



New England Marine Energy Development System NEMEDS

INTRODUCTION

The New England Marine Energy Development System (NEMEDS) is a series of test sites aiming to satisfy the requirements of Technology Readiness Levels (TRLs) for commercializing Marine Hydrokinetic (MHK) devices. The challenges of operating in the ocean environment are daunting and, for this reason, the Department of Energy has adopted TRL's to encourage progressive development through stages of increasing complexity and environmental severity. NEMEDS integrates test capabilities of university and commercial tanks and flumes with additional test sites being developed by the Marine Renewable Energy Collaborative (MRECo), Inc. and its partners to create a complete development environment. The goal of NEMEDS is to develop a consistent set of standards and protocols to provide device developers and researchers with a predictable and cost-effective testing environment, lowering risk and encouraging new technology commercialization.

BACKGROUND

The MHK industry has the potential of providing predictable and reliable power to the United States, electrical grids around the world, and many off grid communities, but the challenges are significant. Several years ago a panel of MHK company CEOs estimated that it would take 10 years and \$80 million to bring a MHK device to market. Given the challenges of operating in the ocean, a major cost of development is testing, and early estimates suggested that permitting was 70% of the cost of a demonstration. Clearly, the cost and risks of commercialization, particularly in testing, represent huge barriers to entry in the market. However, given the current costs of these devices, new technologies are needed to achieve commercial viability. A test environment that would allow standard test protocols at all TRL levels would address this problem by lowering cost and risk. This environment is provided by NEMEDS.

MRECo, formerly the University of Massachusetts Marine Renewable Center (MREC) is a nonprofit corporation that is addressing MHK testing needs by developing NEMEDS. Where

Links to topics:

- **CURRENT/IN STREAM TESTING**
 - **TRL I-III Various University Sites**
 - **TRL IV-V S.O. Conte Anadromous Fish Laboratory (CAFRL), USGS**
 - **TRL VI-VII Bourne Tidal Test Site: A Tidal Energy and Remote Sensor Testing Facility**
 - **TRL VI-VII Muskeget Channel Tidal Test Site**
- **WAVE ENERGY CONVERSION TESTING**
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capabilities exist, such as at TRL I-IV, MRECo works with universities, government labs and commercial entities to share best practices and establish standards. If no capability exists, MRECo is satisfying the needs by developing new test sites. To date, most developers in the region have focused on current driven (aka in-stream or tidal) devices and MRECo's efforts have been primarily in this segment. Where needed, MRECo has worked with wave device developers to find test facilities for these devices. The following descriptions address the needs of testing for current devices.

CURRENT/IN STREAM TESTING

TRL I-III Various University Sites

The New England region has a rich academic and entrepreneurial environment. Tow tanks and small flumes are available at the Universities of New Hampshire, Rhode Island, and Maine, as well as MIT and Brown, among others. MRECo and associated universities have worked with over 20 MHK companies and have significant experience in addressing specific component testing needs. However, the challenge of going from component and small scale testing in a lab to the ocean environment require capabilities that the developers do not have. MRECo will connect developers with these facilities and provide technical support where needed.

TRL IV-V S.O. Conte Anadromous Fish Laboratory (CAFRL), USGS

CARFL is dedicated to fish passage studies and has one of the largest flumes in the United States to support research. The 39 m long open channel facility has a depth of 5 meters, with two 3 meter wide and one 6 meter wide flumes. The facility has a maximum flow of 350 cfs allowing flumes to be configured to support velocities of over 2 m/s. The facility has fish breeding tanks, and a range of telemetry and video capability. It has been used for tidal turbine studies, but each test required extensive setup by the tester. MRECo has worked with CARFL to develop a standardized test protocol to lower test costs and provide a consistent evaluation baseline. In 2012 MRECo secured funding to study the tidal testing capability at CARFL, make recommendations on equipment needs, and purchase additional instrumentation. In 2015 MRECo implemented an agreement with CARFL to allow MRECo to manage tidal testing at the facility. A two week, \$31,000 standard mechanical test protocol is being developed with options for biological testing such as fish passage/strike or micro zooplankton impact, and array studies. Testing is expected to begin in 2018.





TRL VI-VII Bourne Tidal Test Site: A Tidal Energy and Remote Sensor Testing Facility

The Cape Cod Canal has water velocities of over 2 m/s making it attractive for tidal development. However, there is limited opportunity for a large-scale due to the potential impacts on its primary use as a navigation channel. Fortunately, there is a location where a railroad bridge caisson creates a natural flume which has the high velocities required for tidal testing and is out of the navigation channel. This site has been used three times for small demonstration projects. The site is controlled by the US Army Corps of Engineers (USACE), is close enough to the shoreline to allow work to be conducted by crane rather than by barge, and it has a secured building suitable for power electronics and instrumentation.



MRECo has received funding from the Massachusetts Seaport Council to design, construct, install and operate a test platform at the site which will be made available to device developers and sensor manufacturers for in situ testing in the ocean environment. USACE supports the concept of this work and is working with MRECo for permitting.

MRECo has surveyed the site using state of the art ADCP technology along with data processing software that profiles the water velocity through two typical tidal cycles. In addition, the site has been surveyed using sophisticated cameras to characterize the sea bed for sediment composition and for biological diversity, all to satisfy environmental permitting requirements.

The standard protocol envisioned for this site is a three month test.





This site can support testing of axial turbines up to 3 meters in diameter and testing of other conversion technologies.

Remote Sensor Testing on BTTS

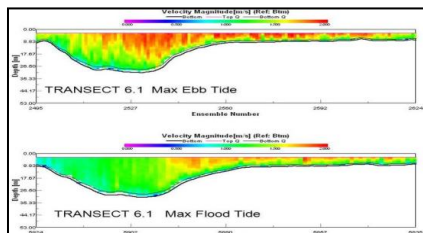
Use of the BTTS for other types of sensors is possible. For instance a company or organization may wish to install a remote oceanographic, meteorological, environmental sensor (s) to test longevity, or data transmission for calibration purposes.

TRL VI-VII Muskeget Channel Tidal Test Site

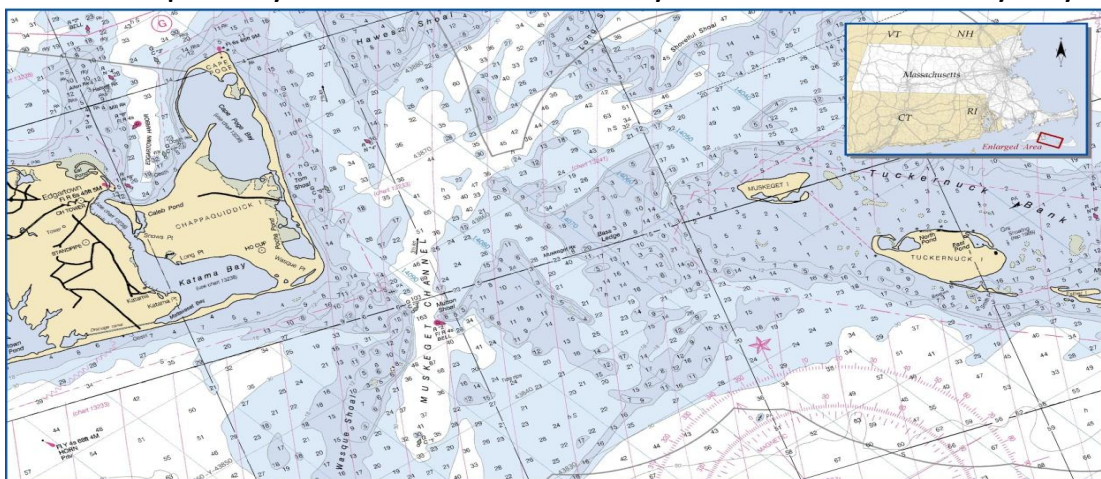
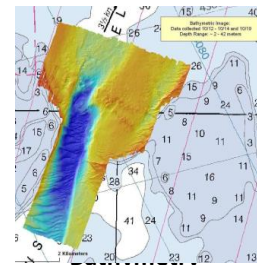
The Town of Edgartown has pursued developing a tidal energy site in the Muskeget Channel between Martha's Vineyard and Nantucket Islands since 2007. MRECo has supported Edgartown by providing resource and environmental studies required by the FERC application process. In return, Edgartown has guaranteed that a berth will be reserved for a tidal energy test site and this has been included as a formal component in all of Edgartown's permit applications. To date over \$2 million have been expended on resource, benthic, sediment, marine mammal and other studies.



Sediment Transport Study



Water Velocity Profile

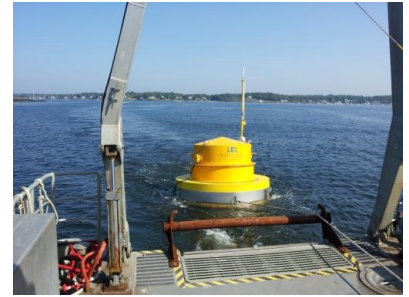


The Muskeget Test Site is usable for a wide range of testing. The site experiences water velocities of over 2.5 m/s and is in 40 meter water depth. Trade studies suggest that a barge would be the most effective form of installation for the site, but bottom mounting is also allowable. If funding is acquired, testing could begin in 2019.



WAVE ENERGY CONVERSION TESTING

MRECo is coordinating WEC test sites in several locations. In New Hampshire, the Open Ocean Aquaculture site off the Isle of Shoals offers a site fully permitted for scientific study with 40 meter depths. The Island of Cuttyhunk is a non grid connected community that is open to shallow water testing and funding for a demonstration there is being sought.



CONCLUSIONS

To be successful, the MHK industry must find newer, more efficient technologies. The key requirement in any new MHK technology is survivability and the TRL system has been applied to avoid the disastrous failures of the past. However, the cost to commercialize new technologies is a barrier that inhibits entrepreneurs from even trying to enter this market. A critical element in this is the cost and uncertainties of testing. MRECo is developing NEMEDS to address this barrier and allow new technologies to advance to market more quickly and at lower costs. ***Give us a call and let's see what we can do to help you advance your particular device. 508-728-5825.***

CONTACT: John Miller, executive director MRECo for details on how your system can be tested at any one of the NEMEDS test facilities. ***508-728-5825. director@mreconewengland.org***