Department of the Navy SBIR/STTR Transition Program

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Topic # N21A-T017
Compact Electric Compressors for Aerospace Applications
Candent Technologies Incorporated

WHO

SYSCOM: ONR

Sponsoring Program: ONR STTR Program

Transition Target: At this time no Program of Record or specific weapon system has been identified as the target of this technology. However, in combination with the Active Flow Control (AFC) technology, the system would be applicable to current and future fleet tilt rotor, tilt wing, and rotorcraft, as well as manned and unmanned conventional aircraft.

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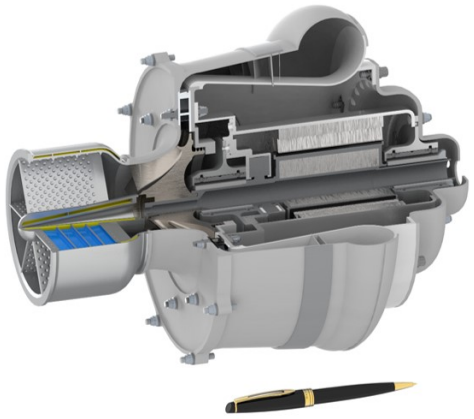

Image Courtesy of Candent Technologies, 2023

Other Transition Opportunities: Another potential transition opportunity is the application of the AFC and compressor technologies to unconventional configuration aircraft, both in the manned and unmanned realm, and in particular those powered by hybrid or all electric propulsion. In addition, commercial aircraft can use the technology to enhance stability and control of the aircraft by applying the AFC to control surfaces such as the vertical tail, where effectiveness can be improved, particularly in low airspeed flight regimes.

Notes: The electric driven air compressor system shown in the graphic above has been designed to provide 1.0 lbm/s of airflow, at a pressure ratio of 2:1, and has a very compact envelope with maximum length of 13.5 in., and a maximum diameter of 10.4 in. The weight of the system is only 22 lbs. It also has a self-contained cooling system for the electric motor.

WHEN

Contract Number: N68335-23-C-0054 **Ending on:** Oct 30, 2024

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Phase I Initial Aero & Mechanical Design Complete	Low	2-D flow analyses results and mechanical design compliant with requirements	3	4th QTR FY21
Phase I Controller Breadboard Test	Medium	Output power and wave form per design intent – Passed Test	4	4th QTR FY22
Phase II Aero Design CFD Analysis	Medium	2-D Flow analysis correlates with 3-D CFD analysis	4	3rd QTR FY23
Phase II Motor Design Completed	Medium	Design analysis shows full compliance with specifications	4	3rd QTR FY23

WHAT

Operational Need and Improvement: Active Flow Control (AFC) can be used to enable/enhance aircraft control/stability by modulating the flow and pressure differential across a control surface or wing. A compact, electric air compressor is an optimal solution that can provide the flow needed to operate the system, and that can be placed in close proximity to the control surface or affected region of the aircraft. This will mitigate the need to use engine bleed air (most often used), which requires heat exchangers, extensive plumbing, and somewhat larger engines to provide the additional flow. Auxiliary Power Units (APU) are also being used, but their size and weight are less than optimal, whereas the electric air compressor is much smaller, lighter, and efficient.

Specifications Required: The electric air compressor must be designed and developed to deliver at least a pressure ratio of 2:1, and provide a mass flow rate on the order of 1.0 lbm/s. Its volume and weight must be optimized in order to minimize installation envelope and supported mass. In addition, the design must include an assessment of filtration requirements, and must be able to withstand typical military aircraft vibration levels as per MIL-STD-810.

Technology Developed: During the STTR Phase I, Candent completed the feasibility analysis and the conceptual and preliminary design of a fully compliant, optimized compact, lightweight, high efficiency electric driven air compressor, which has its own internal, self-contained cooling system. The preliminary design of the electronic controller and the motor were completed, and a successful controller breadboard test was conducted which fully confirmed the design intent. As work progresses now under Phase II, the final aerodynamic, thermal, electrical, and mechanical design of the system is now nearly complete.

Warfighter Value: AFC system technology can be enabled by compact, electric compressors, which are smaller, lighter, easier to integrate with an airframe and to locate near the point of AFC application on the aircraft, while avoiding use of engine bleed air or APUs. The synergism of the AFC and compressor technologies allows the mitigation of phenomena such as rotor downwash impact on the V-22 and other rotorcraft, as well as enhanced vertical tail effectiveness on fixed wing aircraft and unconventional configuration airframes, especially those powered by hybrid or fully electric propulsion systems.

HOW

Projected Business Model: The commercialization strategy includes marketing via trade shows, conventions, conferences and expositions, such as Sea Air Space (SAS), NAVAIR FST Event, American Helicopter Society (AHS), etc. utilizing the Navy STP facilitation and later independently. In addition, the campaign will include extensive plans to pitch the technology to the various targeted Government agencies and potential commercial customers, as well as advertisements in trade publications. In order to minimize the required initial investment, as well as operating overhead costs, Candent plans to outsource manufacturing, prototype through LRIP and full production, of all components to existing experienced, qualified, US based component manufacturers, and limit Candent's activities to performing assembly and test of the final product. This approach minimizes system manufacturing startup costs and provides a smooth pathway to series production. Alternative approaches are being considered to partner, or license or sell the technology to one of several major OEMs with whom we have been exploring use of the technology in their aircraft designs.

Company Objectives: The objective of the commercialization plan is to, in the end, obtain financing, secure a market position, and produce the hardware for dual use aerospace and defense applications.

Potential Commercial Applications: Although no specific application has been confirmed at this time, Candent will pursue potential use on commercial aircraft, fixed wing, tilt rotor/wing, rotorcraft, and unconventional configuration manned and unmanned aircraft, particularly hybrid and all electric powered aircraft.

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