RQ 21-60

1. **Research Title:** Modeling and Simulation Study of Aircraft Environmental Control System for UAS Military Aircraft.
2. **Individual Sponsor:**

Dr. Abdeel J. Roman, AFRL/RQQM
AFRL/RQQ
1950 Fifth St bldg. 18
WPAFB, OH 45433
Abdeel.roman@us.af.mil

3. **Academic Area/Field and Education Level**
   Aerospace Engineering / Mechanical Engineering / Fluid Mechanics (MS or PhD level)
4. **Objectives:** Model novel aircraft environmental control system architectures to reduce and mitigate water and ice formation downstream of air cycle machine. Study aerodynamic and aeromechanic physics of an air cycle machine and compare to experimental datasets. Determining the military utility of these thermal concepts via modeling and simulation-level analysis (e.g. Simulink/ATTMO, Fluent).
5. **Description:** Current UAV legacy capabilities can only operate in permissive environments. This constraint has been fine for the kinds of conflicts the United States has fought recently. However, in conflicts with high-end competitors, these aircraft would be vulnerable because of their slow speed, high visibility, and lack of defensive systems. Electrical power and thermal management are critical enabling technologies required to expand the capabilities of future affordable unmanned autonomous systems (UAS). One critical thermal system technology that leverage on-going power and thermal management efforts is the aircraft environmental control system (ECS). Highly efficient ECS technologies are critical to achieving bleed optimization and highly subfreezing sink temperatures. Advancements in Air Cycle Machine (ACM) technology could lead to highly subfreezing air, thus enabling the reduction of engine bleed demand compared to traditional legacy systems limited to above-freezing air temperatures. Because of the highly subfreezing nature of ACM systems, less technically sophisticated Vapor Compression System (VCS) technologies are required to meet the WSC requirements, thus enabling the use of current legacy VCS components. However, one limitation of this system is the removal of water and ice formation. In this work, modeling and simulation will be conducted to determine potential solutions to reduce water content and ice formation in an ECS system.

6. **Research Classification/Restrictions:** Open to U.S. citizens only. Some aspects of this research may include ITAR restrictions.
7. **Eligible Research Institutions:** **DAGSI** (All DAGSI Universities).

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