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A HISTORY OF SATELLITE RECONNAISSANCE

VOLUME IIIB - HEXAGON

by

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November 1973

Volume IIIB consists of 152 pages.

Copy 3 of 5 copies

PREFACE TO VOLUME IIIB

This portion of A History of Satellite Reconnaissance covers the period of Hexagon gestation before April 1966 as well as the development and early operational missions of that system. At the time this preface was written, in November 1973, the agreed terminal point was July 1973. Therefore nothing that relates to Hexagon mission 1206 (the sixth flight) or subsequent operations is detailed here, and plans for improvements are discussed only as they existed in July 1973. It seems reasonable to assume that at some later time the subsequent flight and developmental history of the system will be completed, but that must for the moment be treated as conjecture rather than promise.

The author's research for this volume was supported by Robert A. Butler, at the time of writing a consultant with Technology Service Corporation, of Santa Monica, California. The history was prepared under terms of a contract between the Directorate of Special Projects (Program A) of the National Reconnaissance Office and Technology Service Corporation.

As detailed in the following pages, Hexagon was the outgrowth of effort undertaken in two earlier pseudo-program enterprises known as Fulcrum and S-2. Both have been treated here in somewhat greater

detail than might ordinarily be warranted, given that Hexagon, as eventually operated, was strikingly different from its apparent predecessors. But the problems that beset Hexagon development from 1966 to 1971 were unmistakably derived, in considerable part, from the assumptions, premises, plans, schedules, and concepts that characterized those predecessor activities. As several principal officials of the sponsoring development agencies later conceded, Hexagon was prematurely advanced from engineering development to system development. Unwittingly, it became at once the most costly and the most lengthy of the several ambitious developments undertaken in the first 10 years of the National Reconnaissance Program. In the end it also became one of the most successful, and that happy outcome largely offset whatever criticisms might have been leveled at its pre-operational phases.

Because Fulcrum, as a program concept, and the Hexagon camera system as a whole were entirely CIA-managed efforts, a full history of the program should not be prepared without first reviewing CIA records. As written, this account is academically defective in that the author had no access to CIA sources. Nevertheless, the principal aspects of the total program appear to have been thoroughly documented in "Program A" records (kept in the El Segundo,

California, offices of the NRO's Directorate of Special Projects) and in policy documents filed in the offices of the NRO staff (in suite 4C1000 of the Pentagon). To the author, therefore, it seems unlikely that any subsequent expansion or enlargement of the manuscript will cause significant alteration of either the recorded sequence of events or the interpretations attached to them.

As with earlier program history contained in this set of volumes, there is no reasonable prospect of understanding the course of events in one system program without taking account of developments elsewhere in the National Reconnaissance Program. Thus from time to time it is essential to discuss events in such programs as Corona, Gambit, Samos, and [redacted]--and to consider in the broad the plans and policies adopted by the Director of the National Reconnaissance Program, the Director of the Central Intelligence Agency, the United States Intelligence Board, the Executive Committee for the National Reconnaissance Program, and the several other officials, boards, panels, and agencies which influenced the establishment, growth, and conduct of Hexagon. Many of the events so mentioned have been described in greater detail in other volumes of this history: Corona, Samos, and Gambit, for instance, are the subjects of Volumes I, IIA, IIB, and IIIA of this set of reconnaissance program histories. Readers concerned about background

and detail that involved those programs with Hexagon should consult those other volumes.

In the interests of avoiding repetition, most interactions between Hexagon and other programs have only been summarized here. Such summaries have been included, even if occasionally repetitious of earlier volumes, in the expectation that some readers will want to have within one set of covers reasonably complete information on Hexagon alone. This volume has therefore been constructed so that it will stand alone, without recourse to other sources, although in some instances it will be necessary to consult those other sources in order to acquire a full understanding of incidents and events mentioned casually here.

The close interaction of Hexagon and Gambit is the principal justification for making histories of those programs Volume IIIA and IIIB of the complete set. Keeping them physically separate from one another has an additional advantage: should it later prove feasible and appropriate to do so, each volume can be extended to include the later histories of those programs without forcing revision of these chapters and pages.

Finally, it is essential to acknowledge the very considerable assistance of Colonel Frank S. Buzard in providing detail and background

information and in clarifying both technical and management matters that for one reason or another were either casually explained or ignored in the voluminous documentation of the Hexagon program. The source notes that follow the text do not adequately credit the comments, additions of detail, and explanations of confusing events that he provided throughout the period of background research for this volume and--most particularly--upon reviewing the initial draft. This acknowledgement must serve as the author's apology for that shortcoming of the manuscript.

CONTENTS

XV HEXAGON - ORIGINS AND INITIAL OPERATIONS

Introduction and Background

Hexagon stemmed immediately from a program known as Fulcrum, which began as an Itek Corporation study initially funded by the Central Intelligence Agency in January 1964. But Fulcrum was preceded by an extended period of technological rummaging about in the requirements for a new search system--a replacement for Corona and for the failed Samos E-6. The conduct of Fulcrum and the subsequent emergence of a Hexagon program were marked by two years of variously intense controversies about requirements, schedules, technology, and organizational prerogatives.

Corona, it will be recalled, had never been intended to serve as more than an interim search system, a temporary and presumably inferior predecessor to other and more capable systems to be developed during the late 1950s and early 1960s. But by 1961 several of the planned successor reconnaissance satellite programs were in technical and financial difficulties while Corona was becoming an operationally effective and generally reliable search system with considerable potential for growth. How that potential should be exploited, and to what extent Corona might be utilized in the place of other and less

attractive reconnaissance satellite systems, had become of considerable interest to the intelligence community by 1962; the composite issue of what system, if any, should eventually replace Corona, involved questions of institutional prerogatives, camera and space vehicle technology, and national requirements for overflight photography that were not acted upon until 1966 and were not fully resolved until 1970.

Once the dual-camera, stereo-capable Corona-Mural system had been proved technically feasible, it was inevitable that a still better system based on Corona concepts and hardware would be proposed. In March 1962, the CIA endorsed an Itek proposal to develop what came to be called the M-2 search system (for Corona-Mural-2). It involved the substitution of a single 40-inch f3.5 lens and a dual-platen film system for the dual-camera Corona-Mural then in use. The estimated cost of design and manufacture seemed acceptable in that the system promised to return broad-area photography with resolution of about four or five feet for considerably less than would be expended in obtaining such performance from alternative systems then proposed or in development.

The M-2 proposal was formally presented for NRO review on 24 July 1962. Six months earlier, in December 1961, the E-5 surveillance system being developed under the aegis of the original Samos

program had been severely cut back, and in July 1962 a programming error had caused the last of the E-5 recovery capsules to stabilize in a high orbit where it would remain until decay and reentry "somewhere east of Africa" more than a year later. Lanyard, a relatively inexpensive composite of E-5 camera technology and Corona vehicles, was making reasonable progress toward a scheduled first launch in December 1962, but like E-5 and Gambit, Lanyard was predominantly a surveillance system.* If Gambit were successful, there would be no need for Lanyard.

Corona, E-5, and Lanyard were Itek camera developments. The need and real potential for Corona improvement was still uncertain. E-5 had been cancelled, and Lanyard was a dubious prospect. Corona, and to some extent Lanyard, represented the only satellite reconnaissance programs under CIA control. The various Samos efforts (by 1963 reduced solely to an E-6 effort with a record of five successive mission failures and a most unpromising future), Gambit, and the several radiation-sensing satellites, were under the cognizance of the NRO's Directorate of Special Projects, on the West Coast. If E-6 could be

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* E-5 and Lanyard were intended to be surveillance systems, and Gambit to be a technical intelligence system. But because only the latter became operationally available, it served as and often was characterized as a surveillance system, none other existing.

made to work, and Gambit performed as its developers anticipated, neither Itek nor the CIA could be sure of a continuing direct role in the development and operation of reconnaissance satellites.

That circumstance was well appreciated by the Department of Defense, the CIA, and all of the participating contractors. Although interagency working level relationships had been outstandingly effective during the earlier days of Corona operations, they were less so by 1963; the CIA and DOD participants in Corona were by then engaged in organizational skirmishing that was within two years to become a source of major concern to cabinet-level DOD and CIA officials.

Operating-level difficulties were paralleled by institutional conflicts at the NRO level, where they would contribute to the 1963 resignation of the CIA's designate as deputy director of the NRO (Herbert Scoville) and the later departures of an NRO director (Dr. Brockway McMillan), his CIA opposite (Dr. A. D. Wheelon), and several lesser officials. Although a variety of questions involving funding responsibilities, program management authority, and organizational prerogatives (as well as some personal differences) influenced events, a central theme in the whole period between 1962 and 1966 was the selection of a new search-mode reconnaissance satellite.

When the M-2 proposal first was formally presented to NRO program reviewers in 1962, the E-6 "successor system" originally intended to provide better search coverage capability than Corona was entering its yet-to-be-acknowledged final decline. E-6, carrying two 36-inch focal length cameras, could in several respects provide nominally better coverage than Corona, but by late 1962 a series of sequentially introduced Corona improvements had made the E-6 relatively less attractive. Then the first two attempts to operate E-6 on orbit ended in recovery failure; perhaps as important, they had been accompanied by serious camera system malfunctions. In July and August 1962, the third and fourth E-6 missions also ended in failure. In October, E-6 seemed so little promising that Major General R. E. Greer (NRO Director of Special Projects) and Dr. J. V. Charyk (then NRO director) decided to suspend plans for the purchase of operationally configured systems. The fifth E-6 sank in the Pacific in November 1962, damaged by reentry heating. Although there were indications of acceptable on-orbit camera operation before the reentry sequence began, by that time the potential advantages of E-6 over Corona-Mural had all but disappeared. The older system was returning film images with resolutions on the order of 13 feet. Even if E-6 could

do better--still not at all certain--and could provide broader coverage because of greater film capacity, the Corona system had reliability attractions that E-6 seemed to lack. Notwithstanding determined efforts to diagnose and correct the defects E-6 had displayed in five successive mission failures, there was no real assurance that the system could be made to work. In January 1963, therefore, Charyk cancelled the E-6 program.[1]

The still undetermined future of Corona M-2 was clouded, during the late months of 1962, by the emergence of another Corona variant, the dual-capsule Corona-J system. Although not formally approved for development until October of that year, Corona-J had actually entered a phase of engineering design in July, with a first launch scheduled for May of 1963. (Because of problems mostly external to Corona-J, actual first launch did not occur until August 1963.) Another objection to proceeding with M-2 was the proposed development of an "improved" and re-engineered E-6 utilizing proven components in place of many troublesome elements of the original. Yet another was the lack of a stated requirement for a relatively high resolution search system, although the requirements that had warranted a 1961 start on E-6 development still remained to be satisfied.

Notwithstanding such uncertainties, the Directorate of Special Projects awarded a study contract to Eastman Kodak in January 1963 that called for examination of the high-resolution, broad-coverage mission and means of performing it. Called Valley, the project quickly focused on a large-optics system providing resolutions of [redacted] or better, to be placed in orbit by a Titan IIIC booster. The difficulties of providing wide area coverage at such resolutions finally caused termination of that part of the study effort. The promising consequences of flying very large optics led, however, to the development of Gambit-3. Moreover, research undertaken after cancellation of the original E-6 Samos program together with the search phase studies led toward Eastman's S-2 designs of 1964.

In the Spring and early Summer of 1963, CIA reconnaissance specialists had proposed two alternatives to M-2 as candidates for the "next generation" reconnaissance satellite. One was a vehicle that could be flown covertly, that could be represented to be something other than a reconnaissance vehicle. Disagreements about the validity of and need for such a concept had been involved in Scoville's resignation in June 1963.

The second concept was even more controversial: the agency suggested the need for a system that could perform wide-area coverage at very high resolutions, the proposed requirement emerging from a series of studies conducted by CIA system analysts in early 1963. Such requirements uncertainties were passed on to the Purcell Panel, a special reconnaissance study group established by John A. McCone, Director of Central Intelligence, in the Spring of 1963.*

Perhaps surprisingly, the Purcell Panel concluded that "the natural incompatibility of wide coverage and high resolution within a given payload, is becoming more acute. . . as the art advances." An effort to combine the two functions in a single system "with only a modest improvement in resolution. . . would not be a wise investment of resources," the committee decided. Rather than to focus immediately on development of a new system, the NRO was urged to concentrate on improving the average quality of returns from Corona. The Purcell Panel made a number of specific suggestions for lines of research that promised to lead in that direction. But the panel suggested that

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* The "Purcell Panel," headed by E. M. Purcell, included A. F. Donovan, E. G. Fubini, R. L. Garwin, E. H. Land, D. P. Ling, A. C. Lundahl, J. G. Baker, and H. C. Yutzy--perhaps the most distinguished group of authorities on reconnaissance, space, and photography ever to be collected in one study group. Many of the

a new system, though ultimately needed, was for the moment a lesser requirement.

The Purcell Panel report had several interesting repercussions, some of them delayed rather than immediate. One that was to become important somewhat later involved interpretation of the qualifications in the "not a wise investment" judgment. The CIA ultimately argued that the panel had endorsed development of a combined search-surveillance system with more than a modest improvement in resolution. The NRO's special projects directorate tended to emphasize the panel's view that combining high resolution with wide coverage was an exercise in natural incompatibility. But in any event, the panel plainly had refused to accept the findings of an earlier study group organized by Greer, at Charyk's direction, in April 1963. Concerned with the broad issue of what should be developed in the way of a new search system, the West Coast group (headed by Colonel Paul Heran) decided that an "improved" E-6 camera system coupled to an enlarged Corona-style recovery capsule should be developed in parallel with the proposed Itek M-2 system, the more promising of the two being produced once its superiority had been verified.

"Purcell Panel" members subsequently became members of the "Land Panel," which between 1965 and 1972 operated as the principal advisor for reconnaissance matters to the President's Scientific Advisory Group and the President's Science Advisor.

(It is worth recalling that by early 1963 the E-1, E-2, E-5 and E-6 had all been cancelled, Lanyard was in some early difficulty, while Gambit, still untested, was recovering from technical and financial troubles that in October 1962 had led to major program restructuring and the assignment of a new project head. The interest of the "Ad Hoc Group" in sponsoring parallel programs and in delaying a system choice until one or the other had demonstrated its capability for effective orbital operations becomes readily understandable in that light. So does the Purcell Panel conclusion: invest first in improved Corona quality; Corona works now. High-risk technology was in disfavor in the summer of 1963.)

The new NRO director, Dr. Brockway McMillan, ordered cancellation of M-2 work at Itek in July 1963.* Itek's efforts were to be principally focused on improving Corona product quality. To that end, General Greer's directorate made a number of specific suggestions for detail changes. CIA technical specialists in reconnaissance, now concentrated under Dr. Wheelon, concluded that the proposals

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* Nonetheless, the elements of M-2 reappeared, in proposal form, at frequent intervals in later years, not finally disappearing until the availability of an operational Hexagon became reasonably certain in 1971. In subsequent incarnations the basic M-2 was given several transitory names, Corona J-4 being the best known.

were inadequate, so in October 1963 Wheelon called into being a new special study group--the Drell-Chapman Committee--"to explore the whole range of engineering and physical limitations on satellite photography. . ." The group, acting under a loose charter proposed by John McCone in conversation with Roswell Gilpatric (Deputy Secretary of Defense), was to be concerned not merely with Corona improvements, but also with standards and needs for new systems.

Predictably, McMillan had pronounced objections to such proceedings. He did not learn of the committee until after it had been established, he felt that its "charter" was far too broad (USIB and the NRO were nominally responsible for generating and validating requirements), and he preferred to spend NRO study funds elsewhere. McMillan also protested that Wheelon had no official role in the satellite reconnaissance program.

McCone named Wheelon his "monitor for NRO matters" three days later, and Wheelon promptly declared his intention of ". . . get[ting] the CIA into the satellite business in a contributing, not just a bureaucratic way."

The most attractive prospect for new program creation still was in the search area. True, an ultra-high-resolution camera was

also on the general requirements list, but it seemed several years in the future and, in any case, in 1963-1964 the surveillance concept that seemed most promising was embodied in [redacted] still embryonic but certain to be an Air Force undertaking. The Drell-Chapman Committee had been critical of progress in Corona improvement; in time, that criticism was to lead to the modifications incorporated in the Corona J-3 configuration, a remarkable improvement over the original Corona-Mural. But Corona J-3 still was only a proposal, and in any case there was agreement that no Corona redesign with less scope than the M-2 undertaking could substantially improve Corona's resolution capability. Camera specialists then believed that if resolution much better than 7 or 8 feet for about half of the returned film were wanted, refinement of the original Corona would not be sufficient.*

Two events followed in close order. On 18 November 1963, the NRO's West Coast directorate contracted with Itek for general

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* Consistent, rather than occasional, resolution of 7 to 10 feet was the Corona goal defined by the Purcell and Drell-Chapman recommendations and ultimately incorporated in the Corona J-3 program. The assumption that Corona could not generate photography with 4- to 5-foot resolutions, however much the system was modified, later proved to be incorrect. Corona J-3 ultimately provided "best resolution" of 4.5 feet.

feasibility studies of a new broad-area search system and for the preliminary parametric design of such a system. That action was the somewhat delayed response to the Purcell Panel findings of June 1963. It also represented, indirectly, a continuation of search system studies undertaken on the West Coast following the cancellation of Samos E-6, earlier that year. Not quite two months later the CIA separately authorized Itek to study a remarkably similar set of problems, but specified a somewhat more ambitious design goal based on the findings of in-house CIA analyses. The CIA action was a delayed response to the Drell-Chapman Committee findings of late 1963, but it indirectly represented a continuation of the search system research approach embodied in the M-2 studies undertaken by the CIA in an effort to find a feasible improvement mode for Corona-Mural. The "West Coast Itek Study" led to S-2; the CIA-funded Itek study was the genesis of Fulcrum.[2]

The CIA's intentions were generally known to the NRO staff in December 1963, somewhat before Itek formally began work. The probability that Greer's NRO group and Wheelon's CIA group would emerge from their respective study programs with competing proposals for a new search system caused some concern among program monitors

high in Department of Defense ranks. (The NRO charter then in effect included no provision for anything resembling the NRP Executive Committee of later years; the Director of the NRO was responsible directly to the Secretary of Defense, CIA participation being assured by the assignment of individuals to various NRO posts--including that of deputy director.) Earlier in 1963, Dr. Eugene G. Fubini, then serving as a senior technical advisor to the Deputy Secretary of Defense, had begun acting as a defense department spokesman in NRO matters. (In the Charyk era no such intermediary function had existed, Charyk having such an effective relationship with Secretary Robert S. McNamara that it was not needed.) Fubini had by late 1963 assumed the role of a mediator in the increasingly acrimonious contacts between McMillan and Wheelon.* In December, speaking with the implied authority of Cyrus Vance, newly appointed Deputy Secretary of Defense, Fubini proposed to McCone that the CIA assign total Corona responsibility to the NRO in return for a free hand in the

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* The principal source of CIA-NRO contention in 1963 was Corona management responsibility and authority. McMillan wanted to concentrate all Corona authority under a jointly staffed West Coast project office reporting to the Director, Program A (then Greer, later Brigadier General John L. Martin, Jr.). Wheelon, firmly supported by CIA Director John A. McCone, argued that CIA control of Corona should be enlarged rather than curtailed. The issue is discussed in greater detail in the first volume of this history.

development of a new search system. McMillan apparently was unaware of the offer until McCone indirectly passed it along. He rejected the compromise out of hand, insisting that the NRO had to have full authority to control Corona and that a new search system could not be arbitrarily assigned to any organization. The disagreement thus expressed persisted into 1965. McMillan's efforts to resolve the issue by obtaining directive support either from McNamara or from the White House were unavailing. The President's Foreign Intelligence Advisory Board recommended strengthening McMillan's hand during a May 1964 meeting, but the draft Presidential directive sent forward in consequence of that meeting was never signed. (The 1964 election played some part in delaying a resolution of the several controversies that afflicted the NRO, the search system requirement, and the Corona program from May through November.)

The net effect was that by January 1964 the CIA had undertaken to sponsor studies with Itek, and subsequently with Philco Corporation and other subsystem specialists, leading toward a broad-area search system called Fulcrum, and the NRO's Special Projects Directorate (Program A) had begun to support a different set of studies oriented toward a different kind of search system, later called S-2. A secondary

consequence was that the authority of the Director, NRO, either to control or to monitor the program of the CIA-sponsored effort had been successfully denied. McMillan certainly knew of the CIA's internal studies and of their general import. It does not appear that he learned of the existence of the funded studies by Itek and Philco until the spring of 1964, five months after their inception.[3]

Evolution of a System

As described by Itek in June 1964, Fulcrum was to be a Titan II-boosted system built around a pair of rotating 60-inch focal length cameras and a transport system for seven-inch film, the general arrangement somewhat resembling what later became Corona J-3. The scale was very different, of course (Corona carried 36-inch focal length lenses and used 70-millimeter film), but resolution was intended to range from two feet to four feet across a ground swath 360 miles wide. Carrying about 65,000 linear feet of film, the system would nominally be able to photograph more than 10 million square miles of the Earth on each mission. Although optics, camera mechanism, film transport, boost, and recovery subsystems were all "new," the film transport and recovery systems (one extremely large capsule) appeared to be the high risk items.*

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* To that time the only film-carrying reentry bodies to be recovered by the United States were variants on the original Corona capsule of 1958 vintage. Both E-5 and E-6 had used "large" capsules intended for recovery from the sea rather than aircatch. E-5 had faults other than in its recovery system, but that too may have been faulty--no capsules were ever recovered for examination. E-6 had been cancelled solely on the evidence of five recovery failures, and two were clearly the consequence of poor capsule design. Mercury and Gemini, NASA's man-carrying orbital systems, provided evidence that bigness was not an impossible constraint; the Mercury capsule was not unlike that tested with the E-5, for instance. But all concerned acknowledged that single "big" recovery bodies were difficult to develop, and recovery was the crucial element in any reconnaissance system of the 1960s.

S-2, as first conceived, was in some respects a simpler system than Fulcrum. Intended to have both panoramic and pointing capability, it would have better resolution in a pointing mode (three feet to four feet) than in a search mode (five to eight feet), and would cover a swath about 150 miles wide during search operations. The "early S-2" embodied new optics and camera mechanism, but would rely on the Atlas-Agena booster combination and an enlarged Gambit-style recovery vehicle. Interestingly, the first "engineering models" undertaken in the two programs were the optics of the S-2 and the film transport of the Fulcrum. Itek remained the principal Fulcrum system contractor; Greer's organization brought Kodak and Fairchild into the camera study program in September 1964 and subsequently funded space vehicle studies by both Lockheed and General Electric. Perkin-Elmer declined an invitation to bid for participation in the embryonic S-2 camera studies, but undertook some work in support of Fulcrum.

While such arrangements were being made, other events occurred that were to have a considerable influence on later developments. For one, Wheelon and McCone separately proposed to McMillan and Vance respectively that CIA responsibility for both development and operation of the new search system--Fulcrum--be formally confirmed. In the

meantime, the CIA provided scant data on the status of or plans for Fulcrum and forbade Fulcrum contractors to release information about their progress to any agency other than the CIA. CIA proposed to establish an internal project office initially composed of five people, with Space Technology Laboratories providing technical support and serving as system integrating contractor; the principal companies concerned with Fulcrum in July 1964 were Itek, General Electric and AVCO (reentry vehicle), Lockheed (space vehicle), and STL.

That procedure, and particularly the withholding of Fulcrum information from McMillan's staff, was a particular irritant to the NRO. It was not, however, unprecedented. In 1963, while questions about the desirability of starting Corona M-2 development were being considered, Greer and Charyk had attempted and very nearly carried off a similar coup. It, too, involved a search system intended to succeed or supplant Corona. When E-6 was cancelled on 31 January 1963, they very circumspectly let contracts covering the study and initial development phases of Spartan, a repackaged, largely re-engineered E-6 camera in combination with a Corona reentry capsule and Thor-Agena launch-orbit vehicles. Scoville, directing CIA

reconnaissance activities at that time, had harshly questioned both the technical feasibility of a "re-engineered E-6" and the motives that underlay its proposal. Had Spartan proceeded to successful operation, it would have provided better capability than Corona. Eastman Kodak was convinced that Spartan had great growth potential--which, if true, would have negated any need for CIA development of a new search system. In the face of Scoville's opposition, Charyk in mid-February 1963 formally disapproved Spartan--but in fact both the study and the procurement of long-lead-time items needed for on-orbit tests of the proposed system continued under the cover of Program A study contracts with Eastman Kodak and General Electric. The name changed. It was listed as SP-AS-63 (Special Projects Advanced Study - 1963), but in all other important respects it was Spartan.

Whether Scoville and the CIA ever learned the details of the effort remains uncertain. Special precautions were taken to prevent the untimely disclosure of "SP-AS-63" activity. All project work on the West Coast was conducted in a suite of offices provided by Eastman Kodak, located about a mile from the Program A complex [redacted] Probably no more than a dozen people of the 150 or so assigned to the West Coast establishment [redacted]

[redacted] were aware of the activity. Even fewer were briefed in the Pentagon. No CIA people visited Eastman Kodak or that part of General Electric concerned with the "study."

The work continued until July 1963. By that time the contractors had completed the preliminary design of a system that had many of the attributes of the later S-2: wide area coverage at about five-foot resolution, dual recovery capsules, relatively simple film transport mechanism, and a variety of innovations in optics that promised consistently good returns. The replacement of Charyk by McMillan in the Spring of 1963 and the difficulty of obtaining funds to proceed from advanced study to system fabrication were, in combination, sufficient to cause abandonment of the main program in July. Eastman's private studies of improved search systems continued and certainly influenced later Eastman proposals for S-2.[4] In the event, little of the "SP-AS-63" effort was communicated to the CIA. The Agency's subsequent denial of Fulcrum information to McMillan and the NRO staff may not have been entirely motivated by the Charyk-Greer ploy of 1963, but there was implied jusitification for Wheelon's actions in the earlier Charyk-Greer maneuver.

By the end of June 1964, when McMillan first was exposed to a full briefing on Fulcrum, the CIA concluded that preliminary studies

had been sufficiently exhaustive to confirm the feasibility of the system. The request that Vance confirm the CIA's responsibility for full development of Fulcrum had been submitted. There were strong indications that the United States Intelligence Board (USIB) would shortly issue an updated search system requirement to replace those dating from 1960. On 9 July, therefore, Dr. Wheelon proposed that the NRO provide the bulk of the funds needed to support a [redacted] Fulcrum development effort during fiscal year 1965. Of that total, only about [redacted] was to be devoted to the camera system; the remainder was to go to spacecraft, booster, and system support work (including preliminary investments in the construction of a launch facility for Titan III-boosted satellites).

The timing was bad. Late in June, Dr. Fubini had been exposed to details of the Fulcrum proposal and had concluded that although it had promise it also had problems, particularly in the highly complex transport system required to deliver large quantities of film to the platens at exceedingly rapid rates. At Fubini's urging, Vance on 8 July had ruled that although the CIA could perform whatever tests were needed to determine Fulcrum feasibility, the NRO's Directorate of Special Projects should conduct comparative studies of alternative search systems. (In effect, Vance was directing continuance of both

Fulcrum and S-2 work at the study and feasibility determination level, but his letter did not reach the CIA until Wheelon's request for full system funding had gone to McMillan.) By January 1965, Vance suggested, enough should have been learned about the various systems to support a rational decision on the desirability of starting full system development and, if appropriate, on the choice of a system to be developed. Given that decision, Fulcrum funding was extended at a level of about [redacted] a month, roughly 20 percent of the sum Wheelon had requested.[5]

The various studies of 1963-1964 and the generous investment in pre-design research to that time encouraged the July 1964 statement of a new and formal search system requirement. Issued under the imprimatur of the United States Intelligence Board on 29 July, it called for a single-capability search-surveillance system with the area coverage equivalence of Corona at resolutions equal to those provided by Gambit. Another system was wanted that would permit interpretation of details at the [redacted] resolution level with Gambit-scope swath widths.[6] Gambit-3 would satisfy the second of those requirements; Fulcrum, as then proposed, came closer to the terms of the first requirement than did the S-2 concept of mid-1964. The requirement was not obviously the product of any single faction in the intelligence community, nor was

the coincident statement of a Fulcrum-oriented requirement and a Gambit-3 requirement merely an expression of an effort to provide continuing work for both the CIA and the NRO's Special Projects directorate. The USIB had taken account of such as the Purcell, Drell-Chapman, and Land Panel studies, the comparison of M-2 and "improved E-6" potential, and several lesser analyses. And even though Fulcrum seemed nearer the new requirement than S-2, neither of the proposed systems represented a fully satisfactory solution.

While the CIA-managed effort continued, chiefly under contract to Itek but also with Philco and Perkin-Elmer, the West Coast group was devoting equivalent attention to camera system studies being prepared by Itek, Eastman Kodak, and Fairchild. General Electric and Lockheed were performing space vehicle and reentry system research for both CIA and NRO sponsors. It seemed inevitable that some version of the solid-rocket augmented Titan III would serve as the boost vehicle, whatever the final system configuration.

Of the several contractors involved in some aspect of camera system design, Eastman seemed to the S-2 program office to have the most promising concept. The CIA clearly favored Itek's approach (which incorporated an optical bar system sponsored by the CIA's in-house lens specialists).

The relatively even tenor of development in parallel was rudely disturbed in February 1965; Itek abruptly renounced any intention of continuing Fulcrum work, advising both the CIA and the NRO that the company would forego any further development work on observation satellites rather than pursue the Fulcrum task as then defined. The decision was motivated by Itek's continuing disagreements with the CIA's technical monitors and the Agency's insistence that Itek defer to Agency specialists in technical matters.

Wheelon concluded that Itek's action had been prompted, or at least supported, by the NRO staff and that Itek had in effect been promised the S-2 contract in return for withdrawing from CIA-supported Fulcrum development. In fact, the NRO staff and McMillan were quite as surprised by Itek's action as were CIA officials; McMillan conscientiously advised Itek that the NRO evaluations of S-2 progress to that time showed the Eastman design to be the most attractive. McMillan had scant knowledge of Fulcrum's status at the time Itek withdrew, having received no written reports on the program since August 1964 and only sketchy verbal summaries. Nevertheless, because S-2 seemed to be proceeding nicely and the withdrawal of the chief Fulcrum design contractor could not but confuse and delay Fulcrum progress, it seemed likely that in any near-term comparison of system proposals leading to a system selection, the Eastman S-2 design would win easily.[7]