Flow Sensor For Densified and Two Phase Flows (Cryometer)

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Description and Objectives

The innovation is a unique non-intrusive system that offers highly accurate density, quality, velocity, and mass flow measurements of two-phase and densified cryogenic flows. The system is called the Cryometer, and can greatly enhance the reliability, safety, and autonomous operation of multiple aerospace systems, including propulsion, space energy storage and generation, and life support. The Cryometer was specifically originated to measure both highly transient and steady state flows, and is expected to have a very fast response. The Phase I work will culminate in the measurement of two-phase water-nitrogen flows. OBJECTIVES are to:

1) Define the Cryometer systems requirements in terms of accuracy, installation, safety, and maintenance such that it will best meet NASA's needs.

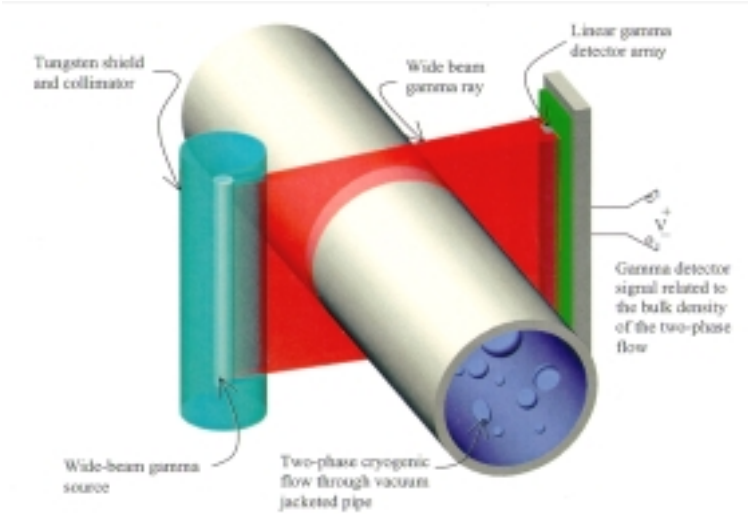
2) Develop models of the gamma ray densitometry and venturi operations to assist with experiment planning and setup, hardware design, and the analysis of experimental results.

3) Ensure the overall safety of the research program and the Cryometer design, and obtain the necessary licensing.

4) Design and acquire the Phase I cryometer system.

5) Conduct a series of progressive tests that will ultimately measure two-phase density, quality, velocity, and mass flow rate of a two-phase flow.

6) Create a preliminary conceptual design for the Phase II prototype commercial Cryometer.



Approach

Task 1. Systems Requirements Definition
Task 2. Modeling and Data Analysis
Task 3. Licensing and Safety
Task 4. Hardware Design and Acquisition
Task 5. Cryometer Testing
Task 6. Preliminary Phase II Design

Subcontractors/Partners

None.

Schedule and Deliverables

6 Months
Phase I Cryometer Prototype
Final Report

NASA & Commercial Applications

An accurate two-phase cryogenic flowmeter has been highly sought after by the aerospace industry for decades. There is a fundamental need for accurate measurement of densified and two-phase cryogenic flows for both ground based, space, and ISRU applications. Fulfilling this need is inherent to providing reliable, safe, and autonomous operations. It is also important during the development and testing of new systems to allow accurate comparisons of competing processes and propellant combinations. Examples of specific Cryometer applications include: determining when the system has been sufficiently chilled down (100% liquid flow present), measuring and diagnosing heat leaks into fluid flow networks; accurate metering and controlled delivery; and measurement of the total mass of cryogen removed from a dewar or tank. Outside of the aerospace community, the Cryometer has commercial potential in the paper, refrigeration, cryogenics, automotive and many other industries. The Cryometer can be used for densified, gas/liquid, and liquid/solid (slurries) flows.