Wave Energy for Powering Science
VIMS Industry Partnership Meeting
February 17, 2012
Company Overview

Commenced Operations: 1994
Incorporation: Delaware, USA
Operating Locations: Pennington, NJ, USA and Warwick, UK
Total Employees: 50
Intellectual Property: 61 US patents issued or pending
Cash and Investments: $43.1 million (as of July 31, 2011)
Public Listing: Nasdaq (OPTT)
Utility PowerBuoy and Undersea Substation
Wave Power Station
Type of Technology

Floating Point Absorber

- Wave capture element is small in comparison to the wave
- Two hull approach
  - Smaller, much more dynamic, fast responding hull
  - Large, floating, slow responding hull
  - Differential motion = wave capture mechanism
PB150, 150kW PowerBuoy Installation - Scotland
PB150, 150kW PowerBuoy Installation - Scotland

Deployment Process – April 2011
Undersea Substation Pod

- Unique features – open platform
- An enabler for field development of marine energy devices
- Lowers cost per MW installed
Autonomous PowerBuoys

Technology Readiness

- First autonomous PowerBuoy tested in 2004 off State of Washington under Lockheed contract
- PB40-rated system operated off New Jersey during 2005-2007
  - Withstood Hurricane Wilma
- LEAP PowerBuoy “mission proven” in 2011 in successful integration with US Navy’s radar-based, operational maritime security system
  - Persistent power in all wave conditions, using proprietary power management system
  - Withstood Hurricane Irene
- DWADS PowerBuoy prototype tested in 2010 demonstrating station keeping for US Navy
  - Power generation in autonomous mode to maintain station and provide power to sonar-based maritime security system

Key Customers and Partners to Date

- US Navy
- Lockheed Martin
Autonomous PowerBuoys

- September 2004 Ocean Test deployed off Washington State
- DWADS near shore trials off Elizabeth NJ Nov 2010
- LEAP PowerBuoy, deployed August 2011 to present
Market Opportunities

Applications for Autonomous PowerBuoys

- Homeland security
- Off-shore Oil & Gas platforms
- Ocean-based communications – cell tower platforms
- AUV Charging Stations
- Off-shore “Open Ocean” aquaculture
- Oceanographic data collection
- Desalination
- Warning system for tsunamis, cyclones, typhoons
LEAP PowerBuoy

Littoral Expeditionary Autonomous PowerBuoy

- LEAP program designed to provide persistent wave energy for radar-based, enhanced homeland security and maritime surveillance
- Deployed off New Jersey in August 2011
  - Performed well during Hurricane Irene
- Enabling technology
  - Unique power take-off with on-board storage capability
  - Proprietary power management system
  - Provides constant power in all wave conditions for sea-based vessel detection system
- Technology can be used for other deep-sea applications
Manufacturing Process

- PowerBuoy fabricated by outside vendor
- PowerBuoy's completed by OPT
- Integration and test of completed PowerBuoy and control system ("smart-part") built in New Jersey
- Power take-off and control system
- Buoy fabricated by outside vendor
LEAP on Deck USCGC Juniper
LEAP New Jersey Post Hurricane Irene
PowerBuoy Monitoring and Control

- Software suite allows for full autonomous operations of PowerBuoy

- Operator can monitor and control PowerBuoy state, motions, power performance
  - Windows based control software
  - Human/Machine Interface – HMI
  - Everything from reading minor values through complete software upgrade

- Data stored locally and exported via Wi-Fi, fiber or radio to SQL database on shore
PowerBuoy Monitoring and Control

![State Control Panel](image-url)

- **PTO 0**
  - Cylinder Position: 0.000 m
  - Cylinder Velocity: 0.00 m/s
  - Temperature Motor A: 0.0 °C
  - Temperature Motor B: 0.0 °C
  - Temperature Motor C: 0.0 °C
  - Coolant Temp In: 0.0 °C
  - Coolant Temp Out: 0.0 °C
  - Brake Pump Press: 0.0 Bar
  - Brake Cyl Pressure: 0.0 Bar

**Manual Control**
- Enable Manual Control
- Cooling Pump 1 Enable
- Cooling Pump 2 Enable
- Enable Brake Control
- Disengage Brake

**Primary PTO Selection**
- Manual PTO Select
  - 2 → 1

**OPT OCEAN POWER TECHNOLOGIES**
# LEAP Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
<th>Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>12.75 m</td>
<td>41.9 ft</td>
</tr>
<tr>
<td>Height above waterline</td>
<td>3.42 m</td>
<td>11.3 ft</td>
</tr>
<tr>
<td>Spar diameter</td>
<td>1.07 m</td>
<td>3.6 ft</td>
</tr>
<tr>
<td>Weight</td>
<td>10,000 kg</td>
<td>22,046 lbs</td>
</tr>
<tr>
<td>Mission payload:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>external</td>
<td>0.25m dia. x 0.60m</td>
<td>0.8ft x 1.9ft</td>
</tr>
<tr>
<td>internal, upper</td>
<td>0.25m x 0.35m x 1.60m</td>
<td>0.8ft x 1.1ft x 5.2ft</td>
</tr>
<tr>
<td>internal, lower</td>
<td>0.60m x 0.60m x 1.50m</td>
<td>1.9ft x 1.9ft x 4.9ft</td>
</tr>
</tbody>
</table>
# LEAP Electrical Specifications

**Power – for one meter wave height avg**

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous</td>
<td>300 W</td>
</tr>
<tr>
<td>Peak (1 hour/day)</td>
<td>7.2 kW</td>
</tr>
</tbody>
</table>

**Voltage Ranges**

<table>
<thead>
<tr>
<th>Range</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 – 300</td>
<td>VDC</td>
</tr>
<tr>
<td>100-240</td>
<td>VAC</td>
</tr>
</tbody>
</table>

*Power is variable based on site specific conditions. Values shown are representative offshore NJ coast.*
LEAP Mooring

- Minimum water depth 25 meters
- Shallow water mooring configuration with side bridle
- Deep water configuration with single point connection on bottom of heave plate
- Connection on buoy for subsea power and communications cable
- Mooring can be provided by OPT or customer
LEAP Science Uses – Sensor Networks

- Provides continuous 300W of power today, larger capacity buoys to follow
- Leverages power to increase spatial coverage of cabled sensor networks
- Reduces maintenance costs by eliminating re-fueling trips
LEAP Science Uses – AUV Docking Stations

Providing persistent power for rapid charging, *increasing* vehicle *availability* and time for scientific investigation !!
Vic Chatigny

OPT Business Development

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