~~TOP SECRET~~

ART-B-1L-7

HANDLE VIA BYEMAN CONTROL SYSTEM

~~TSI~~ NATIONAL RECONNAISSANCE OFFICE

WASHINGTON, D.C.

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THE NRO STAFF

September 12, 1969

MEMORANDUM FOR MR. PACKARD
MR. HELMS
DR. DuBRIDGE

SUBJECT: Spin-Scan

Attached for your information is a description of Spin-Scan which is one of the items to be discussed at the September 16 NRO Executive Committee meeting.

Lew Allen, Jr.
Colonel, USAF
Director

Atch
Spin-Scan

CORONA HEXAGON EARPOP TAGBOARD

HANDLE VIA BYEMAN CONTROL SYSTEM

~~TOP SECRET~~

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Sep 12, 1969

SPIN-SCAN

I. INTRODUCTION

The replacement of CORONA with HEXAGON will provide the NRO with major improvements in capability to perform search and surveillance. However, there are at least two areas in which HEXAGON will be less advantageous.

A. Quick Response: In 1964 a policy was established to maintain one CORONA at launch minus 9 days at all times and approximately 6 vehicles 38 days from launch. This capability was intended to provide a response to crisis situations or vehicle failures. HEXAGON, at four or perhaps three launches per year from a single launch pad, will have much less flexibility. Eventually, it is planned to maintain a "pipeline" HEXAGON at 20 days readiness. This capability plus the four data capsules of HEXAGON will provide some quick response capability, but the expense of HEXAGON, three times CORONA, and the limited flexibility make it unlikely that HEXAGON will be used to provide special, frequent, quick reaction coverage of a crisis area.

B. Survivability: As the Soviet non-nuclear anti-satellite capability has become understood, the NRO has attempted to maintain survival aids for CORONA. At present, [redacted] and other devices which are expected to enable a limited CORONA mission to survive the most likely (b)(1) (b)(3)

Soviet near-term threat. Due to the larger size of HEXAGON, its expense, and less frequent schedule, there is some doubt that a reasonable protective scheme will be devised for HEXAGON against the improving Soviet capability.

II. NRO STUDIES

A number of schemes have been considered at ExCom direction to provide a Quick Response/Survivable reconnaissance capability. Among these are:

A. Maintain CORONA vehicles in inventory for contingency operation.

B. An advanced hypersonic aerodynamic vehicle.

C. TAGBOARD or other drones.

Each of these appeared to be either too expensive or too provocative. A study which offers promise has been made of a minimum cost satellite small enough to be launched as a secondary satellite aboard HEXAGON, [redacted] (b)(1) (b)(3) and then used to provide area coverage at CORONA quality or better with daily return of imagery. This satellite will be described. (b)(1) (b)(3)

III. THE SPIN-SCAN SATELLITE

The following characteristics were determined desirable for such a system:

A. Use of existing technology—to minimize cost and development time.

B. Weight about 450 to 680 pounds to be easily compatible with HEXAGON secondary payload interface.

C. Resolution - as good as feasible but at least as good as best CORONA.

D. Readout - for daily return of imagery.

E. Area coverage of crisis regions daily.

F. [redacted] (b)(1) (b)(3)

G. Propulsion to adjust orbit for specific area coverage.

Two funded and two unfunded studies were performed. Typical satellite description is as follows.

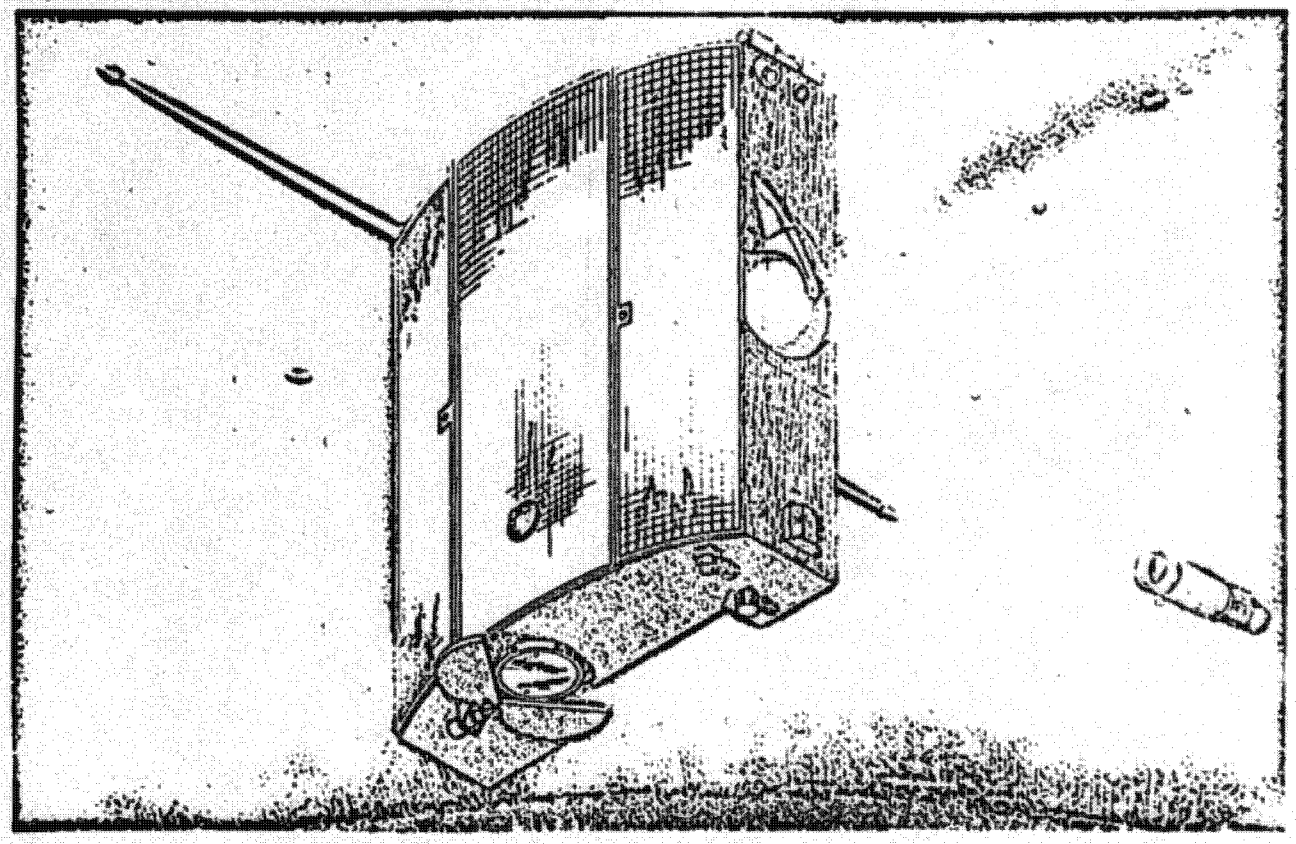


FIGURE 1

The satellite is a spin-stabilized box which is covered on one side with solar cells for electric power. The satellite spin causes the camera to operate in a panoramic mode. The image is recorded on conventional film which is processed on board and then read out when passing over a ground station by a laser scanning system. Pertinent performance parameters for three designs are:

SPIN-SCAN PERFORMANCE

Weight*	450	600	680
Optics			
Focal Length (in)	36	48	60
Aperture (in)	8	12	12
Performance at 90/150 NM			
Resolution, Nadir Avg (Ft)	5.0/8.3	3.7/6.1	3.2/5.3
Resolution, Median (Ft)	5.6/9.3	4.1/7.3	3.8/6.2
Daily Coverage at 90 nm (nm^2)	28,000	16,700	14,400
Total Coverage at 90 nm (nm^2)	350,000	210,000	180,000

IV. CRISIS RECONNAISSANCE

(b)(1)
(b)(3)

[redacted]

[redacted] A satellite is carried into orbit as a secondary payload of HEXAGON on one of

(b)(1)
(b)(3)

* At the indicated weights in each case, [redacted] and the minimum active lifetime at 150-90 NM is three weeks.

(b)(1)
(b)(3)

the existing two subsatellite mounting points. After separation from HEXAGON, an on-board propulsion system is used to

(b)(1)
(b)(3)

of the area. Depending upon various timing factors involved, photographs of the area would be returned to CONUS within, on the average, less than 24 hours of request. If best resolution is desired, as might be the case if ground force actions were of paramount interest, the operational orbit would have a perigee of 90 to 100 NM over the area. Coverage would then be about 16,700 NM^2/day for three weeks with average resolution of about four feet for the 600 pound version. Coverage could be strips about 200 NM wide or discrete 11 NM x 11 NM target areas or combinations as shown in Figure 2. Imagery would be returned to one or more CONUS ground stations as the satellite passed within range several times per day.

If the crisis were such that it was desired to photograph selected targets, such as airfields, within a broad area such as the Soviet Union, a satellite could be placed in a 150 NM circular orbit and photograph up to 250 10x18 NM discrete

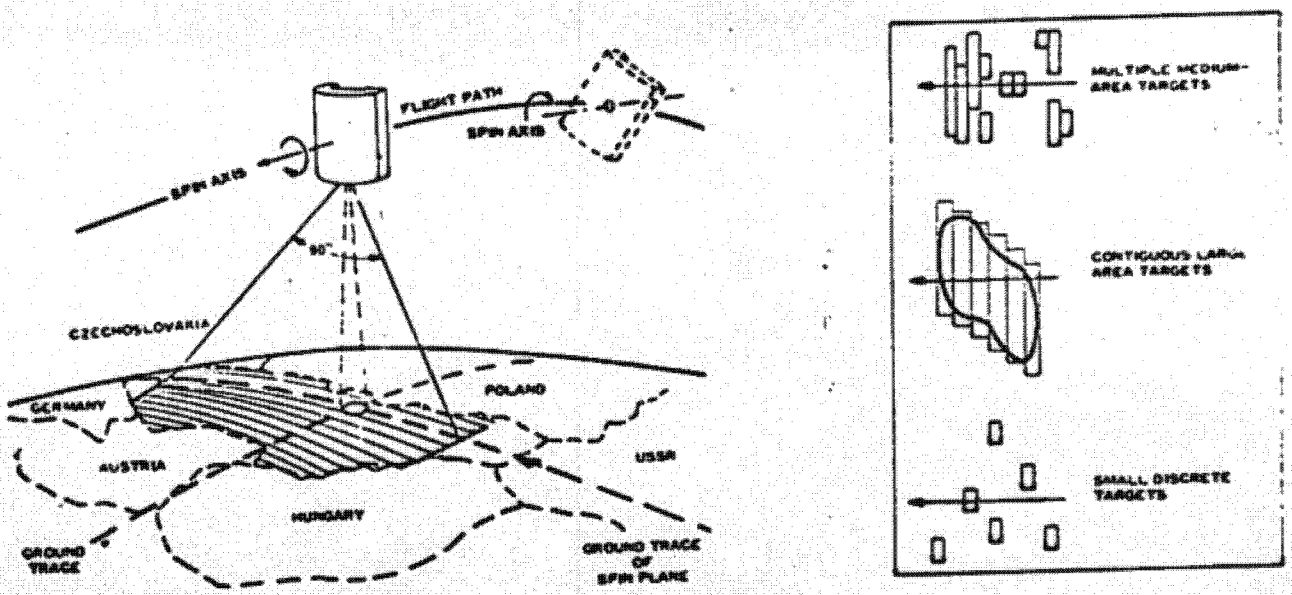
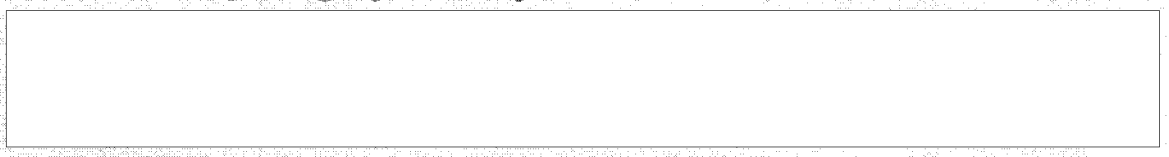


FIGURE 2

areas daily within a 300 NM access swath during a 30 to 45 day operational period at a resolution of about seven feet for a total coverage of over 500,000 NM^2 (again considering the 600 pound version).

A combination of these modes could be used. For the Arab-Israeli crisis, for example, the satellite in the best position could be [redacted] (b)(1) (b)(3) 150 NM circular orbit to give a daily repeating ground trace. The satellite would have access to the entire conflict area, including all of Lebanon, the western half of Syria and Jordan,

the western part of Saudi Arabia, and all of Egypt east of the Nile. The entire area could be photographed in a single pass and one-half the imagery returned to CONUS within eight hours of the overflight for assessment of military activities and damage. The remaining imagery would be returned at the next ground station access. After the initial survey the satellite could be transferred to a 90 x 210 NM orbit to obtain high resolution photographs daily of selected areas. (b)(1) (b)(3)



These imaging characteristics with daily return of data have been applied to various crisis scenarios and are felt to yield intelligence of critical value in most situations. During the recent Israeli-Arab War the coverage would have permitted assessment of the damage at Egyptian airfields, the dispersal and status of Israeli combat aircraft, the deployment of forces along the Israeli border, and the condition of the Suez Canal. During the Czech crisis an assessment of Soviet air order of battle in Western Russia could have been made, Soviet ground activity at major transshipment/staging areas could have been detected, and major changes in equipment levels at established ground force garrisons could have been confirmed.

Such coverage also would be useful against a variety of other intelligence problems with significant time-urgency implications. Included in this category would be selected search of Soviet ICBM complexes for new group starts (as was requested in spring 1969); coverage of rapid build-ups or rapid changes in force deployments along the Sino-Soviet border; coverage of North Korea during periods of crises to assess ground, naval, and aircraft deployments; and comprehensive search of areas like Israel for significant new construction and activity reported from other sources.

V. SURVIVABILITY

It is possible to launch these satellites as a group on a dedicated launch vehicle. Four could be launched on the existing racks of a Thor-Agena and eight or nine on a special Titan IIIB Agena. In the unlikely event that the Soviets decide to harass our existing systems and there is concern regarding the Soviet desire to conceal activity within the Soviet Union, this capability could be used to place several satellites in orbit. The satellites could be phased around the orbit prior to the first pass over the USSR so as to provide access to the entire Sino-Soviet area on the first day. The

Soviets have a very limited capability to intercept on early passes. Thus, since the data could be recovered promptly, the satellites would have a high probability of providing intelligence in spite of Soviet negation attempts.

VI. DEVELOPMENT AND COST

The four studies emphasized the 450 pound version of the satellite and provided design, cost, and schedule data. Essentially all critical components are adaptations of existing hardware. The lens designs suggested are reasonably straightforward, unobscured high performance designs for which high confidence exists. The film transport system requires high film velocity, but the subcontractor, on several of the studies, based the design on an adaptation of the transport system he fabricated and demonstrated during the HEXAGON competition. Film processing was suggested as either BIMAT, as was used successfully in the lunar orbiter program, or wet bath processing as has been designed and developed in prior NRO work. The laser scanner, data link, and ground reproducer are all adaptations of the [redacted] hardware and the associated earlier NRO development effort. Power, command and control, and attitude stabilization were all felt to be high confidence developments by the contractors. The four competitive studies

(b)(1)
(b)(3)

plus Aerospace and Air Force review confirm the confidence assigned to the development.

Cost estimates were obtained for the development and flight of a demonstration system consisting of a qualification model and two flight articles with demonstration limited to immediate use without [redacted] operation from the 150 NM circular orbit. The estimates for this program are from $35 to $40M dependent on the ground station selected. One contractor offered a fixed price contract in this range. Follow-on operational spacecraft were estimated at $4M each. Time to first demonstration launch was estimated at 21 months. (b)(1) (b)(3)

When it appeared that a higher resolution than that achieved in the 450 pound design was desired to insure adequate coverage of deployed ground force equipment and that a reduction in area coverage would be acceptable, a brief additional study was performed to extrapolate the design to weights up to 680 pounds which is near the upper limit of the existing secondary payload interface on HEXAGON. The additional weight allowance appears to permit desirable improved resolution and is expected to increase costs by 10-20 percent.

VII. OPERATIONAL PROGRAM AND COSTS

Based on the four contractor studies and cost estimates, the NRO field organization has prepared a program schedule along with the associated fiscal year costs.

The demonstration systems would be ready for launch 23 and 26 months from program go-ahead if two months are allowed for source selection. Since the HEXAGON vehicle can accommodate two subsatellites, operational capability could be achieved by launching two operational satellites at 29 months and two more at 32 months from the program go-ahead date. Assuming an October 1969 go-ahead, the demonstration launches could occur in September and December 1971, and the operational launches could take place in March and June 1972. The double launches would eliminate the possibility of a P-11 launch on two HEXAGON launches and would require an assessment of the intelligence needs and priorities at the time. Following the initial operational launches, replacement satellites would be launched as necessary.

Fiscal year costs for the 600 pound satellite, assuming a production rate of four per year, a program go-ahead in

October 1969, and a field demonstration flight in September 1971, are given below. These costs include a single ground station in the Washington, D. C. area collocated with an IDCSP ground station, and they assume use of the IDCSP antenna.

	FY 70	FY 71	FY 72	FY 73	FY 74	Total
RDT&E	$22,500	13,400	3,000	800	800	40,500
Missile Proc.	2,500	6,800	20,000	20,000	20,000	69,300
Total	$25,000	20,200	23,000	20,800	20,800	109,800

Costs are in thousands of dollars.