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STATEMENT OF WORK

for the

C-5 SHUTTLE CONTAINER TRANSPORT SYSTEM (SCTS)

DESIGN/VERIFICATION PROGRAM

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1.0 SCOPE

Lockheed-Georgia Company (hereinafter referred to as Gelac) shall perform studies to define the detail design configuration and perform tests to verify the structural integrity of these detail designs for the modification of a C-5 aircraft to be a carrier for the Shuttle Container Transport System (SCTS), provide support to Lockheed Missiles & Space Company (hereinafter referred to as LMSC) for the Container design and support equipment as defined by this Statement of Work, and provide data as specified in the Data Requirements List (DRL). These studies shall be based upon the design concepts outlined in Lockheed-Georgia Company report number LG84ER0094, C-5A Feasibility and Design Concept Definition Study, dated June 1984. The container transport tasks to be performed during this study shall provide detail designs and verification tests sufficient to permit Gelac to prepare kit drawings for the modification of a C-5 aircraft to the SCTS carrier configuration without further design work except for individual aircraft peculiarities. The major tasks for implementing this proposed program shall be as follows:

- Verify C-5 Design Concepts.
- Develop Internal Loads.
- Provide Test Specimen Design Support.
- Provide Detail Design Drawings for the Test Specimen.
- Develop Detail Design Drawings (C-5 Modification Drawings).
- Refurbish and Modify Test Specimen.
- Perform Tests and Test Analyses.
- Modify Design Where Necessary Based on Test Results.
- Document Design, Analyses, Tests, and Test Results.
- Provide Manufacturing and Tool Planning and Design for C-5 Test Specimen Modification.
- Provide Technical support for LMSC container system and C-5 container installation system.

Because of the need to verify structural concepts as early as possible, initial work shall be directed toward the design of the structure embodied in the test article. Subsequently, the remaining structural design and detail

modification drawings shall be released. These drawings shall be used for the planning and tooling activities associated with modifying an existing C-5 aircraft to the container transport configuration.

2.0 APPLICABLE DOCUMENTS

The following listed documents are hereby incorporated into this Statement of Work by this reference and shall be of the issue date and/or revision as specifically cited below and shall be applicable to the extent specified herein. In the event of conflict between documents, the order of precedence subordinate to this SOW shall be established by the order listed herein:

2.1 LMSC Documents

Document Number	Title	Date
TBR		

2.2 Government Documents

Document Number	Title	Date
TBR		

2.3 Gelac Documents

Document Number	Title	Date
TBR		

NOTE: Gelac to provide a list of applicable U.S. Government and Gelac Documents

3.0 TECHNICAL REQUIREMENTS

3.1 Aircraft Modification Design

The design concepts developed during the feasibility study (ref. IWTS WT55A0540N, WT55A0710N and WT55A3150N) shall be verified and refined. Internal loads and detailed structural analysis for the detail designs shall be developed so that the designs can be implemented. Test specimen design support shall be furnished so that testing of the structural areas can be accomplished.

3.1.1 Modification Drawings

Modification drawings conforming to Gelac's Engineering Drafting Manual (based on DoD-STD-100C) shall be used to define the engineering changes/additions required for the modified aircraft. Drawing numbers and format will follow existing C-5 practices. These drawings shall be delivered in accordance with DRL 21. Engineering release of modification documentation will be in accordance with Gelac Engineering Procedure GE 25-79. Storage and control of Engineering Drawings and Associated Data will be governed by Gelac's Engineering Procedure GE 05-4.

3.1.2 Interface Control Documents

LMSC shall provide Gelac an Interface Control Document (ICD) defining:

- The dimensions of the container envelope.
- Power requirements.
- Air conditioning load.
- Loading system.
- Other applicable data.

Gelac shall define for LMSC a space envelope for container loading and stowing in terms of C-5 datums. This shall be delivered in accordance with DRL 7.

3.1.3 Preliminary Design

Preliminary designs and design layouts shall be developed for the aircraft modification and in support of the structural testing described in section 3.3. The portion of the fuselage to be modified is that part extending from C-5 Fuselage Station (FS) 1383 aft as described in Gelac Report Number LG84ER0094.

During the development phase, Gelac shall use its existing approved system of configuration control to provide visibility of development efforts and assure disciplined documentation of development designs.

3.1.4 Detail Design

Gelac shall prepare detail design drawings for the aircraft modifications required to produce the C-5 SCTS Aircraft. The design data shall include, but not be limited to, C-5 modification drawings describing the following major areas:

- The modifications to the pressurized area of the fuselage extending from approximately FS 1383 to FS 2166.
- The troop deck shall be removed and the upper lobe shall be modified.
- The relocation of a pressure bulkhead to approximately FS 2166 with its pressure door system.
- The modification of the pressure barrier around the ramp pressure door location.
- The modification necessary to move the torque deck to provide clearance for loading the container. This area extends from approximately FS 2166 to the end of the aft body.

- The modification of the aft cargo doors - sides and center. The center door shall be modified from a one-piece to a two-piece assembly. These assemblies shall be mounted to the side doors for loading clearance.

- The modifications to the functional subsystems are typically as follows:

  a. Reroute empennage flight control cables.
  b. Relocate cargo compartment environmental duct system.
  c. Relocate oxygen heat exchangers.
  d. Relocate hydraulic lines as required.
  e. Add new hydraulic lines for new pressure bulkhead pressure door and side door actuation.
  f. Relocate electrical wire bundles running under torque deck.
  g. Relocate fire extinguisher bottles and optical detectors located under troop compartment floor.
  h. Rework cargo compartment trim in area of modified side frames.
  i. Delete aerial delivery system provisions.
  j. Delete troop compartment kit provisions.
  k. Provide access to empennage for servicing electronic equipment.
  l. Provide electrical power outlet access for container air conditioning system and container environmental and control system.
  m. Provide routing for the container system remote monitoring and alarm system cable to the pilot and/or crew compartment.
  n. Provide hydraulic power for the winch system.

3.2 Test Article

The Government shall provide a test article, Ship Serial X991, and permit the refurbishment and modification of the article as required.

The test article shall be a full size fuselage from approximately FS 1964 to FS 2735 and full depth below the vertical tail stub. The modification and testing of the test article shall be as described in the paragraphs that follow. The test article will not be restored at the end of the test program.

3.2.1 Test Article Preparation Activities

The following activities shall be performed as a part of the test article modification:

- Transport test article from storage site to test facility.
- Inspect and refurbish test article.
- Material purchase.
- Tool design and build.

The test article shall be supported by a Gelac provided floor-mounted steel frame test fixture. The fixture will contain a pressure reaction bulkhead which shall be spliced to the pressure skin of the test article.

3.2.2 Test Facility

Building B-4 shall be used for the modification of the test article and its testing.

- Test Fixtures - An empennage loading and reaction frame shall be erected to provide support for hydraulic actuators which shall provide tail loadings of torsional, vertical, and lateral bending to the aft body of the test article.

- Test Apparatus - Test apparatus shall be used to provide the following capabilities:

  a. Cabin Pressure - Air shall be the pressurizing medium for both static and cyclic testing. Protection against overpressure shall be supplied by a combination of passive and active safety devices.

b. Tail Loads - Aft body torsional, lateral, and vertical bending moments shall be applied by hydraulic actuators. The actuators shall apply forces to a rigid frame which shall be attached to the stub of the vertical fin. These may be supplemented by body shell loading through bonded straps.

c. Loading Control - Standard Laboratory techniques of load programming and control shall be used. Selection of the appropriate method(s) shall be determined by the final static and cyclic loading requirements.

d. Data Acquisition - All test measurements of forces, pressure, strains, and deflections shall be made by standard laboratory instrumentation sensors. A multichannel high-speed computerized system may be used for data acquisition. This system shall have large storage capacity with real-time processing and CRT displays of data.

3.2.3 Test Article Modification

The following tasks shall be accomplished to configure the test article for testing. The configuration for the tests shall contain representative modifications for the aft fuselage of the modified airplane using the drawings specified in section 3.1.1.

- Modify pressure area from approximately fuselage stations 1964 to 2166.
- Modify torque box area from approximately fuselage stations 2166 to 2340.
- Add new pressure bulkhead.
- Add new pressure bulkhead pressure door.
- Modify side panels structure and add new ramp pressure door seals.
- Install a ramp pressure door.

- Attach a cargo ramp to the test jig at FS 1964, using rigidly mounted hinges.
- Modify the aft cargo doors - sides and center. The center door shall be modified from a one-piece to a two-piece assembly. These assemblies shall be mounted to the side doors.
- Provide all actuators, mechanisms, latches, and locks necessary to demonstrate form/fit/function of the above fuselage closures.
- Modify ramp to fuselage latches and backup structures.

3.3 Test Activities

3.3.1 Design Development Components Tests

Selected structural components shall be static/fatigue tested in support of the design development. Potential candidates shall be, but not limited to:

- Upper Lobe Shear Web Concept.
- WL314 Longeron Modification.
- Main Frame Modifications.
- Hinge Line Elements.
- Ramp to fuselage latches and backup structure modifications.

Gelac shall monitor tests, analyze test results, and recommend required changes to the design brought about by the test program.

Necessary changes identified as a result of these tests shall be reflected in design drawings prior to incorporation in the final airplane modification design.

LMSC shall be notified five (5) days in advance of the start of each test for possible surveillance.

All test procedures not currently approved by the cognizant Air Force Agency must be approved prior to the start of applicable testing.

3.3.2 Static and Cyclic Tests

A series of static and cyclic tests shall be performed. These structural tests shall be conducted with the pressure door in the closed position. These tests shall be:

- Test 1: Proof Pressure Test - A single pressurization of 11.6 psig shall be applied. No tail loads shall be applied. The specimen shall be instrumented with up to 500 channels of strain gage instrumentation and selected displacement sensors.

- Test 2: Cyclic Pressure Test - Pressure shall be varied from 0 psig to 8.3 psig for approximately 11,000 cycles. Tail loads shall be maintained at a constant magnitude through the cycling. Initial and final surveys of strains/displacements, as well as occasional surveys, shall be conducted. Periodic inspections of the specimen shall be conducted and shall be accompanied by actuations of pressure doors to monitor form/fit/function. Minor repairs to the specimen and test fixture shall be accomplished as required.

- Test 3: Final Test of Pressure with Unit Tail Loads - Following cyclic testing, the specimen shall be inspected, repaired as necessary, and prepared for the final tests. Preparations shall include refurbishment of strain gage instrumentation, installation of required displacement sensors and any needed adjustments to closure systems. Three loadings shall be applied, each with a combination of pressure at 13.05 psig and a unique set of tail loads. Data acquisitions and reviews shall be performed for each loading. The specimen shall be inspected following the last loading, and the final statement of condition shall be documented.

- Test 4: Cargo Doors Proof Load - Limit airloads shall be applied to the modified aft cargo side and center doors for the most critical airloads case. This test shall be accomplished in a separate setup. Proof load of the hinges shall be accomplished on the full test article. Doors shall be instrumented with up to 150 channels of strain gage instrumentation and selected displacement sensors.

3.3.3 Operational/Nonstructural Tests

Demonstrations of the form/fit/function of the fuselage aft door complex shall be accomplished with a limited number of powered actuations of the mechanisms.

3.3.4 Test Takedown

The program shall conclude with the dismantling of the test setup and the removal of the specimen and fixture to outside storage. Gelac shall not be required to restore the test article to its original configuration.

3.3.5 Test Equipment

Test equipment and test set-ups used shall be considered an integral part of any test procedure in which they are called out for use. Gelac shall provide information copies of documented changes to test equipment and test set-ups per DRL 6.

3.4 Configuration Management

Gelac shall operate its existing, Government approved, system of Configuration Management (CM). This system shall be described in Gelac's approved Configuration Management Plan to be submitted per DRL 5.

All documentation such as parts materials and process standards, and manufacturing procedures shall conform to Gelac's standard practices and the applicable DRLs.

Gelac's CM system shall have a formal process for release and statusing of authorized configuration identification documents and for safe-guarding the masters (vellums, reproducibles, tapes, computer data bank, etc.) of those documents against unauthorized changes.

3.4.1 Configuration Control

Prior to CDR, Class I changes shall be LMSC directed changes and those changes which impact any contractual requirements (e.g., DRL item schedule, SOW, delivery schedule/quantities, etc., and/or container/aircraft interface) must be approved in writing by LMSC prior to implementation. All other changes are Class II changes and do not require LMSC's prior approval.

Gelac's configuration control system shall assure that only current configuration identification documents and authorized changes thereto are used.

3.4.2 Design Configuration Baseline

A Design Configuration Baseline shall be established with LMSC approval of Gelac's engineering data at PDR. These data shall be submitted with the PDR data package per DRL 23. Subsequent to completion of PDR (closure of action items), Class I changes shall require formal processing. Class II changes shall be presented informally (i.e., telecon) to designated LMSC personnel for review and classification concurrence prior to incorporation of the change.

3.4.3 Configuration Accounting

Gelac shall maintain "as-built" configuration records which will enable configuration verification and retrieval to the lowest level of manufacturing and test history necessary to prepare part/assembly pedigree reports.

Gelac's configuration accounting system shall provide for traceability of Class I change implementation to the lowest level of hardware impact.

4.0 PROGRAM MANAGEMENT REQUIREMENTS

4.1 Program Management

Gelac shall provide the overall management, technical direction, coordination and administrative effort necessary to ensure that the requirements of this Statement of Work (SOW) are properly implemented and performed in a timely and cost effective manner. The Program Management and Controls system employed must be sufficient to provide LMSC with accurate and timely visibility into Gelac's technical approach and schedule performance.

4.1.1 Program Personnel and Organization

Gelac shall establish a program organization and assign a Program Manager (PM) for the period of this Work Statement. The PM shall be assigned responsibility for the timely and successful completion of the effort defined in this SOW. He shall have authority to staff, plan, direct and schedule the related Gelac activities. The PM shall have appropriate authority over key personnel who will be responsible for the management, administration and controls, engineering, manufacturing, procurement, testing and quality control activities associated with the Program. The Program Manager and his deputy shall be changed only with the written consent of LMSC.

4.1.2 Program Controls

Gelac shall implement a program controls system sufficient to provide indepth, accurate, and timely visibility into Gelac's technical cost and schedule performance. Gelac shall establish, maintain and control schedules. As a minimum, the following tools shall be employed.

4.1.2.1 Program Master Schedule (PMS). A program master schedule, which presents an overview of the total Gelac effort, shall be established and maintained. The PMS shall show each SOW item at the second WBS level including start and stop milestones at the third WBS level (as a minimum) and fourth WBS level (if required). The PMS shall be activity-oriented and shall

clearly illustrate the plan and the schedule Gelac intends to follow. It shall include preliminary and critical design spans, engineering release points, procurement, and fabrication and test spans for development. The PMS shall be submitted to LMSC for approval in accordance with DRL 1 and shall not be changed without the prior approval of LMSC.

4.1.2.2 Detail Schedules. Each task and design and support activity depicted on the PMS shall be separately scheduled in detail beginning with feeders and ending with each completed unit/milestone. These schedules shall be based upon commitments from the functional organizations that will perform the work, and shall include realistic procurement spans. Representatives of each functional organization responsible for the work shall convene as necessary to review and reschedule approved changes. These detail schedules shall be submitted to LMSC in accordance with DRL 2.

4.1.2.3 Material Control Document. Gelac shall prepare and submit a Material Control Document which shall describe the parts and materials acquisition and/or procurement system to be employed consistent with current Gelac procedures in support of this program. This document shall be submitted in accordance with DRL 3.

4.1.2.4 Billing/Funding. Gelac shall submit a billing and funding plan by month which will be revised to reflect negotiation or change actions in accordance with DRL 4.

4.1.2.5 Schedule/Manpower Statusing. Schedule and manpower status shall be reported weekly by telephone to LMSC for the milestones identified on the PMS and detail schedules. Missed milestones shall be identified, reschedule and completion dates established. Impact on downstream milestones shall be analyzed and recovery plans developed. Updated schedules shall be submitted to LMSC for approval as required and as changed in accordance with DRL 1 or 2 as applicable.

4.2 Documentation

Gelac shall prepare drawings of the test article modifications. C-5 modification drawings, prepared for this program, shall be used to document the structural modifications. The drawings shall be revised to reflect the changes required by stress analyses before final release to the experimental shops and delivered in accordance with DRL 11.

Final design drawings for modifications that document the configuration of the C-5 SCTS shall be submitted in accordance with established procedures. Structural analyses including internal loads, stress, weights, centers of gravity and flutter, shall be delivered per DRL 20. In addition, test requirements, procedures and results shall be submitted in accordance with DRLs 6 and 13 through 18.

4.3 Program Reviews

Gelac shall conduct formal Program Management Reviews (PMR) in Marietta GA. The meetings shall be scheduled on a monthly basis throughout the life of the IWT.

Each PMR shall include review of both management and technical accomplishments and shall cover technical status, quality status, parts and material status, financial status, and schedule status. Problem areas will be summarized together with a schedule and performance impact summary and a discussion of the corrective actions and recovery plan required. Open action items shall be statused. The format and detailed content of these presentations shall be developed in conjunction with and be subject to the approval of LMSC. Gelac shall submit for LMSC concurrence an agenda for each PMR in accordance with DRL 9.

Gelac shall submit a copy of viewfoils and handouts reviewed at the meeting together with a written summary of the major conclusions of the PMR and a listing of all action items (with scheduled completion dates). This material

shall constitute the Monthly Progress Report for the month containing the PMR and shall be forwarded in accordance with DRL 10.

Gelac shall submit a Monthly Report which portrays the current status of the program in the following areas:

a. The progress being made for each functional task for which effort is being expended.

b. Significant problems and proposed solutions.

c. Behind schedule tasks with recovery plans.

This report shall be hand delivered at the PMR if held, if not then in accordance with DRL 10.

4.4 Design Reviews

Gelac shall conduct at Marietta GA, a Preliminary Design Review (PDR) and a Critical Design Review (CDR) of the C-5 SCTS in accordance with the approved Program Master Schedule. A detailed agenda and outline shall be submitted to LMSC for approval in accordance with DRL 22 prior to each design review.

In accordance with DRL 23 and 25, Gelac shall deliver to LMSC copies of each Design Review Data Package to support each presentation.

4.4.1 Preliminary Design Review

A preliminary design review (PDR) shall be held in accordance with the PMS. This review shall report the progress in detail of the aircraft modifications and status of test article refurbishment, design, and modification. The following list of topics as a minimum will be included in the PDR.

1. Review Current Aircraft Modification Preliminary Design and Analyses.
2. Review Current C-5/Container Design Interfaces.
3. Review Test Article Refurbishment.
4. Review Test Fixture and Facilities.
5. Review Test Article Preliminary Design and Analysis.
6. Review Test Plan and Procedures.
7. Review post PDR Planning.

The PDR Data Package shall be delivered in accordance with DRL 23. The PDR meeting minutes (including action items) shall be delivered in accordance with DRL 24. The minutes of the Design Review shall include a list of all assigned action items (together with completion responsibility and due date).

4.4.2 Critical Design Review

A Critical Design Review (CDR) shall be held in accordance with the PMS.

The following list of topics as a minimum will be included in the CDR.

1. Review Detail Aircraft Modification Final Design and Analyses.
2. Review Final C-5/Container Design Interfaces.
3. Review Preliminary Test Results and Analyses.
4. Review of Final Report Content and Schedule.

The CDR data package shall be delivered in accordance with DRL 25.

The CDR meeting minutes (including action items) shall be delivered in accordance with DRL 26. The minutes of the Design Review shall include a list of all assigned action items (together with completion responsibility and due date).

4.5 Property Control

Gelac shall maintain a Property Control System in Accordance with its approved system. A Property Control Report shall be submitted once a year to LMSC and at the end of the contract per DRL 8.

5.0 IWT REQUIREMENTS

5.1 Contractual Direction

LMSC's direction shall be provided by the authorized representative of Materiel Operations. Contractual direction shall consist of directions and approvals which establish understandings and agreements between LMSC and Gelac and shall be confirmed in writing prior to implementation.

5.2 Technical Clarification

Technical guidance and clarifications shall be provided by LMSC's designated Responsible Equipment Engineer (REE) and shall consist of guiding Gelac within the "as-written" requirements and schedules of this Intra-Work Transfer (IWT) in order to achieve the program objectives. Such guidance and clarification is beyond the REE's authority if Gelac's compliance would result in deletions, additions, or amendments to the IWT requirements specified herein unless authorized in writing per paragraph 5.1 above. Gelac will, before proceeding in accordance therewith, request direction from LMSC's authorized representative of Materiel Operations.

5.3 IWT Management

IWT Management shall be provided by LMSC's Program Manager who has overall responsibility for cost, schedule and technical performance of the IWT. As the manager of the LMSC IWT Management Team he has overall cognizance and is responsible for the integration, coordination and supervision of the IWT in accordance with the provisions of paragraphs 5.1 and 5.2 above.

5.3.1 Responsibilities

All matters pertaining to meeting the requirements of this IWT shall be the responsibility of Gelac as directed by LMSC. LMSC approval of or concurrence with Gelac program documentation or decisions does not relieve Gelac of responsibility to meet the requirements of this IWT.

5.3.2 LMSC Team

Gelac shall provide, for the life of the IWT, facilities/services, i.e., telephones, equipment, working materials, etc., that are necessary to support LMSC's team as required and which are commensurate with facilities and services supplied for positions of like stature in Gelac's organization. Gelac shall provide a copy of all correspondence between Gelac and LMSC to LMSC's Engineering and Product Assurance technical representative(s) when in residence. The resident or visiting quality personnel shall have unescorted access to all areas being used by this program.

5.4 Product Assurance

Gelac shall provide the appropriate Product Assurance effort in accordance with Gelac approved procedures to assure that the deliverable C-5 SCTS is as specified in the requirements of this SOW.

5.4.1 Quality Assurance

Gelac shall maintain a Quality Assurance program which will provide the systems and controls necessary to assure the requirements of this SOW and Gelac's approved system are fully achieved. A Quality Assurance Control Plan shall be delivered in accordance with DRL 27.

5.4.2 Reliability

Gelac shall conduct a reliability program in accordance with Gelac's document (TBR) which shall be submitted in accordance with DRL 28.

5.4.3 Safety

Gelac shall provide assurance that its industrial safety requirements and program will enable it to perform the efforts associated with this IWT in a manner which will minimize safety hazards for both personnel and products. To this end Gelac shall abide by its approved safety plans applicable to the effort associated with the SOW. A copy of the safety plan shall be submitted in accordance with DRL 29.

5.4.4 Hazard Analysis

Gelac shall perform a hazard analysis of the proposed modifications and testing program and submit a report in accordance with DRL 30.

5.5 Technical Support for LMSC Container System and C-5 Container Installation System

Gelac shall provide technical support to LMSC for those areas which involve LMSC's container design; C-5 to container system interfaces for loading, stowage and unloading operations; C-5 flight performance and any operational restrictions or limitations as a result of the modification and container system cargo.

Gelac shall provide (TBD) manhours at (TBD) per hour to support this task. These hours may only be expended with prior written authorization from LMSC's REE. Such authorization shall define those support tasks Gelac is to perform and shall define the manhours authorized. Gelac shall not exceed the manhours authorized nor support any tasks not specifically authorized in writing by LMSC's REE.

5.6 Final Summary Report

Gelac shall provide a Final Summary Report to LMSC which covers the total effort performed under this IWT. This Report shall summarize the IWT effort and shall be delivered in accordance with DRL 19 and 31.

6.0 DELIVERY SCHEDULE

Gelac shall deliver the documentation as required in the DRL.