1. **Research Title:** Unsteady Flow Physics and Aerodynamic Flow Control in High-Work Low Pressure Turbine Passages

2. **Individual Sponsor:**

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

   Mechanical or Aerospace Engineering (MS and/or PhD level – PhD preferred)

4. **Objectives:** The objectives of this DAGSI project is to conduct research related to the complex flows found in very high-work, high-efficiency, highly-loaded low pressure turbines (LPTs) – i.e. flow stability under high pressure gradients, separation characteristics, complex three-dimensional endwall flows, unsteady flow interactions - and the development of relevant active and passive boundary layer and secondary flow control technologies. Research can be focused on better fundamental understanding of the relevant flows, computational modeling, and/or control of the flow physics/flow interactions which generate passage losses through high-lift LPTs.

5. **Description:** The LPT in a gas turbine engine can account for up to 30% of the overall engine weight and contributes significantly to engine part count and cost. Increasing the loading (and therefore the work output) of individual LPT blades can therefore significantly reduce engine weight and cost. However, increased blade loading can result in reduced efficiency, reduced tolerance to off design operating conditions, and enhancement of undesirable secondary flows. Improved modeling capabilities combined with innovative design and flow control methodologies offer the opportunity to develop very highly loaded LPT designs that offer the efficiency, robustness, and wide operating range required for practical use in a gas turbine engine.

   Current research is focused on understanding the fundamental flow physics and reducing the aerodynamic losses in high-work turbine passages through computational modeling and detailed experimental measurements of the flow field. Research interests include better understanding of flow separation across the blade span, unsteady flow interaction, three-dimensional flow physics and dynamics, design and optimization of active and passive (surface shaping) flow control methods to reduce losses through the passage, and development of blade designs with integrated boundary layer and endwall flow control. Detailed experimental measurements can be made using the Air Force Research Laboratory Aerospace Systems Directorate turbine cascade facilities. Tomographic and High-speed Stereo Particle Image

Velocimetry (SPIV), hotwires, surface mounted hot films, and various pressure probes are available.

6. **Research Classification/Restrictions:** The bulk of this research will fall under the 6.1 basic research classification. Some aspects, in particular those dealing with specific engine configurations and performance parameters, will be Official Use Only and may have ITAR restrictions.

7. **Eligible Research Institutions:** DAGSI Universities