

# Department of the Navy SBIR/STTR Transition Program

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NAVSEA #2018-0530

Topic # N16A-T012

Medium Voltage Direct Current (MVDC) Grounding System

Continuous Solutions LLC

## WHO

**SYSCOM:** NAVSEA

**Sponsoring Program:** Program Executive Office Ships (PEO Ships)

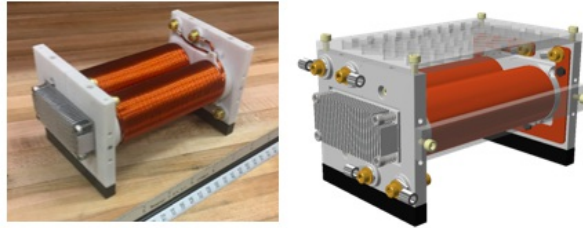
**Transition Target:** Electric Ships Office (ESO) - PMS 320

**TPOC:**  
(215)897-1301

### Other transition opportunities:

MVDC electrical distribution systems are being investigated and analyzed as the next generation for future micro grid technologies and shipboard power systems including those for future surface combatants. The novel choke inductors designed and tested under this contact are crucial for the proper operation of such MVDC system.

**Notes:** One of the key technologies needed for a reasonably priced MVDC system is an affordable (equal to or less than cost of a comparable AC system), reliable method and associated hardware to detect, localize, and isolate faults on the MVDC bus while still maintaining power of the required quality of service.



MVDC Choke Inductor, Copyright, 2018, Continuous Solutions LLC

## WHAT

**Operational Need and Improvement:** The Navy is transitioning and integrating a grounding system for medium voltage direct current (MVDC) zonal system technology for naval ships use. By reducing the amount of power conversion and energy storage required as compared to an AC system, MVDC systems offer the opportunity to incorporate electric weapons and high power sensors in surface combatants under 10,000 MT. One of the key technologies needed for an MVDC system is an affordable, reliable electrical distribution system compared to present AC systems in use today. The work conducted is required in order to create and meet the operational standards and needs for improvement and reliability of MVDC distribution systems.

**Specifications Required:** Desirable attributes of the grounding system include the ability to continue operation during one line to ground fault, the ability to detect and locate line to ground faults, minimizing currents in the hull, and avoiding high line to ground voltages that can stress and reduce the service life of cable insulation. Specifications and first articles for unique MVDC circuit breakers, common mode (CM) chokes and specifications for other concept elements (such as power conversion equipment), which must implement the fault detection, localization, and isolation concept must be developed. The goal for reliability should be a mean time between operational failure of the ground reference system in excess of 30,000 hours. The technology will be installed on future surface combatants following the end of production of the DDG 51 class.

**Technology Developed:** The technology being developed by Continuous Solutions is an inductor that will assist in providing a reduction in CM current and increase reliability in MVDC distribution systems. The sustainable competitive advantage and innovation is the novel inductor design using evolutionary computing through an in-house genetic algorithm used to model, design, and construct a CM inductor choke that will suppress the CM current and increase reliability of such in MVDC systems.

**Warfighter Value:** Continuous Solutions technology is a key enabler for the use of MVDC distribution systems. The developed technology will reduce cost, improve power and energy density, of the overall power system as compared to an equivalent AC power system.

## WHEN

**Contract Number:** N68335-18-C-0108 **Ending on:** December 14, 2018

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Construction of the DC CM chokes	Low	CM Choke is constructed	TRL 4	August 2018
Installation of the DC CM chokes into the micro-grid testbed	Med	Test and simulation results match for the CM chokes	TRL 5	October 2018
Construction of the mid-point resistors into the micro-grid testbed	Low	Mid-point resistors are constructed	TRL 4	October 2018
Installation of the mid-point resistors into the micro-grid testbed	Med	Test and simulation results for mid-point resistors match	TRL 5	December 2018
Modeling overall functionality of MVDC grounded system	Low	Results are well within defined standards	TRL 4	December 2018

## HOW

**Projected Business Model:** The business model of the company is to sell design services to power electronic companies and sell CM choke products to power electronic suppliers of the Navy. The CM chokes are designed for a custom build used in power electronic applications in MVDC distribution systems that allow a stable and reliable operation. With assisting the Navy in writing the standards and specifications for MVDC systems, Continuous Solutions will be well-equipped to provides services and products that follow the standards and specification for power electronic vendors.

**Company Objectives:** Continuous Solutions's objective is to increase the intrinsic value of our technology. We are in business to enhance technology and lead in new product development. Our CM choke designs and capabilities will be sold to vendors working with Navy, DoD, and other commercial entities.

**Potential Commercial Applications:** An affordable fault detection, localization, and isolation method via CM chokes for MVDC systems has many potential commercial applications to include commercial ships, industrial facilities, server farms, large vehicular applications, photo-voltaic farms, wind farms, and offshore/isolated power generation.

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