

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

FY 2023 STATEMENT OF NEED

Weapons Systems and Platforms (WP) Program Area

Lower Global Warming Potential Alternative Refrigerants for Military Use

1. Objective of Proposed Work

The objective of this Statement of Need (SON) is to identify, develop and test lower-global warming potential (GWP) alternatives to refrigerants in use by the Department of Defense (DoD). Of primary concern is development of an alternative to hydrofluorocarbon-134 (HFC-134), a refrigerant used in air- conditioning systems in various military systems. An alternative to HFC-23 for use in very-low temperature operations is also of interest. .

Alternative solutions should show the potential to provide cooling performance and efficiency equivalent to or better than current refrigerants to not only enhance the military mission, but to also reduce greenhouse gas emissions. Proposals may focus on any number of potential lower-GWP alternative solutions such as:

- Secondary loop systems that use hydrofluoroolefin (HFO) HFO-1234yf (or another low- GWP refrigerant) in the primary loop and a non-flammable fluid in a secondary loop that enters the crew/passenger compartment, including optimization to provide equivalent or better energy efficiency and potential operational benefits over legacy HFC-134a systems.
- Other commercially-available non-flammable refrigerants for use in equipment originally designed for use with HFC-134a and/or HFO-1234yf.
- Novel refrigerants or refrigerant blends that are nonflammable under battlefield conditions.
- Non-vapor compression technologies (thermoelastic, magnetocaloric, etc.).
- HFO-1234yf combined with other equipment/technologies to inhibit explosion and burning of the refrigerant and lubricant resulting from military-style threats.
- HFC-23 alternatives for very low temperature operations (-60 or -80°C that use HFC-23, with a GWP of 12,400)

Proposals using alternative refrigerants or refrigerant blends classified as “non-flammable” under industry standards must include plans to demonstrate non-flammability against a military-style threat. Army Research Laboratory is currently developing a laboratory-scale test method to characterize the flammability of refrigerants facing military-style threats, so this may offer one method to demonstrate non-flammability. In addition, any refrigerant alternatives proposed must have a GWP of less than 750 to be considered, but refrigerant alternatives with GWPs of less than 150 are desired. The toxicity and potential health hazards of alternatives in the neat agent, blend,

mixture or pyrolytic form should be considered for occupational exposure and in the event of system leaks or catastrophic failure that may expose personnel to the refrigerant.

2. Expected Benefits of Proposed Work

The outcome of this SON will enable DoD acquisition personnel and technical experts to develop plans for future Test and Evaluation efforts to qualify a lower-GWP alternative solution or to prepare acquisition specifications for new or retrofitted hardware using the alternatives identified.

Program Managers and military technical authorities across all services would benefit from having a suitable lower-GWP solution for use in air conditioning systems on military platforms that also ensures the safety and survivability of our warfighters. In addition, technologies developed here may also have applicability to the commercial transportation sector. This research could reduce DoD's future needs for HFC production to support mission-critical military end uses and could also provide additional alternatives for non-military applications.

3. Background

A global phase-down in the production of HFCs is currently underway as a result of the Kigali Amendment to the Montreal Protocol. In the United States, a phase-down is being implemented under the American Innovation and Manufacturing (AIM) Act. Although the Department of Defense (DoD) receives priority access to HFCs used in mission-critical military end uses, it will become increasingly difficult to acquire and sustain equipment that uses HFC-134a, since DoD is largely reliant on hardware that is derived from the commercial automotive industry, which is transitioning to HFO-1234yf.

While mildly-flammable HFO-1234yf has been shown to have low safety risks in commercial automobiles, this is not the case with air-conditioning systems used on weapons systems that are exposed to military threats. Testing has shown that while HFC-134a mixed with polyalkylene glycol (PAG) lubricant in an air conditioning systems did not react when exposed to small arms fire and a simulated improvised explosive device, HFO-1234yf and PAG lubricant created a fire ball with sustained burning.

Ideally, DoD would like to use the same refrigerant as the automotive industry, but technologies need to be developed that reduce risk to the warfighter. Some work has already been conducted related to the use of secondary loop systems; however, optimization of this type of system is necessary to ensure similar efficiency as current HFC-134a systems and to determine if this type of system can provide other operational benefits.

Implementation of other commercially-available non-flammable azeotropic refrigerant blends or novel new refrigerants/refrigerant blends may be feasible if they can show compatibility with existing automotive hardware, and offer similar performance and efficiency. Non-flammable refrigerant blends might also offer an opportunity for retrofit of existing equipment which could help simplify logistics support by transitioning all equipment (existing and new) to a single refrigerant.

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 3 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 \$250,000 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 Funding & Opportunities page on the [SERDP website](#).