RQ 15-4

1. **Research Title:** Augmentor Development via Improved Fundamental Understanding and Innovative Design

2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level:** Engineering or Science (MS or Ph.D. level)

4. **Objectives:** Research current flameholding mechanisms to understand the physics of bluff-body combustion instabilities and develop innovative flameholding concepts to mitigate static and dynamic instabilities, reduce the weight and length of augmentors, improve combustion efficiency, and decrease total pressure loss. This project would include any effort to design, develop, model, test, and/or characterize the combustion system. The application of advanced or novel time series data analysis techniques is encouraged to further the understanding of thermoacoustic instabilities.

5. **Description:** In general, modern augmentors employ close-coupled fuel injector/flameholder designs. Flame instability in practical combustion systems has been a topic of great interest due to unresolved complexities of the coupling of fluid dynamics, sprays, turbulence, and chemical kinetics, all of which have a direct influence on the combustion-induced acoustics known as screech and rumble. Understanding the reacting flow field behind these flameholders is of great importance to design stable combustion systems free of thermoacoustic oscillations and with sufficient lean blowout characteristics. Combustion instabilities are one of the least understood phenomena in combustion and a major challenge and risk in modern gas turbine engine design. In bluff-body flames, hydrodynamic instabilities associated with vortex shedding and density gradients across shear layers have been identified as potential sources of combustion instability. Due to the dependence on vortex dynamics and the length of bluff-body reaction zones, thermoacoustic oscillations in this type of flame require experiments and simulations that provide information at multiple physical scales and across a large spatial domain, stretching the limits of diagnostic abilities and modern computing power. A better understanding of the fundamental aspects of thermoacoustic oscillations is required to improve the performance of existing systems. For future systems, the characterization of new flameholding concepts in the context of overall augmentor design objectives could provide an innovative solution to the instability issue.

6. **Research Classification/Restrictions:** This research is unclassified and unrestricted.

7. **Interest in Summer USAFA Cadet: No**

8. **Eligible Research Institutions:**

■ Universities (DAGSI & AFIT) ■ AFIT (only) ☐ USAFA

Public Release Pending