DEPARTMENT OF THE AIR FORCE

OFFICE OF THE UNDER SECRETARY

PRO F5

28

MEMORANDUM

November 5, 1969

Gen. Allen

[redacted]

Maj. Schow

May I please have any comments on the attached draft report by Nov. 13. The report has also been forwarded to [redacted] Colonel Norman, and Dr. McLucas for review.

Bob

F. Robert Naka

Attachment
Draft report
on adequacy of
C/H overlap

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HANDLE VIA BYEMAN CONTROL SYSTEM

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November 4, 1969

THE ADEQUACY OF THE CORONA/HEXAGON OVERLAP

Background

At the NRP Executive Committee meeting of June 20, 1969 the HEXAGON Review Committee recommended that:

1. The HEXAGON Project be funded to the minimum level necessary to meet the December 1970 initial launch date.

2. The CORONA launch schedule be revised to provide for

   5 launches in FY 1970
   5 launches in FY 1971
   2 launches in FY 1972.

3. The need for a buy of additional CORONA vehicles be reviewed in December 1969.

These recommendations were accepted.

Statement of the Problem

Although the recommendation was to review the CORONA buy decision in December, I felt that a mid-term review would be very useful. Therefore, I reconvened the same review group* in Los Angeles on October 13 and 14 and in Danbury, Connecticut on October 15. We tried to accomplish the following:

1. Determine the optimum date to make a final decision on whether or not to procure additional CORONA vehicles.

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*Dr. F. Robert Naka, DDNRO
[redacted]
Col. Lewis S. Norman, Jr., Vice Dir., SAFSP when group was set up

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2. Reassess the validity of the June recommendations to the ExCom.

3. Determine the feasibility of providing additional "insurance" to the planned one-year overlap of the CORONA/HEXAGON launches.

Sources of Data

Agendas were prepared and submitted in advance of the Committee's visits to SAFSP and to Perkin-Elmer. Copies of the agendas are attached. In general, each HEXAGON associate contractor's current and projected schedule status, anticipated reliability (based in part on current failure mode analysis), estimated cost to complete (by fiscal year), and current problem areas were evaluated. The two CORONA Program Offices were asked to present the minimum time from "go-ahead" to "launch" if there were a reorder, the cost (by fiscal year) of additional reorders, the cost savings estimate if CORONAs were not launched during the overlap period, and the impact on reliability of the phasing out of the CORONA Program. Finally, the GAMBIT "HIGHBOY" configuration was asked to be presented from the point of view of what changes had to be made to the current GAMBIT design to permit it to operate at a significantly higher altitude and what would be the resultant costs.

Conclusions

The Committee reached the following conclusions:

1. From the standpoint of HEXAGON alone, confidence in mission success naturally rises as time passes. The earliest date prior to launch of passing significant milestones is May 1970. By May 1970 the all-up development model SDV-III will have had an integration test and the first sensor subsystem flight article will have been shipped from Perkin-Elmer to Lockheed.

2. From the standpoint of CORONA alone a decision to buy must occur 24 months prior to launch. The last launch of the 5, 5, 2 schedule is on November 10, 1971. Hence, the next launch would be in late January or early February 1972. Therefore, the decision to buy CORONAs must occur about December 1969 in order to allow some slip in the new CORONA buy schedule.

3. Because of the foregoing, the period of December 1969 to February 1970 becomes critical for HEXAGON schedule. On February 5, 1970 the sensor subsystem development model is scheduled to complete the Chamber A (final) test and be shipped to Lockheed on February 17. Unfortunately, February is marginal for a CORONA buy decision.

4. On December 31, 1969, the electromagnetic interference test will be completed on the development model. This should be the first indication that the sensor subsystem can operate with itself.

5. As a result of the Committee's briefings and discussions, the program offices and the contractors have arranged to accelerate electronic failure mode analysis and test the calculations by interconnecting certain key boxes during December 1969.

6. The results of Items 4 and 5 above are the only milestones one can apply to obtain confidence of HEXAGON mission success. This is somewhat, but not much, better than noting the incremental progress on the schedule.

7. The idea of initiating a CORONA buy with the intent of cancelling in May was examined to see how little cost could be incurred. The notion was, for example, to order Agenas but plan to buy no CORONA-peculiar items and use the Agenas on GAMBIT. That cost was $1.25M, hence too high.

8. The GAMBIT "HIGHBOY" concept was re-examined. The cost of a permanent modification to permit GAMBIT to fly from 65 n.m. to 170 n.m. was $ M. The cost of a kit to apply to a particular GAMBIT mission was $ M, but the decision to fly such a mission had to be made nine months in advance. Therefore, the cost was too high.

9. The June 1969 assessment that the probability of successfully meeting the December 1970 launch date within one month (50 percent), within three months (75 percent), and within six months (95 percent) has increased slightly as a result of this Committee's current evaluation.

10. Management attention should be focused on assuring that associate contract interfacing problems do not get out of hand to a point where the objectives

of the program are jeopardized. This is not, however, considered a major problem at this time.

Recommendation

As a result of its mid-term study, the Committee recommends that the HEXAGON schedule be reviewed in December 1969 as previously recommended and accepted.

Discussion

Of the copious amount of data made available to the Committee, the following are some of the key items impacting on the conclusions:

1. LMSC (SBAC/SVIC)

a. Schedule. Many key milestones due to have been completed since last June have been met on their scheduled completion dates. Others, like the static test vehicle and the dynamic test vehicle, have slipped from three weeks to seven weeks but have not impacted on the initial launch date. Although Phase I of the satellite development vehicle (the system qualification and pad checkout unit) is about three weeks behind schedule, LMSC felt that the third and final phase would be on schedule. The delivery of the midsection for the first flight unit will probably be two and one-half weeks late, but again LMSC felt that this time was recoverable. The black box qualification program showed an extremely heavy concentration of effort during the October 1969 time period. The SDV-3 aft section module showed also a heavy assembly and test impact during the October to November 1969 period as did the first flight unit's aft section module during December 1969 and January 1970. The current two-shift operation at LMSC was felt to be adequate for this work load.

b. Reliability. LMSC reported the following status on their reliability analysis:

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(1) Parts Stress - 80% complete

(2) Failure Mode & Effects - 70% complete

(3) Worst Case - 20% complete

c. Problem Areas - The following includes both Committee- and LMSC-suggested problems, as of this time:

(1) The active thermal control in the forward section was introduced into the system design at a fairly late date and was the result of Perkin-Elmer's end-to-end gradient requirement to avoid film sticking. Qualification of the Temperature Control Electronics Assembly is due to be completed in February 1970 and is clearly the pacing element of the SDV-3 forward section.

(2) The master/slave PCM multiplexer subcontractor (Spacecraft, Inc.) had exhibited difficulties to date in meeting performance and schedule. LMSC feels that this Q.A. problem has now been solved.

(3) The orbit adjust engine had experienced I_{sp} degradation during the deboost burn. Redundant heaters have been added for flight use to provide heating of the propellant, and testing of this change is currently underway.

(4) The high failure rates of a certain solar array diode caused all of these diodes to be replaced with newer ones using improved techniques and processes. The new board design has been requalified and is now in reliability testing.

2. G.E. (Command Programmer)

a. Utica has solved the super flat pack production problem.

b. The Minimal Command System (MCS) is ahead of schedule. The Extended Command System (ECS) for SDV-3 had a minor low temperature problem but is due for delivery to SVIC on 20 November 1969. The ECS for the First Flight Unit is due for delivery on 15 December 1969 for a January 1970 need date.

3. TRW (Software)

a. A satisfactory Milestone 2 (Preliminary Design) was achieved on 30 September 1969 and contract awarded 1 October 1969.

b. Initial operational configuration is scheduled for 25 September 1970 with final operational configuration on 10 September 1971.

4. VAFB

a. The service tower has slipped three months, causing an equivalent slip in the beneficial occupancy date from 31 October 1969 to 30 January 1970.

b. Despite this fact, SP-7 feels that all the remaining key dates can be met:

(1) SDV-3 arrives at the pad on 17 September 1970 and is there for 54 work days.

(2) The launch complex acceptance is 3 December 1970.

(3) The First Flight Unit is on the pad ten days prior to the 17 December 1970 launch date (the booster has been at the pad since 20 July 1970).

5. McDonnell-Douglas (MWC)

a. The main parachute (made by Goodyear) is not as good as that used with the MK-5 RV. The ballute failed its deployment test (the requirement is a 60-70% probability of catch on the first pass), but the problem appears to be a Q.A. problem (and a difficult one) and not a design problem.

b. The B-52 and balloon drop test program is slightly behind schedule.

c. There is a relatively minor problem with access through the thermal "tent".

6. Perkin-Elmer (SSC)

a. Schedule

(1) All of the tests scheduled for the Engineering Model have been satisfactorily completed except for those pending tests associated with Chamber "A", although completed later than originally scheduled.

(2) Completion of two-camera assembly testing on the Development Model is on schedule for 19 November 1969. The DM is plus 11 days against the scheduled 20 February 1970 ship date, because of the current 6-day 10-hour-a-day work week. Many problem areas which have had schedule impact, like late delivery of key electronic boxes and compatibility problems with test equipment, have been solved through "work arounds".

(3) The First Flight Unit is on schedule to a 27 January 1970 completion of two-camera assembly testing and is also plus 11 days against its scheduled ship date to SVIC on 21 April 1970. Astigmatism caused by the folding flat has, in all probability, been resolved, as

the longitudinal color problem on the first two sets of glass. Overtime and shortening of several remaining assembly and test cycle times, based on Development Model experience, would allow additional pad if there are any unforeseen schedule slip problems.

b. Reliability - About 2,000 electrical/mechanical functions and more than 30,000 items at the parts level have been evaluated to date. Only 2 or 3 truly random electronic failures have occurred to date on the Engineering Model. Catastrophic failure mode analysis has been extensive.

c. Problem Areas

(1) The optical bar torque motor may be undersized because of the excessive friction of the rubbing optical bar seal needed for film path pressurization. The corrective action will be to use double commutation of motor windings as are now used in the drive capstans.

(2) Thermally induced local deformations in the folding flat, as well as the previously mentioned gravity-induced astigmatism, have caused some concern with regard to camera performance, but neither appears critical.

(3) The electronic box qual test program calls for an extremely concentrated effort in the November 1969 through March 1970 time period. Qual of four of the six brushless motors and the six encoders in the sensor sub-system between now and February 1970 is also tight.

7. CORONA

a. Current problems related to the reliability of UTE to be flown on future missions and the impact on reliability of the phase-down of the program.

b. The cost estimate for three additional systems, if there were a reorder, was as follows:

FY 1970	FY 1971	FY 1972	FY 1973	Total
$7.8M	$15.3M	$19.8M	$0.6M	$43.5M

based on a December 1969 go-ahead.

c. The minimum lead time from "go-ahead" to "first launch" of a reorder was, as follow:

- MAIN CAMERA - 23 months
- DISIC CAMERA - 14 months
- AGENA - 24 months
- THORAD - 24 months

d. Assuming a 15 February 1970 "go-ahead" for a 15 February 1972 launch (three months after the "last" CORONA) and a 15 May 1970 termination, about $1.4M would be non-recoverable.

e. The cost savings of not having to launch CORONA vehicles during the planned one year of overlap is as follows:

Delete	Cumulative Cost Savings
CR-8 (Nov 71)	$ 3.051M
CR-8, 16 (Sep 71)	$ 9.288M
CR-8, 16, 15 (May 71)	$12.379M
CR-8, 16, 15, 14 (Mar 71)	$15.380M
CR-8, 16, 15, 14, OR-2 (Jan 71)	$18.276M

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8. GAMBIT "HIGHBOY"

a. The following changes would have to be made to the existing GAMBIT configuration in order to fly in the "HIGHBOY" mode:

(1) Photographic Payload System

- Film drive speed change affecting the metering roller diameter, the gear ratio, and the motor speed drive output.
- The drive range of the slant range compensator.
- The slit widths in the slit plate.
- The frequency of the ground scene modulation in the focus sensor.
- Additional thermal analysis which might require additional heaters.

(2) Satellite Recovery Vehicle - change the back-up timer.

(3) Satellite Control Section - additional thermal analysis which might require additional battery capacity.

b. The following launch and delta cost options were presented, including both modifications and schedule revision effects:

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	Launch (FY)			Cost (FY)			
Option	70	71	72	70	71	72	Total
1	0	1	0	$1.2M	$ .3M	$ 0	$1.5M
2	0	2	0	$2.0M	$4.7M	$ 0	$6.7M
3	0	1	1	$1.2M	$3.4M	$4.7M	$9.3M

(3) If the combined GAMBIT and [redacted] missions do not exceed 12 per year, there will be no launch facility impact.

F. R. N.

F. Robert Naka
Chairman

Attachments - 3

Recommended LMSC Agenda for 13 October Briefing

I. SBAC Schedule Status

- A. Mid-Section
- B. Aft Section
- C. Forward Section

II. SVIC Schedule Assessment

III. SBAC Reliability and Failure Mode Analysis

IV. SBAC/SVIC Estimated Cost to Complete (by FY)

V. SBAC Test Results (STV, DTV, SDV-1, etc.)

VI. SBAC Problem Areas

- A. Forward Section Active Thermal Control
- B. Master/Slave PCM MUX Subcontractor
- C. Solar Panels/Power Requirements
- D. Orbit Adjust Engine

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Recommended Agenda for 13-14 October Briefing

I. McDonnell-Douglas (MWC) — SAFSP

- A. Schedule Status
- B. Reliability and Failure Mode Analysis
- C. Estimated Cost to Complete (by FY)
- D. Test Results
- E. Problem Areas

II. General Electric - Command Programmer Status — SAFSP

III. TRW - Software Contractor Status — SAFSP

IV. VAFB - Launch Pad Status — SAFSP

V. CORONA — CIA and SAFSP

- A. Each Contractor's Estimated Cost to Complete (by FY)
- B Minimum Time from "Go-Ahead" to "Launch", if a Reorder
- C. Cost Estimate (by FY) of Additional Reorders of 3 and 6 units
- D. Cost Saving Estimates if Vehicles are not Flown in Calendar Year 1971 (by vehicle)
- E. Impact on Reliability of Phase-Down

VI. GAMBIT — SAFSP

- A. Modifications and Costs (by FY) to Implement "HIGHBOY"
- B. Launch Facility Impact of Additional GAMBIT's

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Recommended Perkin-Elmer Agenda for 15 October Briefing

I. Overall Schedule Status (Showing any Changes Since May 1969)

- A. Engineering Model Status
- B. Development Model Status
- C. First Flight Model Status
- D. Second Flight Model Status

II. Manpower

- A. Current Workload, by Skills
- B. Impact of Additional Overtime, if Needed

III. Costs

- A. Overtime Impact on Cost
- B. Estimated Cost to Complete (by FY)

IV. Reliability

- A. Catastrophic Failure Modes
- B. Impact of Non-Hi-Rel Parts
- C. Model Effectivity of Mission-Critical ECO's

V. Tour

VI. Test Results (Engineering Model and Development Model)

VII. Problem Areas

- A. Folding Flat
- B. Qual Test Program
- C. Others

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