Advanced Technologies for Propulsion Testing

Lead Center: SSC

Nuclear Thermal Propulsion (NTP), Rocket Based Combined Cycle (RBCC) and Turbine Based Combined Cycle (TBCC) propulsion systems have been identified as high priority NASA technology areas by the United States National Research Council. The goal of this subtopic is to foster development of advanced technologies with commercialization potential that will be needed for component and system level ground testing of these systems during the development and certification phases of their life-cycle.

NTP could be an enabling technology to reduce transit time and mission risk to Near-Earth Objects, Mars, and other deep space destinations. Nuclear power and propulsion technologies are key enabling technologies for future NASA exploration missions. Technology development to facilitate ground testing of NTP is required in the following areas:

- Advanced high-temperature and hydrogen resistant materials for use in a hot hydrogen environment (3000 °F).
- Efficient non-nuclear generation of high flow rate (100 lb/sec), high temperature hydrogen.
- High temperature fluid and thermal management systems.
- High temperature flow control and relief systems.
- High temperature power conversion systems.
- High temperature process piping systems and associated components.
- High temperature instrumentation.

RBCC and TBCC could be enabling technologies to reduce cost for and increase frequency of access to space and allow for rapid transit within the Earth's atmosphere, far exceeding our nation's current capabilities. Technology development to facilitate ground testing of RBCC and TBCC is required in the following areas:

- Thrust take-out and thrust measurement systems that address the unique challenges of a RBCC / TBCC test facility design.
• Non-intrusive velocity / temperature / pressure profile measurement of inlet and exhaust flows.

For the above technology subject areas, research should be conducted to demonstrate technical feasibility during Phase I and show a path toward hardware and/or material development as appropriate which occurs during Phase II and culminates in a proof-of-concept system.

**Phase I Deliverables** - Phase I deliverables shall include a final report describing design studies and analyses, system, sensor, or instrumentation concepts, prospective material formulations, testing, etc. Prototype systems, components, sensors, instruments or materials can be developed in Phase I as well. The designs or concepts should have commercialization potential. For Phase II consideration, the final report should include a detailed path towards Phase II hardware proof-of-concept system or component or material manufacturing and testing as applicable. The technology concept at the end of Phase I should be at a TRL of 3-4.

**Phase II Deliverables** - Phase II deliverables shall consist of working proof-of-concept systems, tested material formulations with samples, tested component, sensor, or instrumentation hardware, etc. which have been successfully demonstrated in a relevant environment and delivered to NASA for testing and verification. The technology at the end of Phase II should be at a TRL of 6-7.

Potential NASA Customers include:

• Rocket Propulsion Test Program.

• Nuclear Thermal Propulsion Program.