Department of the Navy SBIR/STTR Transition Program

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NAVSEA #2021-0473

Topic # N161-047

Universal Non-Intrusive Battery Monitoring and Failure Prediction System

Luna Innovations Incorporated

WHO

SYSCOM: NAVSEA

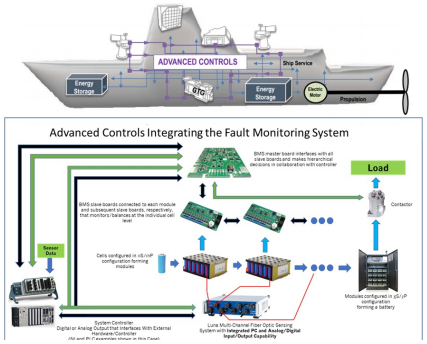
Sponsoring Program:

Transition Target: DDG(X) / PMS 460

TPOC:
(215)897-1413

Other transition opportunities:
Military (Navy, Army, NASA):
Underwater vehicles, Surface Shipboard Energy Storage, Battery Testing and Qualification

Civilian:
Electric Vehicles and Charging Stations, Reusable Energy Storage, Aircraft Battery Systems



This technology will serve as the fault detection system which is critical to the adoption of the high power energy storage necessary to supply future shipboard needs

Notes: In addition to monitoring for faults on Navy energy storage systems, the system can be used in both government and civilian cases for damage propagation studies, thermal characterization of batteries, and structural health monitoring of battery enclosures. Testing has demonstrated fiber optic technology as a safe, effective, and efficient design and monitoring tool at the cell, module, and battery level.

WHAT

Operational Need and Improvement: Various reasons such as overcharge, impact, manufacturing issues, or defects as a function of cyclic fatigue can cause a fault in the batteries used on Naval systems. When a fault occurs, the battery releases toxic and flammable gases which can start and feed a fire or cause significant equipment damage and present catastrophic hazards to personnel safety. If detected early, valuable warnings of single or multiple cell issues can be provided before they evolve into bigger and more hazardous issues that may result in injury to personnel and equipment.

Specifications Required: A battery fault detection system is needed to provide operators with real-time audio and visual feedback of cell and battery faults that may lead to a battery casualty and failure. The threshold space, weight, and power requirements for some applications can be as small or low as 400 cm3, 1kg, 25 watts. The system needs the capabilities of being externally powered via an adaptor relevant for the deployed platform and ruggedized in order to withstand worst-case environments that exist prior to a failure. Similarly configurations will be needed such that it can monitor and detect a single cell event, or multiple events inside the battery enclosure with 100% probability.

Technology Developed: Luna Innovations, a global leader in optical sensing and network analysis, has developed and successfully demonstrated a high spatial density, early warning battery fault indication system that can rapidly detect single or multiple cell issues and will provide operators with real-time audio and visual feedback of cell and battery faults that may lead to a battery casualty/ failure

Warfighter Value: Early warning allows operators more time to complete required preventive and corrective actions, ensure personnel and platform safety, and reduce the probability of asset loss – increasing readiness.

WHEN

Contract Number: N68335-18-C-0227 **Ending on:** May 7, 2022

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Demonstrate Cell Temperature Measurements	N/A	Accurately Measure Cell Temperature	3	January 2017
Demonstrate Failure Detection	N/A	Validate Different Fault Type Detection	4	April 2019
Reduce System SWaP and Integrate into BMS	Low	Prototype SWaP and Complete BMS Integration	5	December 2021
Integrate Prototype System into Testbed Control Loop	Low	Perform Control with Improved Prototype	6	April 2022
Integrate and Test on a Navy Battery	Med	Detect Fault in an Operational System	7	July 2022
Shipboard Qualification	Med	Pass Applicable Mil-STD Testing	8	July 2023

HOW

Projected Business Model: Luna envisions a combination of direct sales and licensing of the battery fault detection system. The application for this technology builds on Luna's current product lines and expertise, providing a pathway for direct dales to DoD and Civilian test facilities and key applications. Customers such as electric vehicle and battery manufacturers, energy storage system companies, and testing laboratories are ideal candidates direct sales of a non-qualified version of the system. The shipboard qualified fault detection system would be licensed to a systems integrator or directly to a prime.

Company Objectives: Luna seeks to achieving "buy-in" from early adopters in the research, commercial, and defense industries. Luna has existing accounts with many prime defense contractors in this space who have had favorable experiences using our distributed sensing products. Luna will work to secure one of these industry players as a Phase III partner to aid in selecting the best method for demonstrating the system on a Navy battery or equivalent power system. Luna is also looking to the Navy for an opportunity to integrate into and test at one of their facilities to complete TRL 7 testing. Phase III funding will originate from an industry partner combined with funds from government stakeholders that will enable the qualification of the system for the shipboard environment. Once qualified, the technology can be transitioned to a Prime for deployment.

Potential Commercial Applications: There are numerous commercial applications for a civilian system within the automotive and energy industries. The development and adoption of electric vehicles is driving the need for new battery designs and chemistries. All of these will require extensive testing to ensure maximum safety. While deployment of a system onto every car will not be feasible, applications exist such as enabling rapid charging by including only the sensor on the car and a control system within the charger or enabling inspection after an accident. Within the energy industry the advancement of renewable energy sources that generate power during certain periods and require storage during others in order to stabilize the supply, have a need for autonomous fault monitoring to ensure energy security. Both of these markets are growing at a rapid pace and would be well severed by the technology.

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