

# Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2016-767

Topic # N14A-T006

A Multi-Tiered Lithium-Ion Battery Thermal Fault Mitigation Architecture

Creare, LLC

## WHO

**SYSCOM:** NAVAIR

**Sponsoring Program:** PMA-265

**Transition Target:** F/A-18 MIL-PRF-29595/3 Battery Replacement

**TPOC:**

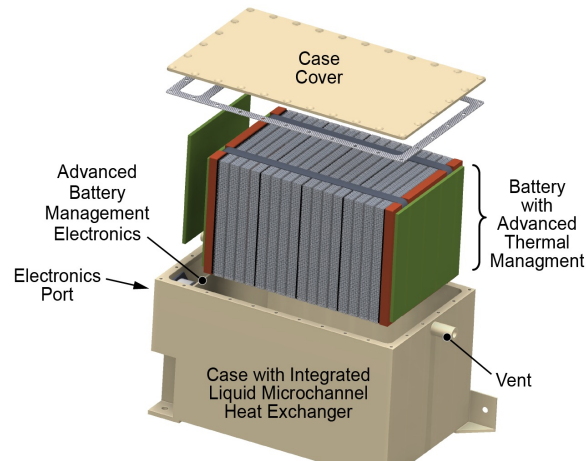
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**Other transition opportunities:**

PMA-261 (H-53)

PMA-263 (UAV Systems)

PMA-299 (H-60)



The SafetyCool System integrates an advanced battery management electronics and thermal management components into an integrated Li-Ion battery system. © 2016 Creare LLC

## WHAT

**Operational Need and Improvement:** With the continued electrification of military systems, lithium-ion (Li ion) batteries are increasingly targeted for electrical energy storage due to exceptional energy and power density. However, Li ion batteries operating in hostile thermal and mechanical environments typical of military aircraft are prone to catastrophic thermally-induced failures. Hazards including loss of power, fire, and explosion are unacceptable for airborne platforms in particular. Consequently, there is great interest in advanced thermal management and thermal fault mitigation strategies to optimize pack performance and enhance safety. This program matures a novel multi-tiered approach coupling high conductance phase change heat removal techniques with active monitoring and control strategies to improve the safety of Li ion battery packs.

**Specifications Required:** The primary object is the development of proof of concept and prototype implementation of a battery pack system ensuring maximum safety in case of thermal event leading to cell fratricide. Use state-of-the-art modeling and simulation (M&S) tools for thermal management design and verify by demonstrating at cell/module level. The resulting system should meet the requirements of MIL-PRF-29595/3 for replacement of an existing F/A-18 lead-acid battery.

**Technology Developed:** Creare has developed the SafetyCool battery system, which combines a high performance passive thermal management system capable of 7x the cooling performance of traditional conductive cooling concepts with an advanced BMS that is capable of identifying and mitigating common faults observed in Li-Ion battery systems.

**Warfighter Value:** The primary value of the SafetyCool system to America's Warfighter is improved safety. Li-Ion batteries, while having substantially better electrical performance and weight than traditional lead-acid battery packs, come with a substantial added risk resulting from the much higher energy density in these systems. Cooler cells increase the operating margin before reaching thermal runaway thresholds. The ability to sense and detect emergent thermal faults before runaway, coupled with the ability to isolate unhealthy cells, minimizes the probability for thermal runaway and catastrophic failures which put the warfighter at risk.

## WHEN

**Contract Number:** N68335-15-C-0396 **Ending on:** September 26, 2017

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Preliminary Design Complete	Med	Completion of PDR	3	August 2016
System Prototype Complete	Med	Prototype Manufactured	3/4	March 2017
Prototype Testing Complete	Med	Prototype Completed Baseline Qualification	4	September 2017
Phase III Prototype Development	Med	Design Package Completed	5	May 2018
Fabrication of Qualification Test Packs	Med	Battery Packs Fabricated	5/6	May 2019

## HOW

**Projected Business Model:** Creare, and/or its sister company Edare, has the capacity to directly supply and support the SafetyCool batteries for initial technology insertion at a rate up to 500 batteries per year. This is more than adequate to support F/A-18 overhaul procurement rates. The low product volume is something that can easily be accommodated within Creare's current business model, which is primarily focused on advanced R&D programs. We have already demonstrated that we can successfully execute this business model with the Navy on several analogous technologies developed under other SBIR efforts. However, Navitas, Creare's partner for LFP cell production, is also interested in pack production and offers an alternative fabrication path.

**Company Objectives:** In addition to development of the SafetyCool technology for PMA-265, Creare is looking for potential NAVAIR and NAVSEA partners interested in adapting other legacy battery systems for improved safety and thermal management. The technology is applicable to most battery systems used throughout Navy platforms, and has the potential for improved safety, decreased weight, and improved battery energy storage.

**Potential Commercial Applications:** The primary benefit of this program is the development of high-efficiency heat removal and thermal fault mitigation strategies that improve safety for a broad range of Li ion battery chemistries, capacities, and configurations. This technology will enable the safe use of large format Li ion battery packs for a range of aircraft; hybrid and electric vehicles; and unmanned land, air, and sea vehicles.

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