FY 2019 STATEMENT OF NEED

Weapons Systems and Platforms (WP) Program Area

MULTIFUNCTIONAL FIBERS AND TEXTILES FOR WARFIGHTER INTEGRATED PROTECTION

1. Objective of Proposed Work

The objective of this Statement of Need (SON) is to investigate multifunctional fibers, textiles and/or impregnated fabrics that utilize formulations with environmentally friendly insect repellants, insecticides and/or flame retardants (FR). The research goal is to develop material formulations and processing techniques to examine a variety of novel fibers and textiles for performance. The effort will determine process engineering approaches to meet current and future performance requirements for the warfighter while eliminating hazardous insect repellants and or FR. Proposals addressing this SON will work with novel materials for the fiber formulations coupled with engineering processing solutions to meet textile performance especially after laundering. Material substitutions should result in equivalent performance and reduced risk to the environment. This SON expands fiber and textile research with an environmental emphasis that can supplement core Department of Defense (DoD) programs focusing on current and future high-performance textile applications.

Specifically, proposals are requested for novel and alternative fibers, blends of fibers, chemical treatments or processing techniques to impart (a) FR properties and/or (b) insecticide or insect repellent properties to military textiles, while posing lower life cycle environmental and health risks than the baseline and current state-of-the-art technologies described below. Proposals should also seek to advance the scientific understanding of such environmental and health risks.

Proposals should include a plan to conduct a Sustainability Analysis of appropriate proportion to the proposed research and development. Proposals should establish a lifecycle framework that can mature as the technology or process advances through the acquisition process. This tiered approach aims to develop and document a minimum data set at each stage of research and development that can be used to make informed decisions and streamline transition to an acquisition program. The Sustainability Analysis may include varying depths of data and information that can inform: the goal and scope of an analysis; the identity and quantity of relevant inputs and outputs to the system; and the estimation of life cycle impacts and costs.

2. Expected Benefits of Proposed Work

Program Managers, installations and, most importantly, Warfighters across all Services would benefit from sustainable, next generation multifunctional fibers and textiles. This is an opportunity
especially with the Nomex FR materials used by all services. This work will help to determine health and immediate environmental issues associated with both Nomex and FR treated materials as well as their lasting impact on the environment from end of service processes to include disposal and biodegradability.

Novel, more sustainable insect repellants imbedded in fibers or fabrics will reduce the potential for vector-borne illness and disease and improve readiness for the Warfighter. Reduced application cycles for insect repellants will reduce the logistics burden of maintaining adequate protection for the Warfighter.

3. Background

It was not until late 2007 that the Army began issuing FR Army Combat Uniforms (ACUs) to dismounted soldiers being deployed to Afghanistan and Iraq to reduce burn injuries when IEDs became a major threat. In 2009, the FR Army Combat Shirt was issued to provide soldiers with improved comfort as well as FR protection. Recently, Congress recommended that all military uniforms have FR capabilities. Unlike Nomex, which is an inherently flame resistant fiber – the flame resistance is part of the polymer chemistry – current FR systems (clothing and equipment) focus on chemically treated fibers or fabrics, or the blending of inherently FR fibers with chemically treated fibers/yarns. Current FR materials often include polybrominated diphenyl ethers (PBDE), which have been shown to persist in the environment and bioaccumulate in the food chain.

FR chemicals are “activated” by intense heat producing char and gases which inhibit combustion. Flame retardant products may represent a health and environmental hazard as the result of gaseous acidic combustion products - hydrogen chloride, hydrogen cyanide, nitric oxides, hydrogen sulfur oxides, and other combustion constituents being generated and released in the form of gasses and/or particulates. Little is known about the operational exposure risks for the Warfighter from off-gassing from FR materials during a fire event. At combustion temperatures (800°F), Nomex releases carbon dioxide, carbon monoxide, and sometimes traces of hydrogen cyanide and nitrogen oxides. Under less stringent heating conditions (below 800°F), Nomex degrades very slowly, releasing small quantities of organic compounds. The investigation into the health and immediate environmental issues associated with both Nomex and FR-treated materials merits further study, as well as their lasting impact on the environment such as disposal and biodegradability of these materials.

Industry is shifting away from brominated chemicals and is moving towards organophosphate flame retardants (OPFRs), such as triphenyl phosphate (TPHP), tris (1,3 dichloro-2-propyl) phosphate (TDCIPP) and tris (2-chloroethyl)phosphate (TCEP). However, there is evidence that inhalation exposure may be greater for OPFRs than for the PBDEs. Preliminary studies have found OPFRs transfer from products to users’ hands and leach from products during normal product use.

Mosquito-borne diseases are a significant health concern with over two billion people, primarily in tropical countries, at risk for diseases such as malaria, hemorrhagic dengue and yellow fevers, and filariasis (elephantiasis). Given the U.S. Military’s presence in tropical regions, this risk is a considerable threat that could have adverse effects on personal health of the Warfighter, and negative implications for military operations. There are a number of synthetic chemicals that are
currently used as insect repellents, with N, N-diethyl-m-toluamide (DEET) being commonly used for civilian and military insect repellent due to effectiveness at repelling mosquitoes and permethrin as a contact insecticide. Despite the wide-spread use of DEET, there are compelling studies that show negative health implications as a result of exposure to DEET. In humans, DEET can be irritating to skin and mucosal surfaces; in addition, toxic encephalopathy has been reported following skin exposure and ingestion. Studies have also shown that a small proportion of mosquitoes is not repelled by DEET, indicating that mosquitoes are beginning to display a resistance to the repellent.

Military personnel training in endemic areas may be instructed to treat their uniforms with permethrin. Currently, permethrin is only approved for use on outer garments, because direct exposure to permethrin can cause skin irritation and rash. It is also persistent in the environment and is toxic to multiple aquatic and terrestrial species, including fish (fresh and saltwater), bees and other beneficial insects and birds. Permethrin is currently the only insecticide that is approved by the EPA for use as a textile treatment and has been shown to persist on the textile even after extended laundering. Durability and replenishing spatial repellents (even in the case of DEET, since treatment must be reapplied multiple times for continued efficacy) has been an issue for the deployed Warfighter. Once applied, the spatial repellent is active and during subsequent laundering cycles would be reactivated, efficacy would be improved with every laundering. In the past, laundering has been the major reason for loss of repellent efficacy (especially in the case of permethrin treated ACUs). Wash-in spatial repellents treatments or direct incorporation of spatial repellants into the fibers could then be applied to all deployed Warfighters’ garments providing protection against vector-borne illnesses and diseases. Additionally, synthetic chemicals used for control of vectors are causing irreversible damage to the ecosystem, as some of them are non-degradable in nature.

Combat clothing such as flight suits and gloves should be manufactured from novel sustainable fiber blend fabrics and evaluated by the military user community for durability, comfort and overall performance in an operational environment. Legacy flight suits and the Army Combat Glove are fabricated from aramid fibers which are solution spun. Replacing half of those fibers with green and sustainable fiber could reduce military use of aramid fiber by up to 50 percent for these items.

The Weapons Systems and Platforms Program Area supports development of technologies and processes that are associated with the manufacture, operations, and maintenance of military equipment, weaponry, and munitions. These life cycle stages of a system may impact workers, the environment, and surrounding communities. Increasing the sustainability of these systems offers opportunities to identify and manage these impacts to lower associated life cycle costs and improve mission readiness. DoD’s Sustainability Analysis uses a life cycle approach to evaluate potential impacts associated with costs, ecosystem quality, human health, and resource availability.

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 are 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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