

# Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2019-755

Topic # N162-092

All Solid-State Batteries for Navy Applications

Bioenno Tech, LLC

## WHO

**SYSCOM:** NAVAIR

**Sponsoring Program:** 4.0T - CTO,  
Chief Technology Office

**Transition Target:** Advanced Fighter  
Aircraft

**TPOC:**  
(301)342-5788

**Other transition opportunities:** V-22  
Osprey (PMA 275)

**Notes:** All solid-state battery (ASSB) technology is being considered as a replacement for legacy battery systems [Lead Acid, Nickel-Cadmium (Ni-Cad) Lithium-Ion (Li-Ion)] as an enabler to increase power density, reduce weight and size and improve safety. Although the primary transition target is Advanced Fighter Aircraft, the technology is considered suitable for integration on a variety of air, ground, surface and undersea platforms – manned and unmanned.



Pouch Cell Prototype. Courtesy of Bioenno Tech, LLC

## WHAT

**Operational Need and Improvement:** Military weapon systems place highly variable, unpredictable demands on power systems and require increasingly energy-dense power supplies that are compact, lightweight and provide long service life without compromising safety. To improve energy and power density, the Navy is developing and transitioning lithium-ion (Li-Ion) chemistries for naval aircraft applications. However, current commercially available Li-ion battery technologies suffer from low safety/durability and potential gains are limited due to hazards associated with their organic liquid electrolytes.

To address these challenges, Bioenno Tech has developed an affordable, novel class of high energy density, long service life/high cycle life, Li-ion all solid state battery (ASSB) technology that exceeds the energy density and power density thresholds of current systems over an increased range of operational temperatures. All solid state construction eliminates hazards – enabling ultra-safe operations.

**Specifications Required:** Energy density exceeding the energy density and power density thresholds of current Li-ion batteries; be compatible and functional with the existing aircraft operational, environmental and electrical requirements; be able to withstand carrier based vibration and shock loads; demonstrate low self-discharge; long calendar life and high cycle life at 100% depth of discharge cycles; possess diagnostic and prognostic features.

**Technology Developed:** Bioenno Tech's Li-ion ASSB technology enables the development of high energy density, long-life/high-cycle ASSBs suitable for shipboard use that are safe, cost-effective and exceed the energy density and power density thresholds of current systems over an increased range of operational temperatures. The battery products (28V, 25Ah and 60Ah) to be delivered will be packaged with appropriate battery and thermal management systems in 6T enclosures to form complete battery systems.

**Warfighter Value:** Bioenno Tech's affordable, low SWaP, reliable and safe ASSBs will significantly improve the performance of power sources and energy storage systems for numerous weapon systems to include manned and unmanned aircraft, ground, surface and under surface vehicles; electronic safe and arm (S&A) devices and personnel portable electronics.

## WHEN

**Contract Number:** N68335-18-C-0685 **Ending on:** February 28, 2021

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Optimize Material/process; Validate electrochemical performance and thermal stability	N/A	4 mAh Coin cells achieve the desired performance	4	August 2019
Develop electrodes made from scaled-up materials for pouch-cell fabrication	Med	Successful testing of 400-500 mAh pouch cells	5	February 2020
Fabricate 5000 mAh pouch cell prototypes	Med	Successful testing of 5000 mAh pouch cells;	5	August 2020
Develop/Fabricate 28V 60Ah prototypes	Med	Successful testing – as outlined in MIL-PERF 29595 (rev A) and S9310-AQ-SAF-010 of 28V 60Ah battery prototypes.	5	February 2021

## HOW

**Projected Business Model:** Bioenno has established a pilot/lab-scale battery cell pack production line capable of meeting low-rate initial production (LRIP) demands that can be scaled up to meet full-rate production demands within 6 months. Bioenno would also consider establishing a joint production with other Li-ion battery manufacturing companies through technology license and/or co-investment for licensing the electrolyte formulation processing method and/or the design/processing of Li-ion SSB technology. Since this battery is a key sub-system for a whole energy system, we would consider partnering/teaming with Primes (i.e. Lockheed Martin, Boeing, General Atomics, etc.) to support integration efforts.

**Company Objectives:** Bioenno Tech's goal is to develop and commercialize our ASSB technology to become the technology of choice for Li-ion ASSB systems for (1) military and commercial aircraft, (2) manned and unmanned electric vehicles, (3) electric UAVs, and (4) robots.

**Potential Commercial Applications:** The successful development of this technology will result in a novel class of low SWaP, long-service-life, ultra-safe, high energy-density ASSBs that can be manufactured on cost efficient, industry-compatible production lines. Bioenno Tech's ASSB technology will significantly improve the performance of power sources and energy storage systems in a wide variety of applications to include: manned and unmanned vehicles (air/ground/sea), electronic safe and arm (S&A) devices, portable electronics, sensors and sensor networks, commercial aviation, transportation, and consumer electronics sectors that require demanding performance in harsh working environments.

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