Statement of Work

Background

NASA's Regenerative Fuel Cell (RFC) Project is advancing an energy storage architecture that can sustain human presence on the lunar surface by storing significant amounts of energy at lower mass than traditional battery systems. A key element of this architecture is the fuel cell (FC) that converts gaseous hydrogen and oxygen into water and usable electrical power. To inform RFC system design and potential integration, NASA Glenn Research Center (GRC) seeks to evaluate Teledyne Energy Systems, Inc. (TESI)'s ejector-driven reactant FC technology in a modified hydrogen electric power system (mHEPS) configuration.

Modification of TESI's Hydrogen Electrical Power System

TESI shall modify the HEPS to support independent operation of the system at NASA GRC when GRC researchers supply the required reactants, coolant interfaces, and electrical load. This modification includes, but is not limited to, modifying the coolant subsystem, reactant supply subsystem (including the passive ejectors), electrical load interface, and controls subsystem to support increasing the mHEPS discharge power to greater than 1 kW, with a target goal of 1.5 kW. TESI shall deliver the mHEPS, a standard operating procedure (SOP), and any additional required documentation to NASA GRC for independent testing.

1 <u>Phase 1 – Program Initiation and Kick-Off</u>

1.1 Contract Mobilization and Planning

- TESI shall confirm scope, deliverables, and constraints with NASA GRC.
- TESI shall finalize resource assignments and internal work breakdown structure.

1.2 Kick-Off Meeting and Presentation (Milestone 1)

- TESI shall prepare and deliver the Kick-Off Presentation within two weeks of contract award.
- TESI shall conduct a two-hour kick-off meeting at a mutually agreed location to review objectives, interfaces, schedule, and risk posture.
- TESI shall establish communication protocols, status reporting cadence, and configuration management expectations.

2 <u>Phase 2 – HEPS Power Increase and Subsystem Modifications</u>

2.1 Coolant Loop Modification

- TESI shall design and implement coolant loop changes to integrate with NASA GRC's coolant infrastructure while maintaining thermal stability at increased power levels.
- TESI shall validate coolant performance across the expected operational envelope (power, duration, and duty cycles).

2.2 Electrical Load Interface Modification

- TESI shall specify and implement new load cabling and interface hardware to match NASA GRC's electrical load configurations and safety requirements.
- TESI shall ensure robust grounding, protection, and instrumentation to support accurate test data acquisition and safe operation.

2.3 Ejector and Reactant Supply Modification

- TESI shall modify nozzles/mixers and passive ejectors to support the targeted power range and stable reactant recirculation.
- TESI shall generate performance curves for the new ejector configuration to inform NASA's test planning and data analysis.

2.4 Controls Subsystem Updates

- TESI shall update control algorithms and logic to support stable, autonomous operation of the modified system at greater than 1 kW, targeting 1.5 kW.
- TESI shall implement appropriate alarms, interlocks, and safety logic to protect equipment and personnel.

2.5 Power Increase Validation

- TESI shall conduct in-house mHEPS power increase validation testing to demonstrate the system's ability to achieve the targeted power and to operate stably under representative test conditions.
- TESI shall document test conditions, results, and any residual limitations or recommended operating envelopes.

3 <u>Phase 3 – Documentation and Standard Operating Procedure Development</u>

3.1 SOP Development (Milestone 2)

- TESI shall develop a comprehensive SOP for the mHEPS to be delivered by Month 3 following contract award.
- The SOP shall include, at a minimum:
    - System overview and theory of operation.
    - Pre-start inspections and configuration checks.
    - Startup, steady-state operation, load management, and shutdown procedures.
    - Fault detection, alarm response, and basic troubleshooting guidance.
    - Safety considerations, hazard controls, and emergency procedures.
- The SOP shall undergo internal peer review, quality check, and configuration control prior to delivery.

3.2 Hardware Documentation Package

- TESI shall prepare an as-built configuration package including:
    - Updated drawings and schematics for modified subsystems.
    - Interface control information for reactants, coolant, and electrical load.
    - Summary of validation testing and recommended operational constraints.
- This documentation shall accompany the mHEPS hardware delivered to NASA GRC.

4 <u>Phase 4 – Delivery, On-Site Training, and NASA Test Support</u>

4.1 mHEPS Delivery (Milestone 3)

- TESI shall prepare mHEPS for shipment to NASA GRC, including pre-ship inspection, preservation, and packaging.
- TESI shall ship the mHEPS to NASA GRC in accordance with mutually agreed logistics arrangements.

4.2 On-Site Training (Up to Three Days)

- TESI shall provide up to three days of on-site support at NASA GRC to:
  - Install mHEPS in the designated test environment.
  - Conduct detailed walk-throughs of the SOP and system architecture.
  - Provide hands-on training in startup, operation, and shutdown procedures.
  - Address NASA operators' questions and tailor operational practices as appropriate.

4.3 Remote Testing Support

- TESI shall provide remote engineering support during NASA's testing (nominally a two-month test window), including support for data interpretation, issue resolution, and operational adjustments.

Milestone Payments

Milestone No.	SOW Section	Description	Objective Success Criteria	Achievement Date
1	1.2	Kick-Off Meeting	Submission of the kick-off presentation	2 weeks after award
2	3.1	mHEPS SOP	Submission of the mHEPS SOP	3 Months after award
3	3.2, 4.1	mHEPS Delivery to NASA GRC	Delivery of the mHEPS and associated documentation to NASA GRC	4 Months after award