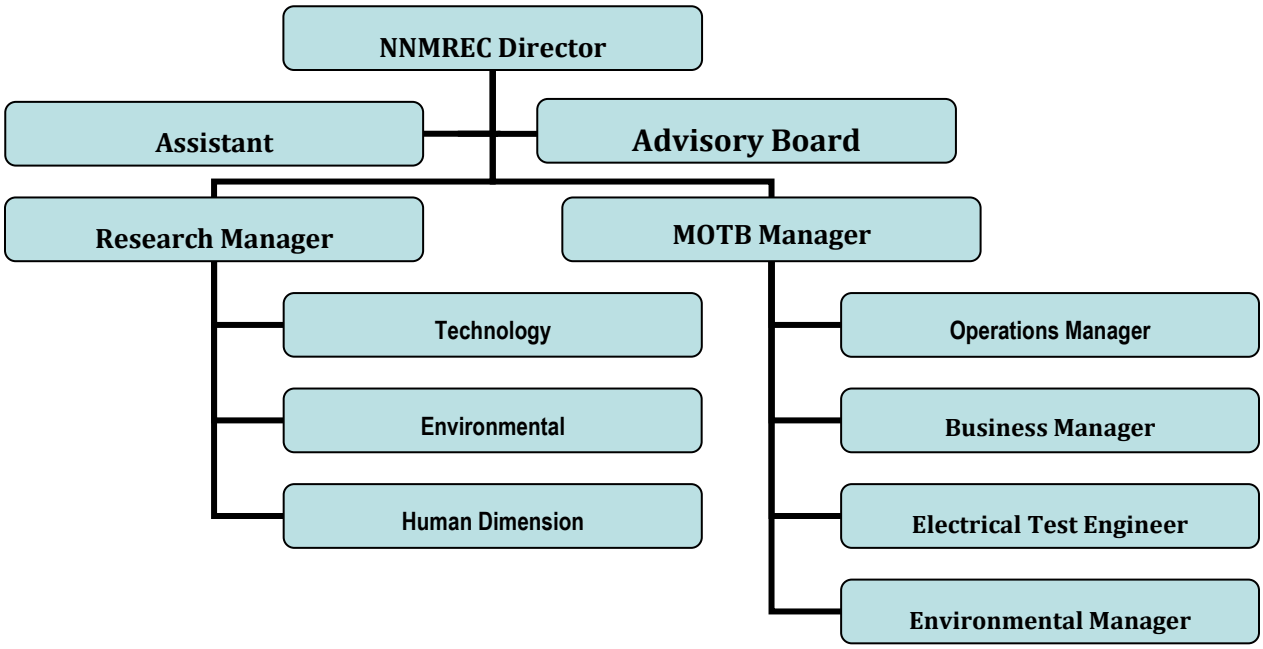
The following Guidance Documents will be developed to define and streamline processes for developers to support the deployment of WEC devices at the MOTB:

- Pathway to MOTB – this document will describe the phases that a WEC developer must progress through from concept to full scale testing at the OTB.
- Pathway through MOTB – this document will describe what a developer should expect as they work with NNMREC to complete the testing of the WEC device at the MOTB.
- Device Permitting – this document will provide the client a roadmap to permitting their device for deployment at the OTB.
- Systems Integration – this document will describe the technical interface between the PADA, ALB, and CJB with the client's WEC device
- Operations – this document will describe NNMREC and the client's respective responsibilities during operation and testing of the OTB.

3.5 MOTB Management

It is anticipated that the MOTB will be managed by OSU and possibly an outside partner, such as NREL to support the testing standardization. A proposed organizational structure for the MOTB management is presented below.

Figure 2. Organizational Plan



NNMREC Director – Overall management and strategic direction of NNMREC as a national testing facility.

Advisory Board – Panel of experts in a range of marine services, including marine deployment, business management, financing, standards implementation, marine ecology, marketing, economic development, port facilities, etc.

MOTB Manager – Responsible for the managing the finances, contracts, human resources, insurance, external relations, etc.; day-to-day operation and maintenance of the MOTB.

Research Manager – Responsible for coordinating research associated with the MOTB both for NNMREC-driven and client-driven projects. This would include ongoing monitoring associated with permitting.

Operations Manager – Responsible for safety, deployment and recovery, MOTB maintenance, and general testing protocols.

Business Manager – Responsible for accreditation, marketing, insurance and bonding, and WEC contracts.

Senior Test Engineer – Responsible for electrical issues, technical support, data acquisition and management, MOTB controls management, and electrical testing protocols.

Environmental Manager – Responsible for permitting, environmental monitoring, and reporting.

Section 4 Industry Outlook

4.1 Market Survey

OSU, through its Close to the Customer Project (C2C) conducted a market research study designed to gather input from wave energy developers. The goal of this project was to uncover the needs and interests of wave energy developers regarding the logistics and technical requirements of testing WEC devices on the Oregon coast. This research was co-funded by the Oregon Wave Energy Trust (OWET). C2C developed a qualified list of 51 WEC developers, of which 24 responded to the e-mail survey. A brief summary of the results is shown below:

- Stage of Development of Respondents:
  - Numerical modeling – 26%
  - Ready for first tank or ocean test – 36%
  - Completed some testing and are developing new device – 36%
- 57% indicated they would be ready for ocean testing in 1-2 years.
- 75% indicated that they already have a test facility in mind.
- 7 companies responded that they were at least somewhat inclined to use the facility. Of the 7, 2 responded that they would definitely test their WEC at the MOTB.
- A wide range of WEC mooring systems and electrical requirements was described.

4.2 Additional Survey Work

Based on the initial survey conducted and the rapidly advancing state of the industry an additional survey is required to quantify the demand of the industry and secure one or more WEC developers as clients of the MOTB.

Oral Interviews – Additional discussions will be conducted with the 7 developers that expressed that they would at least be somewhat inclined to test at the MOTB. The purpose of these interviews is to confirm their interest level and to validate the specification for the MOTB and GCOTB if possible. The specification will be transmitted in advance of the interview, so the client can review them with their appropriate staff and consultants. The objective of these interviews is to 1.) define specifications for the most likely users of the test berth and 2.) secure a commitment for a client to test their WEC device at the MOTB.

Additional Survey - An additional survey process will be conducted with other WEC developers to communicate the MOTB specifications and to reassess their needs and interests relative to a more detailed and expanded offering. This survey will assess the interest of the tidal energy community as well as those WEC developers that may be interested in leasing or buying a PADA or ALB system for use at their site.

4.3 Device Timeframes

Discussion with the potential clients of the MOTB will help determine when the MOTB and GCOTB will need to be deployed to meet their requirements. At this time, NNMREC's first customer will be Columbia Power Technologies (CPT). CPT's full-scale device will be completed and ready for test in April 2012 which sets the completion schedule for the first MOTB. *This section will be updated upon the completion of the oral interviews.*

4.4 Technical Needs for Testing

The College of Engineering at OSU has conducted an initial list of technical requirements based on their experiences. However, more technical details will need to be developed based on the specific needs of each technology. *This section will be updated upon the completion of the oral interviews.*

Section 5 SWOT Analysis

5.1 SWOT Analysis

Strengths: Aspects of OSU, NNMREC, and the selected site that will *enhance* the value of the MOTB include:	**Weaknesses: Aspects of OSU, NNMREC, and the selected site that will *detract* from the value of the OTB include:**
▪ Well documented site conditions; ▪ Ocean testing without costly grid connections; ▪ Adjustable loading for device characterization; ▪ Independent device feasibility studies for developers at a site of interest; ▪ Uniform testing standards for WEC devices. ▪ First planned ocean testing center in the US; ▪ Proximity to a number of planned wave energy development projects; ▪ OSU's broad engineering and environmental sciences skill base; ▪ Proximity to the resources of the Hatfield Marine Science Center; ▪ All weather access to Yaquina Bay;	▪ Perceived complexities of working with OSU (public university); ▪ Perceived challenges of intellectual property ownership when working with OSU; ▪ Logistical difficulties – no rail access and limitations on oversized trucks; ▪ Limited marine construction infrastructure; ▪ Energetic wave climate – may not be optimal for testing sub-scale WECs; ▪ Limited weather window to conduct installation, maintenance, and removal operations; ▪ Valuable fisheries (e.g., – Salmon and Dungeness Crab) may limit choice of Test Site;

▪ Energetic wave climate - ideal conditions for testing large scale WECs; ▪ Cooperation of the Fishermen Involved in Natural Energy (FINE); ▪ Proximity to transmission access (less than 1 mile from beach); ▪ Opportunity to site projects on both sandy and hard bottom; ▪ Recommended by DOE for testing emerging technologies – will funnel DOE funded efforts toward MOTB; ▪ Reasonable barge access from Astoria and the Columbia River; ▪ Proximity to major International airport (less than 2 hours by car);	▪ Complexities of permitting the MOTB and the WEC device; and ▪ May attract a large volume of inquiries because it has been recommended by DOE for emerging technologies
Opportunities: Potential for collaboration efforts with the following organizations and as further detailed in Section 8:	**Threats/Mitigation: Potential of threats to derail progress and mitigation efforts to ensure success.**
▪ European Marine Energy Centre - WaveHub ▪ Pacific Gas and Electric – Wave Connect; ▪ Pacific Northwest National Lab; ▪ Sandia National Lab; ▪ National Renewable Energy Lab; ▪ Oregon Business Development Department; ▪ Oregon Department of Energy; ▪ Oregon Wave Energy Trust; ▪ Oregon Coastal Caucus; ▪ Hawaii National Renewable Energy Center; Other opportunities to enhance value of MOTB: ▪ Collaborate with WEC device developers, such as Ocean Power Technologies to develop the central junction box;	▪ *Threat -* Incomplete funding required to fully construct and operate may hinder some companies from committing to use MOTB. *Mitigation –* Hire an appropriations lobbyist to ensure the continuation or increase in funding for USDOE and other agencies. ▪ *Threat -* Ongoing Territorial Sea Plan amendments and Oregon Marine Spatial Planning efforts may deter WEC developers from locating a first project in OR. ▪ *Mitigation –* Work with Governor's office and State Legislature to make sure that State supports early stage demonstration as well as the responsible development of commercial projects. Emphasize how the MOTB will play a critical role in this transition.

▪ Evaluate the sale or leasing of the PADA and ALB to the tidal, in-stream current, and ocean current energy industries; and ▪ Develop a test protocol that is endorsed by DOE that will be used as the standard for testing new devices. ▪ Develop marine energy testing consortium to increase standardization of processes and procedures, jointly solve problems and possible share resources.	▪ *Threat -* Lack of interest in the site because it is not located near the companies development center ▪ *Mitigation –* Work with Port of Newport, OWET Economic Development, etc. to bring in capacity for servicing marine renewable industry. This will be beneficial to the NOAA fleet as well.

Section 6 Marketing Plan

6.1 International and National Marketing Analysis

NNMREC will conduct additional analysis based on the C2C survey results identified above in Section 4. This section will categorize and prioritize potential customers based on results from the survey.

6.2 Customer List and Potential Usage

NNMREC will conduct additional analysis based on the C2C survey results identified above in Section 4. This section will categorize and prioritize potential customers based on results from the survey.

6.3 Marketing Plan

NNMREC will market the services of the MOTB to industry members in various forms:

Website - NNMREC will focus on the use of web based communications to keep customers and stakeholders informed on the progress of the MOTB and to allow them to access relevant information.

Characteristics of the website will include:

- Public content to allow all users to understand the mission and characteristics of the MOTB,
- Password access to allow customers, potential customers, or various stakeholders to access relevant information (may want to consider using MS Sharepoint to manage multi-user access to various content),
- Subscriber database to manage email and RSS communications.

Website content should include:

- List of MOTB Services

- List of Supporting Services
- Guidance Documents
- Technical Specifications
- Deployment Schedules
- IP Strategy

Website should contain links to other MHK efforts, including:

- Other test centers – EMEC, HI, etc.
- USDOE
- OWET
- MHK KnowldegeBase (www.advancedH20power.com)
- OREC
- OREG
- Other University efforts,
- National Lab efforts

Industry Conferences – NNMREC should present at major industry conferences from 2 to 4 times per year in the US and 1-2 times per year internationally in order to position the MOTB as the premier US test facility.

Technology Recruitment – Continue outreach with national and international technology providers to gain better understanding of needs and interests.

6.4 Coordination with European Partners

NNMREC has formal engaged with EMEC to provide advisory services to assist with the development of the MOTB. In addition, NNMREC will continue to develop relationships with other entities such as NaREC and WaveHub to further coordinate with European Centers.

6.5 Marketing Budget

NNMREC is in the process of developing a comprehensive budget required to successfully attract and recruit technology providers to utilize the MOTB.

This section needs further development.

Section 7 IP Issues

OSU's continuing wave energy technology research will be multi-faceted, including partnering with developers in a supporting/research role to assist in the development of full-scale (utility-scale) wave energy devices. As device power levels approach utility-scale, it is no longer appropriate (or safe) for graduate students to be leading these efforts as part of their M.S. or

Ph.D. thesis research. Therefore, OSU's technology development will *focus* on the 10W – 10kW range. Under OSU policies, title to inventions and discoveries conceived by university employees under a sponsored project is retained by the university.

For research efforts that are contracted through private funds (e.g., by an industry or private foundation), that funding entity has "first right to negotiate" a license. Federally funded research is governed by appropriate federal regulations regarding data rights and patent rights. Intellectual property developed through research sponsored by nonprofit organizations is evaluated by OSU's Office of Technology Transfer (OTT) to determine the best method of commercialization. This could include patent/copyright protection, licensing, and distribution through publications and conferences. **The primary objective of the OTT is to maximize the public benefit of all research results.**

7.1 Existing and Internal Patent Analysis

NNMREC will evaluate all existing patents relative to the PADA, ALB, and CJB and will prepare a patent strategy to build defensibility around the design of these system components. Careful attention will be paid to the CJB, as industry has initiated development of a similar device. Any competitive patents will be evaluated and licensed as required and appropriate.

7.2 Internal IP Strategy

NNMREC will develop a strategy to expand and protect its intellectual property to allow for the sale or licensing of the technology to other marine renewable sectors.

This section needs further development.

7.3 External IP Strategy

NNMREC will develop a strategy to protect its clients intellectual property during testing of devices.

This section needs further development.

7.4 License Strategy

NNMREC will develop a comprehensive strategy to sell or license the resulting IP to the tidal, in-stream hydro, or ocean current energy sector. This analysis will include evaluation of the IP and a capture strategy.

Section 8 Collaborations

8.1 Test sites

The following collaborative efforts will be explored:

European Marine Energy Center – Develop a collaborative relationship with EMEC to leverage their approach to working efficiently with WEC developers;

EMEC offers the following services that may be able to be offered at NNMREC and potentially through the MOTB.

1. Assessment of Performance of Wave Energy Conversion Systems
2. Assessment of Wave Energy Resource
3. Guidelines for Health and Safety in the Marine Energy Industry
4. Guidelines for Marine Energy Certification Schemes
5. Guidelines for Design Basis of Marine Energy Conversion Systems
6. Guidelines for Reliability, Maintainability and Survivability of Marine Energy Conversion Systems
7. Guidelines for Grid Connection of Marine Energy Conversion Systems
8. Tank Testing of Wave Energy Conversion Systems
9. Guidelines for Project Development in the Marine Energy Industry
10. Guidelines for Environmental Appraisal in the Marine Energy Industry
11. Guidelines for Manufacturing, Assembly and Testing of Marine Energy Conversion Systems

Hawaii National Marine Renewable Energy Center - Further explore ways to collaborate with the HNMREC;

US Department of Energy - Develop a test protocol that is endorsed by DOE that will be used as the standard for testing new devices;

Pacific Gas and Electric - explore a cooperative relationship with PG&E to leverage their efforts to deploy test arrays of WECs;

8.2 Universities

Identify other university locations and potential collaborations. Identify links and differences in services offered.

- Wave (University of Edinburgh)
- Tidal (University of Washington)
- In-Stream(University of Washington)
- Ocean Current (Florida Atlantic University)
- Ocean Thermal Energy Conversion (OTEC), (University of Hawaii, Manoa)

8.3 National Labs

The US Department of Energy announced on July 31st the funding for four national labs to support the emerging marine and hydrokinetic industry. NNMREC will work with each of these labs to understand their program, to leverage their efforts, and to avoid duplication of work.

The two projects with a technical focus include:

National Renewable Energy Laboratory (Golden, Colorado), and fourteen partners, including universities, private industry, and three other DOE national laboratories; will develop essential tools and methods for the engineering, design, and testing of marine and hydrokinetic devices. Research will be performed in the areas of mechanical engineering and machine performance; testing hydrodynamics and sediments; development and testing of advanced materials; and system simulation and visualization.

Sandia National Laboratories (Albuquerque, New Mexico), along with partners from universities and other national laboratories, will evaluate hydrokinetic device designs and performance, develop hydrodynamic theoretical and numerical models to create design codes for use by industry; and conduct basic research in materials, coatings, adhesives, and manufacturing to increase the reliability and cost-effectiveness of marine and hydrokinetic devices.

The two projects with an environmental focus include:

Pacific Northwest National Laboratory (Sequim, Washington), in partnership with universities, private industry, and other National laboratories, will identify, analyze, and predict environmental impacts from marine and hydrokinetic energy production. After prioritizing risks, PNNL will conduct experiments and field trials to investigate high priority environmental impacts to reduce uncertainty, and to gain insight into cumulative impacts of multiple stressors from devices and arrays.

Sandia National Laboratories (Albuquerque, New Mexico), in partnership with two universities and two other national laboratories, will identify and quantify the magnitude of changes in key environmental conditions and processes caused by marine and hydrokinetic technologies, including changes in water quality, sediment transport, water flow, and acoustic impacts. Sandia will link these changes to general and specific biological responses in order to determine the nature and magnitude of environmental impacts and assist industry in both the siting of projects and the development of monitoring and mitigation strategies.

8.4 State of Oregon

The State of Oregon has already made a significant investment in wave energy through the Oregon Wave Energy Trust (OWET) and ongoing work to amend the Territorial Sea Plan and to initiate Marine Spatial Planning. In order to leverage the State's interest in promoting Oregon as the leader in wave energy development, NNMREC will coordinate with the following agencies and organizations:

Oregon Wave Energy Trust (OWET) - Coordinate with OWET to evaluate funding strategies and regulatory options to encourage WEC developers to use the OTB;

Oregon Business Development Department (OBDD) - Work with the OBDD to explore ways to provide financial incentives to attract WEC devices to Oregon;

Oregon Department of Energy (ODOE) - Engage with ODOE to evaluate a streamlined approach for WEC developers to obtain a Business Energy Tax Credit (BETC) certification.

Coastal Caucus – Meet regularly with the appropriate State legislators to continue to gain their support for the MOTB.

Section 9 Supporting Services

In addition to the services offered as part of the MOTB, NNMREC will provide other services to help wave and tidal energy technology developers, including, but not limited to;

In-Situ Wave Sensing Devices deployed in the test berths will be monitored for their interaction with the wave field by the OSU Marine Radar Wave Imaging System and by in-situ wave sensors. The mobile radar system will be installed on the vessel that regularly services the test berth and will provide a synoptic view of the ocean surface wave field over a circular area of diameter 2-4 km. Wave crests are tracked within the radar images and analysis of image sequences enables us to measure the wave spectrum at the site using the methods of Borge et al. (1999) and Dankert and Rosenthal (2004). In addition, since these observations are synoptic and phase-resolving, constructive and destructive wave interference patterns will also be imaged. These data will be used to validate modeling efforts as well as to provide information to third-party users of the test berth regarding the motion of their WEC device, as well as the degree of wave attenuation induced by the WEC. In addition, the in-situ wave sensors (AWAC & Waverider buoy) will be regularly deployed at the test berth—one seaward and one shoreward of the berth. The group of remote and in-situ sensors will be an integral part of the test berth.

Device and Array Optimization – The work proposed at NNMREC focuses on developing and validating modeling tools and integrated them into a model system that can be used to predict the coupled behavior of an array of WEC devices, their electromechanical properties and the surrounding wave motion. A detailed fluid-structure interaction study will guide the development of representations of the WEC devices for use in the near shore area wave model; it can also be used to assess the potential shoreline impact of the devices). Electromechanical modeling will be developed simultaneously and integrated with the hydrodynamic modeling.

Environmental Compatibility - The environmental work at NNMREC will fall into two general areas. First, the NNMREC will develop an environmental effects information center to collect and provide access to research and regulations on wave energy conducted worldwide. Workshop participants recommended that timely and easy access to this information would encourage using limited resources on site-specific studies and help to streamline the permitting process.

NNMREC will develop digital collections and provide access to both virtual and physical resources.

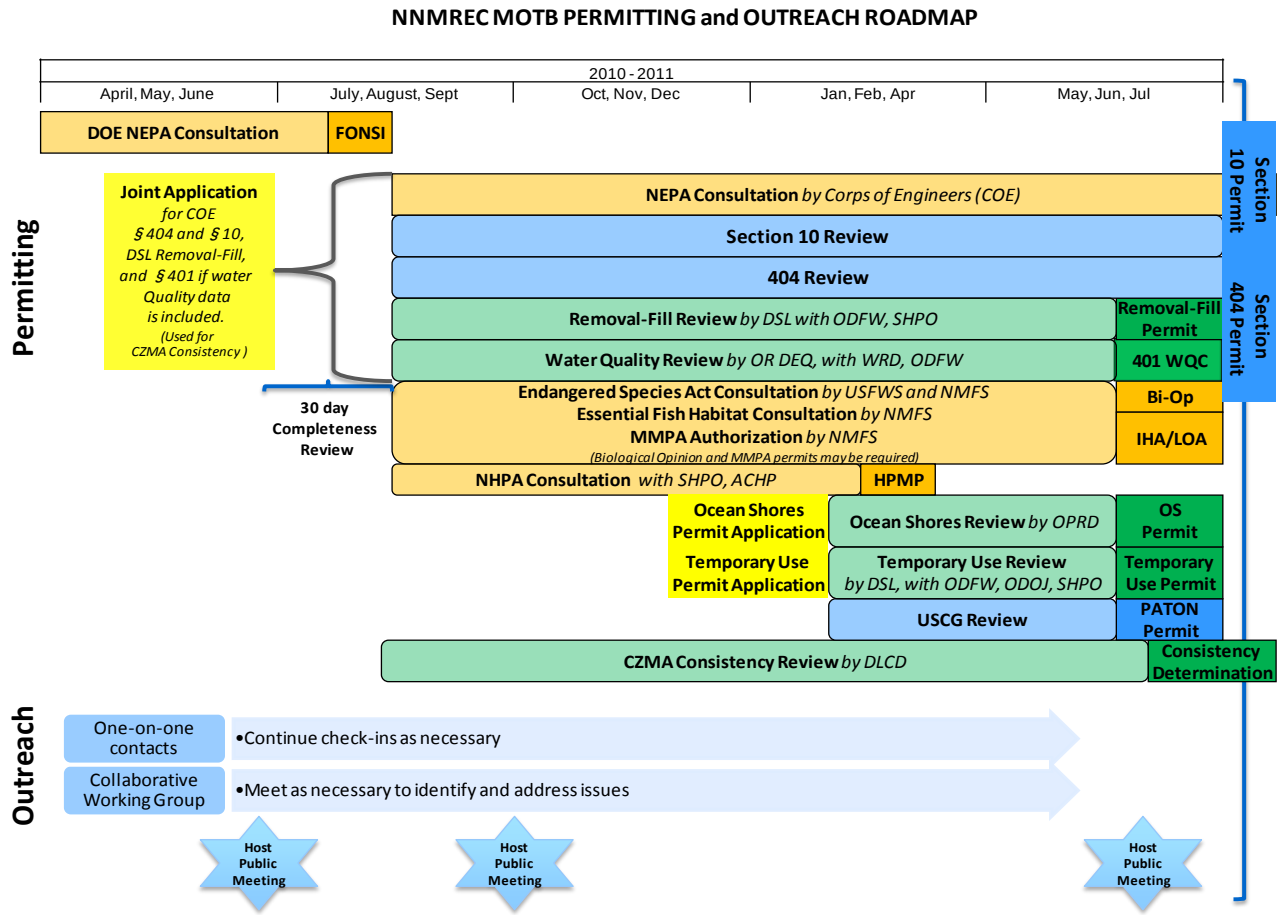
Reliability and Survivability - WEC devices must operate reliably and efficiently to be economically viable. The ocean environment is challenging for mechanical and electrical systems. WEC devices must survive high sea states. Marine bio-fouling can greatly reduce efficiency. WEC device survivability can be assured through several different strategies, including slack mooring, mechanical lockup, underwater immersion or reverse powered operation, depending on the specific device and the expected sea state. NNMREC will provide services for a developer to assess and evaluate the best approach for assuring reliability and survivability.

Section 10 Siting and Licensing Strategy

The licensing strategy includes seeking a Nationwide Permit from US Army Corp of Engineers (ACOE). The ACOE has development section '5. Scientific Measurement Devices' as an alternative to completing a 'Section 10' and Section '404' permit. A '5. Scientific Measurement Device is defined as 'Devices, whose purpose is to measure and record scientific data, such as staff gages, tide gages, water recording devices, water quality testing and improvement devices, and similar structures. Small weirs and flumes constructed primarily to record water quantity and velocity are also authorized provided the discharge is limited to 25 cubic yards. (Sections 10 and 404). In addition to the ACOE process, the MOTB will require NEPA analysis as determined by the US Department of Energy. As of July 1, 2010, the DOE NEPA analysis process was underway to be completed by the year's end.

Figure 3. ACOE Permitting Roadmap

The following graphic details the complete permitting process for a non-grid wave energy facility. Although it is not assumed that this process will be required for the MOTB, it is used here as a reference if a Section 5 exemption does not apply.



Section 11 Funding Strategies

NNMREC's current funding source leverages both state and federal resources. Funds to design and deploy the MOTB also include state and federal dollars. Future sources of funding include, but are not limited to the following:

- Federal Funding (Agency and Direct Appropriations)
- State Funding (Agency and Direct Appropriations)
- User Leases

This section needs further development with specific strategies developed.

Section 12 Considerations for Grid Connected Facility

As described in this plan, NNMREC intends to construct a full scale, grid connected test facility. In addition, to securing funding for such an endeavor, continued market research and analysis will need to be completed before funds are committed to its development. Some considerations to move forward with a grid connected facility include, but are not limited to the following:

- Success of the MOTB
- Secured Funding
- Federal Leadership and Direction
- Technology Acceleration and Market Demand

This section needs further development with specific strategies developed.

Section 13 Schedule

NNMREC intends to deploy the first MOTB in 2011. The following table below depicts the current schedule that includes a grid connected test facility.

Figure 4. Schedule for Deployment Roadmap (Estimated)

PHASE	2009	2010	2011	2012	2013
I. One Mobile Test Berth	**$3 M - OR Legislature**				
II. Up to four more Mobile Test Berths			**$0.5 M – FY09 Federal** **$15 Unfunded**		
III. Central Junction Box		**$1 M – FY09 Federal**			
IV. Grid-connected Test Berth (incl. subsea cable to shore, substation interconnect, land-based facilities at HMSC for data analysis, communications and control)			**$20 M Unfunded**		
V. Demonstration Site (generating up to 5 MW)				**$10 M Unfunded**	