~~TOP SECRET~~

A HISTORY OF SATELLITE RECONNAISSANCE

VOLUME IIA - SAMOS

by

Robert Perry

(b)(1)1.5c [redacted] S

Revised October 1973
from earlier drafts
of 1963-1965, 1972

Volume IIA consists of 322 pages.

Copy 3 of 5 copi

Classified by (b)(1)1.5c [redacted]
Exempt from general declassification
Schedule of Executive Order 11652
Exemption category [ss 5B(2)]
Automatically declassified on
IMPOSSIBLE TO DETERMINE

ADDSY PROCESSED
Date -------- Initials --------

(b)(1)1.5c [redacted]
(b)(1)1.5c [redacted]

~~TOP SECRET~~

scheduled E-2 flights remain in the program for the moment, although again it was apparent that once a set of returns had been received there would be no real justification for further continuance of the E-2 program.[17]

In effect, the February decision halted all work on the remaining E-1 system (vehicle 2103) and caused it to be returned to Lockheed's Sunnyvale plant for bonded storage. All of the necessary directives were in circulation by 15 February, one day after Charyk's verbal instructions to Greer.[18]

There was one additional, almost afterthought aspect to the E-1 program. In April 1961, representatives of the National Aeronautics and Space Administration (NASA) contacted Dr. Charyk's office to ask permission to examine and use E-1 technology in their own programs. It seemed possible for a time that the physical products of the E-1 development might actually find their way into a moon vehicle. One stimulant was the obvious parallel between E-1 equipment and techniques and the devices used by the Soviets to photograph the back surface of the moon in October 1959.

The Soviet feat had excited admiration from a number of American specialists in reconnaissance and from astronomers in general. (The lunar pictures, incidentally, represented the first public disclosure of satellite photography and stimulated considerable conjecture about the existence and capability of a Soviet reconnaissance satellite system.) Without giving any indication that he knew of the E-1 and E-2 specifications, Amrom H. Katz, Rand's foremost optical physicist, calculated the relative ground resolution of the Soviet camera and data link system at about 250 feet from an altitude of 300 miles. That was a shade less effective than the E-1, though in practice the considerable difficulties of transmitting photographic data over distances ranging from 30,000 to 200,000 miles tended to invalidate any general conclusions on that score. (The Soviet system had employed an eight-inch F/5.6 lens and a 20-inch F/9.5 lens to produce simultaneous photographs, each on one-half of a single frame of 35 millimeter film. Katz and others estimated that transmission of a complete negative required about 20 minutes. The satellite never approached closer than 40,000 to 50,000 miles to the moon but nevertheless returned photographs which showed a ground resolution on the order of 5-10 miles.) In the realm of the theoretical, it seemed that the slightly more sophisticated--on paper, at least--E-1 or its E-2 successor might permit the United States to obtain better pictures. At least NASA seemed convinced--so much so that Undersecretary Charyk authorized that agency to deal with the E-1 contractors through General Greer's office. Charyk

(b)(1)1.5c [redacted]

(b)(1)1.5c [redacted]

instructed Greer to permit access to technical data on the camera and on-board processing equipment, data transmission elements, and the ground processing system. However, he forbade the release of specific satellite photography or detailed test results.[19]

There was considerable doubt in informed quarters that the E-1 devices had any useful application to the problem of lunar photography; both Rand and Colonel King freely expressed reservations on that point. Indeed, as analysis of E-1 results continued and as the fund of precise information on system capability increased, confidence in the system tended to decrease proportionately. Concurrently, there was a growing awareness that it would be most difficult to fund all of the assorted Samos systems in the next fiscal year, a circumstance that caused program managers to give new thought to early cancellation of the entire E-2 program. Early in March 1961, when the fiscal 1962 budget for Samos was undergoing final review, the question of what could be done with funds that, though substantial, were definitely limited, focused in part on how many E-2 flights should be carried on the schedule. The issue was complicated by Dr. Charyk's desire to develop and test a mapping and charting satellite (essentially a revived E-4 system) as well as to continue or even expand a basic program that now included ferret satellites, the E-5, E-6, [redacted] and several variants of Corona. Dr. Charyk was willing to consider cancellation of the E-2 program in favor of a new readout-technology approach with more promise, should that seem the best course.[20]

Although in most essential features the E-2 system was technically identical to the E-1, differing chiefly in the degree of lens magnification, there was evidence that all of the complexities of readout had not been resolved by the relatively successful E-1 flight. In May 1961, for instance, the program office reported that the processing unit in the payload vehicle had repeatedly jammed in the course of check-out tests, that the film record was subject to distortion under certain conditions, and that the ground equipment still experienced frequent random failures.[21] Even before the program review that brought such circumstances to the attention of the undersecretary, he had decided to limit the total of E-2 flights to two. On 19 April, the third E-2 vehicle-payload (vehicle 2122) was cancelled. Another significant change came early in July when a succession of payload, tracking net, and booster difficulties forced postponement of the scheduled launch of the first E-2. Even after the original sequence of such difficulties was resolved, a new onset of electronic trouble in the Atlas booster again caused postponement of the launch date into September.[22]

(b)(1)1.5c

(b)(1)1.5c

On 9 September 1961 the initial attempt to orbit an E-2 payload ended in an awesome launch pad explosion. Loss of electrical power caused the Atlas to drop back on the pad less than two seconds after liftoff. The E-2 payload was destroyed in the resulting blast and fire. (The Atlas failure was caused by a delay of .2 seconds in disconnecting the umbilical that carried the signal to switch from external to internal electric power.)[23]

The remaining E-2 flight test vehicle (2121) faced a problem of crowded launch pad schedules. After weighing the prospect of a major malfunction and the clear evidence that basic subsystem performance had been adequately demonstrated in the single successful E-1 flight, Charyk and Greer decided not to launch the second E-2 vehicle. On 30 September the contractor was instructed to remove it from flight readiness processing and put it in bonded storage. For all practical purposes, such action concluded the original readout-oriented Samos program.[24]

Colonel W. G. King, responsible for those aspects of Samos which predated the August 1960 reorganization, saw clearly that the decision to store rather than launch the remaining E-2 payloads meant that readout, "as presently conceived," was no longer "an acceptable alternative solution to the earth recce problems facing us." On

6 October he issued instructions that all work on readout should halt immediately, cautioning the procurement office to look carefully to be sure of finding "a lot of the efforts which are hidden in the bushes . . ." He wrote a brief epitaph with the phrase, "It is presumed the present readout program is defunct."

Colonel King's experience with the E-1 and E-2 had not convinced him that any of the equipment was applicable to NASA's moon reconnaissance program. He remarked mildly that "the gentlemen" with whom he had discussed the NASA proposal "did [not] seem to understand much about the problems of taking pictures from a space vehicle," but then he had earlier concluded (as had The Rand Corporation, independently) that little of the basic equipment could be adapted to a lunar reconnaissance program. His own draconian preference for disposing of surviving payloads was to offer one of the E-1's to a museum and to give the remaining E-2 vehicle to anybody who could afford to fly it.

The residue of the readout program was initially concentrated at Vandenberg Air Force base, although bits and pieces finally settled at other sites over the country. The two remaining E-1 flight models remained at Vandenberg, together with spare parts sufficient to make a third payload. Three assembled or partly assembled but untested

E-1's were stored at Sunnyvale. One E-2 flight model and parts for another were also in Vandenberg storage. Two other non-flyable test models remained, one at Eastman Kodak's Rochester plant and the other at Sunnyvale.[25] After September 1961, there were no serious proposals for Air Force utilization of the equipment, even though lunar reconnaissance kept bobbing up. The flyable payloads went into storage at Milpitas, California, and the Agena vehicles not adaptable to other programs with them. Contractors converted to other uses most test items. Readout in its original form was, as Colonel King had observed, "defunct."

That being the case, King felt himself free to state several viewpoints that would have been considered inappropriate in the manager of a major readout development. Although he agreed that many people thought readout might be the "ultimate" system, King could see no reason at all for developing such a device. A good system, he told [redacted] required a reliable long orbital life, an invulnerable long unattended life, boosters capable of lofting large power supplies, and a readout network capable of doing a first-rate job. The combination, he observed, would be "tough to provide--and costly." ". . . Why spend your time creating a problem so you can work on it?" he wrote Colonel [redacted]

It was also apparent, King noted, that no readout system then conceivable could provide the clarity or definition of recovered film. What could the readout system sense that a small-time differential would degrade, he asked? Would a readout system be more economical thana recovery system if estimates properly weighed the cost of amortizing development? King thought not. He was convinced that with the possible exception of better response to low levels of illumination, everything a readout system could do a recovery system could do better. The need for long on-orbit life pushed a readout system so far out into space, for example, that a 10-foot recovery system would always become a 20-foot readout system.

As for the future, King felt that development of traveling wave tubes would indeed allow much more information to be transmitted, quickly and accurately, than current six-megacycle systems, but he noted acidly that a great deal more would be required to make readout compatible with any of the recovery systems then in development. So, he asked, "Why develop something that will take weeks to cover the same ground that you can cover in 5 days?" As for technology, not only was a stabilization and aiming system capable of supporting a very high resolution readout system rather remote, but it promised to be very expensive. Perhaps more important, an electronic data

[redacted] (b)(1)1.5c

Handle via [redacted] (b)(1)1.5c

link was much more vulnerable, both physically and politically, than any recovery system.

Not even when the proposition was a continuing research program pointed toward possible needs five years hence did it satisfy Colonel King's standards. He was convinced, he told Colonel [redacted] that reliable recovery, even reliable recovery of several packages from the same orbiting vehicle, would always prove simpler than providing a combination of reliable long life on orbit with a good data link. Five years in the future, satellites might provide the only source of reconnaissance information, but by then both readout and recovery would be difficult and the earlier advantages of recovery would have persisted.*

---

* Some of the arguments against readout, though not Colonel King's, were based on advantages of the E-5 and E-6 over the E-1 and E-2 which were the product of general advances in the state of the reconnaissance arts. The E-1 was a fixed camera covering a 100-mile swath on the ground while the E-2 had a stabilized rotatable mount to provide 17-mile-wide strip coverage within a 300-mile-wide strip along the ground track. Maximum resolution of the E-2, under ideal conditions, was on the order of 20 feet. In practice, a resolution on the high side of 35 feet could be normally anticipated. Better optics, improved techniques of film transport, improved vehicle stabilization on orbit, and modes of panoramic photography made both the E-5 and E-6 considerably more attractive in terms of ground resolution, ground coverage, and general picture quality. But with allowances for the fact that stabilization requirements would be more critical in the case of a camera on 300-mile orbit than for one orbiting below 150 miles, the lens, film transport, and panning advances incorporated in the E-6 might well have been built into a readout system, thus .