SON Number: WPSON-16-02 **November 4, 2014**

Strategic Environmental Research and Development Program (SERDP)

FY 2016 STATEMENT OF NEED (SON)

Weapons Systems and Platforms (WP) Program Area

REDUCING OR ELIMINATING HAPS AND VOCS FROM POLYURETHANE RAIN EROSION COATINGS

1. Objective of Proposed Work

The objective of this Statement of Need (SON) is to develop a rapid curing, non-isocyanate erosion-resistant coating containing low to no volatile organic chemicals (VOCs) or hazardous air pollutants (HAPs). This coating must meet or exceed critical performance properties specified in SAE AMS-C-83231 Revision A to include peel strength, flexibility, water resistance, aromatic fuel resistance, rain erosion resistance, electrical transmission, surface resistivity, weather resistance, and strippability (see Table 1 in the Appendix below). In addition, resistance to lubricating oil and hydraulic fluid degradation is desirable (see Table 2 in the Appendix). Proposals for use of alternative materials must include a preliminary toxicological assessment of the alternative materials.

2. Expected Benefits of Proposed Work

Implementing the new coatings envisioned in this SON at radar dome (radome) coating operations at U.S. Air Force (USAF) depots will lead to significant environmental, occupational, safety, and health benefits, as well as increased productivity. Specifically, the project's purpose is to develop a reduced solvent-borne rain erosion coating systems saving VOC or HAP emissions by tens of thousands of pounds per year.

Occupational, safety and health benefits will be realized by eliminating worker exposure to isocyanate-containing coatings, and production improvements will result from significantly shorter coating cure times. Rapid-cure coatings can minimize the overall processing time required for paint application, allowing for the immediate assembly or installation of coated components, resulting in significant increases in production rates. Furthermore, reduced cure time also has the potential to eliminate rework required from coating contamination during application and curing.

3. Background

Some military aircraft and shipboard surfaces, such as radomes, antennas, gun shields, wing leading edges, and helicopter blade leading edges are coated with a specialized erosion-resistant protective coating possessing strict performance requirements such as those specified in SAE AMS-C-83231A. Current specialized protective coatings typically contain up to 800 grams per liter of VOCs and high levels of HAPs such as xylene, toluene and methylisobutylketone (MIBK). These multi-component coatings are cured by chemical reaction, and once mixed, any excess materials must be disposed of as hazardous waste. In addition, many of these coatings contain

isocyanates, which are hazardous and may be prohibited for use in the near future under the Prohibited and Controlled Chemical List (PCCL). There are currently no environmentally benign wear resistant coating alternatives that can meet performance requirements.

In addition to the environmental burden posed by these protective coatings, their use presents a significant production burden associated with application and cure times. The relatively thick coating required to ensure adequate performance means that multiple spray passes are made to achieve the final dry film thickness. With the relatively high solvent content of the coatings, a significant flash-off time is required between coating passes. As a result, the current coatings can take up to 12 hours to properly apply and 5 to 7 days to cure completely. Under less than ideal conditions, such as low humidity or temperatures, these cure times can increase significantly. These long cure times contribute to excessive backlogs in production and reduced availability to warfighters.

Thousands of gallons of these specialized coatings are used annually in the maintenance and repair of DoD weapon systems resulting in large cumulative releases of VOCs and HAPs. For example, Ogden Air Logistics Complex processes approximately 96 F-16 radomes a year, Warner Robins Air Logistics Complex reported processing up to 360 F-15 radomes and 240 C-130 radomes per year and Oklahoma City Air Logistics Complex processes approximately 100 KC-135 radomes and 24 B-52 radomes per year. Additionally, U.S. Navy aircraft such as the P-8A have over 100 radomes or antennas on the exterior of the aircraft that require periodic recoating.

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

Dr. Robin Nissan
Program Manager for Weapons Systems and Platforms
Strategic Environmental Research and Development Program (SERDP)
4800 Market Center Drive, Suite 17D08
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 at www.serdp-estcp.org/Funding-Opportunities/SERDP-Solicitations.

6. Appendix

Table 1 Critical Performance Properties (ref: SAE AMS-C-83231A)

Material Property	Test Method	Target Criteria	Substrate
Peel Strength	Following complete cure, 2-1" wide strips shall be cut lengthwise through the coating. The material will be peeled back at a 180 degree pull at 2 in/minute	7 pounds per inch	Composite
Flexibility	Conditioned at -54 deg C (-65 deg F) for 1 hour then bent over 1/8" mandrel per Fed Std 141 Method 6223	No cracking or loss of adhesion	2024-O anodized
Water Resistance	Immersion in distilled water for 24 hours at standard conditions. The exposed coupons will be tested for visual appearance and peel.	No evidence of blistering, swelling, checking or visible color change. Peel strength shall not be below 7 pounds/in	Composite
Aromatic Fuel Resistance	Immersion in ASTM D471 Fuel B for 1 hour. The exposed coupons will be tested for visual appearance and peel	No evidence of blistering, swelling, checking or visible color change. Peel strength shall not be below 7 pounds/in	Composite
Rain Erosion Resistance	Placed on propeller blade and spun at 500MPH in specialized rain erosion test rig.	No Erosion through a 0.012 to 0.014" coating after 150 minute (minimum) and 180 minute (goal)	Composite Air Foils
Electrical Transmission	Transmission efficiency of microwave power tested between several points on coated substrate.	Min electrical transmission of 85, 90 or 95 %	Composite
Surface Resistivity	500-volt megohmmeter used to measure resistivity between several points on coated substrate.	No less than 0.5 megohms nor more than 15 megohms per square	Composite
Weather Resistance	Continuous outdoor weathering for 6 months	No signs of film deterioration such as: chalking, checking, cracking, embrittlement, loss of adhesion or loss of resiliency	Composite
Strippability	Strippable using laser, Flashjet or approved chemical stripper.	Strippable	Composite

Table 2 Additional Desired Performance Properties (ref: MIL-PRF-32239)

Material Property	Test Method	Target Criteria	Substrate
Weather Resistance	Exposure for 3000hrs in a Xenon-Arc chamber that is cycling between 102 minutes of light only and 18 minutes of light and DI water spray	Color change $\Delta E \leq 1$ Adhesion $\geq$4B GE Impact Flexibility $\geq$10%	Composite Composite 2024-O anodized
Lubricating Oil Resistance	MIL-PRF-23699: Immersion in lube oil for 24 hours at 250±5°F	The coating shall not exhibit any blistering, softening, or other coating defects. Slight staining of the coating is acceptable	Composite
Hydraulic Fluid Resistance (MIL-PRF-83282 & Skydrol)	MIL-PRF-83282: Immersion in hydraulic fluid for 24 hours at 150±5°F; Skydrol: Ref. MIL-PRF-32239 (AF Coating System Specification)	The coating shall not exhibit any blistering, softening, or other coating defects. Slight staining of the coating is acceptable	Composite