

Advanced Space Power Systems (ASPS): Regenerative Fuel Cells (RFC) Project

Game Changing Development Program | Space Technology Mission Directorate (STMD)



ANTICIPATED BENEFITS

To NASA funded missions:

Enable extended high-power operations during eclipse periods.

DETAILED DESCRIPTION

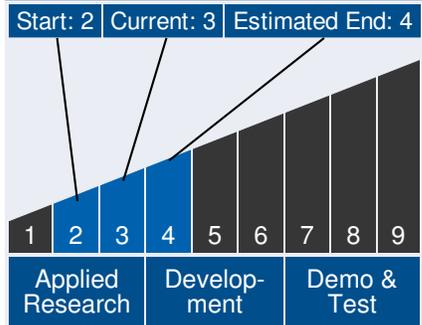
The objective of the regenerative fuel cell project element is to develop power and energy storage technologies that enable new capabilities for future human space exploration missions. Abundant power expands the capabilities of every human mission, including missions to asteroids, planets, moons, libration points, and orbiting structures. Furthermore, abundant power provides benefits for all phases of flight: vehicle operations, electric propulsion systems, and destination applications. Development of high powered energy storage capabilities, such as regenerative fuel cells, can fulfill the strategic goals for NASA, by developing radical, high payoff technologies and enabling missions otherwise energy-prohibitive. The ability to harness abundant power will expand the capabilities of every human mission, including future missions to asteroids, planets, moons, libration points, and orbiting structures. Furthermore, abundant power provides benefits for all phases of spaceflight: vehicle operations, electric propulsion systems, and destination applications. Primary fuel cells and regenerative fuel cell energy storage systems provide numerous benefits for planetary missions that require power while in extended/long periods of eclipse (i.e. shadowed portions of planetary orbits), where batteries and photovoltaic/solar arrays have a limited operational range. Regenerative fuel cells also have the potential to provide the necessary consumables (i.e. water, oxygen) for human missions and for planetary in-situ resource utilization. The development of high powered regenerative fuel cells fills the technical gaps identified by the NASA Spaceflight Architecture Team (HAT) as critical for long duration human exploration, and addresses the



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Technology Maturity



Management Team

Program Executive:

- Lanetra Tate

Program Manager:

- Mary Wusk

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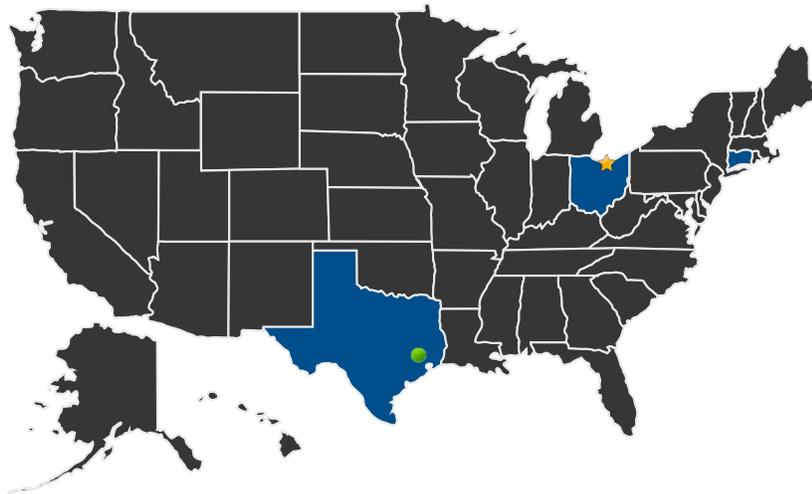
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needs described in the Office of the Chief Technologist's Space Power and Energy Storage Roadmap (TA-03). Technology development within this project aims to provide the best combination of reliable power and energy storage, with safe operation within human systems a paramount objective. The main focus of the Regenerative Fuel Cell project element will be to develop a highly reliable passive regenerative fuel cell capable of providing 10,000 hours of continuous operation. At the conclusion of this project element, critical fuel cell sub-system technologies will be demonstrated at TRL 5 and regenerative fuel cell system technologies will be demonstrated at TRL 3 by the end of FY14.

U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States
With Work

★ **Lead Center:**
Glenn Research Center

● **Supporting Centers:**
• Johnson Space Center

Management Team (cont.)

Project Manager:

- John Lytle

Principal Investigator:

- Charles Taylor

Technology Areas

Primary Technology Area:

Space Power and Energy Storage (TA 3)

- └ Energy Storage (TA 3.2)
 - └ Regenerative Fuel Cells (TA 3.2.3)
 - └ Hydrogen (H₂)/Oxygen (O₂)-Based Regenerative Fuel Cell (TA 3.2.3.1)

Additional Technology Areas:

Space Power and Energy Storage (TA 3)

- └ Energy Storage (TA 3.2)
 - └ Regenerative Fuel Cells (TA 3.2.3)
 - └ Methane (CH₄)/Carbon Dioxide (CO₂)-Based Regenerative Fuel Cell (TA 3.2.3.2)

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Other Organizations Performing Work:

- Office of Naval Research

DETAILS FOR TECHNOLOGY 1

Technology Title

Advanced Space Power Systems: Regenerative Fuel Cells (RFC)

Technology Description

This technology is categorized as a hardware system for transportation applications

Technologies that enable longer life and more efficient regenerative fuel cell systems are non-flow-through fuel cells and static liquid feed electrolyzers that utilize capillary forces internal to the stacks to manage the liquid and vapor fluid separation and eliminate the need for additional external components to perform this function.

Capabilities Provided

- Lightweight, compact, long-life power
- Passive, static liquid feed, high pressure electrolysis
- High specific energy storage

Potential Applications

- Landers
- Rovers for extended missions
- Surface power and energy storage