

**Strategic Environmental Research and Development Program (SERDP)
SERDP Exploratory Development (SEED)**

FY 2015 STATEMENT OF NEED

Weapons Systems and Platforms (WP) Program Area

SUSTAINABLE SOLVENTS FOR USE IN DEGREASING

The SEED Solicitation is a means for researchers to test a proof of concept during an effort of approximately one year.

1. Objective of Proposed Work

The objective of this Statement of Need (SON) is to develop and evaluate novel solvents or blends of solvents for use in Department of Defense (DoD) degreasing applications. Proposed technologies must:

- be free of hazardous air pollutants (HAPs),
- have ultra-low or no volatile organic compound (VOC) content,
- have low or no global warming potential (GWP), and
- be capable of meeting military performance requirements when used in existing degreasing equipment.

Respondents may propose to investigate alternative aqueous or non-aqueous solvents for use in the vapor phase exclusively (i.e., in conventional vapor degreasing equipment) or in both the vapor and liquid phases (i.e., in vapor degreasing equipment with liquid immersion or spray stages).

The key technical challenge is achieving consistently high cleaning effectiveness on a variety of military relevant soils, substrates, and hardware configurations without necessitating major modifications or upgrades to degreasing equipment already in use. Proposed alternatives should be characterized for properties such as solvency, cleaning efficiency, flammability, flash point, boiling point, vapor pressure, stability, pH, materials compatibility, corrosivity, and composition. Depending on the target application (e.g., aluminum aircraft parts, steel ground vehicle parts, electronic assemblies, etc.), a number of different test methods may be needed to measure relevant chemical and physical properties against a wide variety of specifications, standards and performance requirements. Therefore, respondents should propose a complete test protocol containing all suitable test methods, specifications, standards and requirements relevant to the target applications.

Proposals addressing a single type of degreasing application will be considered, but preference will be given to those with the flexibility to address multiple applications. All respondents should include an assessment of the human health and environmental impacts of proposed

ingredients, formulations, and byproducts to ensure they are not only less harmful than baseline materials but also supportive of long-term sustainability goals.

Proposals to test and evaluate alternative cleaning processes or equipment (e.g., aqueous parts washers) are not responsive to this SON.

2. Expected Benefits of Proposed Work

Multiple installations across all military services and the National Aeronautics and Space Administration (NASA) would benefit from sustainable degreasing chemistries. The primary quantifiable benefits associated with sustainable degreasing chemistries stem from the reduced use, emission of, and exposure to current solvents. Fulfillment of this SON will avoid the need to purchase and install costly new airless/air-tight degreasers to comply with emerging VOC standards, and it will secure the availability of sustainable solvents as future regulations lead industry to transition away from high GWP chemicals. An added benefit results from the fact that numerous DoD industrial facilities have been forced to discontinue (or avoid installing) vapor degreasing operations due to a dearth of high-performing, compliant alternatives. Fulfillment of this SON would provide such facilities with the flexibility to choose the most effective cleaning process suited to their unique operations.

3. Background

Top performing degreasing solvents in use at military installations today include perchloroethylene (PCE), trichloroethylene (TCE), and normal propyl bromide (nPB). Both PCE and TCE have been identified as human carcinogens and HAPs, while a petition has been filed to list nPB as a HAP in response to emerging science regarding its toxicity. Both TCE and nPB are regulated as VOCs. Degreasing operations at Army depots alone utilize TCE and nPB on the order of tens of tons per year.

Vapor degreasing in military maintenance applications is unique in that it must be robust enough to process a wide variety of substrates, hardware configurations and (often unknown) soils. Conversely, many industry applications are focused on high volume production of a small number of uniform parts with well characterized greases.

The Joint Services Solvent Substitution Working Group (JS3WG) has identified several candidate alternatives to PCE, TCE and nPB. These solvents have been evaluated at the bench scale, and some have even been implemented in select applications at DoD and NASA installations. The most promising alternative blends contain trans-1,2-dichloroethylene (t-DCE) at roughly 50% to 90% by weight, with the balance made up of various fluorinated compounds. All of these alternatives are HAP-free, and some appear to perform as well or better than the baseline solvents. However, many fluorinated compounds are greenhouse gases with high GWP, and t-DCE is a VOC subject to regulation at the local, state, regional, and federal levels. The JS3WG is pursuing full-scale demonstration of one or more of these alternatives despite their undesirable VOC content and GWP, because elimination of toxic and carcinogenic solvents is currently a high priority to DoD and NASA. However, alternative solvent blends based on t-DCE and fluorinated compounds represent near-term bridging technology to eliminating PCE, TCE, and nPB but are not fully sustainable long-term solutions to sustainable degreasing operations sought by this SON.

One particular long-term sustainability concern is South Coast Air Quality Management District Rule 1122, (<http://www.aqmd.gov/rules/reg/reg11/r1122.pdf>) which requires that all degreasing equipment (both vapor degreasing and cold cleaning) that is not airless/air-tight must use a solvent with a VOC content of no more than 25 g/L. The majority of vapor degreasing equipment in use at DoD and NASA installations is not airless/air-tight, and the extremely low VOC limit (roughly equivalent to 3% VOC by weight) would disqualify TCE, nPB, and all promising available alternatives containing t-DCE. As a result, current DoD and NASA operations are unable to comply with the requirements of Rule 1122. The rule does not apply directly to any sources outside of southern California, but other regions across the country have borrowed heavily from Rule 1122 in developing their own VOC standards, including the Ozone Transport Commission (OTC) covering the entire northeastern U.S. from Virginia to Maine.

GWP is not yet widely regulated for degreasing solvents, but California has banned certain high GWP ingredients, and other regulatory bodies are expected to follow suit in the coming years. In June 2013, the United States and China reached an agreement to phase down high GWP hydrofluorocarbons under the Montreal Protocol on Substances that Deplete the Ozone Layer. Numerous industry sectors have begun to move away from high GWP chemicals voluntarily in anticipation of such regulations, making it more difficult and/or more expensive for DoD to continue procuring them in the future.

Respondents to this SON should also be aware of drivers outside of emerging toxicity studies and the evolving regulatory climate. The Environmental Protection Agency Office of Research and Development is interested in advancing the science of sustainable solvents through green chemistry, with particular focus on bio-based, bio-degradable and bio-renewable materials <http://www.epa.gov/research/greenchemistry/>. In addition, the U.S. Department of Agriculture recently established several new categories for various specialty precision cleaners, aircraft cleaners, and metal cleaners under its BioPreferred program <http://www.biopreferred.gov>.

4. Cost and Duration of Proposed Work

To meet the objectives of this SEED SON, proposals should not exceed \$150,000 in total cost and approximately one year in duration. Work performed under the SEED SON should investigate innovative approaches that entail high technical risk and/or have minimal supporting data. At the conclusion of the project, sufficient data and analysis should be available to provide risk reduction and/or a proof-of-concept. SEED projects are eligible for follow-on funding if they result in a successful initial project.

5. Point of Contact

Dr. Robin Nissan
Program Manager for Weapons Systems and Platforms
Strategic Environmental Research and Development Program (SERDP)
4800 Mark Center Drive, Suite 17D08
Alexandria, VA 22350-3605
Phone: 571-372-6399
E-Mail: Robin.A.Nissan.civ@mail.mil

For SEED proposal submission due dates, instructions, and additional solicitation information, visit the SERDP web site at <http://www.serdp-estcp.org/Funding-Opportunities/SERDP-Solicitations>.