

WHO

SYSCOM: NAVAIR

Sponsoring Program: NAWCAD

Transition Target: PMA-251 and EMALS Integrated Product Team

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Other Transition Opportunities: NAVSEA, DDG(X), Integrated Warfare Systems (IWS), Directed Energy Weapons (DEW), energy storage charging, and pulsed DC loads

Notes: The existing transformer rectifier (T/R) used by the Navy is large, heavy, and difficult to replace. If the transformer fails, the entire T/R must be replaced, which is a costly and time-consuming process. The Compact Transformer Rectifier design will convert medium voltage Alternating Current (AC) to low voltage Direct Current (DC) with modular, line-replaceable units (LRUs) that are compact and lightweight, such that two personnel may quickly and easily replace a hatchable failed unit. This design will improve maintainability, reduce costs, and improve system availability with potential at-sea replacements using onboard LRU components.



<https://www.navair.navy.mil/product/Electromagnetic-Aircraft-Launch-System-EMALS>

WHAT

Operational Need and Improvement: The Aircraft Carrier's power distribution for EMALS currently utilizes a transformer/rectifier that is 450 cu. ft. and weighs nearly 40,000 lbs. If the transformer fails, significant maintenance effort is required to remove and replace the unit. This process is expensive and time-consuming. This process also reduces operational readiness as the repair must be conducted in port. The Navy is seeking to improve maintainability and decrease mean time to repair (MTTR).

Specifications Required: The U.S. Navy seeks a maintainable and portable transformer rectifier for megawatt (MW)-class loads. The solution must be able to fit through shipboard hatches with modular, replaceable components. Components must be smaller than 26" x 66" x 33" for hatchability and reasonable in weight to enable two-person carry. The system must be capable of providing output power in the single-digit MW range continuously for tens of minutes and output power of less than 0.5 MW for greater than one hour.

Technology Developed: Hepburn and Sons with North Carolina State University developed a megawatt class active front end power converter design based on the neutral point clamped converter topology. This design achieves modularized power capacity using a LRU architecture featuring fully parallel Medium Voltage AC inputs and DC outputs.

Warfighter Value: The Compact, Hatchable Transformer Rectifier improves operational availability by reducing MTTR. Increased power density enables additional applications to be installed onboard. The design improves maintainability, reduces costs, and improves system availability with potential at-sea repair using onboard LRU replacements.

WHEN

Contract Number: N68335-22-C-0546

Ending on: Aug 06, 2024

Milestone	Risk Level	Measure of Success	Ending TRL	Date
LRU Discovery Testing	Low	Risk reduction/discovery testing of LRU system at medium voltage	4	4th QTR FY23
If Option exercised, LRU Validation Testing	Medium	LRU prototype system validation test	6	2nd QTR FY25
If Option exercised, Demonstration Event	Medium	LRU demonstrates subscale power rectification	6	3rd QTR FY25

HOW

Projected Business Model: Hepburn and Sons' strategy is to work with the end production in mind. Our business plan requires increasing the Manufacturing Readiness Level through commercialization partnership or standing up production beyond the University setting. Seeking the appropriate Phase III commercialization/production partner will enable us to license the developed technology for a program of record. We intend to identify this partner during Phase II. Once identified, there is potential to establish a spinoff subsidiary with the production partner that will sell hatchable active front end power conversion systems directly to DoD and commercial customers.

Company Objectives: Hepburn and Sons LLC serves as a trusted advisor and counselor to the government, defense, and maritime industries. The company is comprised of three divisions that align with our main objective areas: Advisory Services, Engineering Support Services, and Technology Transition. The Advisory Services Division's two primary functions are strategic analysis and expert witness. Engineering Support Services provides expertise in naval architecture, naval engineering, ship integration and safety, test planning/execution and overall program coordination. The Technology Transition Division shepherds technologies through the research and development phase, and into government, defense, & maritime applications.

Potential Commercial Applications: Transformer rectifiers are useful for energy transmission, storage, and charging applications. As the energy sector moves towards renewables, this technology would be useful in the energy conversion for Electric Vehicles (EV), energy storage devices, data centers, and utility substations.