RQ 19-6

1. **Research Title:** Advanced Thermal Management System Simulator – 1. Cryogenic Fuels
2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level**

Chemistry, Physics, Chemical Engineering, Mechanical Engineering, Aerospace Engineering
Thermodynamics, Heat Transfer, Fluid Dynamics, Modeling

4. **Objectives:** To establish basic experimental simulator capabilities (reduced scale) utilizing cryogenic fuels (liquid methane) with ambient fuels (Jet A) to study complex interactions and behaviors of a two-temperature regime fuel system.

5. **Description:** In modern high performance aircraft, the fuel serves multiple functions; energy source for the combustion process, thermal fluid, and auxiliary functions (e.g. lubricant, hydraulic fluid). The role of fuel as a thermal fluid is becoming increasingly a limiting factor in future designs as the desired heat loads to be managed greatly exceed the capability of simple hydrocarbon-based fuels to accommodate, and as components within the proposed systems become less heat tolerant. One possible addition to an advanced fuel-based thermal management system is the incorporation of a cryogenic fuel to provide significant added cooling capability to the overall system, and to provide cooling to low temperature heat loads (e.g., electronics). In order to understand the implications of a mixed cryo-ambient fuel system (heat transfer, fluid transport, fluid mixing, pressure effects, and phase changes) we intend to explore the addition of a cryogenic component to our ambient fuel system simulator capabilities. The experimental system will them be capable of investigating heat transfer phenomena under dynamic conditions, where the data collected is meant to establish predictive modeling capabilities. In addition, the system will be used to examine fuel system components and behaviors under multi-phase operations. Exploration of unique components, designs, and operational conditions is anticipated.

6. **Research Classification/Restrictions:** Open to U.S. citizens only. Unclassified, public releasable.

7. **Eligible Research Institutions:** Indicate to what organizations this topic should be provided

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