

1. **Research Title:** High Work High Efficiency Low Pressure Turbine Aerodynamics
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 and reducing pressure losses in the endwall region of high lift LPT blades through computational modeling and detailed experimental measurements of the flow field. Research interests include unsteady flow interaction in the endwall region, three-dimensional endwall 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. 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:** Indicate to what organizations this topic should be provided

DAGSI (All DAGSI Universities). PA Approval #88ABW-2017-3609.