WHS-449
Copy # 1 of 14
No. of Pages 15
20 September 1967

SUPPORT MODULE PHASE I STUDY

STATEMENT OF WORK

DOUGLAS

20 SEPTEMBER 1967

CONTENTS

DEFINITIONS

AEROSPACE GROUND EQUIPMENT (AGE)

All equipment required on the ground to make a system, command and control system, support system, advanced objective, subsystem, or end item of equipment operational in its intended environment. This includes all equipment required to install, launch, arrest, guide, control, direct, inspect, test adjust, calibrate, appraise, gage, measure, assemble, disassemble, handle, transport, safeguard, store, actuate, service, repair, overhaul, maintain, or operate the system, subsystem, end item, or component. AGE is functionally sub-classified as Operating Ground Equipment (OGE) and Maintenance Ground Equipment (MGE).

AEROSPACE VEHICLE EQUIPMENT (AVE)

Equipment which is of itself, or is part of, the vehicle which operates in the Aerospace environment.

ALLOCATED SUPPORT MODULE TASKS

The allocated Support Module tasks are a specific group of additional tasks assigned to the Contractor as part of the Laboratory Vehicle System Segment to support the addition of the Support Module AVE and AGE to the unmanned automatic mode MOL System.

ASSIGNED SYSTEM RESPONSIBILITY TASKS

These are specified tasks at the Orbiting Vehicle, the Flight Vehicle, and the MOL System levels that are performed by Douglas as the Laboratory Vehicle System Segment Contractor. These tasks are in addition to Program Integration tasks, Mission Simulator System Segment tasks and Laboratory Vehicle System Segment tasks.

INTEGRATION

Integration is one of the activities of system engineering and ensures that, as the operations and pieces of the system are identified by the system engineering process, they are interrelated functionally, mechanically, and physically so that the final system performs as specified.

INTERMEDIATE INTEGRATION

Intermediate integration is the integration of the system engineering functional data developed for each of the thirteen (13) top-level blocks of the MOL System Functional Flow Diagram. Intermediate integration is performed by the Associate Contractors and Government agencies that have been assigned primary responsibility for top-level blocks; the Associate or Agency responsible for a top-level block is the intermediate integrator. Intermediate integrators collect all the functional data developed for their respective blocks, review it for compatibility, and assemble it into a single data package for the particular block. The data package for each of the thirteen (13) blocks contains the following functional data: fundamental requirements, time-lines, functional flow diagrams, and functional schematics.

LABORATORY VEHICLE SYSTEM SEGMENT

Laboratory Vehicle System Segment is the contractual package including, but not limited to the following items and services: the integrated Laboratory Module with attendant software and AGE, the Mission Module structure, accommodation of experiment equipment within the Laboratory Module, and accommodation of interfaces with the other MOL System segments.

SUPPORT MODULE (SM)

The Support Module is the specific grouping of flight hardware specified by CEI Specification _____ and consisting of the Structure, Payload (RV's), film chutes, expendables sufficient for a 60 day on-orbit life (propellants, cryo, DRV's and film), and associated equipment unique to the unmanned automatic mode MOL film return process.

DACO PORTION OF SM

The DAC portion of the SM is composed primarily of the external fairing, the primary Support Structure, fairing ordnance, thermal control, 60 day resources and DAC peculiar instrumentation. LM accommodations for the SM are also included in the DAC effort.

SUPPORT MODULE SYSTEM SEGMENT

The Support Module has no contractual significance as a system segment.

SYSTEM ENGINEERING

MOL System Engineering as defined in MOL System Engineering SAFSL Exhibit 20007 is a set of operations, including intangible manual procedures and software, that are organized to satisfy a definable user requirement.

SCOPE

Statement of Work

The Contractor shall perform the selected MOL Integration tasks (assigned System Responsibility tasks) and the allocated Support Module tasks as set forth in this Statement of Work.

The definitions and structure of this Work Statement are identical to or a logical extension of those of the current Work Statement for the Douglas contract. There has been no attempt to identify tasks as to the eight section WBS as this is a Phase I task.

1.0 SELECTED MOL INTEGRATION TASKS

The Selected MOL Integration tasks defined below are an added set of tasks in the category of the current contracted tasks identified as Assigned System Responsibility tasks.

1.1 System Engineering Integration

The Contractor shall conduct the system engineering integration for the Unmanned Automatic Mode MOL System. This task is specifically defined and limited to the following sub-tasks:

1.1.1 Mission Analysis

Conduct mission analysis for the Unmanned Automatic Mode MOL System as defined in the specific operational requirements to define the quantitative and qualitative mission requirements, performance requirements, safety requirements and effectiveness (reliability, etc.) requirements as applicable to the MOL SP/DR and MOL Program Management Plan.

1.1.2 System Requirements Analysis

1.1.2.1 Conduct System Engineering analysis for the Unmanned Automatic Mode MOL System to define and allocate the requirements of the SP/DR to the assigned intermediate integrator. This task includes the necessary analysis and system engineering to determine that the System Requirements Analysis in each of the assigned intermediate integration areas is developed compatible with the MOL System requirements. This task will be conducted in accordance with SAFSL 20007 and the assigned intermediate integration responsibilities in the MOL SP/DR as amended by the Proposed Support Module Addendum to the SP/DR.

1.1.2.2 Conduct intermediate integration for those functional blocks assigned in SS-MOL-1A as amended by the Proposed Support Module Addendum to the SP/DR. The analysis will consider the Support Module and its effects on the Unmanned Automatic Mode MOL System.

1.1.2.3 Conduct a System Design Review (SDR) of the Support Module and its effects on the Unmanned Automatic Mode MOL consisting of a review of selected system requirements. The scope of the SDR will encompass all affected Associate Contractors and will be determined by mutual agreement between the SPO and the Contractor.

1.1.3 Specifications

1.1.3.1 Prepare a section of the System Performance/Design Requirements Specification (SP/DR) for an Unmanned Automatic Mode MOL which incorporates the results of the mission analysis of Section 1.1.1 and integrates all inputs from the Associate Contractors/Agencies.

1.1.3.2 Prepare the LV, SM, OV, and FV Specifications for the Unmanned Automatic Mode MOL. The specifications shall incorporate the results of the mission and functional analyses and integrate inputs of the Associate Contractors/Agencies.

1.1.3.3 Prepare a Specification Tree for the Unmanned Automatic Mode MOL System.

1.1.4 Requirements Analysis, Allocation and Control

The Contractor shall assemble the total requirements of the Support Module and its effects on the Unmanned Automatic Mode MOL into the below listed categories, and conduct the following tasks:

1. AVE
2. AGE (including Mission Control)

3. Facilities

4. Test

5. Safety

6. Effectiveness

7. Software (AVE and AGE).

1.1.4.1 List in each above category, all requirements differences between the Manned and Unmanned MOL System. Review the differences in each category and conduct analyses to recommend:

a. New hardware and software

b. Block changes to be incorporated in the MOL System (AVE, AGE, facilities) for Flight 6 and subsequent

c. Modifications to be incorporated in only Unmanned Automatic Mode AVE

d. Resources for 60 day life.

1.1.4.2 Conduct a MOL System safety analysis for the Support Module and its effect on the Unmanned Automatic Mode MOL to include on-site handling operations and in-flight safety requirements.

1.1.4.3 Conduct an analysis to determine the requirement for a Mission Simulator for the Unmanned Automatic Mode MOL.

1.1.5 Special Studies

1.1.5.1 Initiate a study of the impact of the proposed follow-on program goal of a two-week launch pad cycle time of the Unmanned Automatic Mode OV.

1.1.5.2 Conduct a comparison study in conjunction with Associates/ Agencies of RV installation at four points in the SM factory-to-pad flow; EK, DAC, GE and VAFB. All pertinent factors shall be considered and safety will be the prime criteria.

1.1.5.3 Perform thermal/structural deflection studies to determine the movement of primary and secondary structures due to thermal gradients.

1.1.5.4 Conduct an integrated preliminary analysis and design of the 60 day Unmanned Automatic Mode MOL to determine hardware (AVE, AGE and facilities) compatibility (fit and function) with the baseline MOL System. The analysis shall include preliminary analysis and design supplied by the required Associate Contractors.

1.1.5.5 Provide a study involving analysis and rationale supporting follow-on Manned/Unmanned manufacturing, assembly and launch cycles and conversion cycle requirements. Included will be actual techniques and philosophy on 6 and 7 concerning the conversion capability. Conversion of Manned/Unmanned version will be defined for the MOL Program.

1.1.6 Integration Test Planning

Analyze the Unmanned Automatic Mode MOL System test requirements, develop an Unmanned Automatic Mode MOL System Test Plan, allocate system test activities, and integrate all MOL system tests, planning, and scheduling. Conduct analyses in association with MOL Associate Contractors/Agencies to determine an optimum factory-to-pad flow recognizing allocations to Contractors/Agencies, segments and develop an integrated factory-to-pad flow schedule. Compile, analyze, and prepare the MOL Program hardware and exchange hardware requirements necessary to support the system test, factory-to-pad flow and MOL Integrated Schedule.

1.1.7 Program Management

1.1.7.1 Prepare a System Integration Plan to conduct the selected MOL Integration tasks of Section 1.0. Define Associate Contractor/ Agency method and extent of participation and the support/data required to perform the integration tasks.

1.1.7.2 Conduct a DORIAN security analysis, in conjunction with Associates/Agencies, for the Support Module and its effects on the Unmanned Automatic Mode MOL. Prepare an integrated MOL DORIAN Security Plan for the Unmanned Automatic Mode MOL.

1.1.7.3 Prepare a Program Management Plan for the Unmanned Automatic Mode MOL System as defined by the addition of the Support Module. The major events in the development through operation and evaluation shall be described in terms of who, how, when, and where. New or revised program management tools (SAFSL Exhibits, etc.) shall be evaluated and their specific use described. The roles and responsibilities (TAB-A) shall be defined after approval by the SPO of the major event descriptions above. The Program Breakdown Structure (PBS) for the Unmanned Automatic Mode MOL shall be developed with full consideration of the existing MOL PBS.

2.0 ALLOCATED SUPPORT MODULE TASKS

The Contractor shall conduct system engineering analyses of the Support Module and its effects on the Unmanned Automatic Mode MOL. Determine requirements for the Support Module AVE, associated AGE, STE, and facilities to be supplied by the Contractor.

2.1 Support Module System Engineering

2.1.1 Fairing Shape and Size

Optimize the configuration of the Support Module fairing within the constraints of aero-dynamic design, structural loads, jettisoning requirements, compatibility with the launch complex, packaging of the equipment, weight, and other factors bearing on the design requirements.

2.1.2 Accessibility and Maintainability Requirements

Study and establish SM accessibility and maintainability requirements.

2.1.3 Thermal Requirements

Establish the thermal requirements and constraints for the Support Module.

2.1.4 AGE Requirements

Identify requirements for AGE.

2.1.5 Specifications

Prepare CEI Part I Specifications and Interface Specifications for the allocated Support Module hardware responsibilities.

2.1.6 Preliminary Design Reviews

Conduct Preliminary Design Reviews.

2.1.7 Mock-Up

Build an integrated scale model (approximately 1/4 scale) of the Support Module and partial Laboratory Module to facilitate three dimensional space allocation. Associate Contractor equipment shall be scaled to drawings supplied to the Contractor.

2.2 Modular or Integrated Concept

In the first 60 days after "go-ahead" on Phase 1A, the Contractor shall perform the preliminary design, layout, and studies necessary to make a selection between the modular design concept and an integrated Support Module concept. The studies shall include, but not be limited to, the following:

a. Tank Module-Film Transport Space Allocation.
b. Preliminary Subsystem Layouts (2 configurations) to include Test Flow Planning for both Configurations.
c. Preliminary Subsystem Resource Requirements for 60 days (DAC expendable).
d. Preliminary Subsystem Accessibility and Maintainability.
e. Mass Properties Data.
f. Preliminary Dynamic Analysis.
g. Preliminary Thermal Analysis.
h. Preliminary Thermal/Structural Deflection Study.
i. Preliminary AVE Atmosphere (composition) Study.
j. DRV Installation Study.
k. Support Module/Lab Module Mating Study.
l. Film Transport Pressure Gas and Control Study.
m. (Partial) Functional Analysis Data Inputs - SED.
n. STV Acoustic Test at Contractor's Plant.
o. Lab Module/Support Module Thermal Vacuum Study.
p. Payload Gains due to Jettisoning Fairing/Doors.
q. Preliminary Spec Tree.
r. Lab Module Modifications for 60 day film Load.
s. Lab Module Accommodations for a Two Platen Camera.

Results of these items will be available for presentation at 15 November Configuration Review.

2.3 Preliminary Design Engineering

2.3.1 Preliminary Design of Selected Concept

The Contractor shall do the additional preliminary design work required to define and incorporate the selected Support Module Configuration.

2.3.2 Aero-dynamic Analysis

Conduct aero-dynamic analysis of the fairing and its jettisoning.

2.3.3 Structure

Investigate structural materials and construction necessary to establish a preferred preliminary design. Support GE on its DRV exhaust plume studies on surfaces and contamination.

2.3.4 Dynamic Analysis

Develop a dynamic model suitable for load determination. The model will be the load cycle model current at the time of the analysis except for the substitution of the Support Module structure. Model data will be transmitted to the Martin Company for load calculations. The Contractor shall determine dynamic load factors, structural dynamics loads, and critical deflections using Associate Contractor data on equipment for which they have primary responsibility. Sources of excitation shall include subsystem equipment motions, ascent vibrations and pyrotechnic shocks. Fairing separation dynamics shall be studied.

2.3.5 Thermal Analysis

Conduct thermal analysis of the SM. Hardware interfaces with the Laboratory Module and Associate Contractor's Support Module equipment shall be considered in studying thermal balance.

2.3.6 Accessibility

Show accessibility requirements of equipment in the SM and LM can be met.

2.3.7 Compatibility with the Laboratory Vehicle

Show compatibility of the Unmanned Mode with the Manned Automatic Mode Laboratory Vehicle.

2.3.8 AGE Preliminary Design

Perform preliminary design of new AGE, STE & Facilities required by the addition of the Support Module.

2.3.9 Reliability

Conduct reliability analysis of Automatic Mode MOL to identify critical items for a 60 day mission. A report shall be prepared to identify the scope of necessary qualification/life testing. Preliminary results of this analysis to be available for, and presented at the 15 November 1967 Configuration Review.

2.4 Program Management

2.4.1 Phase II Program Plan

The Contractor shall prepare a Program Plan for its Phase II Support Module activities. The plan shall show how these Phase II activities will be integrated into the on-going design, production, testing, and field operations.

2.4.2 Hardware Test Planning

Plan for development, qualification and acceptance testing of the Support Module and the SM incorporation into the Unmanned Automatic Mode MOL.

2.4.3 Exchange Hardware Requirements

Define Phase II exchange hardware requirements. The exchange list shall include hardware nomenclature, description, use, quantity, and delivery schedules.

2.4.4 Compatibility with Contractor's MOL Facility

Investigate the compatibility of manufacturing and testing the Support Module, and incorporating it into the Unmanned Automatic Mode MOL, with the Contractor's MOL facility. Any new equipment or facility modification requirements shall be identified.

2.4.5 Hardware List

Provide a list of Support Module hardware (to be produced during Phase II) identifying nomenclature, description, use, quantity and spares of the following:

AVE,
Simulators & Training Equipment,
AGE,
STE.

3.0 PHASE II PROPOSAL

The Contractor shall prepare a fixed price incentive proposal for a Phase II contract.

3.1 Support of Phase IC

The Contractor shall support required activities during Phase IC.

Attachment No. A: Proposed PhIb Deliverable Data (Partial List), (2) pages.

Attachment No. B: Phase IB Data Due at Go-Ahead plus 60 Days, (1) page.

ATTACHMENT A

Proposed PhIb Deliverable Data

(Partial List)

SOW Paragraph	Name or Description
1.1.7.3	Program Management Plan
1.1.1	Major Events
	Tab A
	PBS
1.1.1 1.1.3.1	Unmanned Automatic Mode MOL SP/DR Addendum
1.1.2.2 1.1.2.1	Expanded functional flows, RAS's, etc., for assigned top level functional flow blocks
1.1.3.2	Unmanned Automatic Mode MOL LV Spec
1.1.3.2	Unmanned Automatic Mode MOL OV Spec
1.1.3.2	Unmanned Automatic MOL Flight Vehicle Spec
1.1.3.3	Specification Tree for Unmanned Automatic Mode MOL
*1.1.4.2	MOL System Safety Analysis
*1.1.4.3	Report findings of Mission Simulator use analysis
*1.1.5.1	Report findings on impact of two week launch pad cycle time
*1.1.5.3	Report thermal/structural deflection study reports
*1.1.5.4	Report impact of 60 day mission analysis

1.1.6	MOL System Test Plan
	Contents:
	Requirements Alleviation of test activities Schedule Factories-to-pad flow and alternatives Hardware and exchange hardware requirements
1.1.7.1	System Integration Plan on how to conduct the selected integration tasks of 1.0
1.1.7.2	Integrated MOL DORIAN Security Plan
*2.1.2 2.2.2.5	Final report on accessibility and maintainability
*2.1.3 2.2.2.4	Thermal requirements, constraints, and design solutions
2.1.4 3.1.4	AGE Requirements List
2.1.5	Part I CEI Specification
2.1.5	Interface Specifications
2.1.6	PDR Minutes
*2.2.2.1 2.2.2.3	Fairing aerodynamics and dynamics
*2.2.2.2	Results of structural materials and construction investigations
*2.2.2.3	Report dynamic structural analysis
*2.2.2.4	Report final results of thermal analysis
*2.2.2.6	Compatibility of SM with Manned Automatic Mode Lab Vehicle
*2.2.2.7	Convey conceptual design of new AGE required
3.0	Phase II Proposal

* Indicates may be organized into Single Phase I Final Report.

ATTACHMENT B

PHASE IB DATA DUE AT GO-AHEAD PLUS 60 DAYS

SOW Paragraph	Name or Description
2.2.1	Briefing on work leading to design concept selection recommendations (Vu-graphs and paper copies of them). (Document Briefing)
	Briefing will include the following:
2.2.1	Results of specific studies called out in 2.2.1.
1.1.5.2	Report results of study to determine point in factories-to-launch flow where DRV's should be installed.
1.1.5.5	A separate report will be submitted for Convertability Study.
2.1.1	Report on optimized fairing size and shape findings.
2.1.2 2.2.2.5	Report preliminary accessibility and maintainability requirements and provisions.
2.1.3 2.2.2.4	Report results of preliminary thermal requirements and analysis.
2.2.2.1 2.2.2.3	Preliminary aero-dynamics, dynamics of fairing and its jettisoning.
2.2.2.4	Preliminary Specification Trees.