

Topic: N171-075

PC Krause and Associates, Inc.

Submarine Shipboard Power Supply Bridge

Existing uninterruptible power supplies (UPS) for naval applications typically use large batteries with excessive holdup time for bus-transfer events on submarines. PC Krause and Associates (PCKA), a company specializing in electromechanical and thermal dynamics of integrated systems including power electronic converters rated up to hundreds of kilowatts, is developing a UPS that utilizes wide-bandgap semiconductors and high power-density energy storage to fit a 40 kW UPS with ≥ 100 ms of holdup into a 4U height, 19 in. rack-mount enclosure. Prototype hardware has been constructed that demonstrated key subsystems and operating modes. The initial target application is power holdup for critical loads on modern submarines; however, the technology is adaptable to other UPS applications. PCKA is seeking interested military customers and prime contractors for technology integration and deployment opportunities.

Technology Category Alignment:

Energy storage

Power Control and Distribution

Power Generation/Energy Conversion

Power and Energy

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SYSCOM: NAVSEA

Contract: N68335-19-C-0135

Booth: 1101

Room: FST at NSL

Presenting: Nov 6th at 4:15 PM

 Corporate Brochure: https://navystp.com/vtm/open_file?type=brochure&id=N68335-19-C-0135

Department of the Navy SBIR/STTR Transition Program

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NAVSEA #2019-0568

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WHO

SYSCOM: NAVSEA

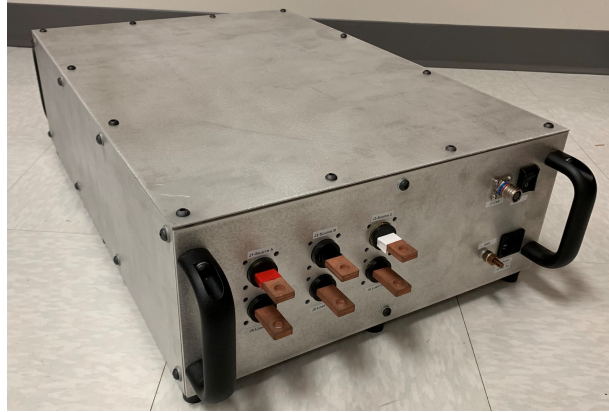
Sponsoring Program: Program Executive Officer, Submarines (PEO SUB)

Transition Target: VIRGINIA Class Program Office (PMS 450) and OHIO Replacement Program Office (PMS 397)

TPOC:

Other transition opportunities: Navy submarines and surface ships, other weight/volume sensitive Uninterruptible Power Supply (UPS) applications

Notes: Existing UPSs for naval applications typically use large, heavy lead-acid batteries with more holdup time than needed for bus-transfer events on submarines. Weight and volume are significantly reduced compared to existing UPS solutions by utilizing wide-bandgap semiconductors and a high power-density energy storage matched to a short holdup requirement. The photo shows the Phase I prototype, which was used to demonstrate key functionality and operating modes.



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WHAT

Operational Need and Improvement: Critical loads require uninterrupted power even during disturbances on the main electrical power system. Redundant power systems with an automatic transfer switch can be used to reduce the downtime experienced by loads, but a UPS is needed to bridge power during the remaining interruptions. Existing UPSs can fulfill this function, but are typically large and heavy due to carrying significantly more energy storage than needed for short-duration disturbances. The U.S. Navy needs a reduction in weight and volume of uninterruptible power supplies for naval applications with short holdup time requirements.

Specifications Required: 40 kW power rating, 115 V delta, 100 millisecond holdup, 19-inch rack-mount with 4U height

Technology Developed: The UPS developed reduces weight and volume compared to existing solutions by matching high power-density energy storage to the short holdup requirements of a submarine power system fed by an automatic transfer switch, and by utilizing wide-bandgap semiconductors to minimize the weight and volume of the power electronics, EMI filtering, and thermal management. The UPS operates at high efficiency, enabling an air-cooled 40 kW, three-phase UPS to fit in a 4U, 19 inch rack-mount enclosure.

Warfighter Value: A UPS with reduced weight and volume will allow critical loads to be protected while occupying less space, and could also improve up-time and reliability for applications that previously could not tolerate the weight and volume of a traditional UPS. The use of ultracapacitors offers significantly lower maintenance requirements compared to conventional UPSs with lead-acid batteries.

WHEN

Contract Number: N68335-19-C-0135 **Ending on:** January 30, 2020

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Reduced-scale prototype	N/A	Demonstrate key subsystems, functionality, and operating modes	4	March 2018
Full-scale pre-qual prototype	Med	Testing at full power level in laboratory environment	5	January 2020
Environmental, electrical, and EMI testing of prototype (if option awarded)	High	Perform electrical, EMI, shock qualification testing	5	July 2020
Prototype revisions and qualification testing as necessary (if option awarded)	Med	Pass electrical, EMI, and shock qualification testing in a high-fidelity laboratory environment	6	January 2022
Final qualification testing, LRIP, and technology transition	Med	Pass final qualification testing, testing in operational environment, transition to program of record	7	January 2023

HOW

Projected Business Model: As an advanced technology company, PCKA is primarily focused on the modeling, simulation, analysis, design and development of demanding electrical, mechanical, and electro-mechanical applications. While PCKA has the capability to fabricate prototypes and low-volume production units, our business strategy is to contract volume production of our designs allowing our engineering staff to remain focused on research and development. PCKA would directly manage the construction and shipping of the product until production volumes reach sufficient levels to warrant contracting the complete assembly, inventory management, and warranty support to a contract manufacturer. It is currently anticipated that the final assembly and shipment will be feasible for PCKA to handle internally in the first one to three years following Phase II completion.

Company Objectives: Meet with prime contractors for integrating the proposed UPS into subsystems for VIRGINIA and COLUMBIA class submarines. PCKA's UPS technology is also adaptable to other UPS applications and PCKA is seeking interested military customers and prime contractors for technology transfer and deployment opportunities.

Potential Commercial Applications: In addition to Naval UPS applications, this product could find commercial applications in weight/volume and efficiency sensitive applications, and the high-current GaN power stages and shock-hardened ultracapacitor modules developed could be used in various future military and commercial applications.

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