1. **Objective of Proposed Work**

The objective of this Statement of Need (SON) is to generate a database of correlated exhaust flow and noise measurements from high-performance gas turbine engines to gain an improved fundamental understanding of the physics of noise generation in supersonic military jet engines. Based on the data collected, proposers ultimately should identify flow features that must be incorporated into laboratory experiments and numerical models used to predict and reduce noise from these engines.

To address the objective, flow and noise data must be acquired during operation of one or more suitable engines over the full operating range from idle to maximum afterburner. Suitable engines include any full-scale low-bypass turbofan/turbojet with afterburning capability relevant to tactical aircraft application. Information on the availability of qualified test facilities and engines for testing is available in the Appendix below.

The measurements of interest include: (1) mean temperature and velocity as well as turbulent velocity statistics through the jet plume acquired with sufficient resolution to allow for the correlation of full scale engine features with numerical models and laboratory-scale measurements, (2) highly detailed near-field pressure and/or noise measurements that allow for the correlation of flow features with the production of noise, and (3) detailed far-field noise measurements. The measurements must be made such that the flow data and acoustic data can be correlated. If flow and acoustic measurements are made in separate tests, appropriate baseline data must be acquired throughout all testing to ensure test conditions are consistent across individual tests. Conversely, if measurements are made simultaneously, data must be acquired to ensure the different measurement techniques do not interfere and adversely influence each other.

2. **Expected Benefits of Proposed Work**

Successful completion of this work will provide a better understanding of the major sources and mechanisms of noise generated by the engines of high-performance military aircraft. The results are expected to: (1) enhance aeroacoustic analogies using noise-source models derived from Reynolds averaged Navier-Stokes solutions, (2) validate and improve large eddy simulation solutions used to predict noise from large-scale structures in relevant jet exhausts, (3) quantify
linear and non-linear propagation regions for predictive code development, (4) quantify near-field noise for predictive code development, and (5) guide development of realistic experiments designed to understand and reduce jet noise sources in high-speed, hot engine plumes. This knowledge will enable the development of technologies to predict and reduce noise from engines while minimizing the impact to engine performance.

3. **Background**

The Department of Defense (DoD) operates increasingly higher performance, supersonic military jet aircraft using very high-power, low-bypass, supersonic-jet-flow gas-turbine engines. Despite increasingly restrictive aircraft operational guidelines, DoD high-performance jets are significantly louder than commercial aircraft in all operational modes. With the growth of communities surrounding DoD installations, noise from the operation of military aircraft is an increasing concern. These noise levels are already causing significant pressure for reductions in aircraft numbers and/or available airspace for training and operations. Additionally, some DoD personnel perform duties in the acoustic near-field of engine plumes and are exposed to very high noise levels that are a known safety concern. Veterans Administration claims related to hearing impairment are the single largest category of claims, and are increasing.

The DoD is aware of the issues and impacts on the environment from noise generated by high-performance supersonic military aircraft such as the F-35 Lightning II Joint Strike Fighter (JSF), F-22, and F/A-18 E/F. Current and potential U.S. and international noise regulations and policies threaten to impact future basing considerations as well as operations and training requirements.

Research and development activities focused on reducing the noise generated by high-performance supersonic aircraft are limited. Effective noise reduction technologies cannot be developed through a trial and error approach on a real aircraft. The costs associated with this approach are prohibitive and rarely lead to success. Technology development occurs through a combination of numerical modeling and laboratory experiments. A relevant database, including comprehensive and correlated flow and noise measurements from a real engine, does not exist to guide technology developments in the laboratory or for numerical simulations. In addition, data sets are not available on supersonic jet engines that include sufficient measurements needed to correlate and compare numerical models or scaled/wind-tunnel test data. This SON aims to obtain a relevant database and close the gap between our understanding of noise sources in simplified experiments and simulations and those present in real, supersonic, jet-engine exhausts.

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 $150,000 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**

Dr. Robin Nissan  
Program Manager for Weapons Systems and Platforms  
Strategic Environmental Research and Development Program (SERDP)  
4800 Mark Center Drive, Suite 17D08  
Alexandria, VA 22350-3605  
Phone: 571-372-6399  
E-Mail: robin.a.nissan.civ@mail.mil

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)

6. **Appendix**

Suitable test facilities must be able to support the safe operation of a high performance engine, and make accurate measurements of required noise-related parameters. Government test facilities exist that are suitable and potentially available for purposes of this SON. In addition, military engines exist in inventory that may be used as Government Furnished Equipment for purposes of this SON. For information on cost and availability of assets, Points-of-Contact from the following services/agencies are provided:

- U.S. Department of Navy – Tom Weiss, 301-757-3420, thomas.weiss@navy.mil  
- U.S. Air Force – Barry Kiel, barry.kiel@wpafb.af.mil  
- National Aeronautics and Space Administration – Brian Fite, brian.fite@nasa.gov