

Topic: N142-116

## Advanced Cooling Technologies, Inc.

Affordable, Scalable, Ocean Energy Harvesting System

Advanced Cooling Technologies, Inc. (ACT), a premier thermal management solutions provider, has developed a system to generate electricity for Unmanned Underwater Vehicles (UUV) from ocean temperature gradients. Heat extracted from warm waters is stored on-board in phase change materials to provide a continuous energy source. Integrated into UUVs or scaled up for applications such as a UUV charging station, this environmental energy harvesting system provides a competitive advantage as a renewable power source, extending UUV mission duration, improving life cycle costs, or increasing operational capabilities for UUV mission planners. After a successful prototype demonstration, ACT is currently optimizing and scaling up our innovative ocean energy harvesting system. ACT's goal for transition is to license our technology to a prime UUV contractor and manufacture key components.

### Technology Category Alignment:

Energy & Power Technologies

Energy storage

Power Generation/Energy Conversion

Thermal Transport and Control

Unmanned Ground and Sea Vehicles

### Contact:

Nathan Van Velson

[nathan.vanvelson@1-act.com](mailto:nathan.vanvelson@1-act.com)

(717) 295-6822

<http://www.1-act.com>

**SYSCOM:** ONR

**Contract:** N68335-16-C-0114

 Corporate Brochure: [https://navystp.com/vtm/open\\_file?type=brochure&id=N68335-16-C-0114](https://navystp.com/vtm/open_file?type=brochure&id=N68335-16-C-0114)

# Department of the Navy SBIR/STTR Transition Program

STATEMENT A. Approved for public release; distribution is unlimited.

ONR Approval # 43-2203-16

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Affordable, Scalable, Ocean Energy Harvesting System

Advanced Cooling Technologies, Inc.

## WHO

**SYSCOM:** ONR

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

**Transition Target:** Unmanned underwater vehicles deployed in anti-mine, anti-submarine, or surveillance roles.

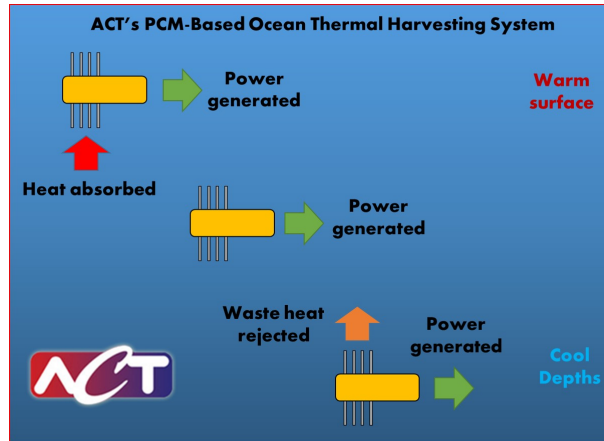
**TPOC:**

Ms. Maria Medeiros

[maria.medeiros1@navy.mil](mailto:maria.medeiros1@navy.mil)

**Other transition opportunities:**

This technology is potentially applicable to any underwater platform that would benefit from an alternative and renewable energy source, including both unmanned and manned vehicles.



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(ACT)

## WHAT

**Operational Need and Improvement:** The small temperature differentials that exist in the water column in the ocean interior provide a potential renewable energy source that may be exploited to power autonomous and unmanned underwater vehicles (AUV/UUV). Because these vehicles are continuously immersed in this environment, there is a substantial opportunity to exploit this resource. Small footprint ocean thermal energy harvesting devices can function as a power source for underwater gliders and probes. Alternatively, larger scale systems can replenish the batteries of underwater charging stations at which UUVs may rendezvous to charge their on-board batteries. Either scale system has the potential to substantively increase the endurance and mission capability of AUVs and UUVs.

**Specifications Required:** An affordable ocean thermal energy harvesting system will be developed that can be scaled to provide power both for small AUVs such as gliders and ocean probes, and for large scale underwater power stations. The small scale systems should generate between 0.25-1.0 W of power in a compact form factor, and meet or exceed the power density of current power systems. The large scale systems should operate at up to 2 kW to support current and future UUV missions with power requirements higher than that of gliders/probes, and provide a means of docking and charging of UUVs.

**Technology Developed:** ACT has developed an ocean thermal energy harvesting system which utilizes phase change material (PCM) thermal storage to generate electricity from naturally occurring ocean temperature gradients. Thermal energy is extracted from warm surface waters and stored in PCM, which provides a constant heat source for a power generating cycle. ACT's two-phase technology is used to passively control the flow of heat to and from the ocean, resulting in an energy harvesting system that can generate electric power regardless of depth.

**Warfighter Value:** The developed technology has the potential to substantially improve the operational capability, range, and life cycle costs of unmanned underwater vehicles deployed in anti-mine, anti-submarine, or surveillance operations.

## WHEN

**Contract Number:** N68335-16-C-0114 **Ending on:** February 16, 2018

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Develop an ocean energy harvesting system concept	N/A	Bench-top proof-of-concept prototype demonstration	3	February 2016
Component level technology development	Low	Optimized system design and performance model	3	October 2016
Improved sub-scale prototype design	Low	Successful demonstration of sub-scale prototype in laboratory environment	4	March 2017
Full-scale prototype design	Med	Laboratory testing of full-scale prototype	4	February 2018
Field testing of full-scale prototype	High	Successful field demonstration of technology in ocean environment	5	August 2019

## HOW

**Projected Business Model:** ACT intends to license the developed ocean energy harvesting system technology to a prime contractor for system integration. Additionally, ACT plans to manufacture key components of the system. Strategic partnerships will be formed to increase the TRL of the technology and fully transition it to a program of record.

**Company Objectives:** ACT is looking for organizations interested in an alternative energy source for their underwater operations and applications. Potential partners for further development efforts and integration of the technology are being sought.

**Potential Commercial Applications:** The developed technology is of interest to prime defense contractors who design and manufacture underwater vehicles and platforms. In addition to defense applications, there is a large fleet of AUVs deployed in the world's oceans for scientific research and monitoring. A renewable on-board power source can extend the capabilities of these research platforms. An underwater power station incorporating ACT's energy harvesting system could also enable or increase the capabilities of deep water AUVs used for pipeline inspection and ocean floor mapping.

**Contact:** Nathan Van Velson, Research and Development Engineer  
[nathan.vanvelson@1-act.com](mailto:nathan.vanvelson@1-act.com) 717-295-6822