FLIGHTLINE CHARGING INFRASTRUCTURE DEMONSTRATION

Statement of Objectives

1.0 Background: Currently flightline mission support equipment and vehicles are based on continuously running fossil-fuel engines (internal combustion or turbine). It is common to have three to five pieces of this continuously running support equipment around an aircraft during maintenance activities. Much of this equipment is old, inefficient, over-sized, and not operator friendly. For example, one piece of equipment (A/M32A-60 GENSET) that was designed for Vietnam-era aircraft, consumes approximately 30 gallons of fuel per hour, and requires maintainers to wear double-hearing protection.

Previous AFRL-led technology demonstrations, in collaboration with the Program Office (AFLCMC/WNZ) and Lead MAJCOM (HQ AFMC/A4M), have shown that some flightline combat capabilities can be improved with battery-based equipment and vehicles. In addition to technology demonstrations, Executive Orders and Air Force Policy/Strategy are increasingly calling for clean-energy capabilities.

The electrification benefits of flightline support equipment depend on the specific equipment but demonstrations have shown potential benefits to the DoD:

- Economic: Reduced energy demand and costs (~3-7x), reduced lifecycle costs (~2x) and enable the utilization of renewable energy sources
- Operational: Enhanced energy resilience, improved equipment performance & readiness, improved indoor operations capability, and reduced maintenance
- Hazards: Significantly reduced noise and harmful emission to operators, reduced CO2 emissions to the environment, and improved safety

To employ new battery-based electric flightline support equipment and vehicles, charging infrastructure must be installed. A Phase 1 Flightline Electrification Charging Infrastructure Study was conducted at Holloman AFB and Robins AFB to prepare the government for a Phase 2 Demonstration at these sites.

The purpose of the Phase 2 Demonstration effort is to install charging infrastructure and conduct a demonstration at these sites to define charging standards, operational approaches, technologies, and risks. This learning will enable a smoother and faster transition to a future Phase 3 wide-spread implementation effort.

2.0 Scope: The scope of this research and development activity is distributed over five major subtasks that will occur at two locations (Holloman AFB and Robins AFB).

2.1 Charging Infrastructure Assembly & Demonstration: The first major subtask is the design, fabrication, and demonstration of the charging infrastructure. This subtask is required to comply with local policy and approvals associated with each respective base. Activities associated with gaining approvals to operate and install this infrastructure are necessary and included in this scope. Each base will have the same basic charging infrastructure scope illustrated below in Figure 1. The primary site on each base will have up to three 6-Charger System (6CS) assemblies and a DC Fast Charger. An optional secondary site will have a single 6CS without a DC Fast Charger.

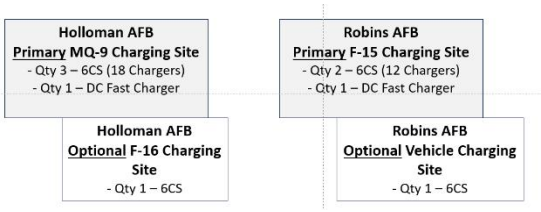

Figure 1. Charging Infrastructure Assembly Quantity and Locations

2.2 Electric Flightline Equipment & Vehicle Assembly & Demonstration: The second major subtask is to identify, recommend, and acquire electric flightline equipment & vehicles that will be used in the integrated demo. It is possible that some items may require minor modifications and stand-alone, item-unique, demonstrations. Large-scale development efforts of electric equipment or vehicles will not be part of this demonstration and be considered out of scope. Activities associated with gaining approvals to operate this equipment and vehicles during the integrated demonstration, to include connecting to aircraft, is necessary and included in this scope.

2.3 Integrated System Demonstration: The third major subtask is to conduct an integrated system demo with both the installed charging infrastructure and the down-selected and approved flightline equipment and vehicles. The demonstration, and demonstration/test plan, will include Concept of Operations (CONOPS) development, Training & Operating Manuals, and identify Standardization and Policy recommendations for future follow-on Phase 3 wide-spread implementation.

2.4 Standards, Specifications, CONOPS, and Training Development and Documentation: The fourth major subtask is to develop standard technical specifications, recommended CONOPS, and initial training material for a standard Flightline Charging Infrastructure System implementation in a future Phase 3 wide-spread implementation effort.

2.5 Property Transfer and/or Removal: At the conclusion of the demonstration the items associated with this contract will either be transferred to the government as real property and equipment or removed and/or disposed of. Ideally, the goal is for the installations to experience real-world benefit of the technology and desire to retain the equipment for future use. Any vehicles acquired for demonstration purposes will require an approved "Vehicle Authorization" from the 441 VSCOS if bases desire to retain. While it is impossible to know what will be removed at the end, for the purpose of this contract assumes that everything (minus new concrete) will be removed and disposed of.

3.0 Objectives: There are four major objectives of this research and development project.

3.1 The first is to gather lessons learned from the **design and fabrication** of the prototype flightline charging infrastructure assembly and 6CS. Included in this objective is the identification and recommendation of electric flightline equipment and vehicles to use in the integrated demonstration (ref para 2.1).

3.2 The second major objective is to **perform an industry scan** to identify, recommend, and acquire electric flightline equipment & vehicles that will be used in USAF flightlines and employed in the integrated demo (ref para. 2.2). Due to the complexity in this task, a fixed budget will be allocated towards acquiring equipment and vehicles that will be a part of the demo (ref para 12 Special Instructions).

3.3 The third major objective is to **perform a demonstration** to evaluate the system technical maturity, develop potential Concepts of Operations (CONOPS), and identify life-cycle factors. The demonstrations are for the subtask components (ref para 2.1 & 2.2) and the integrated system demonstration (ref para 2.3).

3.4 The fourth major objective is to synthesize and integrate the lessons learned from the design, fabrication, and demonstration objectives above to **develop standard technical specifications, recommended CONOPS, and initiate training material for a standard Flightline Charging Infrastructure Assembly and 6CS building block** to be implemented in a future Phase 3 wide-spread implementation. Therefore, the work performed in this contract shall be documented in a final report that shall be non-proprietary in nature and be available for distribution in a potential future open and competitive Phase 3 wide-spread implementation program. It is expected that many sub-components will have proprietary elements and proprietary sub-component information that will not be required in the final report.

4.0 Description of Work:

4.1 The Contractor shall **design** charging infrastructure assemblies based on a standard 6CS that shall serve as the standard "Building Block" on all implementations. The 6CS will be based on a SAE J1772 or SAE J3400 Level 2 charger with maximum output per charger at ~17-20kW. The 6CS should have flexibility to also accommodate occasional 80v 2-pin DC chargers depending on the equipment and vehicles used in the demonstration. It is envisioned that flightline charging will be implemented in increments of 6CS's for commonality across bases, to improve speed during wide-spread implementation and attain flexibility for future scaling. The 6CS shall contain elements that include an overhead solar-shade structure, built in photo-voltaic (PV) energy generation, energy storage for the PV and for Resiliency (power-outage) conditions (for your proposal assume 8 hours backup during routine conditions), switchgear, a main disconnect from the base's power feed line, dedicated transformers and chargers for the flightline equipment and vehicles. If two or more 6CS's are implemented in the same general location they may share components, as appropriate. In addition, a single DC-Fast Charger based on the SAE J3400 NACS or SAE CCS interface shall be installed at both bases. Everything from the main-disconnect on out shall be considered developmental and may be removed and not converted to real-property at the conclusion of the project. Multiple 6CS's could be implemented in series or in parallel. An artist rendering of a potential single 6CS concept is shown in Figure 2. All designs will need approvals, and/or permits, as required, from the host bases.

Figure 2. Artist Rendering of a potential 6 Charger System (6CS) Concept

4.2 The Contractor shall **fabricate** the charging assemblies and comply with all local policy, permits, guidelines, and restrictions as appropriate.

4.3 The Contractor shall **perform an industry scan** to identify, recommend, and acquire electric flightline equipment & vehicles that will be used in USAF flightlines and employed in the integrated demo. The government project lead shall approve all equipment and vehicle purchases prior to their acquisition.

4.4 The Contractor shall **develop** demonstration/test plans for subtasks 2.1, 2.2, and 2.3. The demonstration/test plans will require approval from the government six months prior to planned execution. Operating conditions for the demonstration/test shall consider: Routine Operations, Surge Operations, Power-out Operations, and Long-term Maintenance Operations. The contractor will be responsible for accomplishing any require MIL-SPEC/STD compliance testing for equipment and vehicles and presenting the findings to obtain approvals for connecting to aircraft as required.

4.5 The contractor shall **execute** the demonstration/tests for subtasks 2.1, 2.2, 2.3. The contractor will be responsible for shipping equipment and vehicles as required. The contractor will be responsible for maintaining the charging infrastructure assemblies, equipment, and vehicles for the duration of the contract. The contractor shall provide the requisite personnel to operate the equipment and provide technical support during the demonstration/test. The demonstration/test could range from weeks to months depending on the equipment, vehicles, and site. In addition to demonstrations, CONOPS testing is required. The contractor shall provide the programmatic and technical support to coordinate the demonstration/test with the selected test agent (if needed). The contractor shall provide technical resources to travel to the demonstration locations and to provide up to one week of on-site training and operational instruction.

4.6 The contractor shall produce a final report and companion briefing which aggregates and synthesizes the lessons learned from the design, fabrication, compliance/compatibility testing, and demonstrations and **develops standard technical specifications, recommended CONOPS, and initial training material for operations and maintenance of a standard Flightline Charging Infrastructure System** to be implemented in a future Phase 3 wide-spread implementation. Schematics, pictures and illustrations of the developed system, a summary of the demonstration performance, and lessons learned shall also be included in the final report and presentation. The final report shall have standalone appendices for: Operations Training, Maintenance (short and long term in same appendix), Recommended Specs/Schematics/Drawings. The final report and presentation must be releasable to any follow-on contractor and the final report and presentation shall not include any proprietary information or markings.

5.0 Deliverables:

5.1 Deliverables as listed below:

Deliverable #1	Scientific & Technical Reports (Final Report)
Deliverable #2	Funds & Man-hour Expenditure Report
Deliverable #3	Contract Funds Status Report
Deliverable #4	Status Report
Deliverable #5	Presentation Material
Deliverable #6	Test Plan
Deliverable #7	Material and Processing Digital Data Package (MPDDP)

5.2 Test Samples, Prototypes and Residual Materials; The contractor shall return to the Government all test samples, prototypes and residual materials not consumed in testing at the conclusion of the technical effort. Material and Processing Digital Data Package (MPDDP) shall be non-proprietary and in a format such as CAD/BIM/Digital Model.

6.0 Government Furnished Equipment: No additional GFE required.

7.0 Security Requirements

Operations Security (OPSEC)

The contractor shall participate in all activities associated with the disciplines of the organization's Industrial Security, Information Security, Personnel Security, Operations Security (OPSEC), and Antiterrorism programs, following appropriate measures in each program as required for this particular contract. Security measures are required to reduce program vulnerability from successful adversary collection, exploitation of critical information, and violations of export control requirements. The prime contractor shall ensure all subcontractors, if applicable, conform to these requirements as required by the prime contractor.

Program Protection Plan (PPP) Requirements

Any potential critical program information (CPI) generated as part of this effort will be reviewed to determine the need for a PPP or to be included as part of an existing PPP

CUI Information

The contractor shall ensure that personnel associated with this effort have annual training on OPSEC as well as Information Handling, Marking, Storage, Transmission, Release, Destruction and Reporting points related to Controlled Unclassified Information (CUI).

Sharing of Information

Approval of technical and programmatic information shared external to this effort shall be approved by the CO IAW DFARS 252.204-7000.

8.0 Government Furnished Facilities and Information (base support):

- Holloman AFB supports the study and potential follow-on demonstration to bring reliable, sustainable and economically viable electric energy opportunities to the flightline.
- Robins AFB supports the study and potential follow-on demonstration to bring reliable, sustainable and econimcally viable electric energy opportunities to the flightline.

9.0 Start Date: Commensurate with Contract Award

10.0 Place of Review, Inspection, and Acceptance: TBD

11.0 Period of Performance: 36 months, 18 months estimated for design and fabrication. 18 months estimated for demonstration/test and reporting.

12.0 Special Instructions: Estimated funding allocations for equipment and vehicle purchases to support this demo will be ~$3M in FY24 and an additional ~$3M in FY25. The contractor will be responsible for insurance covering equipment, vehicle, materials, and components throughout contract execution. Contractor is not responsible for equipment, vehicle, materials, and components when being operated by government personnel.