RQ19-11

1. **Research Title:** High-Altitude Combustion Ignition and Relight Research
2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level:** Aerospace Engineering / Mechanical Engineering / Chemical Engineering / Engineering Physics (MS or Ph.D. level)
4. **Objectives:** The proposed topic aims to improve the combustion performance, efficiency, and the reliability of ignition and relighting at high-altitude of a real and operational, aviation, gas turbine combustor. Research, characterize, and modify the combustion and ignition system for an in-depth investigation.
5. **Description:** There exists a need for understanding and enhancing aviation combustor performance and efficiency during extreme, high-altitude ignition conditions. During high-altitude-relight events, the required ignition energy is many times that of atmospheric due to deteriorating combustor performance, efficiency, and atomization. This poses a risk to both military and commercial aviation aircraft. Next-generation combustor technology must demonstrate robust performance at these extreme operating conditions. The ability to simulate the low pressures and temperatures necessary for high-altitude studies is required for a complete investigation. The primary goals of this study are to:
    a. Evaluate the performance and efficiency of a real, aviation combustion system during high-altitude relight.
    b. Investigate the ignition characteristics of the combustion system at high-altitude conditions, including the flame propagation, transient behavior, steady state behavior
    c. Study the effects of hardware modification(s) on its performance and efficiency.
    d. Propose techniques/modifications to enhance relighting capabilities and combustion efficiency during these extreme conditions.

    Emphasis will be placed on developing an analytical framework to model the ignition process at altitude as well as developing a reliable system for measuring and obtaining experimental data for model validation. Novel energy deposition approaches that can be experimentally demonstrated and quantified with respect to conventional ignition strategies that rely on high energy arc discharges are sought. Additionally, there may be opportunities to collaborate with the AFRL/RQT Combustion Research Complex to execute a portion of the proposed research.
6. **Research Classification/Restrictions:** Open to U.S. citizens only. Some aspects of this research may include ITAR restrictions.
7. **Eligible Research Institutions:**

[redacted] **DAGSI** (All DAGSI Universities). PA Approval #88ABW-2017-3609.