

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

FY 2020 STATEMENT OF NEED

Resource Conservation and Resiliency (RCR) Program Area

**INSTALLATION RESILIENCE RESEARCH: THEORETICAL
FRAMEWORKS FOR COMPOUND THREATS**

1. Objective of Proposed Work

The objective of this Statement of Need (SON) is to improve the analysis of compound threats such as natural hazards, resource unavailability, and technology failure to DoD installations through basic or applied research focused on the development of appropriate frameworks and modeling methods. Additionally, the relationship between risk of compounding events and resilience to them should be investigated since the lack of recovery and adaptation capabilities hold the potential to contribute to the risk of precipitating additional events. Specific research objectives include the following:

- Development of methodological approaches for assessment of the gains of resilience with specific strategies/structures, considering the costs and benefits with and without specific disruptive events and unknown systematic threats.
- Mapping the interaction of threats in ways that identify installation and facility vulnerabilities to multiple types of events.
- Development of strategies that support recovery from compound or catastrophic events that consider the role of DoD in the surrounding community.

Proposals are not required to address all of the above listed specific research objectives. Proposers should note that advanced technology demonstration is not being sought.

2. Expected Benefits of Proposed Work

The proposed research work will benefit the DoD's critical need to optimize resilience enhancements and improved understanding resulting from this research will directly impact the DoD's ability to implement strategies for resilience in the face of major catastrophes, broadly enhance DoD's ability to protect assets, increase adaptability, and support power projection and global operations.

3. Background

Military installations face the threats that afflict modern societies, such as natural hazards, resource unavailability, and the failure of technology, yet their military mission requires the installations to maintain their functionality in the face of these threats. The compounding of risk, however, makes

the maintenance of functionality even more difficult and unpredictable. Compounding risks result from threats which interact and trigger additional events that thereby heighten the threat to functionality of physical infrastructure. Currently, for the purposes of risk management, the potential impacts of a threat are often assessed for specific scenarios. In these scenarios, both the threat and system vulnerability are specified, which necessarily but inadvertently excludes many plausible unspecified compound threat scenarios. As a result, risk management solutions often address a limited number of threats and vulnerabilities, are confined to a limited number technology areas, and tend to primarily focus on assessing and hardening individual components of complex systems under a specific threat scenario. This approach can be costly across environmental, economic, and societal domains while still missing the compounding events risk.

While efforts have long existed to understand and prepare for extreme events driven by single causes, less is known about how systems can be resilient to compounding events risk. Compounding events cannot currently be sufficiently or practically addressed by traditional risk assessment and mitigation approaches. When a high degree of interdependence among systems is observed, the underlying systemic risk is difficult to characterize since the pathways that can cause impact (i.e., vulnerabilities) to complex systems move along multiple pathways. Perhaps an approach more tractable than adopting specific safeguards for specific events may be to develop systems and structures for rapid and efficient recovery of mission critical functions following disruption without regard of the combination of events that might occur. To determine the validity of this hypothesis, research is needed to examine how and to what extent DoD installations and other infrastructure systems might frame the risk of disruption from compound events and the ability of installations to recover and adapt mission critical functions. In addition, other hypotheses may provide fruitful lines of discovery and may be proposed as research foci.

Prior and existing initiatives at the DoD have examined aspects of resilience and compounding events risk; nonetheless, a distinct gap remains in understanding how to consider installation resilience to compound events risk. Risk-based approaches have been applied to the problem of addressing vulnerabilities in these systems, through methods such as mapping the interaction of threats, identifying vulnerabilities to multiple types of events, and conducting “red team” analyses for various assets and facilities; each has their weaknesses. In addition, historically applied statistical and probabilistic frameworks appear to have limited utility in light of uncertainty and increasing complexity.

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 four 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](#).