

# Department of the Navy Office of Naval Research



## Wave Energy Conversion Renewable Energy Project

### Program Objective

- ❑ The purpose or main objective of this project is to gather operational data, which will be used to validate the technology base required to design and reliably operate an ocean wave PowerBuoy™ from Ocean Power Technologies.
- ❑ This demonstration project will help the Navy validate the potential of using wave energy technology as a reliable source of electrical power for Navy and Marine Corps bases.

### Benefits of Wave Power

- ❑ Provides a portable source of renewable, nonpolluting energy with no noise and limited visual impact.
- ❑ Could provide significant savings to Navy/Marine Corps facilities operational costs.
- ❑ Complies with Presidential Executive Order No. 13123 that emphasizes development of renewable power resources at federal installations.
- ❑ Complements federal energy policy to reduce the nation's dependence on foreign oil.

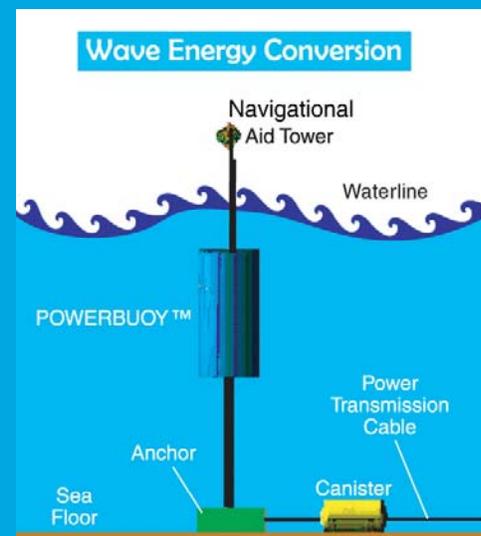
### Background

Congress has provided funding to initiate a wave energy project in Hawaii. The Office of Naval Research is the sponsor and will provide program management.

Ocean Power Technologies, Inc. of New Jersey has developed the wave energy system that will be used in the project. Buoy-like structures will be anchored off the coast of Marine Corps Base Hawaii, in Kaneohe Bay, on the island of Oahu.

The Naval Facilities Engineering Service Center at Port Hueneme, CA, will be managing the project and providing technical oversight as required.

The Pacific Division, Naval Facilities Engineering Command at Pearl Harbor, will manage on-site and environmental requirements for the project.





# Wave energy and the PowerBuoy™

**F**irst, wind is caused by differences in temperature due to the solar heating of the earth's atmosphere. When wind skims over the sea, an interaction is caused in which energy is exchanged between the wind and the sea surface.

At first, little ripples arise on the surface. Then, the wind that skims along these ripples causes higher air pressure more at the front of the wave than at the back. As a result, the ripples change into small waves.

As this process continues, the waves become higher and the distance between the tops of the waves (wave length) becomes longer. The amount of converted energy generated depends on the wind speed, the time the wind blows over the waves, and the distance in which it covers.

Wave energy, then, can be seen as a concentrated form of solar energy. During this process of conversion, energy is concentrated more and more. It may start off as an initial level of sun energy of 100 watts per square meter of ocean, then converts itself to a power level of over 100 kW per meter of wave front (height) at the end of the conversion process. Hawaii has one of the highest annual, mean power of waves per meter of wave front. (See figure below.)

In the area where waves arise, they form an irregular pattern. Waves can also displace themselves with a

minimum loss of energy far beyond their place of origin. During this voyage, they shape into more regular waves, commonly referred to as swells. At ocean shores, the swells are very discernable, even when the sea is calm.

Ocean Power Technologies' PowerBuoy™, which resemble an ocean buoy, efficiently and reliably convert the mechanical energy in ocean waves into electric power for transmission into a region's power grid, for direct use in place, or even for storage in batteries.

An OPT "power plant" will consist of an array of identical, modular PowerBuoys electrically connected to provide the desired electrical power capacity.

OPT's PowerBuoy, submerged more than a meter below the water's surface, converts the mechanical energy generated in an ocean wave into electrical energy. Inside the buoy, a piston-like structure moves as the PowerBuoy bobs with the rise and fall of the waves. This movement pumps hydraulic fluid that drives a generator on the ocean floor, producing electricity, which is sent to shore by an underwater cable.

OPT's power generation system is based on proprietary technologies and innovations including: a patented electronics systems for control and power conversion; a patented wave energy conversion and transfer system; unique generators that function effectively at low and variable speeds; and modularity of construction.

## Wave Energy Around The World

*Hawaii has one of the highest annual, mean power of waves per square meter of wave front. The higher the number, the more potential power the wave generates. In other words, for waves generating in Hawaiian waters, every square meter of wave front has on average some of the highest recorded wave power around the world.*

