2011 Water Power Peer Review Meeting

Development of a wave-actuated power take-off device for electricity generation

by
Resolute Marine Energy (RME)
Boston, MA

Purpose, Objectives, & Integration

Need improved electric power takeoff solution for point absorber WECs

Fundamental challenges

- Primemover velocity (linear or angular) is very low
- Hence PTO must react very high thrust or torque and generator must achieve a very high voltage/speed constant
- Most point absorbers are single-acting and a PTO restoring force device is required
- Power flow is oscillatory and peak/average is unfavorable

Existing linear direct-drive electric generators are unattractive

- Inefficient material use--only portion of magnets, copper and steel contribute to reaction thrust
- Material use is especially inefficient where a wide tide range must be accommodated
- Inefficient structure--difficult to achieve stiffness required to maintain the air gap
- Difficult to maintain linear bearing lubrication
- Difficult to seal and protect components from sea water corrosion and biofouling

Linear restoring force springs are unattractive

- Difficult to seal from ocean environment
- Difficulty in accommodating wide tide range

The developed PTO will support the program's mission and objectives

- Develop a cost-effective, robust power take off for a unique Resolute Marine Energy WEC
- Assess cost-to-manufacture PTOs at various scales--multi-kW units for early-stage off-grid settings and larger units for grid-connected arrays

Technical Approach

Our PTO employs a mooring tether-driven rotary generator and spring

Solutions to problems posed by linear systems

- Sealed rotary generator with high material utilization
- Tether drive increases generator airgap velocity and voltage 2 - 3 times over that of a linear generator
- Sealed spring maintains tether bias tension over a wide tide range
- High strength mooring tether with anti-fouling features

Key issues being addressed to assure long, unattended service life

- Spring fatigue endurance--Goodman diagram analysis found >10 years
- Protecting generator and spring from sea water infiltraton and maintaining long-life lubrication
- Tether endurance--employ high strength line with anti-biofouling treatment
- Concept development of a companion, seabed power converter with local energy storage to reduce output power peak/average and facilitate efficient power transmission to a shore terminal

Plan, Schedule, & Budget

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

Schedule

- Initiation date: 01/01/11
- Planned completion date: 04/30/12
  - RME requested a 6 months extension. Extension was approved by DOE.
  - No impact on budget
- Milestones FY11
  - Task 1 to 4: completed
  - Task 5, 6, 9: in progress
  - Task 7, 8: not started

Budget

- No variances from planned budget
- So far 27% of the total budget ($258.6K) has been spent

FY2009		FY2010		FY2011	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share