BIF-107-50237-68
Total Pages 8
Copy 1 of 2

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MOL MONTHLY PROGRESS REPORT

For

1 September 1968 through 30 September 1968

for J. F. Chalmers
Systems Engineering Director
Management Systems

for W. C. Williams
Vice President, General Manager
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1.0 GENERAL

All segments report that, during the month of September, their major effort was directed towards review of supplementary agreement documentation. Upgraded versions of AVE, AGE and Software CEI Specs were reviewed and Associate Contractor negotiations actually commenced. The various statements of work, CDRL, deliverable item lists and all other documentation required to define the upgraded contract baseline were all reviewed and discussed with Associate Contractors in preparation for the issuance of the new supplementary agreement approximately 18 October 1968.

Difficulty is anticipated in the near future in scheduling our limited technical resources in support of negotiation activity. The negotiations must be given top priority since they are basic to the structure of the program and successful Air Force program management. It must be recognized that, during the negotiation period, the technical direction of the on-going program will suffer.

2.0 LOADS

A general instability buckling failure at 81% of limit load occurred in August during static testing of the COA barrel. The Deputy Director of MOL was briefed 24 September on the proposed EK/DAC fix for this structural failure. As previously reported, preliminary load cycle 4 data indicates marginally higher than currently specified design loads for especially the forward portion of the COA and also the mirror mounting hardware. A stop order on COA assemblies was recommended together with a high priority analysis effort to develop design and static test criteria. Implementation of doubler fix on the SLS to withstand revised design load conditions was directed. Aerospace and Martin Company personnel are currently involved in a mutual resolution of load cycle 4 discrepancies.

A detailed review of loads impact on the COA is in progress and will be completed following receipt of total loads package on 15 November. DAC is acting as a subcontractor to EK in the design and construction of the COA barrel. This relationship has somewhat increased the difficulty of maintaining technical control over this area of activity.

3.0 ALIGNMENT

The Aerospace MOL Program Office and Engineering Science Operation studied the technical trade-off of various locations of flight alignment monitor system light source. The location selected was X_2 as being the most favorable for the FAMS operation.

The General Electric special study team on alignment is re-evaluating the complete alignment requirements and design and presented the status of their study in a meeting with the Air Force Systems Office on 10 September. It is still believed that the current FAMS design is inadequate and the next meeting of the special study team is scheduled for mid October.

4.0 BEARINGS

This subject will be deleted from future monthly progress reports unless the official load cycle 4 information reopens the bearing "brinelling" question.

5.0 CONTAMINATION

During the month of September, 1968, six plume contamination tests were conducted in test cell 8-V at Arnold Engineering Development Center (AEDC). Of these six tests, three were pulse mode firings and three were steady state firings. Both MDAC-WD and General Electric participated in the tests with the following results:

5.0 CONTAMINATION - Continued

5.1 A panel (and its associated samples) heated to approximately 100°F had significantly less contamination on it than one at -60°F.

5.2 A fence on the panel in the rarefied portion of the plume significantly reduced the steady state contamination behind it.

5.3 A model of the Mission Module door seal was effective in reducing the steady state contamination inside the cavity.

5.4 Modifying the propellant temperatures, thruster temperature and mixture ratio were all ineffective in reducing pulse mode contamination.

5.5 A heated nozzle shroud (approx. 700°F) was effective in intercepting and decomposing pulse mode contamination.

5.6 An unheated nozzle shroud was effective in intercepting pulse mode contamination.

6.0 FLIGHTS 6 AND 7

A Technical Sign-Off Meeting (TSOM) was held at MDAC-WD on 17-19 September. It was attended by personnel from the three contractors, the Air Force and Aerospace - a total of 70 people. Sign off was achieved on approximately 20 percent of the interface technical documentation. The documents signed off covered parts of the structure, environment and electrical interface requirements. The agreements reached will form the basis for the interface control drawing (ICD) activity which will follow.

The major technical problem is in the area of thermal control in Bay 1. The temperature and humidity requirements in the vicinity of the camera have not been agreed to among the contractors. Aerospace is continuing to work to solve the environmental requirements problem.

7.0 IMAGE VELOCITY SENSOR (IVS)

The O'Brien Committee on the IVS met at General Electric on 20-21 September. Aerospace prepared a document on the IVS for the Committee to help prepare the members for the meeting. The paper explores IVS history, program requirements, problems, theory of operations, etc. Aerospace personnel attended the September meeting of the O'Brien Committee and supplied answers to a variety of questions from committee members.

In general, the committee agreed with Aerospace recommendations on contractor selection.

Presentations were made by each vendor (Itek, Goodyear, and Hycon) and by General Electric. The following conclusions were reached:

1. The IVS program is proceeding satisfactorily.
2. There is high confidence of success with either Goodyear of Hycon approach.

Goodyear and Hycon received a go-ahead for completion of testing and evaluation. Itek was requested to complete fabrication of their unit and to deliver it to the Avionics Lab at Wright Patterson Air Force Base.

Major questions generated by the committee were as follows:

1. Could the null accuracy be slightly increased?
2. Could an increase be made to the large error gain tolerance?
3. Is the Weiner spectrum applicable at each vendor's frequency range?
4. Would it be possible to simplify the IVS specification?

On the above questions, General Electric agreed to determine a Weiner spectrum and to determine the advisability of not requiring IVS operation in the presence of clouds. They were requested (but did not agree) to study the advisability of tightening the open-loop requirement.

The IVS tester was also discussed and the basic design was approved as satisfactory. However, since its design penalizes Goodyear more than Hycon, some changes were directed in the test program to make the test results comparable.

Work is continuing on answering the above questions and in the design of the IVS and Aerospace will continue to technically direct General Electric in the IVS area.

8.0 IDENTIFICATION AND DEFINITION OF HARDWARE EXCHANGE

Considerable progress has been made in resolving several controversial exchange hardware test substitutes and handling equipment problems.

8.1 ACTS Gyro/NAV-FAR Interface Equipment

GE was directed to utilize a mathematical simulation of the gyro outputs since a prime ACTS gyro is not available for DDS-1. DAC and GE will jointly validate the model by comparing digitized output data resulting from identical inputs to the math model and to gyros under test at Minneapolis-Honeywell.

8.2 TM Installation Guidance Equipment

GE need dates for EG-47 for installation of EK-1/EG-48 into DDS-1; and EG-32 for installation of other TM subs into 113D, 113T, etc., could not be met by EK. GE claimed a day-by-day schedule slip following their need date for both DSS-1 and 113D.

GE advised that (1) EG-47 is deleted, and (2) due to schedule incompatibility, EG-32 would not be available for 113D TM installation. GE directed to utilize crane and hydro-set for DDS-1 and 113D, with technical support from EK. EG-32 to be provided in time for 113T installation.

8.3 LM/MP Inertial Substitutes (GE-3/GD-27/GD-38)

Two sets were originally on contract, GD-3 for wire harness development at GE then utilized for DTS at Huntington Beach; and GD-27 for FV-2. Due to the addition of the A2 Birdcage and DTS schedule conflicts for use of GE-3, GE requested the addition of GD-38. A work-around was accomplished whereby, (1) wire harness development will be accomplished at GE, and (2) GD-38 will now be used for the A2 birdcage and DTS. GD-27 has thus been deleted.

8.4 TM Dynamic Substitute (Ring/Flexures/Mirror Subs)

EG-48 for DSS-1 still remains a problem; however EK currently feels they can provide prime ring and flexures by about 25 April 1969. GE states a day-by-day slip for completion of DSS-1 will occur if EG-48 is received later than 1 April 1969.

9.0 FUEL CELLS

An extensive study was made by Aerospace of the development test experience with Allis-Chalmers and Pratt-Whitney matrix fuel cell for the MOL. DAC is currently in the process of selecting a fuel cell subcontractor and the Allis-Chalmers and Pratt-Whitney power plants are the prime contenders.

Investigations indicate that the Allis-Chalmers powerplant has, by far, the most comprehensive test experience. It has in one instance demonstrated the MOL requirements with the testing of EDS-1 which has served as the Design Verification Test powerplant for the NASA AAP. Two other powerplants of this same configuration (which is being proposed for MOL) have exceeded planned tests of 1500 hours

duration and nine other powerplants with similar electrode configurations have reached or exceeded the NASA AAP design endurance of 1500 hours. From the tests it appears that Allis-Chalmers could meet the MOL design objectives with no significant development or integration problems apparent at this time.

Test experience of the Pratt & Whitney PC8 powerplants is much more limited with only three powerplants having run under MOL conditions. Longest duration of these powerplants is the 750 hours of the NASA/MSC powerplant. Performance levels in these tests appear to be too low to meet MOL requirements. A test of a PC8A at NASA/ Lewis was of 1500 hours duration and an in-house test of a stack operated for 2200 hours but these tests were at temperature and performance levels below those proposed for MOL. Several problems such as pump endurance, cell life, reactant and coolant distribution have been identified in these tests. It appears that a number of development problems are indicated for the Pratt & Whitney PC8 powerplants and it could be expected that difficulty might be expected in meeting the present MOL schedules.