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28 JAN 1968

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. Flax and General Berg, and one copy each of CORONA and HEXAGON is attached for forwarding to SAFSP.

JOHN N. McMAHON
Acting Director of Special Projects

Attachment: As stated

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CORONA HEXAGON TOP SECRET ZAMAN

SUBJECT: OSP's NRO Quarterly Report on
NRP SATELLITE SYSTEMS

DDS&T/OSP/PAD/PCB/ [redacted] (18 Jan 68)

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BYE-7030-68
Page Two

QUARTERLY PROGRESS REPORT

SATELLITE SYSTEMS

1 October 1967 through 31 December 1967

I. CORONA PROGRAM

A. J-1 System Status

1. J-43 Summary

J-43 (Mission 1044) was successfully launched, operated and recovered.

a. Major Areas of Interest

(1) Pan Cameras (202 and 203) functioned normally throughout the mission.

(2) Stellar Index Cameras (D-99, D-104) functioned normally throughout the mission.

(3) Film Type 3404 was used for both cameras during this mission. As a test for a new processing technique developed by E.K., selected lengths were processed by the humpback (dual gamma) method. This was compared to the film processed by the Trenton method. The PET and NPIC comparative analyses favored the dual gamma process.

(4) The life boat timer on the Agena side of the interface became activated (possibly by a loose ball of solder shorting a relay). This anomaly dictated an early recovery of the "B" bucket.

2. New Proposals

An extended capability of the H-timer (3/4 speed) is being considered for CR flights after 1 July 1968.

B. J-3 System Status

1. CR-1 Major Problem Areas

a. Low Temperature Throughout the Payload. This resulted in poor focus on all cameras. The thermal coating on future flights will be adjusted to overcome this. ~~The problem was eliminated~~ in CR-2.

b. Poor Back Focal Settings on the Main Cameras. The problem was eliminated in CR-2.

c. Transients in the RT Command Associated Circuitry Which Produced Command Restrictions. Circuits were modified to overcome this problem. The problem was eliminated in CR-2.

d. The binary data block was found missing on the last few frames of each operation. The fault was found in the circuit and was corrected in CR-2.

e. The DISIC Terrain Product was Soft. The DISIC stellar product evidenced considerable flare. A temporary baffling fix was installed in CR-2 to attempt to eliminate or reduce flare. Preliminary results were promising but detailed analysis has not been completed.

2. CR-2 Summary

CR-2 (Mission 1102) was successfully launched, operated, and recovered.

a. Major Areas of Interest

(1) Pan Cameras (304 and 305). Both cameras functioned normally during the entire mission. At a point near the end of the mission

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CORONA

(with both cameras still loaded with film) a test was run showing the effect of using the mono-mode for the camera system. No anomalies resulted from this test. An MIP of 100 was assigned to the product of both halves of this mission.

(2) DISIC (S/N 4). The DISIC unit performed normally throughout the mission until the last 200 or 300 frames at which time there seemed to be a malfunction in the capping assembly which resulted in short bursts of light reaching the film during transport. The DISIC (terrain lens) is capable of automatically switching between two different shutter speeds 1/500 sec. and 1/250 sec. This switching is controlled by timers correlated to solar elevation. However, before this mission it was decided to use only the 1/500 sec. shutter speed on the terrain lens--the 1/250 sec. shutter speed was in effect disabled. Further evaluation is being conducted on the malfunction.

(3) Filters. Two new filters were used during this flight. The preliminary results show clear negatives; however, a rigorous evaluation has not yet been conducted. The new filters used were the SF09, a polarizing filter, and a SF05 for multi-spectral photography.

(4) The five position exposure control (slit width) device for the main cameras worked satisfactorily throughout the flight.

(5) Film. A split load of 3404 and SO-230 was used in this mission. Results will be known early in the next quarter.

(6) Recoverable Tape Recorder. This unit performed satisfactorily throughout the mission, giving useful data both for the diagnostic and user (NPIC) purposes.

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3. J-3 Payload Proposals and Future Changes

a. An extended capability of the H-timer (3/4 speed) is being considered for CR flights after 1 July 1968.

b. DISIC Intermix. This would provide a four operation selectivity for emergency operation of the main cameras and a real time control for the independent mode of operation of the DISIC camera subsystem, thus providing more selectability of independent operations of the DISIC payload.

c. SRV. It is planned to reuse the structural components (capsule, Capsule covers, etc.) on recovered J-3 SRV's for future flights. It is estimated that this would save the Government approximately $115,000 on SRV's for CR-13 through 16.

d. Filters. Glass filters are still under development. The coating on 0.005 inch quartz substrate has been solved. However, further development is necessary to insure correct optical properties of the completed filter.

e. NPIC has recommended continued use of the recoverable tape recorder in all J-3 flights because of manpower and time savings. The tape recorder was originally planned to be flown only on the first four J-3 flights. Sufficient spares were ordered to enable incorporation of the tape recorder on CR-5--this has been authorized. Studies are now under way to determine costs and concepts of incorporating tape recorders on all J-3 payloads.

f. UTB Tests. UTB tests on QR-2 started at AP on 6 November 1967. Since that time all modifications have been completed for both the main camera and the DISIC subsystem. Preliminary tracking tests have been run. Chamber tests will start on 15 January 1968. The expected date for completion of all UTB tests is 21 February 1968.

g. QR-2 Refurbishment. Upon completion of UTB testing on QR-2, the subsystems will be sent back to ITEK, FCIC, and G.E. for refurbishment.

h. Shift Register. The engineering design on the AGE items for the shift register has been completed. Electrical design has been completed; however, several of the breadboarded circuits were returned via FEDR because of incompatibility among the relays and associated circuits. The harness design is being incorporated into the CR-6 harness and will be ready for the system tests on 2 February 1968. The command box wiring is finished and is in functional tests. The qual unit is expected to be ready in Sunnyvale by 1 March 1968 and the first flight article will be ready by 15 March 1968. Barring unforeseen developments, the shift register should be available for operational use effective with the CR-6 flight now scheduled for November 1968.

4. Deliveries to AP

a. Instrument Deliveries

CR-4 - 14 November 1967

b. SRV Deliveries

SRV Nos. 749/750 - 27 October 1967
SRV Nos. 815/816 - 20 November 1967

c. DISIC Subsystem Deliveries

S/N 7 - 18 December 1967
S/N 6 - 19 December 1967

C. Missions Completed During This Quarter:

Mission No.	1044	1102
Booster No.	221	514
Agena No.	1639	1642
Payload No.	J-41	CR-2
Instrument No.	202/203	304/305

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C. Missions Completed During This Quarter: (continued)

SI No.	D99/D104	-
DISIC No.	-	4
DRCG No.	606	626
SRV No.	733/734	805/806
Flight Date	11/1/67	12/9/67
Feet Payload Flown	16000/15972	16257/16258
Feet Payload Transferred	16000/15972	16267/16258
Recovery Dates	11/8/67 - 11/11/67	12/14/67 - 12/22/67

D. Missions Planned For Next Quarter:

Date	1/24/68	3/6/68
Mission	1045	1046
Payload	J-45	J-48

E. Meetings and Briefings

1. Program Managers' Meetings

CORONA Payload Managers' Meetings were held at AP on 16 October and 19 December 1967 to review J-1 and J-3 program progress and problems.

2. Agency Meetings (DISIC)

A briefing was conducted for SOC personnel at Headquarters on 12 December 1967 to explain the DISIC intermix proposal.

3. Ad Hoc Committee

The first meeting of the Ad Hoc Committee for J-3 CORONA payload capability evaluation met at NPIC on 12 December 1967 to review the experiments planned for the first four J-3 flights and to establish procedures for handling domestic and overflight product containing experimental footage.

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4. PET Meetings

Mission 1101 PET Meeting was held at NPIC on 17 and 18 October 1967. The PET Meeting for Mission 1044 was held at NPIC on 28 and 29 November 1967.

QUARTERLY PROGRESS REPORT

SATELLITE SYSTEMS

1 October 1967 through 31 December 1967

II. HEXAGON PROGRAM

A. Programmatic

1. During the past Quarter a new organizational structure was placed into effect at Perkin-Elmer (P.E.). The new organization is structured to provide better control of schedules and costs, as well as checks and balances between operational and management divisions of the program. The reorganization also provides lines of responsibility and authority which allow clearer assignment of duties to the many new program employees.

2. The program Statement of Work has been completed by the Project Office and is undergoing negotiations with the Contractor. Audit analysis of accounting methods and rates was obtained. The Program Plan is under revision to provide the supporting information for definitive contract negotiation. Negotiations are expected to begin early in February.

3. The Assembly and Checkout Plan and the detailed flow is under development by the Assembly and Checkout Working Group representing SPO/SSPO. Interface Control Documents were prepared and issued by the Integrating Contractor. The contents of these documents are under review and negotiations by the various SPO/SSPO Interface Working Groups.

4. A Government Furnished Equipment List was defined by both the Satellite Basic Assembly Contractor and the Sensor Contractor and need dates were provided. Resolution of GFE specifications and schedule compatibility is in progress.

5. The final version of the System Performance Specification was issued by the SPO. The document is now under review by the SSPO. A mutually acceptable specification should be finalized in January.

6. The SSPO was requested by the SPO to defer the development of the film take-up system until an RV contractor is selected so that the interface could be mutually established. For the Sensor Contractor to meet the present schedule, it is necessary to proceed with the design of the take-up system and procurement of long-lead items, such as brushless motors and encoders. Close liaison is being maintained with SPO personnel to try to minimize any design changes which might be required by the RV Contractor.

7. The SSPO and SPO have identified interface difficulties in the following areas:

a. responsibility for the sensor subsystem maintenance concept,

b. responsibility for the test plan involving the sensor subsystem tests in the integrated HEXAGON system,

c. need dates for various GFE items, and

d. software requirements for test and evaluation of sensor subsystem performance throughout all stages of the Program.

e. Thermal interface problems being referred to DNRO.

While there are differences in other interface areas, we are hopeful that a resolution may be satisfactorily negotiated by the SPO and SSPO. Those cited above have already undergone several iterations without resolution.

B. Technical

1. Both the thermal and mass models of the sensor subsystem were completed during this period and are presently undergoing extensive testing. Test results to date have been favorable. Results of thermal model shroud

test which will be used to verify the thermal analytical model will be available during the next quarter.

2. Final specifications for the abbreviated film path simulator were completed and the major portions of the two systems were fabricated. The 10' x 12' vacuum chamber was completed and shipped to Perkin-Elmer for installation. The chamber will be operational in January, and a series of tests to prove out all film drive elements with the abbreviated film path equipment will start as soon as the chamber is operational. During the next quarter the film path simulator will be operational and should be capable of moving film through the complete film path with the performance specified for the flight systems while covering the complete range of camera operating conditions.

3. A decision was made to reorient the film supply reels from a roll axis to a pitch axis orientation. This orientation was preferred by the SBA Contractor to reduce momentum disturbances to the roll axis, particularly during monoscopic operation. The new orientation required a major supply system design change; however, the design will be completed in time to make the sensor subsystem PDR date of 29 February 1968.

C. Personnel

1. The System Engineering and Technical Support (SETS) effort of TRW will be carried at a level of 65 MTS through system PDR. After PDR the level of effort will be reduced to about 43 MTS for the balance of the fiscal year, or an average of 57 MTS, to remain within approved NRO funding.

2. Perkin-Elmer is continuing to build toward the required staffing level. In recent months the company has been able to hire several key people who are materially improving its ability to meet desired performance on the program.

D. Facilities

1. Construction of the Danbury facility is proceeding on schedule with occupancy scheduled to begin early in February. Thermal-vacuum chamber "B" has been erected and is in the outfitting stage. Fabrication of chamber "A" (52' spherical chamber) is commencing. All facilities are on schedule.

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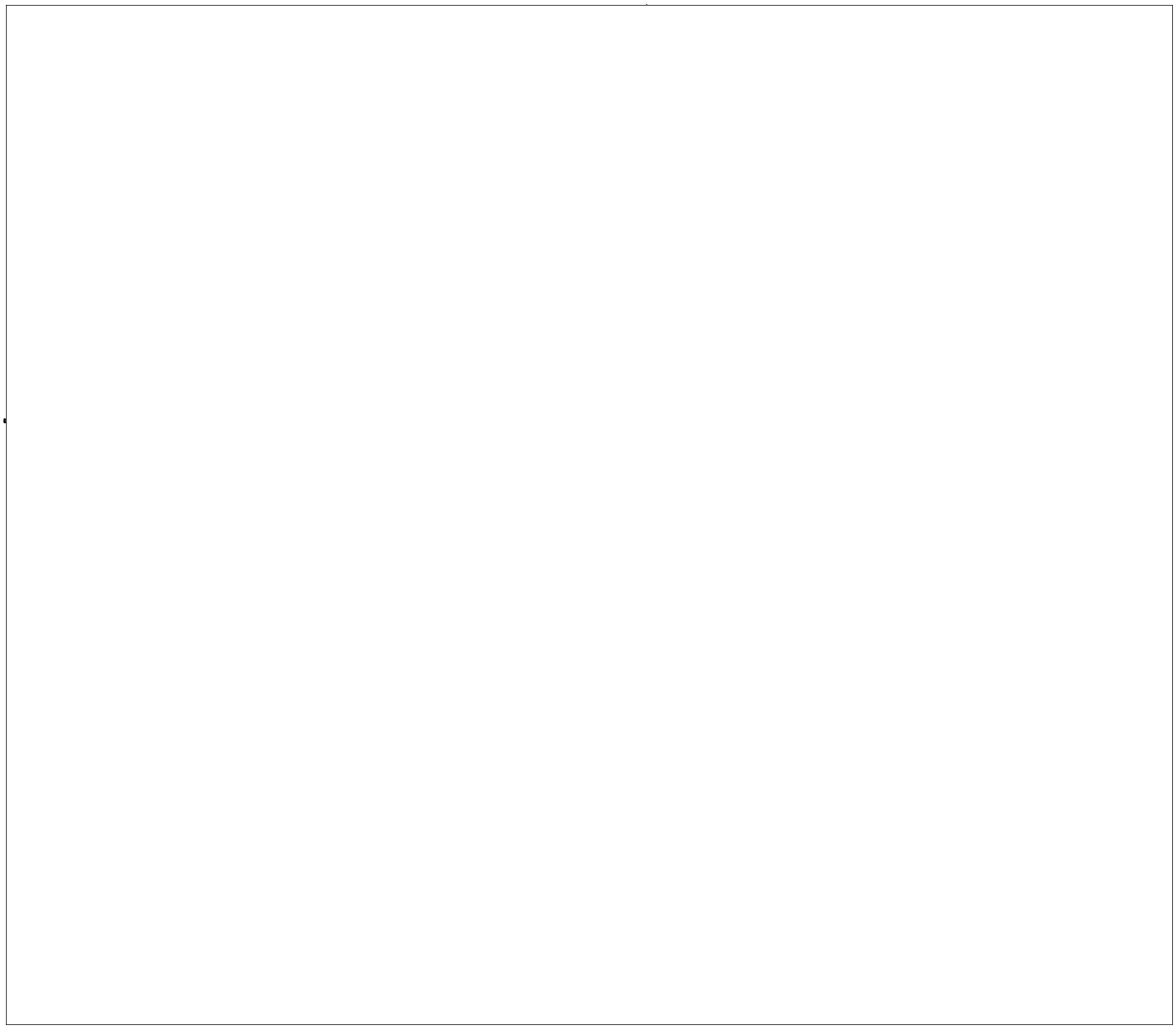
QUARTERLY PROGRESS REPORT

SATELLITE SYSTEMS

1 October 1967 through 31 December 1967

III. ELECTRO-OPTICAL READOUT TECHNOLOGY (ZAMAN)



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

A. Sensing Techniques and Devices

No contractual effort in this category was performed during the quarter.

B. Optical Fabrication and Evaluation Technique Development

1. Selective Vacuum Deposition Technique for the Figuring of Large Optics - The process of selective deposition permits the programmed zonal correction of precise optical surfaces by the iterative vacuum deposition of appropriate thin films. Existing figuring techniques, using essentially traditional approaches, are tedious. time consuming and most importantly, suffer from a considerable degree of unpredictability.

During this quarter, Perkin-Elmer has completed Phase IA involving a theoretical and experimental examination of general feasibility, practicability and utility of the selective deposition process. Subsequent phases will lead to the development of a research facility capable of figuring large, asymmetric, aspheric, refractive, and reflective optical elements.

Since the substrate must first be figured to about 1/2 wave length, the work accomplished during this phase included (1) a study of the conventional techniques for predictably correcting surfaces to 1/2 wave length, (2) an examination of the feasibility of the process including the correction of several 6-inch diameter flats in an 18-inch bell jar system, and (3) the preparation of detailed plans for the development and operation of a facility for correcting large size elements of various shapes.

In the course of Phase IA, it was found that many design definition questions related to vacuum evaporation techniques could not be adequately pursued with the existing 18-inch bell jar system. Furthermore, other questions, largely independent of vacuum chamber size, such as mask making, required further research efforts prior to the initiation of a development phase; also, it appears that the ultimate size of an optical element for operational applications may substantially exceed the 80-inch size originally contemplated.

Therefore, the next work phase has been modified to include

a. a trade-off study of size versus cost, element handling and mounting problems, sizing with boosters, and the potential advantage of large active optics elements,

b. initiation of the development of an intermediate size system for correcting 36-inch diameter elements, and

c. the option to initiate the design and development of an ultimate size facility when sufficient information has been developed as a result of steps (a) and (b).

It is planned to initiate the contract for Phase IB in January 1968.

2. The Development of a Hologram Interferometer - During this quarter the effort at Perkin-Elmer to develop a modified on-axis Hologram Interferometer has proceeded on schedule. Successful implementation of this technique will be required to continually monitor the condition of an optical surface during its fabrication.

Recent activity in this area has centered around the generation of hyperbolic and elliptical wave front programs; previous problems experienced with these computer programs were corrected. Also, the two hologram interferometer (THIN) was set up using two holograms from the on-axis interferometer and good reconstructions were obtained.

Work is now underway to test the polishing of one of the autocalibration mirrors. The mathematical analysis necessary for the interpretation of the fringes in Task I will be continued.

C. Optical Material Development and Evaluation

1. Beryllium-Based Material Development - Experiments were carried out during this quarter at Stanford Research Institute to determine the effects of hydrostatic prestressing on the microstrain behavior of beryllium rings. Some samples have been compressed at up to 12,000 psi without significant changes in results.

Greatly improved vacuum sintering techniques have been developed through the intentional doping of the starting powder with aluminum. Samples fabricated utilizing this process are presently being machined by Lockheed; previously fabricated samples for dimensional stability measurements have been received at SRI from Perkin-Elmer and will be evaluated within the next month.

During the previous month the existing program has been modified to include a review and analysis of anticipated requirements of Beryllium-based materials for satellite reconnaissance components; also, consideration will be given to the eventual production processes which might be used for making these components.

D. Mechanical/Optical Structures

No contractual effort in this category was performed during the quarter.

E. Advanced Electromechanical Development

1. Sheet Film Transport Development - During the quarter RCA began work on the next phase of the Sheet Film Transport program. A new pumping unit is being installed on the vacuum chamber to decrease the operational pressure by one decade; also, equipment is being prepared to supply dry N2 as a lubricant rather than ambient air. These latter two developments will permit brassboard testing and evaluation of the "out gassing" problem inherent in sheets or stacks of film in a vacuum under zero tension.

Work is now underway to convert the existing convoluted chute to a rotational mode of operation. Completion of this effort will permit experimental verification of the proposed scheme to transfer sheets of film from the stationary magazine to the chute and back to a holding magazine in an orderly fashion at speeds up to 200 inches per second.

A new computer format is being developed to permit the rapid generation of velocity data for larger quantities of film than presently available. This development will be the first step in correlating film damage to various machine functions. Also, the existing brassboard is being adapted to handle UTB film sheet.

F. Data Transmission, Processing and Display Techniques

No contractual effort in this category was performed during the quarter.

G. Development of Procedures, Criteria and Equipment for Collection System Evaluation

1. Objective Criteria for Film Image Evaluation - The final report on an effort at Perkin-Elmer to determine optimum film/processing combinations was submitted and evaluated during this quarter. The results indicated that very little difference in signal-to-noise ratio was evident over a wide range of exposures for both low and high gamma processing.

No further effort in this particular area of research is contemplated in the immediate future.

V. VULNERABILITY

[redacted]

[redacted]