Statement of Work (Draft)
Twin Otter NADIR Port

SCOPE

To provide Engineering Services for the design of a "NADIR" (downward looking) viewport on the NASA DHC-6 Twin Otter, serial number 004. This nadir port is to be installed under the cabin floor, along the centerline of the fuselage, between frame station 301.57 and frame station 321.50. The port will be designed with a provision for a blanking plate and with an adapter plate to enable installation of optical glass. The size and shape (round or rectangular) of the nadir port will be determined by the engineering design process with the minimum acceptable design size being a 16 inch diameter port or equivalent size of not less than approximately 200 square inches.

As options, NASA may also have the Contractor fabricate the NADIR Port, and install it on the aircraft at either the NASA Glenn Research Center facility (preferred) or the contractor's site.

Base Effort

Procure:
Engineering, Structural Analysis, Design, and Complete Fabrication/ Installation Drawings for NADIR Port installation on the NASA GRC DHC-6 Twin-Otter aircraft serial number 004.

The NADIR Port will be a permanently mounted structure on the aircraft, keeping these design characteristics in the forefront:

- it should consist of an aluminum-type framework that is both structurally and aerodynamically sound
- have interchangeability between an optical window adapter plate or a blanking plate
- to fit in the fuselage cavity between frame stations 310.57 and 321.50, underneath the cabin floorboards
- positioned on the centerline of the fuselage
- to have the bottom face of the window normal to straight and level flight

To further detail the scope of this project, the engineering, structural analysis, and design methodology will all have to be provided to and reviewed by NASA Engineering oversight. This will be done in the form of a scheduled concept design review, preliminary design review, and critical design review.

Concept Design Review:
The objective of the Concept Design Review (CoDR) is to approve the scope and design approach to be used in the project. The requirements shall be reviewed to verify technical content, intent and completeness in order to ensure that feasible engineering approach is in place which will meet these requirements. The major review items of the CoDR are the work plan and system requirements. The general approach will be:

1. Review the proposed design concept for compliance with the proposal requirements.
2. Review top level schedule including proposed review milestones.
3. Review each item of the task requirements for technical content, compliance with applicable practices and standards, and completeness.

4. Establish that design meets or exceeds top level design requirements or is consistent with them.
5. Review the proposed product development approach.

NASA approval of the design concept will be considered as authority to proceed.

Review item discrepancies (RID's) and associated action items will be addressed. Specific changes resulting from the RIDS's and action items will be incorporated into the appropriate requirements documents.

Preliminary Design Review:

The objective of the Preliminary Design Review (PDR) is to verify that the design satisfies the task requirements. The agenda for the PDR will be established by NASA Engineering. The general approach to accomplishing the PDR will be:

1. A requirement-by-requirement review of how the design satisfies the requirements.
2. Key trade studies; issues and results.
3. Design approach; layouts, schematics, mounting, packaging etc.
4. Parts, components, materials selection.
5. Reliability; derating, safety margins.
6. Testability.
7. Preliminary system layouts.
8. Environmental analyses: thermal, acoustical, vibration, structural physical.
9. Schedule; manpower and funding resource management, identification of critical path.
10. Closeouts; RID's, action items.

NASA approval of the preliminary design will be considered as authority to proceed. Review item discrepancies (RID's) and associated action items will be addressed. Specific changes resulting from the RIDS's and action items will be incorporated into the appropriate requirements documents.

3.3.1 Critical Design Review:

The objective of the Critical Design Review (CDR) is to validate the final design. The general approach will be to review changes in the design since PDR. The CDR will normally be scheduled when the final design is approximately 90% complete, but prior to the initiation of production. The agenda of the CDR will be established by the Review Committee Chairperson. The general approach to accomplishing the CDR will be component and system level design evaluation considering:

1. satisfaction of technical requirements
2. adequacy of design criteria
3. adherence to design standards
4. human engineering principles
5. soundness of approach

Technical requirements will not be critiqued, unless changes have occurred since PDR. The emphasis will be on the critical features (those that affect major functions, overall performance or have significant potential impact on costs and schedule) of the design and on any changes to the design since PDR. The CDR will separately address each engineering discipline according to the following considerations:

1. Satisfaction of design requirements
2. Final system layouts, schematics, drawings, sub-assembly drawings, etc.
3. Material selection and compatibility
4. Fabrication processes
5. Compatibility of system interfaces
6. Design margins, component derating, reliability calculations, etc.
7. Qualification and test plans
8. Schedule; manpower and funding resource management, identification of critical path, "work-around's
9. Closeouts; RID's, action items
10. Adequacy of product verification plans

NASA approval of the critical design will be considered as authority to proceed. Review item discrepancies (RID's) and associated action need to be addressed. Specific changes resulting from the RIDS's and action items will be incorporated into the appropriate requirements documents.

All engineering designs shall be pre-approved by the COTR (Contracting Officer's Technical Representative) and shall meet the following standards: it should be noted that this work will be conducted on a public aircraft and that all final approvals for engineering, modifications and exceptions will come from NASA engineering oversight, not the FAA, and furthermore NASA reserves the right to provide technical oversight by having a Technical Representative present at anytime during the fabrication or installation process. NASA maintains final airworthiness authority on NASA owned aircraft; therefore an FAA Supplemental Type Certificate (STC) is not a requirement for this modification.

1) Design data and properties of materials shall be obtained from MIL-HDBK-5 and MIL-HDBK-23, or its replacement titled "Metallic Material Properties and Standardization (MMPDS) Material properties and strengths based on static and fatigue test data developed per a nationally recognized standard is acceptable with appropriate references.
2) The strength substantiation reports shall be prepared in accordance with standard aerospace industry practices for flight hardware. Organization of reports shall be clear and logical per ANSI/NISO Z39.18-1995. Documentation shall clearly provide a geometric description of each component, identification of all applied loads and potential modes of failure, type of material and applicable strengths, analysis, test and engineering rationale substantiating strength of hardware, proper identification of references for all input into the analysis, and a summary of all calculated margins of safety.
3) Drawing practices per ASME Y14.100 shall be used in the preparation and revision of engineering drawings and associated lists. All drawings and documentation shall be provided electronically in a PDF format.
4) The design shall meet or exceed the flight envelope of the aircraft (25, 000 ft MSL, unpressurized, etc). This includes the temperature and ambient pressure variations that are inherent with this envelope.
5) Three dimensional Computer Aided Design geometry shall be provided in ISO 10303 STEP format

All work performed by the contractor shall be in accordance with all Federal, State, and local environmental regulations, Presidential Executive Orders, NASA Environmental Policy and Requirements, and the NASA Glenn Research Center (GRC) Environmental Programs Manual.

Option 1
Fabricate: NADIR Port Hardware and Blanking Plate

The contractor shall perform all work in accordance with the following:
1. Equipment or Manufacturers Manuals, as well as the NASA Glenn Aircraft Maintenance Manual
2. Workmanship must be of a high standard. The methods of fabrication and joining shall be consistent with standard aerospace practice (AC 43.13, etc.).
3. DHC-6 Maintenance Manual 1-6-2, Illustrated Parts Manual 1-6-4, and Structural Repair Manual PSM 1-6-3RS if applicable.

Option 2
Install: NADIR Port and Blanking Plate
Any installation that is performed on NASA Aircraft will be conducted in a FAA licensed repair facility or military equivalent by mechanics certified per 14 CFR Part 65. All engineering designs and installation variances shall be approved by NASA.

Task Detail
This Task is comprised of both a Basic Effort and Options 1 and 2. The Proposer shall perform the Basic Effort only, unless and until the NASA Contracting Officer modifies the contract in writing, unilaterally exercising an Option or Options.

The Government has the right to unilaterally exercise any one or more of the Options, all of the Options, or none of the Options. In the event NASA exercises one or both of the Options, it is highly anticipated that the Options will be exercised at the time of Contract award. However, NASA may exercise an Option at any time during the contract Period of Performance provided that NASA gives the Contractor a preliminary written notice of its intent to exercise the option at least 30 days before the Basic Effort period of performance expires. Any change to the work plan/task plan shall be mutually agreed to by the government and the contractor.

The Contractor shall provide a detailed list of all hardware it intends to install in the aircraft to the NASA Technical Manager. This list shall include relevant part numbers, weight and installation location (frame number/station). Any Government Furnished Equipment required for the install shall be indicated in the work plan and returned in a working condition after the completion of the Base Effort and any Option(s) they are required for (tow bars, etc).
If the installation at the contractor facility option is exercised, NASA will transport the aircraft to and from the contractor's worksite at a date and time determined by the NASA Pilot, after consultation with the contractor.

The Contractor shall supply NASA with the following documentation:
1. Aircraft Logbook Entry (if installation option exercised)
2. Weight and Balance Entries in a spreadsheet format.
3. All parts certifications/TSO information.
4. Parts replacement information (and vendor contract info), and continuing airworthiness instructions.
5. Engineering drawings, hazard analysis, and substantiation documents.
6. Technical Manuals

In order to accomplish the Base Effort and Options, the Contractor shall perform the necessary systems modifications/installations, including but not necessarily limited to those indicated in the Base Effort and Options.