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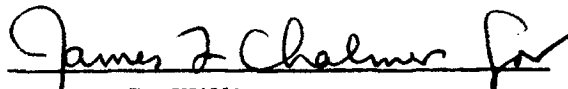
MOL MONTHLY PROGRESS REPORT

FOR

1 JANUARY THRU 31 JANUARY 1969



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1.0 GENERAL

1.1 An AD HOC Systems Test Group was formed during the reporting period and the Executive Review Board conducted a survey of all program testing as well as the hardware test flow plan. The AD HOC Group provided the basis for discussions which were an in-depth survey of the entire Systems Test Program. The test program was covered with the following subjects in mind:

- a. Program requirements
- b. Elimination
- c. Redundancy
- d. Alternate planning
- e. Cost effectiveness
- f. Management (program) risk
- g. Test location
- h. Supporting hardware, equipment
- i. Current status
- j. Future planning

All Aerospace offices participated in identifying problems based on the above criteria. Action items were assigned to solve identified problems.

One of the principal benefits of this review was the full and complete understanding of the parameters, requirements and status of the present testing program.

No major changes were identified but a slip of 30 days was authorized in GE dynamic testing.

1.2 One of the most striking current developments in the MOL Program is the presentation of major hardware items for acceptance and delivery.

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1.0 GENERAL - Continued

Three major pieces of exchange hardware were delivered during the month:

1. DE 15A LM Adjacent Structure Substitute (Bay 1)
Produced by MDAC-WD for EK development testing.
2. GE 48 LM Component Support structure for use with
with DE 15A (Bays 2 & 8) produced by
General Electric for EK development testing
3. DG 7 Mission Module Forward Structure produced
by MDAC-WD for General Electric use in
thermal testing

Contract delivery dates were met on all of the above hardware. As might be expected, since these are some of the initial hardware deliveries, certain problems were encountered. The hardware was built and delivered to the original specifications plus some, but not all, required changes and it was determined that each unit would require more or less modification to match the interface with test equipment at other associate contractors. These deliveries pointed out the need for a review of the Interface Program and Configuration Control procedures. Action was initiated to complete this review and prevent any recurrence of hardware mismatches.

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2.0 LOADS

During the reporting period, Loads Cycle 4 was in its final stages of completion. All of the design loads have been completed by Martin-Marietta Co. (MMC) and have been transmitted to the contractors. Subsequent SO direction was sent to the contractors to use these data.

MMC is currently calculating all thrust termination loads. These data will be used for structural evaluation only. They are expected from MMC by mid March. Also, expanded load cycle 4 data, i. e., relative displacement transform matrix II and the revised Subsystem C loads transform, have been transmitted to MMC for deflection and loads calculation. The displacement matrix data have been received and transmitted to MDAC-WD for use in the interface dynamic excursion study. Subsystem C data is expected by 1 March 1969.

The only other load cycle 4 item for consideration is the loads calculation for the revised Subsystem B dynamic model. This update was required to determine the validity of the ten percent factor included in the previous loads data to account for Subsystem B model discrepancies.

The Aerospace subdivision has concluded their studies of the revised model, and preliminary data indicates that generally the loads are within the ten percent bound.

General Electric Company (GE) is currently calculating comparable Subsystem B modes for submittal to MMC for their calculation of the official revised Subsystem B loads.

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3.0 CONTAMINATION ✓

3.1 Plume Contamination

A MDAC-WD funded plume contamination test program was initiated at Marquardt during this report period. Vertical down pulse mode firings were conducted with vehicle simulating surfaces at cold (-50⁰F) and ambient temperatures. Significantly less contamination than that noted in the AEDC sub-scale tests was generated with the full scale thruster. Testing will be concluded during the next report period.

3.2 Mark I Plume Test

A study of the Mark I full scale contamination test concluded that the objectives could be accomplished during the Marquardt plume tests. As a result, the Mark I test was cancelled.

4.0 ALIGNMENT Ⓜ

GE and Aerospace have resolved their differences in the error analyses of the new airborne alignment scheme, and have reached an agreement that the method proposed by Aerospace has smaller errors. GE proposed use of the star tracker self test capability for the alignment leg from the base of the star tracker. This new approach has required further study and GE is expected to recommend a baseline approach during the Program Review in March.

5.0 IMAGE VELOCITY SENSOR (IVS) ○

The evaluation tests at GE of the Hycon and Goodyear engineering model image velocity sensors have revealed the sensors are still not providing specification performance. While many of

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5.0 IMAGE VELOCITY SENSOR (IVS) - Continued

the deficiencies that existed during the Phase I testing have been corrected, the sensitivity to center of power variation has not been overcome. As a consequence of this and other difficulties, the completion of the evaluation will be delayed to allow for incorporation of modifications and to provide for retesting.

In parallel to this effort, Aerospace is further refining the evaluation technique by developing statistical weightings for such parameters as stereo angle, target types, modulation and light level. These will be used in combining the test data to get a representative performance for typical mission operations.

6.0 ELECTRICAL POWER SYSTEM ✓

6.1 Fuel Cell Gas Supply System

A meeting was held at SAMSO on 17 January 1969 to discuss the selection of K-bottles vs. long lines from holding areas as a means of supplying fuel cell gases to the LM during pre-launch operations. MDAC-WD presented trade study data citing advantages of storing cryogenic gases in the storage areas and utilizing long lines rather than an excessive number of K-bottles. The decision was made to retain the "long line" concept.

6.2 Fuel Cell Gas Specifications

A meeting was called by Aerospace at SAMSO on 24 January 1969 to discuss the status of fuel cell gas procurement specifications.

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6.0 ELECTRICAL POWER SYSTEM - Continued

Present plans call for using NASA specifications for liquid hydrogen, gaseous oxygen and liquid oxygen. Effort is currently under way to determine if any problems are known at this time or anticipated with procuring fluids per the NASA specifications.

6.3 Fuel Cell Reactant Purity Requirements

A meeting was held to discuss the status of purity requirements for the MOL fuel cell. The requirements for the Allis Chalmers fuel cell oxygen and hydrogen reactant purities are the same as the previous MOL baseline fuel cells. These requirements were later re-confirmed at the Allis Chalmers fuel cell Preliminary Design Review (PDR). The requirements associated with GFE procurement of the reactants and AGE procedures to control the purity level during servicing were also discussed.

6.4 Silver Ion Generator

Meetings were held at Aerospace on the impact of incorporating the AiResearch Silver Ion Generator in the Allis Chalmers fuel cell. Presentations by AiResearch and DAC on the operating characteristics of the existing hardware indicates that the AiResearch component can only work in the continuous and low flow region of the Allis Chalmers water removal subsystem of the fuel cell. This requirement has not been implemented in the fuel cell Technical Requirement Specification (TRS). Allis Chalmers and MDAC-WD are assessing the impact of this change on the fuel cell development schedule and cost, and overall program risk.

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7.0 OPTICS o

7.1 General

On 27-28 January 1969, a Technical Review of the Photographic System Segment was held by Air Force/Aerospace at EK. This was the first of a series of such reviews that will be scheduled at about seven-week intervals. The review included a tour of the component and COA and MM level test facilities as well as the polishing area for the large mirror. Several side sessions, held during the review, contributed significantly to resolution of some of the items discussed.

The EKC study report on optical system improvements was received in late January. Plans were prepared to review the study documentation during February 1969. Representatives of the Advanced Plans & Requirements Office and MPSS Offices of the MOL Division and the optical support group will participate in the study review.

A short study (two weeks) was performed to estimate the capability of the Dorian optical system when used in conjunction with low-light level TV sensors and infra-red sensors. The results of this investigation will be available in February.

7.2 Light Trap

A meeting was held at EKC on 29 January 1969 with EK and GE to provide followup guidance to support the earlier OPR TWX on the problem of controlling stray light reflectance from the tracking mirror bay. An approach utilizing the EKC black velvet, including a scheme to measure average reflectance was worked out. The success of this approach will largely depend upon the care used in the application of the velvet by GE. EKC has agreed to provide design assistance at a design meeting at GE during the week of 10 February 1969. An ICN is to be prepared for discussion at TSOM 9.

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8.0 TRACKING MIRROR DRIVE & ATS DRIVE STABILITY

GE and Aerospace noise analysis and stability studies were reported in mid-January and were in complete agreement. The conclusions of the studies were tracking mirror support flexures must be stiffened. DSS-1 test data will be utilized to determine if the CEI Specification for tracking rate performance is satisfied for the new flexure stiffness values provided by EK.

8.1 ATS Drive Stability

Aerospace studies of the ATS drive stability have indicated that the stiffening of the Douglas shell structure was not necessary and stability could be guaranteed with the current values of system parameters. Interface signoff should proceed normally the week of 24 February 1969.

9.0 FLIGHTS 6 AND 7 ACTIVITIES

The ground rules for submitting Phase II proposals for Flights 6 & 7 were established for all contractors. These proposals are scheduled to arrive from early February to mid March 1969.

Portions of the Phase II package have already been received and reviewed. Comments have been supplied to the contractors. The review of the majority of the documents is in process and is expected to continue for several months.

At the end of January 1969, the responsibility for Flights 6 & 7 activities was transferred from the Systems Engineering Office to appropriate segment offices. The review of Phase II proposals will continue on a segment basis.

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10.0 ADVANCED DATA SYSTEM ✓

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The redefinition of SCF/MOL resources for flight support, resulting from major changes in the STC configurations and objectives, entered high gear in January. Six Air Force/Aerospace/Contractor teams, each with several groups, are devoted to the project full time. Aerospace provided the pre-baseline system definition for use in the study, is providing key members on all teams (including three of the team captains) and is represented on the technical coordinating group and overall steering committee. The total manpower on the effort is over 120 systems engineers. The first phase of work is intended to produce a comprehensive MOL Flight Support Plan on 28 February. The second phase involves updating of all specifications by 15 April. The 6600 decision leaves MOL without an Orbit-Ephemeris Program in fact or on contract. Requirements definition and evaluation of alternatives commenced in January.

TOR-1001(2107-25)-4 Reissue A (U) Program 632A Orbital Requirements Document for Manned Flights, was approved and published. This ORD was based upon MOL ground computer programs operating in CDC 3800 computers at the STC. Revisions reflecting use of CDC 6600 computers will be published approximately three months after the CDC 6600 baseline is established.

A briefing was prepared defining a pre-baseline and approach to the problem for the 6600/360 System Definition Program. Full support is being given to this effort, including chairing the Implementation and Test Working Group and participation in other software groups.

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11.0 SOFTWARE STATUS ✓

11.1 AVE Software

The revised Category I Test Plan for the GE AVE Software CPCEI was reviewed and comments from Aerospace MOL offices and the technical support offices were assembled. The comments were reviewed in a meeting with GE. Modifications required to the Test Plan and action agreements related to the development and test concept were documented in the minutes to that meeting. A series of discussions were held in-house related to GE's development and testing plans. The need for a "scientific validation," quantitative requirements for testing software, and the fidelity, availability, and visibility of the simulator for AVE S/W verification were the topics of these discussions. The latter topic regarding the simulator was coupled with considerations of the necessity of an "interpretive computer simulation." A briefing was prepared for Aerospace MOL Division management on the above topics. The meeting will be held and discussions will continue into the next reporting period.

During this reporting period, the contractors reported that the ADC time utilization during the worst case "100 millisecond cycle" was estimated at 137%. This represented an increase of 49% over the last report. Meetings were held with GE and MDAC/IBM to determine means of resolving the problem. Briefings were also prepared for in-house management in order to explain the problem and to report on the status of the resolution of the problem. At this time, potential solutions have been defined. Direction will be given the contractors for implementing selected solutions during the next reporting period.

A meeting was held with MDAC, IBM, Air Force and Aerospace personnel to discuss the Aerospace comments on the Executive and Maintenance Diagnostic Programs' test plans. A revised set of comments were prepared reflecting the results of the discussions for formal transmission to the contractor.

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11.1 SOFTWARE STATUS - Continued

The problem of holding, resetting and stopping the vehicle clock during integrated pre-launch vehicle tests was discussed in-house. The technique for providing this capability could involve an AVE software modification. Meetings with the contractors will be held during the next reporting period on this problem.

The AD HOC Systems Test Group (See Section 1.0, General) was supported during the reporting period. Test flows, AVE S/W test capabilities in the various hardware test facilities, critical paths in the test flow, and the capability for late revalidation of AVE S/W were topics investigated as part of this support effort.

Discussions were held with GE on the implementation of the ATS streaming and hopscotching modes for the on-orbit focus determination exercise. The results of these discussions were documented for coordination.

Discussions were also held with GE on selective core dump implementation. The results of these discussions were documented and will be coordinated during the next reporting period.

Contractor reporting procedures for core and timing status have been developed in-house and are in coordination.

11.2 Ground Software

Mission Planning Software - The Mission Planning Software Preliminary Design Review has been reviewed by Aerospace, and the current status of the design has been incorporated into the review comments.

Mission Evaluation Software - Some meetings were held at TRW regarding unresolved problems from the PDR such as the proper coordinate systems for viewing geometry and the test plan.

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11.2 SOFTWARE STATUS - Continued

A meeting relative to the PDR was also held in Washington. TRW presented their approach to the MCD and the Community discussed which items they consider necessary for inclusion in the MCD and how they should be presented. It has been decided that there will be no single all-inclusive MCD output report, but rather that each user will devise his own strip and re-format requirements to print out those items which satisfy his needs.

Command and Control Software - Comments on the PDR material have been provided for the DAC (LMCP) and are almost complete for GE (CG804). Primary efforts have been devoted to the STC 6600 redefinition.

Mission Studies - In order to support the time line effort, a new target tape and data base parameters have been generated in coordination with the Air Force. The description of the new target tape and the data base parameters have been documented, and these will serve as the basis for all future time line studies over the next six months.

An integrated study plan has been prepared showing basic study areas, and in each area specific study requests have been coordinated where applicable between various users.

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12.0 SAFETY ,

As a result of a review of the MDAC-WD effort in the materials flammability and toxicity areas, it was determined that associate contractor intercommunications and data exchange was inadequate. MDAC-WD data requirements and plans for use were reviewed with a view to placing these requirements on the associates through the appropriate OPR.

An informal review of the GE Safety Program was conducted on 21 January 1969. It was recommended that the contractor initiate submittal of Hazard Reports as defined in the Form 9.

The Safety Office participated in the Wire Harness Technical Review at MDAC-ED.

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13.0 [REDACTED]

A bidders' briefing was held on 20 January. A technical advisory group has been formed to evaluate contractor proposals due in February.

14.0 ADVANCED PLANS ✓

14.1 MOL Geodesy Applications Study

The Geodesy application study was completed in January 1969. The results of this effort demonstrated considerable capability for such an application of MOL. Target positions (x, y) on the order of 300 ft. (or less) and altitude data (h) on the order of 150 ft. (or less) can be achieved.

14.2 Wide-Band Data Systems Review

A status briefing was prepared and presented to J. T. Stewart on 28 January 1969 in Los Angeles. The briefing concluded that extensive capability (data rates \gg 20 mbits/sec) could be included aboard MOL for costs on order of \$25-30 million (ROM). A number of system options (optical, X-band, S-band, satellite relay) could be available at this cost level.

Costs of approximately \$10 million would be required to achieve a minimum capability system (data rates \lt 5 mbits/sec). Additional study by Aerospace and industry will be required prior to selection of the most attractive options.

14.3 Low-Fly Study

Preliminary studies were completed to determine the orbital sustenance velocity required to operate the MOL vehicle at perigee altitudes as low as 60 n. mi. In addition, a Gemini B low altitude heating study was initiated.

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14.0 ADVANCED PLANS - Continued

14.4 Extended Duration MOL Design Option Study

A study was initiated to assess the system impact of EDMOL configurations designed to achieve maximum low-fly or extended duration capabilities. In the maximum low-fly configuration, the EDMOL modification would provide additional propellant tankage. The maximum extended duration modification provides additional cryogenic storage. A blend of low-fly and extended duration capabilities could be produced through a "mix" of propellant and cryogenic tankage.

A brief examination was made for the EDMOL vehicle of the potential benefits of moving the unpressurized compartment forward with an aft extension to house added expendables. Briefing charts were prepared describing these benefits and listing approximate cost savings commensurate with the benefit items.

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