

STATEMENT OF WORK

Effluent Scrubbing of Engine Exhaust of a Nuclear Thermal Propulsion Engine

Background:

Nuclear thermal propulsion (NTP) is a high NASA technology priority area, an assessment recently confirmed by the National Research Council (NRC). It is a relatively near-term enabling technology to reduce human transit time (and mission risk) to Near-Earth Objects (NEOs) and Mars. NTP is game changing for space exploration, providing a specific impulse of roughly double that of state of the art chemical engines.

The feasibility of an in-space launch vehicle utilizing NTP was demonstrated during the Rover and NERVA programs (1955-1972). The current resurgence of interest in NTP technology development comes from the United States' renewed interest in human exploration beyond low earth orbit and the recognition that NTP offers the best hope of achieving this goal near term (Reference NRC 2010 Report 'NASA Space Technology Roadmaps and Priorities - Restoring NASA's Technological Edge and Paving the Way for a New Era in Space'). However, the infrastructure needed to develop and test NTP engine and vehicle technology does not presently exist.

The most recent study of NTP technology development ground test facility needs was funded by NASA/MSFC in 2006 and performed and published by Ares, Inc, (Report No. 05025011_01) titled, 'Nuclear Thermal Engine Ground Test Approach and Site Assessment'. This study provides an assessment of approaches to ground testing of an NTP rocket engine, identifying two concepts to mitigate the environmental hazard risk of nuclear fission's radioactive byproduct contamination in the engine propellant exhaust; (1) containment of contaminated engine exhaust by firing the engine into an alluvium soil ground bore hole that absorbs the nuclear contaminant and (2) direct treatment of engine exhaust that captures the nuclear contaminant and flares to atmosphere the environmentally safe hydrogen effluent.

SSC's Office of Chief Technologist has provided funding via its Center Innovation Funding budget to initiate investigation of NTP engine exhaust scrubbing technology. This project's goal is to mitigate the technical immaturity of the direct gas treatment (effluent scrubbing) approach; to investigate its feasibility and identify design requirements. The scope of this effort is to:

1. Identify and research the latest technologies in radioactive effluent scrubbing on the order of magnitude of NTP engine and stage vehicle development testing (i.e., 25-60 lb/sec hydrogen flowrate for 1 hour duration)
2. Scope and estimate the cost of the specific work and effort required to develop a hydrogen scrubber system to support NASA's NTP engine and stage development goals.

NASA/SSC is seeking specific knowledge and expertise in radioactive hydrogen effluent filter technology to augment internal resources in its research of NTP engine exhaust scrubbing system technology and the design of this system.

Tasks:

1. Evaluate NTP engine exhaust scrubbing requirements and define corresponding filter and scrubbing system size requirements
 - a. Filter material
 - b. Operating temperature range
 - c. Static and trans-filter pressure differential max/min
 - d. Associated effluent flow rate
2. Provide technical assistance in establishing facility requirements; i.e., pre & post-test safing, filter inspection and hazard mitigation:
 - a. Scrubber system operational constraints with selected filter technologies
 - b. Post-test/operations facility safing, filter replacement disposal requirements
 - c. Facility cost estimate

Deliverables:

A final report summarizing all work performed under this task, research findings and recommendations on CD media and one (1) hard copy.

Period of Performance:

The period of performance shall be from the date of this order and continue through September 30, 2013.