

Topic: N142-116

Seatrec, Inc.

Development of Ocean Thermal Energy Harvesting Systems

Seatrec's thermal energy harvesting systems exploit small temperature differences within the ocean to generate electric power. This essentially-infinite environmental power source enables underwater platforms, sensors, and vehicles to transcend the endurance limitations of traditional storage batteries while reducing operations and maintenance costs and enhancing safety and environmental stewardship. Compared to traditional and sometimes hazardous energy storage methods (primary and rechargeable batteries, seawater batteries, fuel cells, and diesel generators) environmental energy sources offer increased endurance and reduced logistical complexity. Thermal energy harvesting can be effective underwater, at night, at high polar latitudes, and in situations where other environmental sources such as wind or solar are unavailable, inappropriate, or tactically undesirable. Phase II laboratory development has demonstrated fundamental proof-of-concept and ongoing research will result in increased power output. Our goal is to engage in early-stage field trials with a defense contractor developing capabilities for persistent underwater monitoring, including underwater sensing, communications and UUV networks.

Technology Category Alignment:

Autonomy

Energy & Power Technologies

Power Generation/Energy Conversion

Maintainability/Sustainability

Unmanned Ground and Sea Vehicles

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SYSKOM: ONR

Contract: N68335-18-C-0176

Department of the Navy SBIR/STTR Transition Program

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WHO

SYSCOM: ONR

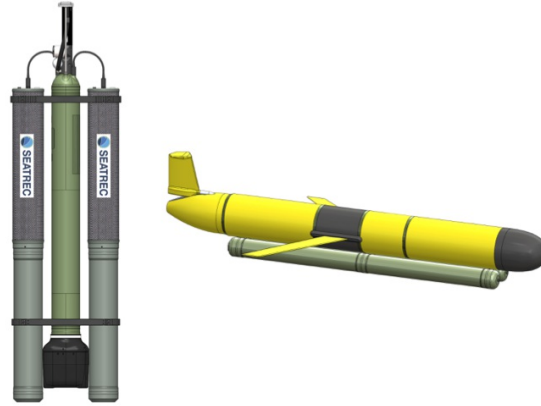
Sponsoring Program: Unmanned Maritime Systems Program Office (PMS 406)

Transition Target: Unmanned Maritime Systems Program Office (PMS 406); Other programs in which UUV endurance and mission flexibility are critical (mine countermeasures; surveillance; anti-submarine warfare)

TPOC:

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Other transition opportunities: PMS 408 (Underwater Explosive Ordnance Disposal); National Oceanic and Atmospheric Administration; U.S. Coast Guard; Oil & Gas Industry; Subsea Telecommunications; Aquaculture



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WHAT

Operational Need and Improvement: Despite continual increases in battery energy density, unmanned underwater vehicle (UUV) design and mission capabilities continue to be strongly influenced by onboard energy storage limitations. Primary and rechargeable lithium-chemistry batteries constrain operational endurance, require high initial investment and significant ongoing operations and maintenance costs, and are associated with both safety hazards and negative environmental impacts. Environmental energy harvesting provides a means to transcend the limitations of onboard energy storage, maximize operational flexibility and safety, and enable underwater platforms and vehicles to contribute their full potential.

Specifications Required: Develop and demonstrate at sea an affordable, scalable, energy harvesting device capable of extracting energy from the internal ocean thermal gradients to produce electrical power for naval missions. Develop conceptual designs for a scalable energy harvesting system that can operate (1) at 0.25W in a compact form factor for integration into an underwater glider as well as (2) a 2kW underwater power station.

Technology Developed: Seatrec has developed a compact thermal engine that extracts energy from the ocean's vertical temperature gradient and converts it to stored electricity. The thermal energy contained within the stratified ocean is essentially infinite in extent, broadly distributed and available to both fixed and mobile platforms. We have completed development of a commercial version of a 0.25 W thermal energy harvesting system that is available today for use on expendable profiling floats and autonomous underwater gliders. We continue to pursue development of a compact moored system capable of substantially greater power output for use as an underwater power station.

Warfighter Value: Seatrec thermal engines offer the potential for unlimited environmentally-sourced electrical energy for subsurface applications. As UUV missions become more complex, widespread, and interdependent the penalty for running out of energy will increase – as will the cost of operations and maintenance for expansive UUV arrays and persistent sensor networks. As these systems mature and multiply the ability to deploy a platform or vehicle for indefinite duration will become a key operational and economic advantage made possible by environmental energy harvesting technologies

WHEN

Contract Number: N68335-18-C-0176 **Ending on:** June 4, 2020

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Laboratory proof-of-concept	N/A	Demonstrated function	3	3rd QTR FY19
Laboratory testbed emulating operational environment	N/A	Demonstrated function with ocean-relevant temperature differential	4	3rd QTR FY19
Operationally-useful net power output	Med	Continuous net power of O(100 W) from laboratory testbed using ocean-relevant temperature differential	4	3rd QTR FY20
Small-scale prototype system laboratory demo	High	Laboratory demonstration of system packaged for ocean deployment.	5	2nd QTR FY21
Small-scale prototype system ocean demo	High	System deployed and operated at sea. Continuous net power O(100 W) demonstrated	6	1st QTR FY22

HOW

Projected Business Model: Seatrec anticipates partnering with an established contractor for development and field testing of a full-scale underwater power station. Subsequent production would most likely be via license to a partner.

Company Objectives: Our goal is to engage in early-stage field trials with a defense contractor developing capabilities for persistent underwater monitoring, including underwater sensing, communications and UUV networks. We expect that a transition sponsor would enable extended testing in a relevant operational scenario to mature the technology to a TRL 9

Potential Commercial Applications: UUV recharging (industry, defense, research); Undersea communications (cabled or acoustic); Undersea resource extraction (oil&gas, mining, aquaculture); Aids to Navigation; Weather Buoys; Oceanographic Research.

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