Wave Energy Conversion Buoy

The design, testing, and implementation of a point absorber energy device

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Introduction:

Facilities and Laboratories. Digital image. School of Marine Science and Engineering. University of New Hampshire, 2014. Web. Apr. 2014.

The Wave Energy Conversion Buoy (WECB) is a senior design project for the Undergraduate Research Projects Program for the 2013/2014 school year.
The WECB team's goal is to design construct and implement a point absorber wave energy device, which will generate electrical power from ocean waves. The power expected from the device is 190 watts for waves with an average height of 2 feet at 4 seconds, which are typically seen on the east side of Appledore Island during summer months.

Design:

The point absorber design chosen uses the relative motion between two buoys to drive a generator.

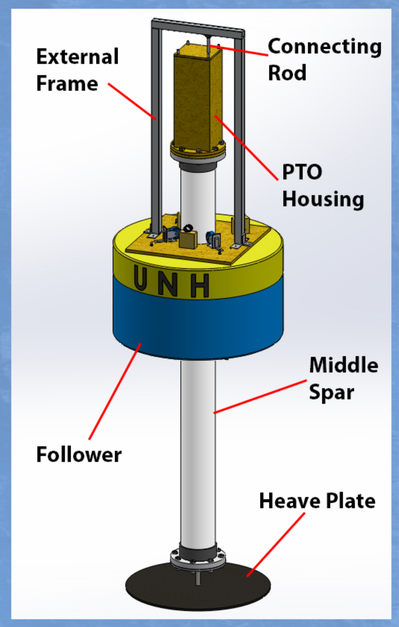
Driving Design Factors:

- Wave Height
- Wave Period
- Theoretical Power

- Middle spar is intended to remain motionless

- Follower oscillates in response to the passing waves.

- Connecting rod feeds into PTO housing from the external frame driving the generator.



The linear motion of the connecting rod is translated into rotational motion by the dual rack and pinion system.

To show proof of concept, an LED lighting array is mounted on top of the external frame and powered by the generator.

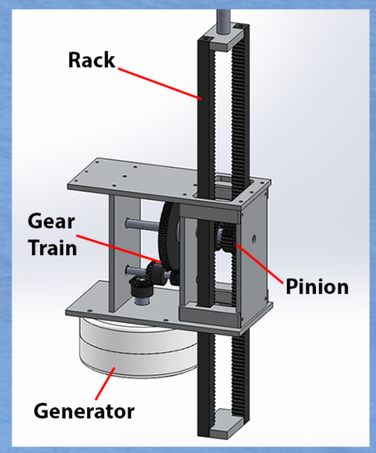
Power Take-off

- Housed on top of spar buoy

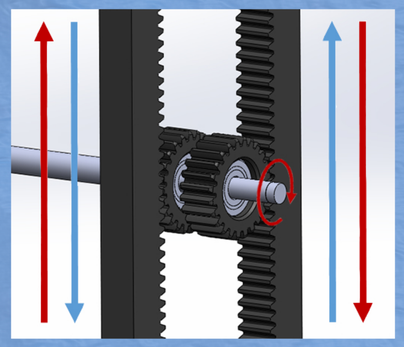
- Gear train converts linear motion to rotational motion

- 300 Watt, 3-phase AC generator, wired through a rectifier circuit

-Two racks and two pinions



Dual Rack and Pinion:



- One-way clutch bearings press-fit into pinion gears allowing generator to always spin in same direction

- On each stroke one pinion drives while the other freewheels, then they switch roles

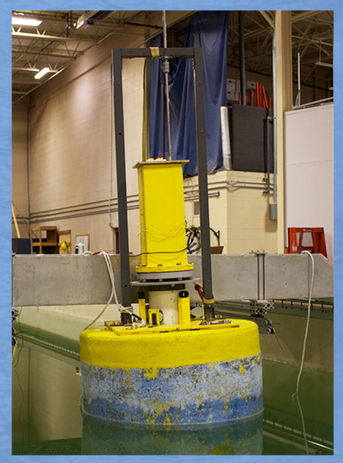
Locked Gear
Free Wheel

Wave Tank Testing:

- Tested in the Wave Tank at the Jere A. Chase Ocean Engineering Laboratory.

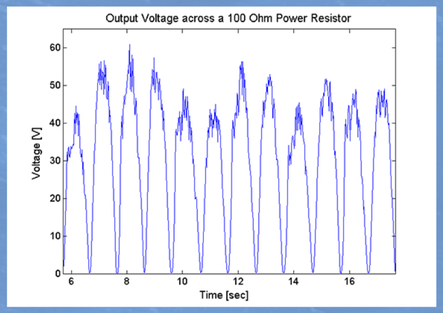
- Tank testing provides a controlled environment to observe the buoy at known wave heights and periods.

- Measured electrical characteristics to obtain power output



Results:

The Voltage produced by the generator was measured across a power resistor as waves moved past the buoy.



Equations:

$$P = \frac{{V_{rms}}^2}{R}$$

$$\eta = \frac{P_{extracted}}{P_{available}}$$

Power Produced from 20 cm. 2 Second Waves

Resistance [Ω]	Power Extracted [Watts]	Efficiency [%]
50	8.2	9.5
100	12.5	14.6
150	11.1	12.9
200	12	13.9
250	11.2	13
300	8.7	10.1

Future Work:

Current Team Goals:

- Complete additional tank testing with various wave conditions

- Deploy the buoy in the ocean to observe its behavior in that setting

"Satellite View Appledore Island." Google Maps. N.p., n.d. Web. Apr. 2014.

Future project teams should consider the following objectives:

- Refinement of the dual rack and pinion system
- Full analysis on the generator
- Fine tuning of buoy components and construction
- Longer ocean deployment

Acknowledgments:

Many thanks to our advisors Professors Rob Swift and Ken Baldwin. Thank you to Jim Irish, for lending us the follower buoy. Thank you to Professor Barry Fussell, Professor Michael Carter, Matthew Rowell, Jason Ebner, Paul Lavoie, Scott Campbell, Tobias Dewhurst, and Bruce Smith for their input on this project. Thank you to the Sea Grant Foundation and the Mechanical Engineering department, whose grants provided the necessary financial support for the project.