Topic: N132-127

American Superconductor

Compact, Lossless, Ruggedized, Electromagnetically Shielded Connectors for Power and Signals
American Superconductor (AMSC) designed, developed, manufactured, and field-tested a High Temperature Superconducting (HTS) degaussing (DG) (low voltage DC) cable system for surface fleet use. This technology will be leveraged to create a highly efficient, lightweight, and high capacity power cable to meet the Navy's greater power demands, especially for advanced weapons systems (Directed Energy and Electro Magnetic Rail Guns) and sensors (High Power Radar and Laser Self-Defense Systems). HTS wire has the unique ability to transfer high power with zero electrical loss (near perfect efficiency). The power required for cooling this system is far less than the conventional electrical loss in conventional copper cables.

Technology Category Alignment:

Energy & Power Technologies
Engineered Resilient Systems (ERS)
Ground and Sea Platforms
Materials & Manufacturing Processes
Weapons Technologies

Contact:
Glenn Driscoll
gdriscoll@amsc.com
(978) 842-3055
http://amsc.com
SYSCOM: ONR
Contract: N00014-15-C-0114
Corporate Brochure: https://navystp.com/vtm/open_file?type=brochure&id=N00014-15-C-0114

Department of the Navy SBIR/STTR Transition Program

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ONR Approval # 43-2203-16

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WHO

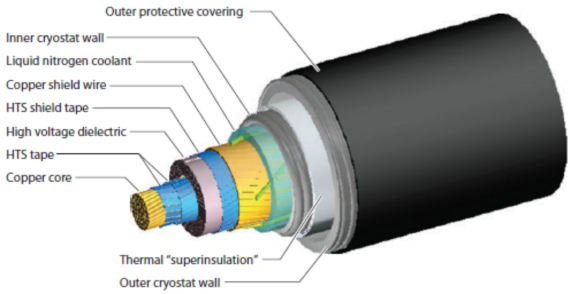
SYSCOM: ONR

Sponsoring Program: Code 33

Transition Target: Electric Ship Office, Future Surface Combatant

TPOC:
Captain Lynn Petersen
lynn.j.petersen@navy.mil

Other transition opportunities: Primary transition target is the surface fleet. This is where the largest need is in terms of high energy density weapons systems that will benefit from high capacity, efficient power transfer. Secondary transition targets would be the 1. Air Force's Hybrid Electric Propulsion program (high capacity, lightweight), 2. NASA next generation flight vehicle programs (lightweight, high capacity DC Buss) and 3. Army Research labs Magnetic Cable Energy (MACE) and Battlefield Superconducting Magnetic Energy Storage (SMES) programs. Non military transition opportunities include the commercial data center market as well as power dense manufacturing facilities.



Typical Land Based HTS Cable Geometry, © 2016, Courtesy of Nexans.

WHAT

Operational Need and Improvement: The Navy continues to see increased demand for power both on and off the ship. The most important of which is high power density advanced weapons systems and sensors. Free Electron Lasers, High Power Radar, Laser Self Defense Systems, Electro Magnetic Rail Guns and Active Denial (Directed Energy) systems are just a few of the Navy applications that demand higher capacity more efficient energy transfer before deployment to a platform in the fleet can be realized. Continued space and weight limitations for these ship applications drives the need for new power solutions to be light and compact easing installation on new ships and enabling upgrades on existing ones.

Specifications Required: Superconductors are an established technology that is helping the Navy meet its future power demand needs. The ultimate technical objective of the Phase II contract is to develop, manufacture and test a lightweight, compact, high capacity, robust, quick-disconnect power cable suitable for use in AC or DC applications aboard Navy Combatants. Specifically, the HTS Power Cable hardware produced for this effort will be capable of achieving 4800 Amps at 450 volts AC and/or 5000 Amps and 1kV DC, but the design will be scalable to higher currents and voltages to ensure its utility to the Navy

Technology Developed: Technology from AMSC's land based cable program is being leveraged for this program. The power cable connector is a key piece of new technology that is being developed. AMSC does manufacture low voltage HTS DC cable connectors for the HTS DG program, but a high voltage HTS AC connector does not exist today. The connector is the critical enabler for ship board implementation and must provide the high current capacity noted above, while still providing both thermal insulation and cable coolant flow across the connection point.

Warfighter Value: HTS Cables provide higher capacity, higher efficiency power transfer at a fraction of the weight and space of conventional copper cables. Weight and space savings can be used for additional cargo and/or payload capacity. Higher efficiency reduces power consumption providing additional power for other applications and/or reduced operations costs (energy savings).

WHEN

Contract Number: N00014-15-C-0114 **Ending on:** March 30, 2017

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Completion of Connector Beta Units	Med	5000 amp capacity @ 1kV	5	March 2017
Completion of Cable and Connector Assembly	Med	5000 amp capacity @ 1kV	6	September 2017
Completion of Cable and Termination System	Med	5000 amp capacity @ 1kV	7	June 2018

HOW

Projected Business Model: AMSC (NASDAQ: AMSC) generates the ideas, technologies and solutions that meet the world's demand for smarter, cleaner ... better energy. The company's solutions are now powering gigawatts of renewable energy globally and enhancing the performance and reliability of power networks in more than a dozen countries. Founded in 1987, AMSC is headquartered near Boston, Massachusetts with operations in Asia, Australia, Europe and North America. AMSC's Amperium® high temperature superconductor (HTS) wire conducts approximately 200 times the electrical current of copper wire of similar dimensions. Used in high-current AC or DC cable applications, such as power transmission and distribution, high-capacity Amperium wire offers a significant increase in the amount of power that can be carried regardless of voltage.

Company Objectives: AMSC's Superconductor Cable Systems utilize Amperium® high temperature superconductor (HTS) wire in place of traditional aluminum or copper conductors. Cables that utilize HTS wire can transmit up to 10 times more power than conventional cables or can carry equivalent power at much lower voltages. Ideal for both direct current (DC) and alternating current (AC) systems, superconductor cables may be used in utility power networks or in commercial and industrial applications such as data centers. Through the SBIR program, AMSC will develop an HTS power cable and terminations specifically suited for use aboard US Navy Surface Combatants.

Potential Commercial Applications: AC superconductor cable systems can be used to in any application demanding increased power and/or system reliability, both on land and at sea. As the transmission medium for DC applications, superconductor cables can move virtually any amount of power with much greater efficiency than any other transmission technology – and they are smaller and lighter than other solutions which is particularly relevant to the surface fleet. Additionally, with DC superconductor cables, a single superconductor cable can be installed that is designed to meet the current power demand, while still providing surplus capacity for future power demand.

Contact: Glenn Driscoll, Managing Director, Superconductor Development Projects
gdriscoll@amsc.com 978-842-3055