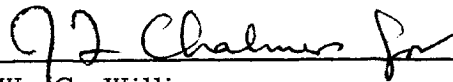


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MOL PROGRAM
MONTHLY PROGRESS REPORT
FOR
15 APRIL - 15 MAY 1969



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1.0 GENERAL

During April attention was primarily directed at reviewing suggestions for reduction in program scope and schedule adjustments required to fit funding restrictions. It is now apparent that, for funding reasons, the '69 baseline schedule will probably be altered by dropping the first launch (booster qualification) and by slipping the first manned launch some six to seven months. Aerospace effort was expended on determining the technical impact of this course of action. The possibility of assembling the entire vehicle on the pad was also thoroughly investigated.

The attached list of proposed deletions, changes and some few additions were also studied in preparation for a meeting with the Associate Contractors scheduled for 6-9 May 1969. The purpose of the meeting will be to arrive at a program schedule, determine the cost and schedule impact of each of the listed candidate items and to receive cost reduction suggestions from all program participants.

Another of the continuing series of Technical Signoff Meetings (TSOM) was held during the reporting period. Among the more important items discussed during TSOM #10 were the SLC-6 ground air conditioning interface (with agreement being reached on the settling time constant of the conditioned air) and the ATS thermal problems. It was decided that tradeoff studies of possible solutions to the ATS thermal problem should be made by both GE and MDAC-WD and that these alternatives be evaluated at a technical interchange meeting in early June.

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2.0 LOADS

As noted in the previous progress report, the Loads cycle 4 situation is currently under control and will be dropped from further discussion in this report unless further difficulties occur.

3.0 SHOCK

Shock level data from the main door separation development test (1A82B) has been reduced by Aerospace. The shock spectra presented by MDAC-WD have been verified and found to be higher than the current SAFSL Exhibit 10003 levels. Planning for the re-run of 1A82B has been conducted. The re-run is required to verify positive door separation which was questionable on the previous test. The LM shell from 1A16 (pressure compartment development test specimen) will be included in the second test. Inclusion of a complete LM shell will permit determination of shock levels at the birdcage hangers. (GE has expressed concern for the beryllium tripod structure and critical components of the TM assembly at the higher shock levels.)

Discussions were held with LMSC and Battelle Memorial Institute personnel on the subject of effects of pyro shock on beryllium structure. The conclusion of these conversations was that it is highly unlikely that beryllium structure adjacent to the pyro joint would suffer damage. Action is being taken to initiate planning for a door separation test on 113D at GE which will permit determination of shock levels and associated transmissibilities throughout the Tracking Mirror assembly.

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4.0 CONTAMINATION

A review of the contamination problem has resulted in deletion of some of the analytical effort being expended in defining the problems in favor of a "design around" approach. The primary effort has been directed at resolving the ascent staging contamination influx problem and reviewing the effects of outgassing sealants used in the mission module. The contamination influx problem will be controlled by increasing the sealing requirements of the mission module. The increased sealing requirements amplify the need for a lower outgassing sealant. Development efforts are proceeding on an improved sealant, however, total acceptability of the revised material is still questionable.

4.1 Plume Contamination

Plans for the full scale plume contamination test at AFRPL were finalized during this report period (Ref. IOC 69-5132.44-8). This program will consist of a series of "screening" tests during May 1969 followed by the primary weighing tests in June-July 1969. Thruster operating temperatures will be varied over the range of -20°F to $+120^{\circ}\text{F}$ to determine the dependency of pulse mode contamination production on hardware temperature. The primary objective of the test program is to determine if the baseline minimum thruster temperature of $+60^{\circ}\text{F}$ is sufficient to eliminate the production of pulse mode contamination.

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5.0 OPTICS

During the reporting period concern has grown over the possibility that the camera will not be able to meet specified minimum operational vibration specifications.

A meeting, originally scheduled for April, to review camera vibration problems slipped to May at the request of the contractor. This meeting will be held at the end of the May Technical Review.

6.0 LAUNCH LOCKS TRACKING MIRROR RING DEFLECTION

As noted in the previous progress report, the contractor analysis indicated the redesigned launch locks allow excessive deflection of the TM pitch trunnion during boost. Aerospace analysis indicates that the deflection with both the old design and the redesigned configuration is approximately the same and within the allowable deflection, 6 arc min., stated by GE. This difference in analytical results will be discussed with the contractor at the Technical Review to be held in May.

The contractor was given direction allowing him to use the old launch lock design, due to the serious schedule and cost impact stated by the contractor against the use of the redesign. We have requested:

- a. a more detailed contractor review of the structural adequacy of the old lock design to provide assurance that additional problems in maintaining TM ring deflection do not exist with this design, and

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- b. a follow-on study of the incorporation of functional redundancy in the lock design on a retrofit basis.

7.0 ALIGNMENT

The status of alignment has not significantly changed since the March report. One new problem has arisen: since the startrackers are mounted off the upper leg of the beryllium tripod, relative motions between the Mission Module shell and the startracker require enlargement of the cutouts in the shell. This will require redesign of two frames in the Mission Module and will impact MDAC-WD.

8.0 IVS

The task to finish testing of the two vendor's sensors is progressing according to the plan described in the March report. However, due to fiscal problems overtime was deleted from the program and vendor selection will probably be deferred until July. Retest of the two sensors with fixes incorporated are currently planned for May and early June.

9.0 TRACKING MIRROR DRIVE AND ATS DRIVE STABILITY

Both the tracking mirror and ATS drive stability and ATS jitter problems are being worked according to action plans previously established. No significant milestones have been accomplished since the last report.

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10.0 ATS/LM INTERFACE

The problem identified in the March report of the effect of relative motion between the LM radiator and the ATS on orbit shroud has essentially been solved. The problem was solved by attaching the on orbit shroud to the pressure shell instead of the meteoroid shield. The ICN's to incorporate these fixes were signed off at TSOM #10.

11.0 EC/LS

An EC/LS Working Group Meeting was held at MDAC-WD on 24 April 1969. Significant areas covered are summarized as follows:

- a. The Astrovac portion of the Waste Management System was demonstrated successfully and met with approval of the flight crew.

There was some question as to the adequacy of the man-machine interface of the waste collection equipment. The flight crew is expected to visit the MSK for a demonstration during the next reporting period.
- b. The Humidity Control Assembly has been modified to prevent freezing on exposure to vacuum. This new design also has slightly higher performance for latent heat loads.
- c. Bacteria control for the potable water system will be provided by a silver ion generator now located downstream of the fuel cell rather than being included within the fuel cell package.
- d. Modifications to the cabin vent valve electrical circuit are being initiated that will prevent a single failure from causing a Category IV failure. The new circuit design will allow a crew response time of five minutes for corrective action. The mechanical failure modes are currently being worked by MDAC-WD and their MSK.

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11.0 EC/LS - Continued

- e. The Thermal Control System now has a radiator flow reversal valve as a result of ESE #1 that allows for improved performance at high negative beta angles. The fuel cells have incorporated proportional controls in lieu of "off-on" solenoid controls to alleviate the problem of thermal spikes to the Thermal Control System.

11.1 ECS

The ECS Critical Design Review was held at Hamilton Standard, Windsor Locks, Connecticut. The CDR covered all items except the Gemini-tunnel repressurization hardware which will be CDR'd in July 1969 and the temperature and humidity control assembly which will be CDR'd in December 1969. Almost every item reviewed requires some small action on MDAC-WD or Hamilton Standard before final approval can be made. Major problems that will be solved before final approval include:

- a. Cabin dump and relief valve design for ascent and on-orbit safety and vibration failures.
- b. Water chiller internal leakage permitted between coolant and potable water loops.
- c. Water heater external leakage causes shorting of electrical controller.
- d. Removal of thermal insulation of CO₂ Removal System.
- e. Potable water relief valves are undersized to handle the high water flow rate from the A/C fuel cell.

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12.0 ACTS AND PERFORMANCE

12.1 ACTS/GE Interface

All the outstanding ICN's for the ACTS/GE Interface have been signed. This terminates a long effort to establish primary performance requirements across this interface. ECP's modifying the SP/DR and the MDAC-WD CEI are in process. These ECP's represent the last known pending performance changes impacting the ACTS/SCE.

12.2 ACTS/SCE CDR's

A meeting was held at MDAC-WD to discuss a preliminary list of agenda items for upcoming CDR's. The tentative CDR scheduling for ACTS/SCE components and the subsystem is:

- a. VVSA (ion sensor) - 14 May 1969
- b. HSA (horizon sensor) - 1 June 1969
- c. CIA (inverter) - 11 October 1969
- d. SCE (subsystem) - 28 July 1969

12.3 Thrusters

A full scale ACTS panel was acoustically tested to anticipated flight levels. Thrusters were mounted to the panel longerons in an attempt to reduce the acceleration levels noted during the March 1969 tests. The result of attaching the thruster mount to the longerons was to shift the vibratory spectrum such that higher frequencies were attenuated (200-2000 cps) and lower frequencies were amplified (< 200 cps). These preliminary results are being evaluated to establish the program impact of redefining the random vibration requirements to the thruster subcontractor.

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13.0 ESE-1 FAIRING EJECT

The Contractor's proposal for ejection of the ESE-1 fairing during ascent did not meet the Program criteria that a single failure would not cause inadvertent eject initiation. A detailed study by Aerospace using technical data supplied by the THIM and LM resulted in three acceptable methods of implementation. The approach which uses ARM and FIRE signals from each of two THIM programmers and having backup by the LM command system was selected as the least complex and lowest in cost.

14.0 REMOTE OPERATION OF CITE AT THE TEST FACILITY

Investigation of the use of a single CITE to support tests in several areas at the Associate Contractor's test facility was initiated as a potential Program cost reduction item. Transmission of a large number of power and signals over lines up to 400 ft. in length posed special problems due to voltage drop, impedance noise, and timing requirements. A DSO design was prepared meeting overall requirements by the increasing of power line wire size, use of line drivers and termination circuitry, use of coaxial lines for approximately 30 signals, and adjustable delay for a few signals. The proposed design was reviewed in detail with GE and it was agreed to be feasible and that the small sized carry-near test equipment would eliminate the need for additional racks of equipment on the facility floor.

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15.0 TRANSPONDER TECHNICAL REVIEW

The development model TTCV transponder¹ failure to meet specifications in approximately 20 areas during tests at TRW was the subject of a joint technical meeting at TRW. The majority of problems were resolved by correcting test procedures and realignment. Areas of particular concern were false lock of the receiver under certain conditions, some loss in sensitivity, and phase noise during the ascent acoustic/vibration environment. TRW will correct the false-lock problem and is submitting an analysis to substantiate their claim that the DAC sensitivity specification is not realistic. TRW/Collins/DAC proposed a hardware change which eliminates the phase noise problem by operating the transponder in a non-coherent mode during ascent. Subsequent evaluation by Aerospace concluded that while the proposed change contained desirable features, it reduced on-orbit reliability and was, therefore, undesirable. Discussion of the phase noise also revealed a lack of understanding of the phase noise specification of ± 12 degrees and the method for test. Study by Aerospace is continuing and a meeting for further technical discussion with DAC has been planned.

16.0 OPERATIONS

Continued emphasis was placed upon integrated MOL and SCF activities with respect to the proposed 6600 operating system and the hardware/software for ADS. New sections for the MOL Flight Support Plan (MFSP) were published during the reporting period (1 May).

Aerospace is preparing documents on vehicle command loading and telemetry responses for the Space/Ground interface meeting scheduled in early May.

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17.0 AVE SOFTWARE

The responses to GE action items levied at the March Technical Review Meeting were discussed in a series of meetings. Discussions covered (a) determination of GE's approach to scientific validation, (b) evaluation of the use of an interpretive computer simulation (ICS) for AVE S/W development and testing, (c) determination of the AVE S/W CDR data package content, and (d) providing a revised development/implementation plan.

MDAC proposed SCNs and preliminary design material pertaining to the Executive Control System Block 2 Changes were reviewed and a PDR on these changes was supported during the period. Material was also received and reviewed pertaining to the Group 3 programs of the MDAC "On-Board Set" software CEI. A PDR will be held on these programs during the next reporting period.

A software working group meeting was held with MDAC to discuss the following: (a) PCM control by the AVE Software as compared to complete ground control, (b) error handling provisions in the MDAC S/W, (c) core allocations for MDAC CEIs, (d) binary patch requirements, and (e) the System Generation software CEI.

17.1 Ground Software

A preliminary report prepared by TRW as a part of their study of cue ordering and analysis was reviewed. Meetings were held during the period with TRW and ACIC with respect to this topic and the topic of cue production itself, i. e., the Master Photo Chip (MPC) effort of ACIC.

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17.1 Ground Software - Continued

Problems associated with running TWONDER on the 3800's in Sunnyvale have been solved and the program is now operational at that location. Targeting runs for timeline purposes have been made.

18.0 ADVANCED MOL SYSTEMS STUDIES

A plan for studies intended to place MOL Follow-on alternatives in context with DOD and NASA Manned Systems Planning is in process of development for presentation to J. D. Stewart, WDCO.

Informal discussions have been held with several industry contractor advanced planning organizations to review their activities relative to future MOL planning applications. Emphasis has been placed on obtaining preliminary information on characteristics of system concepts currently being proposed for DOD and NASA Space Transportation Systems, and, on assessment of potential DOD missions.

19.0 SAFETY

During this reporting period the MOL Safety Council was convened to review the Gemini B Fire Test Program and the selection of the Hamilton Standard constant wear garment. This review resulted in deletion of the requirement for a full scale Gemini boilerplate fire test and emphasized concentration on special subsection testing. It was also concluded that a cotton constant wear garment, although flammable, can be accepted if protected by Teflon coveralls.

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19.0 SAFETY - Continued

Technical reviews were held with MDAC-WD to resolve the Laboratory Module dump valve failure characteristics. The initial proposal for a design change incorporated protection against single failures causing rapid depressurization. Further effort is required to assure compatibility of the design approach with ascent venting requirements.

Multicontractor meetings were conducted to force closer coordination in both the safety and nonmetallic materials integration area. Data requirements have yet to be resolved which allow the responsible contractors to fulfill their integration tasks. However, significant progress has been accomplished as a result of the review and no further contractual problems are anticipated.

In response to MOL SO request, a review of the fire hazard associated with the use of mylar thermal blankets in the Mission Module was conducted. It was proposed that lexan, a GE developed product, be used as a replacement for the mylar blankets. It was determined that, although mylar is flammable, in the present application the risk is not sufficient to warrant a change.

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