SON Number: WPSON-21-C2 **24 October 2019**

Strategic Environmental Research and Development Program (SERDP)

FY 2021 STATEMENT OF NEED

Weapons Systems and Platforms (WP) Program Area

OPTIMIZATION OF ADVANCED BATTERY PROCESSING AND RECYCLING TECHNOLOGIES

1. Objective of Proposed Work

The objective of this Statement of Need (SON) is to optimize advanced battery processing and recycling technologies in order to increase reclaimable efficiencies, reduce hazardous waste, and develop more effective and efficient transport of battery materials out of theater.
Proposals should address one or more of the following sub-objectives:

- Development of in-theater battery de-energization and neutralization processes, novel recycling methods, and materials separation. It is recommended that potential second life reuse applications and markets for batteries be examined to determine the viability of batteries with expired shelf life.
- Investigation of processes to significantly decrease hazardous waste generation as a result of battery demilitarization and disposal processes.
- Development of novel technologies for bulk transportation of hazardous battery materials.

While there are substantive issues with lithium based batteries, proposals that address other battery types are also of interest.

Proposals should include a task to conduct a Sustainability Analysis of appropriate proportion for the proposed research. Proposals should establish a lifecycle framework that can mature as the technology or process advances through the acquisition process. This tiered approach aims to develop and document a minimum data set at each stage of research that can be used to make informed decisions and streamline transition to an acquisition program. The Sustainability Analysis may include varying depths of data and information that can inform: the goal and scope of an analysis; the identity and quantity of relevant inputs and outputs to the system; and the estimation of life cycle impacts and costs. The environmental analysis needs to detail toxicological as well as other environmental impacts and risks of battery recycling technologies.

2. Expected Benefits of Proposed Work

Successful completion of this work will result in more battery materials being disposed of as general waste, greater reclamation of recyclable materials and precious metals, and lower costs as a result of neutralized and demilitarized batteries overcoming travel and transport restrictions.

Advanced battery recycling technologies will result in lower environmental impacts as a result of more potentially hazardous materials being converted to general waste resulting in lessened toxicological effects on the environment and personnel.

3. Background

The statutes, regulations, and instructions governing the logistical handling of batteries within the Department of Defense, especially end-of-life demilitarization and disposal are listed below. These documents guide agencies, most importantly the Defense Logistics Agency, in the ultimate processing, recycling, and transportation of battery materials:

- Technical Bulletin TB 43-0134, Battery Disposition and Disposal
- DoDI 4160.28 - DoD Demilitarization (DEMIL) Program
- DoD 4140.1-R DoD Supply Chain Materiel Management Regulation
- DoD 4160.21-M - Defense Materiel Disposition Manual
- DoD 4160.21-M-1 - Defense Demilitarization Manual
- 49 CFR - Transportation

In excess of 1,000,000 pounds of batteries are used in OCONUS theaters of operation annually. Transportation via aircraft is costly such that hazardous wastes are almost entirely disposed of using land and shipping routes. There is also a safety concern of transporting dangerous and toxic materials that could damage or destroy aircraft and result in loss of life. Previous in-theater disposition of batteries included burn pits. Batteries disposed in burn pits present potential toxicity issues to servicemen. In-theater disposition is further compounded by batteries with greater than 38V which are export controlled items. These factors suggest that an in-theater disposition capability is needed to render components inert and safe for storage and shipping.

Primary batteries are widely used for military combat applications, rescue missions, remote light beacons, and remote controls. The most common primary battery types are AA and AAA. Alkaline batteries are the most used primary battery due to their low cost and versatility. They can be stored for up to ten years, are more environmentally friendly, and are safe for transport aboard aircraft without transport and other regulations. Lithium metal primary batteries offer higher energy densities and longer shelf life, but at a higher cost and with transport regulations. Secondary batteries include lead acid, nickel cadmium, nickel metal hydride, and lithium-ion. Lead acid batteries are the oldest rechargeable battery type, although lead is toxic and cannot be disposed in landfills.

Lithium batteries, both non-rechargeable and rechargeable, offer performance advantages well above the capabilities of conventional aqueous electrolyte battery systems. They have the highest energy density (watt hours/kilogram), highest volumetric energy (watt hours/liter), and one of the best storage lives of currently available battery systems. For the soldier, while lithium batteries initially cost more, they last two to 10 times as long, which means soldiers carry fewer batteries for the same mission. This is resulting in an increasing number of lithium batteries entering the military supply chain. As more lithium batteries collect in the military theaters of operation across the globe, the disposition of these hazardous items becomes increasingly challenging.

4. Cost and Duration of Proposed Work

The cost and time to meet the requirements of this SON are at the discretion of the proposer. Two options are available:

Standard Proposals: These proposals describe a complete research effort. The proposer should incorporate the appropriate time, schedule, and cost requirements to accomplish the scope of work proposed. SERDP projects normally run from two to five years in length and vary considerably in cost consistent with the scope of the effort. It is expected that most proposals will fall into this category.

Limited Scope Proposals: Proposers with innovative approaches to the SON that entail high technical risk or have minimal supporting data may submit a Limited Scope Proposal for funding up to $250,000 and approximately one year in duration. Such proposals may be eligible for follow-on funding if they result in a successful initial project. The objective of these proposals should be to acquire the data necessary to demonstrate proof-of-concept or reduction of risk that will lead to development of a future Standard Proposal. Proposers should submit Limited Scope Proposals in accordance with the SERDP Core Solicitation instructions and deadlines.

5. Point of Contact

Robin A. Nissan, Ph.D.
Program Manager for Weapons Systems and Platforms
Strategic Environmental Research and Development Program (SERDP)
4800 Mark Center Drive, Suite 16F16
Alexandria, VA 22350-3605
Phone: 571-372-6399
E-Mail: Robin.A.Nissan.civ@mail.mil

For Core proposal submission due dates, instructions, and additional solicitation information, visit the SERDP website.