1. **Objective of Proposed Work**

The objective of this Statement of Need (SON) is to improve our fundamental and applied understanding of wildland fire combustion processes for the purposes of elucidating the dominant processes driving fire behavior in wildland environments. Given the prevalence of the use of prescribed fire by Department of Defense (DoD) managers to mimic historical, low-intensity surface fires, a primary focus is improved understanding of the processes involved in fine-fuel heat exchange, ignition, and fire spread and how they may be affected by fuel condition.

Specific research needs include improving our understanding of the following:

1. Open combustion processes at fine to landscape scales with a focus on the flaming and short-term (hours) smoldering phases.
2. Fire spread across heterogeneous fuels through either particle-scale or fuel-bed scale type combustion processes.
3. Role of fuel characteristics in the combustion process, including the burning of live fuels (as distinct from dead fuels), and how this affects fuel consumption.
4. Measured or modeled physics of heat transfer and fire propagation as a coupled fire-atmospheric dynamic.

Outcomes of proposed research should be developed in a manner that enables them to be incorporated into fire behavior models useful for predicting ecological effects and emissions responses. It is expected that additional work beyond this SON will be required to accomplish this incorporation and to subsequently validate these models.

Proposals must address the SON objective and one or more of the research needs. **Proposals must be explicit with respect to how they address the objective and research needs.** The combustion processes chosen for study must be relevant to multiple DoD installations in the United States or its territories and associated vegetation types that DoD manages using prescribed fire, with a particular focus on the fine fuels associated with open-canopied forest systems.
2. Expected Benefits of Proposed Work

The desired outcome is knowledge that improves our understanding of the processes involved in fine-fuel heat exchange, ignition, and fire spread and how they may be affected by fuel condition that can then be incorporated into fire behavior models useful for predicting ecological effects and emissions responses. Such understanding will not only advance the science but will be developed in such a manner that resultant models and tools will be appropriately targeted to the DoD fire manager.

3. Background

Modeling the physics of open combustion in wildland fires continues to be an area of priority research in the wildland fire community; however, fire behavior remains an elusive area of inquiry with a need to more comprehensively understand heat transfer processes (e.g., radiant or convective heat release and consumption), define relevant variability in fuels and fire behavior responsible for those processes, and ultimately to advance modeling tools capable of delivering the science to managers. Predictive modeling tools that describe the pyrolysis and combustion processes have been dominated by empirical and semi-empirical approaches rather than physics-based approaches. The dominant processes of heat transfer (in particular, convection), buoyancy, and turbulence are poorly measured at multiple spatial and temporal scales and poorly understood in complex open burning environments. Assumptions must be made in current fluid dynamics modeling as to the interactions of these dominant processes in producing observed fire behavior.

Linking open combustion processes and mechanistic understanding of fire spread is particularly critical for low intensity prescribed fires—used extensively by DoD resource managers—and at fine-to-operational spatial scales, in which fuel particles (i.e., leaves, needles, pinecones) and fuel bed properties merge. An improved understanding of combustion science and fire behavior is a critical first step in understanding mechanistic fire effects in these systems. In particular, improved understanding of processes governing variability in the combustion environment is needed to facilitate predicting ecological responses in an uncertain future of novel ecosystems and climate change. Moreover, an improved understanding of combustion processes and fire behavior enhances our knowledge of emissions production and smoke management.

The DoD is second only to the Department of Agriculture in the number of acres burned by prescription each year. Prescribed fire is critical to the military mission by reducing fuels loads in impact areas and ranges due to the high probability of ordnance-caused wildfires. DoD has also hosted numerous interagency fire science projects and this SON should further interagency inquiry into the field of wildland fire science.

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 of up to $150,000 over approximately one year. 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](http://www.serdp-estcp.org/Funding-Opportunities/SERDP-Solicitations).