Muskeget Channel Tidal Energy Test Site

UMass Dartmouth Marine Renewable Energy Consortium – MREC

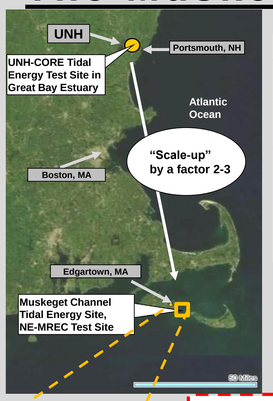
and the

University of New Hampshire Center for Ocean Renewable Energy - CORE

Goal: Provide a permitted, instrumented site at which developers can affordably test hydrokinetic turbines between TRLs 7-9 (DECC stages 4-5).

UNH and UMass Dartmouth are jointly developing a test platform in Massachussets' Muskeget Channel. Extensive environmental research has been conducted and a FERC Draft Pilot License Application has been submitted by the town of Edgartown, MA for a 5 MW commercial tidal energy pilot plant that would include the MREC test site. With funding from MREC, CORE is analyzing several possible test platforms, including floating and bottom-mounted structures for deploying MHK devices, as well as a natural berth option for developers who are ready to put a complete system to the test.

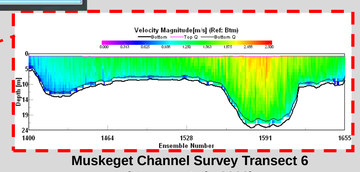
The Muskeget Channel



Site Parameters				
Water Depth	30-43	m	100-143	ft
Maximum Current (Semi-diurnal tides)	2.5	m/s	5	knots
Distance to Grid Connection	Option 1: Via Chappaquiddick			
	5.6	km	3.5	miles
	Option 2: Via Katama			
	8	km	5.0	miles

The Muskeget Test Site is designed to complement the existing UNH General Sullivan Bridge Site, now being upgraded to accommodate turbine sizes up to 3X5 m (10X16 ft).

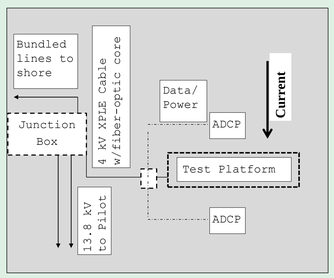
UMASS Bathymetric Survey - Summer 2009 (From Stephen Barrett, HMMH, 2010.)



Muskeget Channel Survey Transect 6 (Howes, et al., 2009)

Thorough oceanographic surveys by UMass Dartmouth, including bathymetry surveys and vessel- and bottom-mounted ADCP studies, have yielded detailed information about the test site.

Natural Berth



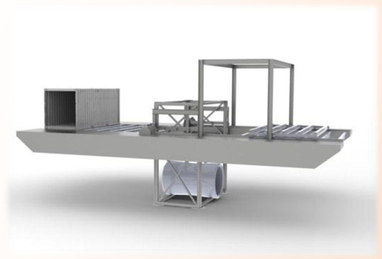
The "Natural Berth" setup would include constant ADCP monitoring of upstream and downstream current conditions and an interface for fully monitored power takeoff, so that developers at the TRL 9 (DECC stage 5) level could install their completely integrated systems on the ocean floor without the cost of cabling or the difficulty of obtaining a permit application.

The Edgartown Tidal Energy Plant project provides an unprecedented opportunity for a test center and a commercial energy endeavor to join forces and share the formidable challenges to building a hydrokinetic energy site. Should both projects proceed, permitting, power electronics and cabling, current monitoring, and other key components of a successful tidal energy venture will be shared in a mutually beneficial relationship that will set the example for the marine renewable energy community.

Test Platform Design Alternatives Analyses

Floating Platform

A floating platform would be similar to the existing General Sullivan Bridge site, at 2-3 times the scale.

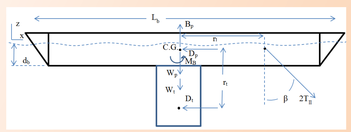


Advantages:
- Turbines would be tested in the high-velocity region near the surface.
- The platform could be towed to harbor for repair, maintenance, and turbine operations, and also in the threat of extreme storms, etc.

Disadvantages:
- The rough seas in the Channel are adverse to a moored surface platform.
- A surface presence is undesirable.

Analysis

Basic design and Analysis of the Floating platform included:
- Tipping Analysis.
- Finite Element Analysis of the complete hull-derrick design
- Preliminary wave loading analysis.



Hydrostatic Analysis for Scaling from GSB Platform

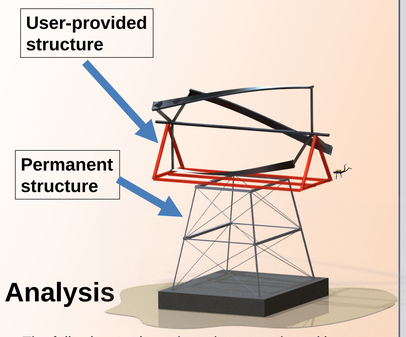
Table 4. Hydrostatics Variables			
r_T	Turbine Hub from Surface	r_i	Distance from CG to Mooring Attachments
β	Bow-down Angle	β	Mooring Line Angle from Vertical
W_p	Platform Weight		
W_t	Turbine Weight	T_i	Tension in a Single Mooring Line
D_p	Platform Drag	B_b	Buoyant Force
D_t	Turbine Drag	D_b	Platform Draft
r_t	Distance from CG to Turbine Drag	L_b	Platform Length (At waterline)
		M_R	Righting Moment

The following will also need to be conducted:
- •Fluid-structure interaction in site-specific wave conditions.
- •Detailed mooring design.
- •Corrosion and biofouling investigation.

Gravity Foundation

Advantages:
The platform would be below most surface traffic, providing 25' (8 m) of clearance.

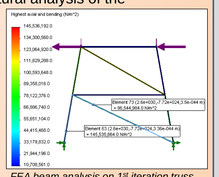
Disadvantages :
- The platform mounting structure must extend at least half the distance to the surface to place turbines in the high-velocity region.
- Maintenance and turbine installation/retrieval would require involved underwater operations.
- Scour would need to be considered.



Analysis

The following analyses have been conducted in investigating the feasibility of the gravity foundation:
- •Tipping analysis for worst-case drag conditions.
- •Sliding analysis, using Coloumb's model of friction.
- •Finite Element structural analysis of the indeterminate truss configuration.

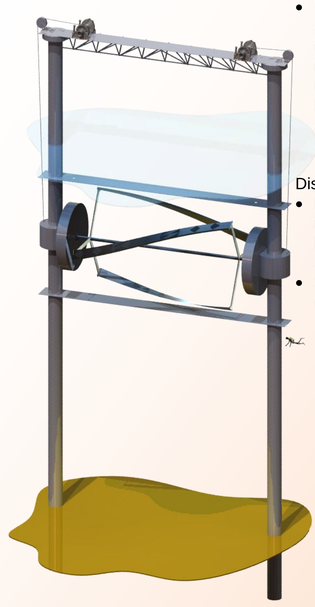
The following will also need to be conducted:
- •Vibration analysis.
- •Scour study.
- •Corrosion and biofouling investigation.



FEA beam analysis on 1st iteration truss design. Rods under compression removed.

Pile Foundation

Two-Pile, Surface-Piercing, Self-raising Platform



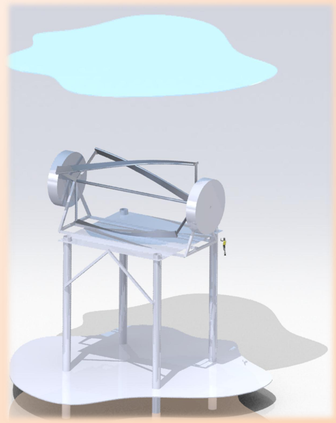
Advantages:
- The platform could greatly reduce turbine installation/ retrieval and maintenance costs by bringing the device to the sea surface for service.

Disadvantages :
- Platform installation would likely be expensive.
- Scour would need to be considered.

Four-Pile Mid-depth Platform

Advantages:
- The platform would be out of the way of most surface traffic.
- A pile group offers greater resistance to lateral loading.

Disadvantages :
- Maintenance and turbine installation/retrieval would require involved underwater operations.
- Scour would need to be considered.



Analysis

The following analyses have been conducted in investigating the feasibility of the gravity foundation:
- •Structural analysis using the simplified assumption of cantilevered beams.
- •Meyerhof's method for soil mechanics of axially loaded piles.
- •Brom's method for soil mechanics of laterally loaded piles.

The following will also need to be conducted:
- •Vibration analysis.
- •Scour study.
- •Corrosion and biofouling investigation.

UMass Dartmouth is currently planning a combined scour and biofouling experiment for the summer of 2011. Those results will further inform this study of the feasibility of a tidal energy test site in the Muskeget Channel.

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