BRIEFING CHART

NASA SBIR/STTR Technologies
An Advanced Cooling System for In-Situ Resource Utilization.
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Identification and Significance of Innovation

Objective: Reduce power and mass required for in-situ production of cryogenic oxygen and hydrogen for extraterrestrial exploration

Innovation: Miniature, gas-bearing turboalternators that create refrigeration during expansion from electrolysis pressure to storage pressure

Primary Challenges: Small rotor size, high rotational speed, operation in two-phase flow

Benefits for NASA Lunar Exploration:

Input power reduced by 420 W
Mass reduced by 222 kg

Expected TRL at the end of Contract: 4

Miniature High-Performance Turbine Rotor

Technical Objectives

- Specify top-level design details to optimize the approach.
- Perform detailed analyses to develop preliminary turboalternator designs. Specify critical details that impact performance, mass, and dimensions.
- Quantify thermodynamic performance.
- Determine mass and size.
- Demonstrate bearing operation with two-phase rotor flow.

Work Plan

- Optimize top-level trade-offs between thermodynamic performance, mass/size, and development effort. Consider: rotor size and speed, number of expansion stages, pressure ratio for each stage, degree of geometric similarity, and bearing flow configuration.
- Specify design details including: aerodynamic features, rotor assembly, bearings, clearance seals, electric rotor/stator, power conversion electronics, and materials. Quantify performance, mass, and size.
- Demonstrate gas bearing performance with dynamic perturbations caused by two-phase flow.

NASA Applications

- Oxygen and hydrogen production for lunar surface exploration
- Exploration of other moons and planets
- Liquid methane production
- Cryogen production for space stations and space transportation vehicles
- Re-liquefaction for in-space refueling
- Improved efficiency for turbo-Brayton cryocoolers and generators

Non-NASA Applications

Small to moderate scale production of cryogenic fluids for laboratory and industrial uses:

- Gas separation
- Superconductors
- Magnetic resonance imaging systems
- Material conditioning
- Cryogenic manufacturing
- Academic research
- Cryogenic storage
- Re-liquefaction of LNG boil-off
- LH2 production for automotive fuel cells

Contact

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