SON Number: WPSON-14-02 **October 25, 2012**

Strategic Environmental Research and Development Program (SERDP)

FY 2014 STATEMENT OF NEED

Weapons Systems and Platforms (WP) Program Area

DEVELOPMENT OF REPLACEMENTS FOR POLYIMIDE COMPOSITE MATERIALS CONTAINING METHYLENE DIANILINE (MDA)

1. Objective of Proposed Work

The objective of this Statement of Need (SON) is to develop material systems to replace composite materials containing methylene dianiline (MDA) for Department of Defense (DoD) weapons systems and platform applications. PMR-15, a widely used high-temperature resin for aircraft engine components, contains MDA, a known carcinogen and a liver toxin. Legacy aircraft and engines utilize structures that are fabricated from PMR-15 resin based material systems, but future availability of this material is of increasing concern.

The non-MDA polyimide materials currently available for structural composite applications have different limitations associated with them (e.g., difficulty in processing and inferior thermal oxidative stability) that must be balanced against the need for introducing replacements in fielded weapons systems. Proposals responding to this SON should: (1) develop replacement materials for existing applications of MDA-containing composites, and (2) characterize the properties of the alternative materials. Proposed systems should yield solutions that will meet or exceed the performance of baseline materials containing MDA. All proposed projects should include an assessment of the human health and environmental impacts of proposed constituents and byproducts of the alternative materials to ensure they are not only less harmful than those containing MDA but also supportive of long-term sustainability goals. Alternate materials other than polyimides or new polyimide formulations may be proposed.

It is imperative that any novel materials not only meet new environmental regulations, but also perform as well as, or superior to, existing MDA-containing materials.

2. Expected Benefits of Proposed Work

The proposed research will provide benefits in several areas: (1) reduce risk to the supply chain by addressing an increasingly limited material and part manufacturing base associated with MDA availability, (2) potentially reduce costs resulting from increased competition offered by the larger manufacturing base available for non-MDA materials, (3) reduce manufacturing costs by eliminating certain environment, safety and occupational health (ESOH) issues (such as required medical surveillance, excessive personal protective equipment, and restricted manufacturing facilities), thus yielding increased production efficiency, and (4) reduce hazardous material usage and disposal costs. Manufacturers will be able to remove MDA-containing

materials from production facilities, eliminating the ESOH risks associated with their use. These benefits may also flow down to the military maintenance community in repair depots where major re-work occurs, potentially enabling maintenance to be conducted at depot level rather than at original equipment manufacturer (OEM) facilities. The elimination of MDA-containing materials will minimize the life-cycle burden of purchasing, handling, storing, using, and disposing of hazardous high-temperature structural composite materials containing MDA. The health and safety benefits will also offer enhanced quality of life for workers.

3. Background

Polymer matrix composite (PMC) technology is integral to meeting specification requirements for lighter weapons platforms with increased performance. Polyimide composites in particular address the need for reduced weight in the highest range of operating temperatures typical for PMCs. For many years, components made with polyimides containing MDA, such as PMR-15 reinforced with carbon or Astroquartz, have been in use in most military engine and some airframe applications. The PMR-15 resin system was developed in the 1970s by NASA and has since been applied on a wide variety of engine components exposed to operating temperatures up to 550 °F. One of its constituents, MDA, a known carcinogen and liver toxin, has placed the resin system under heightened ESOH scrutiny, resulting in a limited part manufacturing base and a single material supplier. Manufacturers of PMR-15 hardware encounter substantial obstacles to continue economically processing PMR-15 as the uncured prepreg must be handled in restricted rooms, the workers must don burdensome personal protective equipment, and worker exposure must be monitored through regular medical surveillance. MDA has been placed on the European Union's (E.U.) Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH) list of substances of very high concern (SVHC) which are expected to be banned from use by E.U. manufacturers in the near term. Similar regulations are under consideration in the U.S. and other countries. Legislation to amend the Toxic Substances Control Act (TSCA) that would limit manufacturing and processing of carcinogenic materials has been proposed in both the House and the Senate in 2010 (H.R. 2420 and S.3209). Furthermore, the only remaining source known for aerospace grade MDA is a company located in Japan, and the single source for PMR-15 prepreg is demanding year-over-year price increases from key customers. These factors combine to put the availability of PMR-15 based components from any airframe and engine OEM at high risk without a fully matured and demonstrated alternative for complex hardware.

A number of non-MDA containing alternative structural composites and adhesives have been developed and characterized for use in military applications. Most of these materials, however, have issues such as cost or difficult processing conditions that make selection of replacement systems challenging. With proper selection and development, non-MDA alternatives can offer improvements in worker health and safety, allowing for potential cost reductions relative to PMR-15 and increased competition generated by a potentially broader manufacturing base.

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:

<u>Standard Proposals</u>: 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 web site at www.serdp-estcp.org/Funding-Opportunities/SERDP-Solicitations.