SON Number: WPSON-17-02 **October 29, 2015**

Strategic Environmental Research and Development Program (SERDP)

FY 2017 STATEMENT OF NEED

Weapons Systems and Platforms (WP) Program Area

NO/LOW GLOBAL WARMING POTENTIAL ALTERNATIVES TO OZONE DEPLETING REFRIGERANTS

1. Objective of Proposed Work

The objective of this Statement of Need (SON) is to develop sustainable, non-ozone depleting, low global warming potential (GWP) refrigerants for military applications. To meet military requirements for efficiency, materials compatibility, flammability, and toxicity, proposals may 1) develop novel second generation Ozone Depleting Substance (ODS) alternatives, 2) explore options for modifying formulas or systems, or 3) develop new alternative formulations, blends or refrigeration technologies. Proposed solutions must maintain low GWP. All proposals should include an assessment of the human health and environmental impacts of proposed ingredients, formulations, and byproducts. Full proposals will be required to establish a baseline lifecycle framework and identify the elements of a life cycle inventory that are already known, those that will be investigated during the course of the project, and those that are beyond the scope of the proposed work.

2. Expected Benefits of Proposed Work

Program Managers, installations, and warfighters across all services would benefit from sustainable, next generation refrigerants for military applications. The alternatives sought by this SON would enable the Department of Defense (DoD) to sustain procurement of refrigeration systems that meet military requirements in the event that industry phases out current refrigerants. New refrigerants and systems would reduce flammability risk in weapon systems and reduce warfighter exposure to potentially toxic byproducts associated with the current generation of low-GWP ODS alternatives offered by industry. Critical toxicity data for existing, new, and projected refrigerant chemistries and their breakdown products will inform risk management decisions.

A sustainable alternative to the high GWP hydrofluorocarbon (HFC)-134a is likely to make a large quantitative impact due to its widespread use. Hundreds of thousands of pounds per year of HFC-134a are used across multiple variants of the High Mobility Multipurpose Wheeled Vehicle (HMMWV), the Mine Resistant Ambush Protected (MRAP) vehicle, and numerous other tactical and ground combat systems, as well as some aircraft and watercraft. In addition, other high GWP refrigerants such as R-410a (HFC-125 and HFC-32) and R-407c (HFC-134a, HFC-125 and HFC-32) also are used in quantities on the order of tens of thousands of pounds per year

throughout DoD. R-404a (HFC-143a, HFC-125 and HFC-134a) also is becoming of substantial interest and use.

3. Background

To replace ODS critical to military refrigeration and fire suppression applications, industry initially introduced HFCs as alternatives. Military organizations tested, evaluated, and implemented some of these chemicals in applications where they met performance, flammability and toxicity requirements. However, HFCs are considered greenhouse gases, and many of them have high GWP. As a result, these first generation, high GWP ODS alternatives are now under scrutiny to be regulated globally.

The details of the global phase down are still being negotiated by the Parties to the Montreal Protocol, but the U.S. government and industry have already begun moving toward second generation ODS alternatives. The U.S. Environmental Protection Agency (EPA) has begun removing some high GWP HFCs from the Significant New Alternatives Policy (SNAP) list for applications where low GWP alternatives are available. The DoD represents only a small portion of the global refrigerant market, so there is a risk that industry could stop producing refrigerants and systems that meet military flammability and toxicity requirements.

Military applications must address three primary concerns: efficiency, toxicity, and flammability. Toxicity and flammability do not pose a significant safety threat in commercial applications, but make it highly unlikely that the proposed second generation ODS alternatives can be used in military applications without significant modifications.

Efficiency: It is important for the next generation of ODS alternatives to be as efficient as current systems. Even a very small decrease in efficiency would result in indirect greenhouse gas emissions from burning fossil fuels, which could far exceed any climate benefit from reducing direct emissions from refrigerants, in particular for large refrigeration systems on Navy ships.

Toxicity: The risk of toxic byproduct generation in strictly commercial HFC-based refrigeration applications is negligible, so little is known about the conditions that could lead to unacceptable toxicity risks for the military. Exposure to HFC breakdown products (i.e., hydrogen fluoride and carbonyl fluoride) can cause devastating injury and death in certain scenarios unique to the military. The Navy already requires that refrigerants used in submarines must not produce toxic breakdown products when exposed to the onboard atmosphere control systems (i.e., carbon dioxide scrubbers and carbon monoxide/hydrogen burners). Further, initial results of an Army Public Health Command study on acute inhalation exposure to gaseous hydrogen fluoride and carbonyl fluoride suggest that carbonyl fluoride may be more harmful relative to hydrogen fluoride than had been believed previously. The breakdown of HFCs tends to produce more carbonyl fluoride than the halons that they were implemented to replace.

Flammability: To replace the high GWP HFC-134a in mobile air conditioning applications, industry is trending towards unsaturated HFC-1234yf, which has low GWP but is known to have flammability properties that may pose an unacceptable threat to military applications. Navy refrigeration systems, for example, can be located near nuclear or conventional-powered machinery spaces on ships and submarines where no level of flammability is acceptable. In other

air conditioning applications, industry had been using blends of HFCs to reduce flammability. R-410a is a mixture of equal parts HFC-125, which is not flammable but has high GWP, with HFC-32, which is flammable but has relatively lower GWP. Industry is now looking towards accepting flammability risk in exchange for reduced GWP by using straight HFC-32 without blending it to reduce flammability. For some refrigeration applications, industry is looking towards very flammable hydrocarbon blends almost certainly not acceptable in combat scenarios and likely not in certain DoD fixed facility applications, such as rooftop air conditioning units that are unprotected from blast or impact.

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 $200,000 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.