SON Number: WPSON-16-03 **November 4, 2014**

Strategic Environmental Research and Development Program (SERDP)

FY 2016 STATEMENT OF NEED

Weapons Systems and Platforms (WP) Program Area

ENVIRONMENTALLY SUSTAINABLE MANUFACTURING FOR ENERGETIC FORMULATIONS

1. Objective of Proposed Work

The objective of this Statement of Need (SON) is to develop and mature novel technologies to reduce the environmental, safety and occupational health impacts of the manufacture and load-assemble-pack (LAP) of energetic formulations. Technologies of interest include but are not limited to alternative solvents, solventless processing techniques, or novel mixing technologies for all energetic formulations, including primers and detonators, rocket and gun propellants, secondary explosives, and pyrotechnics. Proposals should address high-use production or LAP methodologies, with a focus on current manufacturing processes. Additional consideration will be given to proposals that can be applied across multiple production processes or for technologies that can improve formulation performance (e.g., improved mechanical properties, increased solids loading, decreased sensitivity, etc.). Proposals must include the following elements:

- Laboratory evaluation of manufacturing processes including, but not limited to, relevant testing for material compatibility, processing time, processing temperature, energy and water use, and recycling capabilities.
- Small-scale energetic formulation to evaluate performance and sensitivity of the as-produced formulations.
- Pilot scale production of formulations.
- Evaluation of potential environmental properties and toxicity of the manufacturing process per ASTM Standard E2552-08, "Standard Guide for Assessing the Environmental and Human Health Impacts of New Energetic Compounds."

The SON is focused on manufacturing only. Proposals associated with synthesis of energetic materials are not of interest and will be considered nonresponsive.

Coordination with a manufacturing partner is highly encouraged as production processes should be compatible with current manufacturing methods.

2. Expected Benefits of Proposed Work

DoD needs cost effective, scalable technologies and methodologies for energetic formulation and LAP to reduce solvent, water and energy use and enable increased recycling or recovery of solvents and energetic materials both in manufacturing and at the end of service life. Alternative

manufacturing processes and technologies will reduce the potential for worker exposure to hazardous materials, the compliance burden through reduced reporting and permitting requirements and the cost of handling, treating and transferring regulated materials. Alternative processes and technologies also will sustain manufacturing capabilities by avoiding regulatory action by federal and state environmental regulators. Less flammable solvents, or solventless processing, will significantly reduce fire hazards in energetic production and during training exercises.

3. Background

DoD and its contractors process millions of pounds of energetic materials into a final usable formulation and load them into billions of items per year. This requires the use of hazardous materials and solvents in the manufacture and LAP of formulations for primary explosives, conventional ammunition, gun propellants, rocket and missile propellants, and pyrotechnics. Solvents generally are not incorporated in the final formulation, but are used in mixing materials to reduce viscosity of formulations or reduce dust for better processability, with the solvent evaporated off from the final product.

The current manufacturing base relies on processes that require workers to handle material or be in close contact with the formulations at different stages throughout the final formulation and LAP process. Many of the solvents have a high vapor pressure, which increases the likelihood of worker exposure through inhalation. Personal protective equipment and proper ventilation systems may be necessary to maintain compliance with current safe workplace occupational exposure levels. In addition, many of the solvents are flammable and require additional safety measures in the processing facility. Residual solvent in formulations has been linked to fire incidents during training exercises. Solvent containment, solvent recycling, and solventless processes have been evaluated in the past with varying success. Many alternatives have proven to be more expensive or do not meet final performance requirements.

Common solvents used in energetics manufacturing include methylene chloride (castable rocket propellants), ethyl ether, ethyl acetate, acetone and ethanol (gun propellants and pyrotechnics). These materials can be respiratory and skin irritants with acute toxicity effects, and methylene chloride is classified by the EPA as a probable cancer causing agent. Waste solvent must be handled as a hazardous waste and most require additional reporting requirements for use and release. Nitric acid, commonly used as the primary nitrating agent for many energetic materials including propellants, is also used as a key carrier solvent in energetic manufacturing. Excess nitrates can lead to significant waste in the production process.

Water is commonly used as a solvent for mixing in pressable formulations. While water is an environmentally preferable solvent, this water must be treated prior to release in the environment and the clean-up process to remove residual energetic materials completely can be difficult and energy intensive. Water is typically used in excess, and a large influx of water can strain wastewater treatment facilities. This makes it more difficult to remove all residual energetics from the water and increases the risk of releasing potentially regulated materials into the environment.

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 $150,000 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

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For Core proposal submission due dates, instructions, and additional solicitation information, visit the SERDP website at www.serdp-estcp.org/Funding-Opportunities/SERDP-Solicitations