NASA SBIR/STTR Technologies

X10.01-8855 - An Advanced Wet Expansion Turbine for Hydrogen Liquefaction

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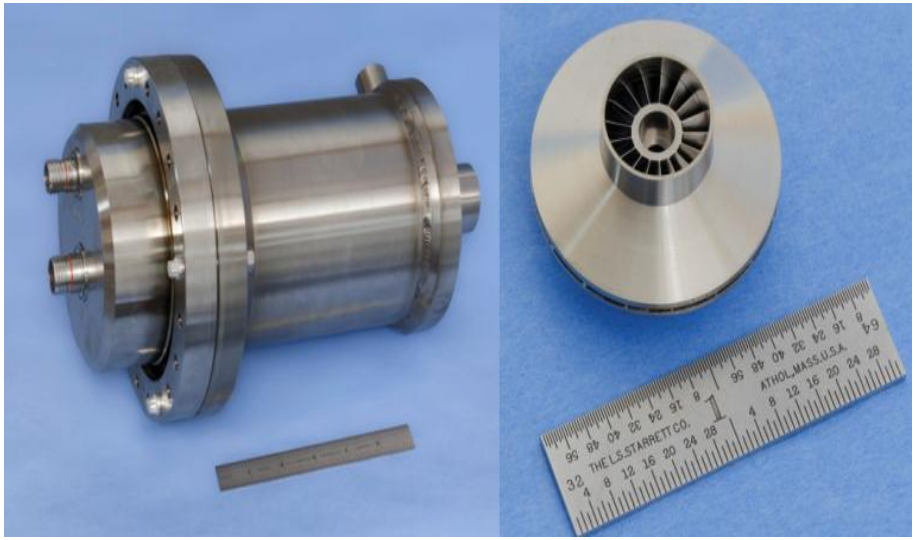
Identification and Significance of Innovation

This proposal is responsive to NASA's need for efficient small- to medium-scale hydrogen liquefaction technologies to support future spaceport, planetary, and lunar surface missions. Our approach is to add expansion turbines to the product stream to cool and help liquefy the hydrogen gas. This approach has been shown by analysis to reduce liquefier input power by 17 to 18%. The impediment to realizing this savings is the availability of expansion turbines that can meet the requirements of the application. Commercial turbines are too large and have been designed for higher capacity. This work directly supports renewable energy and energy efficiency initiatives by enabling a more efficient liquefaction system for hydrogen. The turbines can also be used in Brayton cryocoolers being considered for use in large superconducting wind turbines.



Estimated TRL at beginning and end of contract: (Begin: 4 End: 5)

Technical Objectives and Work Plan

On this Phase II project, Creare will demonstrate cryogenic expansion turbines for use in hydrogen liquefiers. The expansion turbines will be reliable, compact, lightweight, and efficient and will be able to operate in a two-phase system. They will have the innovative feature of recovering the expansion work through use of an alternator instead of dissipating work through a brake wheel. This approach greatly simplifies controls, improves reliability, and reduces system mass and input power. Creare has extensive experience developing and building miniature expansion turbines at the size, speed, and capacity required for this application, including turbines that operate with two-phase flow.

NASA Applications

The turbines will be suitable for use in liquefiers for spaceport, planetary, and lunar surface operations including those being planned for installation at NASA-KSC.

Non-NASA Applications

The commercial applications include cooling for laboratory- and industrial-scale gas separation, liquefaction, storage, and transportation systems; high-temperature superconducting motors, generators, transmission lines and magnetic resonance imaging systems; liquid hydrogen fuel cell storage for the automotive industry; and commercial orbital transfer vehicles and satellites.

Firm Contacts

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