

Topic: N161-047

Lynntech, Inc.

Early Warning Fault Indication System for Li Batteries

Early detection of lithium battery faults provides critical warning before these issues evolve into more hazardous situations, such as fire, toxic off-gassing, or catastrophic failure. Lynntech is developing an early warning fault indication system (EWFIS) with low volume, weight, and energy. It provides high speed monitoring at the cell level along with system performance monitoring, triggering an alarm when a battery fault precursor is detected. Lynntech has significant experience in developing lithium batteries, miniature chemical sensors, and integrated electronics. EWFIS can be adapted to many battery packages and chemistries, including Li-ion batteries in Navy's UUVs and submarines. EWFIS prototypes have been successfully designed, fabricated, and tested for monitoring Li-ion batteries (8 or 32 cells). The ultimate transition goal for this technology is government and prime contractor systems for monitoring lithium batteries, increasing safety and reliability.

Technology Category Alignment:

Advanced Electronics

Energy & Power Technologies

Survivability

Unmanned Ground and Sea Vehicles

Power and Energy

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**SYSCOM:** NAVSEA

**Contract:** N68335-18-C-0232

 Corporate Brochure: [https://navystp.com/vtm/open\\_file?type=brochure&id=N68335-18-C-0232](https://navystp.com/vtm/open_file?type=brochure&id=N68335-18-C-0232)

# Department of the Navy SBIR/STTR Transition Program

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NAVSEA #2019-0645

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## WHO

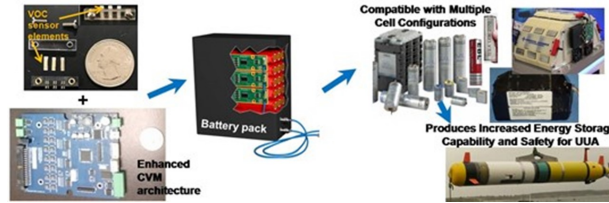
**SYSCOM:** NAVSEA

**Sponsoring Program:** PEO Submarines

**Transition Target:** MK18 Mod 2, UUVs on submarines

**TPOC:**  
(401)832-2887

**Other transition opportunities:** VOC sensor for NAVFAC battery storage/charging, Navy and other DOD agencies' Li-ion battery applications to Unmanned Underwater Vehicles (UUVs), Advanced Seal Delivery System (ASDS), Dry Combat Submersible (DCS), Unmanned Aerial Vehicles (UAVs), aircraft, soldier power, and other high energy systems.



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## WHAT

**Operational Need and Improvement:** A fault in current Navy-used Lithium (Li) batteries (primary and secondary) can occur for various reasons such as overcharge, impact, manufacturing issues, or latent defect. When a fault occurs in one of these batteries, toxic and flammable gases may be released, which can start and feed a catastrophic fire. Besides causing equipment damage, Li battery fires create significant hazards to personnel and entire weapons systems. Li battery management systems (BMS) address overcharge or discharge issues and some Li batteries cases have temperature sensors, but neither can provide sufficient early warning of a fault at the cell level in order to implement mitigation steps to prevent catastrophic failure. By detecting faults early, critical warnings of cell issues are provided before they evolve into a hazardous situation.

**Specifications Required:** Threshold: volume 400 cubic centimeters, weight 1 kilogram, power 25 watts. Actual: volume 163 cubic centimeters, weight 100 grams, power 1.5 watts for 126 cell battery.

**Technology Developed:** Lynntech is developing a universal early warning fault indication system (EWFIS) with low volume, weight, and energy. It provides high speed monitoring at the cell level, along with system performance monitoring, triggering an alarm when a battery fault precursor is detected. EWFIS' design and components offer great flexibility for adaptation in an array of battery packages and chemistries, including Li-ion batteries used in UUVs (unmanned underwater vehicles). EWFIS is designed to simultaneously detect several battery fault indicators, among them VOCs (volatile organic compounds) generated from a faulty cell's electrolyte. Response time (the generation of an alarm) is less than one second once a precursor is detected. Lynntech's EWFIS allows for (i) effectively sensing numerous points down to the cell level, achieving a more robust system than only monitoring at the overall battery level; and (ii) a modular design enabling easy interface with a wide variety of battery configurations.

**Warfighter Value:** Lithium-ion battery fires are well-documented. Advancement in early warning and fault detection is needed within the Navy, military services, other government agencies and throughout the commercial sector. Lynntech's EWFIS provides the increased warning needed to take corrective action to prevent faults from becoming catastrophic failures. Specifically, warfighters in confined spaces such as submarines and aircraft will directly benefit from the early warning indication provided by Lynntech's EWFIS by increasing personnel safety, limiting catastrophic losses, and ensuring mission success.

## WHEN

**Contract Number:** N68335-18-C-0232 **Ending on:** April 24, 2021

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Lab Scale EWFIS Breadboard tested	Low	Detection of event within 0.5 sec in 8 cell battery	3-4	January 2019
EWFIS prototype tested mock battery	Low	Detection of event within 0.1 sec in 32 cell battery	4-5	April 2019
EWFIS prototype tested actual battery	Med	Fault detection with Remus 600 batteries	6	April 2020
EWFIS prototype tested in UUV	Med	EWFIS tested inside UUV on land and in water	7	April 2021

## HOW

**Projected Business Model:** After completing a Phase II project, Lynntech plans to commercialize the technology by either (i) licensing the technology to a battery partner(s); or (ii) producing the components at Lynntech and selling the components to companies. The current business strategy is to sell or license to existing battery manufacturers. This will lower the required investment and provide an established customer base.

**Company Objectives:** Lynntech's objective for this project is to develop a EWFIS prototype with volume, weight, and energy that meets the Navy's requirements. Lynntech is a for-profit business and believes that if we properly meet the above objective, safes and profit will follow.

**Potential Commercial Applications:** In addition to Navy and DOD's UUVs, submarines, and aircraft using Li-ion batteries, civilian applications include commercial aviation, electric and plug in hybrid electric vehicles, auxiliary power units, and consumer electronic devices that use Li-ion batteries.

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