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20 JAN 1970

MEMORANDUM FOR: Director, CIA Reconnaissance Programs

SUBJECT : OSP's NRO Quarterly Report on NRP Satellite Systems

Attached for your consolidation into an overall CIA Reconnaissance Report is OSP's NRO Quarterly Progress Report. Two additional copies are attached for Dr. McLucas and General Berg, and one copy each of CORONA and HEXAGON is attached for forwarding to SAFSP.

JOHN J. CROWLEY
Director of Special Projects

Attachments: a/s

SUBJECT: OSP's NRO Quarterly Report on NRP Satellite Systems

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QUARTERLY PROGRESS REPORT

SATELLITE SYSTEMS

1 September 1969 through 31 December 1969

I. CORONA PROGRAM

A. System Status

1. Mission 1108 (CR-9) launch occurred successfully 4 December 1969. The Performance Evaluation Team will convene 13 and 14 January to evaluate the flight. Initial evaluation by NPIC assigned MIP ratings of 105 and 100 to the "A" and "B" portions respectively. It should be noted that this mission was flown at perigees from approximately 80 nm to 100 nm. The primary anomalies noted during this flight were:

a. Main camera slit-width failed safe.

b. Switch programmer malfunctioned.

c. DISIC failed to operate after rev. 205.

During the "A" portion of the mission, the overall image quality of the forward looking camera was rated as fair and the aft looking as good. Although the forward camera provided the MIP frame for this portion, the aft looking camera image quality was reported as less variable. The "B" portion forward camera result again provided the MIP frame with the overall imagery rating as fair; the aft camera imagery was reported as good and again less variable. The color (SO-242) results were "overall image quality, color balance, and color saturation is considered good." The best ground resolution was comparable to the best color from Mission 1106, which used SO-121 color film.

2. Post flight review of Mission 1108 flight anomalies mentioned above indicates:

a. Slit width fail safe attributed to either a short circuit or foreign particle. This anomaly was able to be handled operationally with no effect on mission results. Corrective actions were reviewed and assembly and acceptance inspection procedures were re-emphasized. Historical review of the CR-8 switch programmer failed to provide a clue to the suspected short or any other potential hardware problem.

b. The minor slope programmer malfunction appears to have resulted from the Haydon timer. This is a recurrence. More stringent EMC tests of future Haydon timers will be conducted. In addition, proposals are being requested from the Agostat and Dian companies for a more reliable timer. This failure had no impact on mission operations or product.

c. DISIC failure most probable cause is a 400 cycle inverter failure. Analysis still in progress.

B. Ultra-Thin Base Film Usage

An in-depth review of the results of tests conducted utilizing ultra-thin base film in systems CR-11 (Mission 1109) resulted in a decision to fly UTB. Mission parameters are being examined to optimize the performance using UTB.

C. Low R.H. Film Test

Tests have been completed and the rolls of SO-380 are at Westover Photographic Center for measurements. Results are expected to be available in February 1970.

D. Proposals and Future Change

1. Glass Filters

Itek is continuing with the endeavor to provide glass filters, both .040 and .037 inches. Most substrate is available at Itek, W-21's, W-23's, W-25's, W-28's and clear glass filters are involved.

2. Splices

To evaluate further the ultrasonic splices, the AP Facility will order film with ultrasonic splices and utilize these for ground system tests other than HIVOS. These results will be evaluated and a decision made either to continue the permacel splices or change to ultrasonics.

E. CR-8 Refurbishment

Evaluation of major structure and reassembly of major sub-assemblies is in progress and on schedule.

F. Move of AP to buildings 156 and 152 was approved and should be completed by September 1970.

G. Missions Completed This Quarter:

Mission No. 1108
Booster No. 69-039
Agena No. 1655
Payload No. CR-9
Instrument No. 316/317
S.I. No. S/N 12
Film Type - Main Instrument - 3404/SO-242
Flight Date - 4 December 1969
Feet Payload Flown - 31,500 (3404) 800 ft. (SO-242)
Feet Payload Recovered - 31,500 (3404) 800 ft. (SO-242)
Recovery Dates - 11 December 1969
22 December 1969

H. Mission Planned for Next Quarter

Date - 18 February 1970
Mission - 1109
Payload - CR-11

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II. HEXAGON PROGRAM

A. Programmatic

1. The development of HEXAGON Operational Software progressed on schedule and the contract was awarded to TRW. Air Force and CIA Program Offices continued close liaison to resolve interface problems and to assure software compatibility between the Space Vehicle and the Sensor Subsystem.

2. Initial meetings between SPO and SSPO System Engineers have taken place to examine areas for cost reduction and/or performance improvement. Several areas have been identified and tradeoff analyses will be conducted to establish the gains to be realized. It is planned to develop these tradeoffs on an overall systems basis and to prepare supporting data on a system level.

3. Planning was completed for the physical combining of the HEXAGON and CORONA Programs on the West Coast. The CORONA facility presently located at the LMSC Advanced Projects Building at Palo Alto, California, will be moved into buildings 152 and 156 at LMSC, Sunnyvale, California. This consolidation of Project Offices will result in cost savings and better utilization of manpower and computer support between the programs. It also provides access to a large pool of cleared technicians who are not available in the present location.

4. A revised HEXAGON Sensor Subsystem Operation Program (HSSOP) document was completed by the Program Office and Perkin-Elmer (PE) and issued to the Systems Program Office (SPO). The HSSOP document provides the basis upon which the operational software for the sensor subsystem will be developed.

5. A Request for Proposal (RFP) for a follow-on quantity of six systems has been prepared and will be issued to Perkin-Elmer in January. Perkin-Elmer has issued RFP's for all major subassemblies for competitive bidding to provide the cost base for follow-on cost negotiations. The present status of the program will not support competitive bidding of the prime contract; however, all parts and subassemblies are being competitively bid on a fixed price basis wherever possible.

6. Program expenditures and commitments through the end of the Second Quarter track closely the budgeted values for this period. A slight underrun in direct labor is expected to be offset in extra shift and overtime during the next quarter required to meet Development and Flight Model schedules.

7. Slippages in the Development Model test schedule caused by minor technical problems and underestimates in testing time lines projected a delay in the delivery of the Development Model for system integration of about one month. Schedule alternatives were discussed by the SPD/SPO/SSPO which established February 27, 1970 as the date for sensor subsystem delivery. To meet this date, portions of the qualification test program have been moved from the Development Model to the First Flight Model. Since the Development Model is on the critical path to the December 17, 1970 launch, this additional test effort on the First Flight Model did not impact the first flight date.

B. Technical

1. Engineering Model

The testing program on the Engineering Model has been terminated to avoid conflicting with the Development Model.

Although the information obtained was not as complete as originally planned, several significant accomplishments were achieved:

a. The acceptance test stations were checked out, which will reduce AVE/AGE integration and testing time on the Development Model.

b. Photography of collimated targets was obtained under a thermal vacuum environment and confirmed that the system would meet specifications in an orbital environment.

c. Considerable thermal data on the Sensor/SBA thermal design was obtained. Preliminary data indicates that the design is conservative and that spatial and diurnal variations will be less than originally predicted.

d. The capability to operate the Sensor Subsystem in a completely automatic mode through start up, a pre-programmed operating run, and shutdown under both maximum and minimum film velocities was demonstrated.

2. Development Model

The Development Model two-camera assembly (TCA) which consists of a complete stereo camera less the film supply and take-up was operated in all its modes using a simulated supply and take-up.

The model was installed in the vehicle mid-section and ambient environmental tests were started. Tests to obtain the electro-mechanical baseline measurements for the system are scheduled to begin immediately upon correction of problems in one electronics box and a mechanical section of the film path. Upon completion of the ambient tests; EMC, baseline thermal vacuum, vibration, post-vibration thermal vacuum, and vertical baseline tests are to be conducted.

3. Flight Article No. 1

Optical testing of both optical bars for the first flight model was completed and the bars exceed the specification requirements.

The first flight model was assembled and is undergoing electro-mechanical checkout. To date, the integration of the electronics with the mechanical systems of the Film Path has gone well and the testing of this model is proceeding about on schedule.

4. Film Test Program

The major portion of the film sticking test program at Wright-Patterson Air Force Base was completed. Test data so far indicates that the film (SO 380) begins sticking to itself in the 70°F/80% RH regime. The air bar sticking tests are still being evaluated. These are of great interest since excessive air bar sticking can cause servo instability and possible system failure. However, the preliminary data indicates that only 6 ounces of tension are required to move film at 80°F/80% RH conditions. A test program review is scheduled for late January.

The film supplier has agreed to provide film with a maximum RH of 40%.

No sticking data was obtained on the SS Engineering Model because the Development Model schedule forced the Engineering Model out of the TV Chamber. The Chamber utilization is being re-evaluated to determine if the Engineering Model may be tested for film sticking at a later date.

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III. ELECTRO-OPTICAL IMAGING TECHNOLOGY

A. Program Planning

The Electro-Optical Imaging Program has moved forward during the Second Quarter of FY 70 according to plan within Readout Technology Program Approvals. Significant progress has been made toward the January milestones necessary to allow the initiation of the System Definition Phase of the EOI Program in February 1970. It is anticipated that the technical data required for approval will be available on schedule.

A baseline program management plan document has been prepared to supplement the EOI System Logic Network. A revision of the Logic Network was made in the Second Quarter to reflect the structure and goals of the FY 70 program.

B. Imaging Satellite System Studies

A number of imaging satellite system studies were initiated during the Second Quarter of FY 70 and are scheduled for completion in the Third Quarter of FY 70 in preparation for System Definition

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IV. GENERAL RESEARCH AND DEVELOPMENT IN SUPPORT OF RECONNAISSANCE SATELLITE PROGRAMS

A. Sensing Techniques and Devices

1. Dry Silver Film Development (3M)

The unique resolution and processing characteristics of Dry Silver Film make it attractive as a photoreconnaissance acquisition material. Resolution for various contrasts have been consistently higher for this material than the high resolution aerial films currently used. Furthermore, Dry Silver Film is processed simply by uniform heating to approximately 94°C for short time periods. This developing process, by its simplicity not only would allow for faster processing, duplication and dissemination of satellite photography, but also makes this film suitable for an on-board process and scan operation mode. To date the main shortcoming of this material has been its lack of adequate sensitivity for an acquisition application, the primary concern of OSP. A 12 month program concerned with enhancing the speed of this film while retaining resolution was started during the Second Quarter.

2. Thermoplastic Transducer STX (Xerox)

A final six month program was initiated during the past Quarter. The major goals of this program are to quantify the process parameters in the fabrication of transducers, refine the image evaluation equipment, and ultimately to specify with precision fabrication procedures and device characteristics.

B. Optical Fabrication & Evaluation Technique Development

1. Selective Vacuum Deposition for Figuring Large Optics (Perkin-Elmer)

Work continued on the installation in the chamber of those instruments necessary for proper monitoring of

the deposition process during operation. All of the temporary equipment used in the demonstration correction has been replaced with permanent instrumentation. In particular, the electron beam guns have been installed and evaporation distribution runs have been made to determine their operational characteristics. Software development has been proceeding on schedule with the Interface, Data Logging and Open Loop Control routines essentially completed. Some initial runs employing semi-automated control have been made.

2. Hologram Interferometer (Perkin-Elmer)

The hologram interferometer development program which ended this Quarter concerned itself with three main areas: 1) determination of the limitation to holographic testing due to film emulsion dimensional changes 2) development of techniques for the generation of synthetic holograms to be used as the source of a standard reference wavefront in a hologram interferometer 3) determination of dimensional tolerances required for the elements of the interferometer as well as general design specifications for the instrument. A rough draft of the final report has been received and reveals some deficiencies in the contractors performance in areas 2) and 3) above. Steps will be taken to remedy these shortcomings.

3. Fiber Optics Technology (American Optical)

In order to determine the full potential of the coupled fiber/photodiode array for the EOI system a program was initiated with Westinghouse to investigate array coupling techniques and determine the ultimate performance capability of the composite. The first set of fiber arrays supplied by American Optical for this program showed an improvement in positional accuracy over previous attempts. This reflects some fabrication modifications which are being further refined and which should produce even better fiber alignment in subsequent arrays delivered to Westinghouse.

4. Low Scatter Coatings (University of Arizona)

Results obtained in the recently concluded low scatter coating investigation have shown that effects originally attributed to residual gas pressure in the coating deposition chamber, are in fact a function of the type of gas present. Other experiments were run to determine the effects of deposition rate and high vacuum aging on scatter and adhesive characteristics of reflective

coatings. Further investigation into these and other areas concerned with obtaining better quality optical coatings will be pursued in a follow-on program which will begin in the Third Quarter.

C. Optical Material Development and Evaluation

1. Beryllium-Based Material Development (SRI/P-E)

The 12 inch diameter beryllium sample supplied by SRI to P-E for extensive testing has been found to be quite isotropic, thus corroborating the preliminary x-ray measurements made at SRI. While this demonstrates a scale-up capability for the SRI process, the question of scaling the process to the large sizes of interest to the reconnaissance community remains unanswered. A follow-on program has been proposed to help resolve this remaining uncertainty. A modest three month interim program with SRI and P-E has been funded to assure program continuity should funds for the broader program be made available.

2. Free Radical Film Development (Horizons)

Film based upon free radical chemistry possess several characteristics which make it very attractive as a photoreconnaissance acquisition material. Since resolution elements are of molecular dimension as opposed to silver halide grain sizes, resolutions on the order of 1500 cycles per mm are readily obtainable. Furthermore, since the material is not subject to the resolution/sensitivity trade-off typical of silver halide film, there is theoretically no reason why materials exhibiting both high resolution and sensitivity cannot be developed. A 12-month program has been initiated with Horizons Inc. during this Quarter to investigate the feasibility of several approaches for making free radical film practical in a photoreconnaissance application in spite of its tendency to loose sensitivity rapidly as a function of time.

D. Mechanical/Optical Structures

No contractual effort in this category was performed during this Quarter.

E. Advanced Electromechanical Development

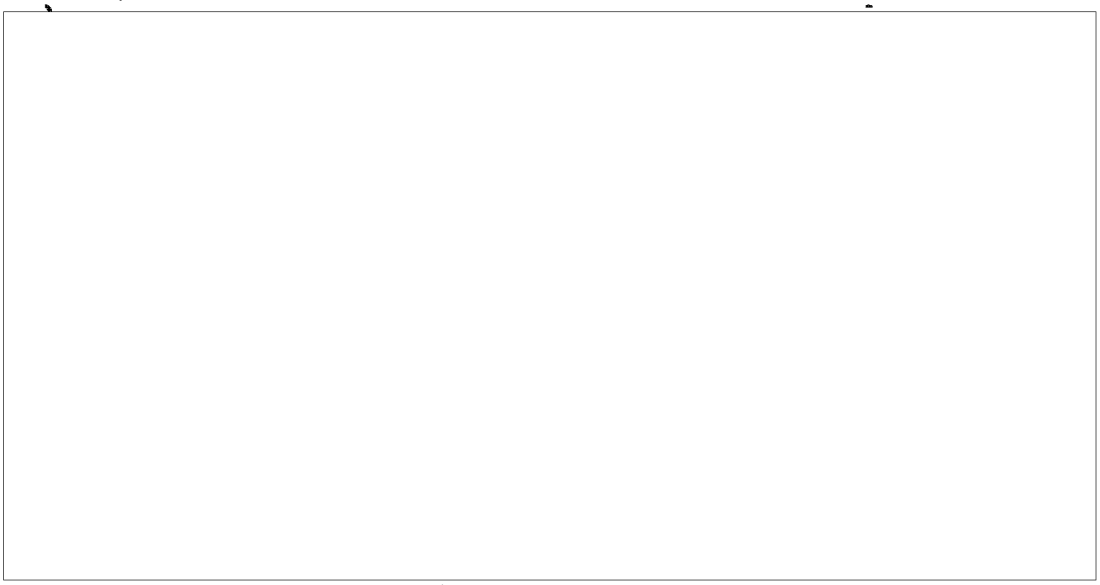
1. Sheet Film Transport (RCA)

The evaluation and testing of the Sheet Film Transport development model was completed this Quarter and provided a good quantitative description of the operating tolerances for the device. A demonstration of the device which was run during the Quarter was a qualified success. While a large volume of film did indeed pass properly through the device, some jamming of film took place. On a subsequent run 400 sheets of film passed through the model with no difficulties encountered. Funds have not been made available for any follow-on effort and at this time a decision is being awaited in this regard.

F. Data Transmission, Processing and Display Techniques

1. Photographic Coverage Assessment

The large volume of film expected from each Hexagon mission makes some form of automatic or semi-automatic coverage assessment a necessity. While the PCA device developed for assessment of Corona photography has proven the validity of the semi-automatic approach, a second generation device specifically designed for Hexagon requirements is desired. The problem has been discussed with potential contractors and at present this office is in the latter stages of the source selection process.



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V. VULNERABILITY

Work continues at TRW on the updating of the Threat Model Notebooks. Drafts have been completed on all sections and once approved, they will be distributed. Close liaison is being maintained with SP-6 at SAMSO.