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A HISTORY OF SATELLITE RECONNAISSANCE

VOLUME IIIB - HEXAGON

by

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PREFACE TO VOLUME IIB

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

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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,

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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 IIA of this set of reconnaissance program histories. Readers concerned about background

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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

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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.

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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

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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

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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.

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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.

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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

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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.

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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 IIC 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.

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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

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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.

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(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

* 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.

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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

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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] [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.

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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.

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

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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.

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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

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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

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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.

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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

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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

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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]

[REDACTED] Probably no more than a dozen people of the 150 or so assigned to the West Coast establishment [REDACTED]

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██████████ 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 justification 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

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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

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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

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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).

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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

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The Itek affair had extensive and unexpected consequences. Perhaps most important, it exacerbated the already disharmonious relationships between the CIA and the NRO and sharpened the existing antagonism between McMillan and Wheelon. Perkin-Elmer, rather than Itek, became the principal Fulcrum camera system contractor. And, as McMillan had predicted, when the S-2 project office was obliged to designate a preferred agent for S-2 development, in May 1965, Eastman got the nod. But in the end expectations that the development of a new search system would proceed from exploratory development status to system development in 1965 proved optimistic. Although McMillan approved a plan to spend [REDACTED] on S-2 development in fiscal year 1966, in the event expenditures were limited to a rate somewhat below [REDACTED] a year pending a decision on the start of the system selection process. Fulcrum funding was concurrently reduced to about the same level.

For practical purposes, the effect of the Itek affair had been to delay any decision on starting development of a new search and surveillance system. Approval of that start required the concerted support of the Director of Central Intelligence and the Deputy Secretary of Defense. On 24 June 1965, McMillan advised Brigadier General

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John L. Martin, Greer's successor as Director of Special Projects (Program A) for the NRO, that no agreement on a system approval process had emerged from DOD-CIA meetings and that none could be immediately expected.⁸ Vice Admiral W. F. Raborn, who had succeeded McCone as CIA director in April, proposed to Vance in June that no action be taken on the selection of a new search system until the basic issue of NRO reorganization had been resolved. The NRO charter of 1963 was by mid-1965 being honored chiefly in the breach. Extensive readjustments of responsibility and authority in program management, funding control, operation of on-orbit satellites, and the program decision process had been proposed in the interim. But however sweeping the reorganization, it was unlikely to result in a working relationship that could accommodate both Wheelon and McMillan. As early as February 1965, a week before the Itek affair, the deputy NRO director had resigned in frustration; a senior CIA employee assigned to the NRO, he found himself so thoroughly distrusted by both staffs that he was almost totally ineffective. The S-2 and Fulcrum project groups had little direct interaction, but they were bitter competitors for funds and held divergent views on how the search system requirement should be satisfied.

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Raborn's intransigence on the search system issue, the definition of a new NRO charter without inputs from the NRO, and the virtual collapse of communications between McMillan and Wheelon, the principal managers of the National Reconnaissance Program, had their inevitable effect early in July. McMillan privately advised the NRO staff that he planned to resign his post and return to private industry. His decision apparently was precipitated by the failure of a final effort to force a decision to develop the Eastman S-2 system, keeping either Itek or Perkin-Elmer as a supporting contractor. Raborn balked, and was backed by the Land Panel's judgment* that as yet insufficient data were available to support the selection of a single search system for intensive development.⁹

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The Land Panel, headed by Dr. Edwin Land, was created at the direction of the Special Assistant to the President for Science and Technology, Dr. Donald F. Hornig, early in July 1965. Its charter extended to "an overview of the NRP," but initially it was concerned with the technology of, requirements for, and status of search and search-surveillance systems in development or proposed for development. The group first met on 21 July 1965 and continued to meet at irregular intervals until President Nixon abolished the office of science advisor in early 1973. The panel provided specialized technical support to Hornig and his successors, operating in some respects as a counterpart (or counterweight) to the NRO and CIA technical staffs that supported the DOD and CIA members of the NRP Executive Committee. Generally, however, the Land Panel evaluated proposals, studies, and programs rather than generating them, as was the case for the CIA and NRO special staff groups.

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The program proposal that went to the Land Panel late in July from McMillan was paralleled by a program summary prepared by the Fulcrum project group. After having weighed the evidence, the Land Panel advised Dr. Hornig that "there is no technical basis for selecting for development at this time one system over the other, nor does the Panel see any urgency for making a selection now rather than, say, three months from now." Hornig advised Vance, therefore, that work on all three systems (Itek and Eastman on S-2, Perkin-Elmer on Fulcrum) should be continued at about the same rate for at least three additional months "in order to better define the advantages and disadvantages of each system." Thus, Hornig hoped, it might be possible to substantiate the performance claims for the various proposals.¹¹

Vance subsequently ruled that in the interim all effort was to be concentrated on the camera systems, which meant cessation of work on satellite vehicles, boosters, reentry capsules, and associated subsystems. That was decidedly awkward for both Fulcrum and S-2 managers, because in the early months of 1965 quite extensive preparations for full-scale development had included letting contracts of one sort or another with Lockheed, General Electric, and Martin. For the S-2, a Lockheed-General Electric competition was pending, while for Fulcrum a GE orbital vehicle and an AVCO reentry vehicle had tentatively been selected.¹²

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The NRO-preferred configuration of S-2 in early August provided for a four-bucket recovery system (with potential growth to a six-bucket design) associated with a camera capable of providing three-foot resolution (at nadir) from an altitude of 120 miles. The payload would satisfy both search and surveillance coverage requirements if launched at a rate of six to nine systems per year. Carrying 1000 pounds of primary film (and 63 pounds of film for a stellar-indexing camera), S-2 would have a length of 50 feet, a diameter of 7.5 feet, and an on-orbit weight of 12,000 pounds for a 25-day mission. The incorporation of a supplemental crisis reconnaissance capability, as suggested by the Land Panel and the United States Intelligence Board, permitted complete access to any area of the earth between 20° North and 20° South latitude every five days.¹³

Compliance with Vance's instructions meant stopping General Electric's work on satellite control and reentry vehicles and confining Eastman's level of effort to that scheduled for August, actions that were taken early in September. The difficulties thus created were compounded by a special problem involving Eastman Kodak. That concern was then producing Gambit-1 payloads, developing and building initial lots of Gambit-3 payloads, building a Lunar Survey payload for

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NASA under NRO cognizance, * and developing the S-2 payload. Added to that formidable set of tasks was [REDACTED]

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[REDACTED] although the decision had not yet been announced in mid-August; there was no practical way for Eastman to proceed with both Gambits, the Lunar Survey payload, S-2 [REDACTED]. Something had to give. McMillan's solution was to propose transfer of the Eastman S-2 design to Itek, with Itek also continuing development of the second-preference S-2 camera already in process. Although complex, the transfer was not unprecedented, Itek's original Fulcrum camera design having been shifted to Perkin-Elmer in the aftermath of the February 1965 dispute between Itek and the CIA.

McMillan's proposal went to Secretary of Defense Robert S. McNamara on 30 August; on 22 September McNamara authorized termination of the Eastman S-2 activity and its transfer to Itek for

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The NRO was involved in the Lunar Survey program because the readout camera being carried was a modest improvement of the Samos E-1 camera of 1960. Use of the E-1 camera and readout system was an economical means of performing the survey mission, the alternative being to develop a comparable camera system using NASA funds. In order to keep the nature and capability of earlier reconnaissance camera development secret, however, it was necessary to provide the E-1 through clandestine channels--which meant NRO control of the production process.

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design completion. [REDACTED]

[REDACTED] Finally, there emerged a clear understanding that three camera designs were to be competitively evaluated for selection as the new search-surveillance system: the Perkin-Elmer (Fulcrum) proposal, the Eastman S-2 design (generally known thereafter as the Itek/EK proposal), and the backup Itek design (usually identified as the "pancake" proposal, a term generally descriptive of the optical mirror layout preferred by Itek).¹⁴

Between February 1965, when the Itek-CIA disagreement suddenly flared, and October of that year, when Flax officially succeeded McMillan as Director of the National Reconnaissance Office, virtually every aspect of the search-surveillance system program had radically changed. The Land Panel and the NRP Executive Committee had come into being; both were to be dominant influences in the eventual selection of a design and a system contractor. McCone, McMillan, Wheelon, Greer, and several lesser figures in the S-2 and Fulcrum programs had left government service or moved to assignments remote from satellite reconnaissance. Perkin-Elmer had become the principal Fulcrum system developer, replacing Itek (and working more intently on the inherited Itek-Fulcrum design than on the original Perkin-Elmer design for Fulcrum), while Itek had acquired custody of the NRO-

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preferred S-2 system originated by Eastman (and was proceeding also with the Itek-pancake design that represented a backup for the favored Eastman S-2 proposal). Work on satellite and recovery vehicles, boosters, and supporting subsystems had largely ceased in September after having earlier advanced to the preliminary selection of design and development contractors.

On 6 October 1965, the Executive Committee for the National Reconnaissance Program held its initial meeting. The first order of business was the search-surveillance system. Colonel David L. Carter, for the NRO, and L. C. Dirks, for the CIA, briefed the committee on the three design proposals then being funded. (Until September there had been four. Perkin-Elmer had been working both on the design transferred from Itek and an alternative Perkin-Elmer design dating from the time when that company was the CIA backup for the Itek-Fulcrum design.) Although both suggested that proposals would be ready for evaluation by December 1965, there were indications that no competition could begin until sometime early in the following year.

Dr. Flax, charged by McNamara and Vance with reconciling the differences among the principals in the search-surveillance system controversy, presented to the Committee a comprehensive plan for

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proceeding toward system selection in an orderly fashion, one that would overcome the earlier tendency to use Fulcrum and S-2 as devices in an institutional squabble. Flax had early concluded that the requirement approved by the USIB the preceding year was inappropriate in that it specified technical capability rather than an intelligence objective. He proposed, therefore, to create a technical task group composed of representatives from the CIA (Fulcrum) and Special Projects (S-2) elements of the NRO. The task group, he suggested, would "prepare a statement of system operational requirements, . . . recommend the selection of a system configuration, . . . formulate plans for contractor selection, and . . . recommend a program plan including a schedule." Flax also advised the Committee that he intended to establish a separate task group to "define the project management structure"--which meant, in practical terms, to decide what roles the CIA and Special Projects groups would play in the eventual development of the chosen system.

Flax had prepared his ground carefully. None of the Committee principals was surprised by the carefully constructed proposal for proceeding. All had seen the material beforehand. Without much discussion, the Executive Committee endorsed the Flax plan and for the first time in two years the search-surveillance program had reasonable coherence.

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During its second meeting, in mid-November, the Executive Committee turned its chief attention to the many other problems of national reconnaissance. The search system requirement received brief but pointed attention. [REDACTED] the NRO's Comptroller, reported somewhat ominously that the Bureau of the Budget might well take "an adverse view" of the development proposal on grounds of cost. Cyrus Vance, the chairman, asked for a formal statement of the Bureau's views--particularly relevant because, owing to the various delays in the search system program, it now appeared that Corona operations would have to be extended for at least a year past the point at which the new system had been earlier scheduled to enter service. One of the interactive complications was the necessity of diverting to the procurement of additional Corona systems some of the funds earlier planned for allocation to search system development. ¹⁶

In the meantime, Flax had issued instructions for the deliberative evaluation of search-surveillance system proposals. He named the chief of the NRO staff, Brigadier General J. T. Stewart, to chair a management evaluations committee that included John McMahon of the CIA and Colonel Paul Heran of the NRO's Directorate of Special Projects. Carter, Dirks, and Colonel W. G. King (NRO Special Projects) were appointed to a technical task definition group. With interesting

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promptitude, Carter issued a preliminary paper describing the search requirement and the plan for system development. (Both had long been in preparation, of course.) The concept included use of a Titan IID booster (including two- or three-segment strap-on solid rockets for augmentation) capable of placing 13,000 pounds of payload in orbit; a satellite vehicle consisting of an orbital control module, a sensor module, and recovery vehicles (two reentry vehicles were suggested); and first launch 28 months "after development go-ahead." A discussion of the rationale for a two-bucket system provided some insight into the problems the new system would confront on the way to design approval: in the judgment of Carter's group, a two-vehicle configuration represented the best compromise of reliability and cost, although four or more reentry vehicles would provide a crisis reconnaissance capability only marginally present in the two-vehicle configuration. In the group's opinion, development of a three- or four-vehicle configuration would prove troublesome; Corona had provided experience in dual-reentry-vehicle operations, but there was no background for the complex cut-and-splice operations that would be required if more than two buckets were used. Finally, Carter's group maintained, "the severe weight and cost penalties

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of three or more RVs argue against compromising the primary mission and configurations for the crisis role."¹⁷

There was no question in anybody's mind that the camera system would be the pacing item in the development. It was with some dismay, therefore, that Martin and Flax learned late in October that Itek did not propose to complete a variety of essential tests, calibration efforts, and technical analyses until late July 1966. Until that work was in hand, there would be no fair basis for comparing the Itek-EK and the Itek-pancake designs. The transfer to Itek of the Eastman drawings, tools, and test data appeared to be an easy task; Eastman assistance to Itek was scheduled to continue until at least February 1966, by which time (the principals fervently hoped) Itek would be capable of carrying on independently.

Flax responded, somewhat acidly, that "the Itek schedule for completion of those activities is not compatible with the anticipated decision milestone for the new search/surveillance system." Assuming that Itek would tend to favor its original design over the less familiar EK design, Flax instructed Martin that unless Itek agreed to push both designs to evaluation readiness quickly, "we must . . . consider another course of action in this regard."*

*The Itek and EK approaches differed in concept as well as detail. In the judgment of S-2 program managers, the EK design was simpler, less risky (in a technical sense), more certain to appear on time, and potentially cheaper.

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General Martin assigned to Colonel Heran the delicate task of inducing Itek to agree to complete the work necessary to permit evaluation of the three principal systems by 3 January 1966. After extended discussion with Itek officials, Heran obtained the necessary commitment, but he cautioned that owing to the short period left for completion of the scheduled work it was likely that evaluators would have less confidence in an Itek-EK design proposal than in the Itek-pancake design proposal. In passing Heran's findings to Flax, Martin urged that an additional period be provided for equalizing the confidence in the two designs, so that both Itek bids would be honestly competitive with the Perkin-Elmer submission.

Flax accepted the altered schedule, and Itek's assurances of conscientious effort on both the Itek-EK and Itek-pancake designs, but he was in no position to extend the period of preliminary design past that earlier specified. He insisted that by January 1966 the three designs be available for competitive evaluation, promising that evaluators would make the necessary allowances for status differences.¹⁸ Itek reluctantly acceded to the conditions, and on 22 November the formal transfer of the EK design to Itek custody received Martin's endorsement.¹⁹

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In the event, it was April 1966 rather than January before the several search-surveillance system proposals were eligible for the transition to a formal competition stage. The EK design--paper and hardware--was not fully in Itek's custody until mid-January; several intervening reviews of camera system design status in December 1965 and January and March 1966 indicated that Itek's ability to cope with the EK design was developing slowly.

For practical purposes, Colonel Carter's task force spent most of its time working out the details of a Request for Proposal to be issued to Itek and Perkin-Elmer when all else was ready. The earlier rivalry between Fulcrum and S-2 approaches had not vanished, even though diminished by Flax's skillful assignment of responsibility to special interagency task forces. The CIA draft version of the Request for Proposal, for instance, called for inclusion of what was, in Carter's opinion, "the most optimistic [schedule] which could be envisioned" and provided for holding the formal pre-proposal briefing some two weeks before Itek would have completed its effort to become fully conversant with the transferred EK S-2 design. But by February Itek was capably briefing such groups as the Land Panel on the status and prospects of both designs, and by late March Flax had concluded that nothing was to be gained by further delaying the start of a formal competition.²⁰

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The main elements of Flax's proposal were a plan for source selection and a management plan. For the first of those, little that was controversial remained for decision, and in other than a casual way the NRP Executive Committee did not look into its details. The management plan, however, specified the organizational arrangement to be honored during the development of the system and thus encompassed all of the highly controversial aspects of CIA-NRO relationships that had troubled the National Reconnaissance Program for more than three years. Even in its draft form, as circulated for comment, it had evoked strong reactions from both CIA and NRO spokesmen. The original proposal, as worked out in advance of the 15 October 1965 establishment of the task group on management, had represented a skillful compromise of organizational prerogatives. There was no longer any doubt that the CIA would exercise responsibility for the development of whatever camera subsystem won the competition. That much had been implied in the compromise arrangements of August 1965. But whether the sensor project office would be located with the main program office on the West Coast, as Martin wanted, or would continue to operate from CIA headquarters in Langley, Virginia, was argued at length, and the scope of sensor project office responsibility continued to be debated for months. (Would it extend to

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the surrounding spacecraft structure, to the whole of the payload-vehicle structure, or be confined merely to optics-plus-film-transport and supporting components?)

General Martin, who had been NRO staff director during much of the period when divided responsibilities and ill-defined command lines had made chaos of Corona management, argued that a combined program office was essential, that co-project-leader arrangements could never be made to work. Supported by most of the NRO staff and his own West Coast group, he held out for assigning system integrating responsibility to the principal program office and limiting the sensor project office to custody over the camera subsystem alone.

Flax eventually concluded that integration of the camera with the payload must be a System Program Office responsibility, the CIA retaining sensor subsystem design responsibility and the Program A group on the West Coast being totally responsible for the main vehicle structures. That Solomonian edict was one of the few of the Flax proposals that occasioned arguments during the Executive Committee meeting of 26 April 1966, where final decisions were confirmed. John J. Crowley, the CIA's principal agent for sensor development, urged the Committee to assign to the CIA full responsibility for the structure enclosing the sensor system as well as responsibility for the development, production, and integration of the stellar

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index camera. Crowley contended, with Admiral Raborn's backing, that so extending the CIA's responsibilities would reduce the amount of interagency interface required for program management "and thereby markedly improve the possibilities of satisfactory performance within the time limits of the program."

Only one other difference of viewpoint surfaced during the Executive Committee meeting. Dr. Flax had provided that both the Special Projects Directorate and the CIA project office were to be authorized to issue program access clearances, and that each would honor without question the need-to-know determinations of the other. The CIA asked for a veto; Flax responded that his object was "to eliminate the use of security as a means of frustrating . . . legitimate access to information. . ."

The three principals of the Executive Committee met privately and alone after the briefings and discussions had ended. Vance, the chairman, advised Flax as soon as the three-man group had completed its deliberations that the program proposal had been approved precisely as submitted.²¹

What had been approved was a detailed plan for conducting competitions for sensor systems and other elements of the reconnaissance satellite and a specification of the relationships that were to

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characterize the subsequent period of development and system operation. What remained for near-term decision was the choice of a camera design and a contractor, after which questions of satellite vehicle design, subsystem design, contractor selection, and booster design and selection might be taken up in order. The plan of April 1966 envisaged completion of development and first launch by mid-1968--roughly two years from the date of program approval.

The effort to do away with the institutional rivalry that had marked the preceding three years of search-surveillance system development extended, finally, to nomenclature. In his 22 April memorandum proposing a structure and schedule for the program, Dr. Flax had noted that the system to be developed would carry the designator Helix. That name lasted less than a week; it had unwittingly been assigned earlier to another activity. On 30 April, the CIA assigned a substitute nickname: Hexagon. Retroactively, it was introduced into the minutes of the Executive Committee meeting that signaled program approval. The names Fulcrum and S-2 that had epitomized the earlier stages of the Hexagon program disappeared. None of the many principals ever expressed regret.²²

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Hexagon: Program Onset to First Flight

The situation of Hexagon and the pattern of program development as anticipated at the time of program go-ahead were fairly represented by the several papers Dr. Flax submitted on 22 April, and which the NRP Executive Committee approved for action during its 26 April meeting.

The camera system, universally acknowledged to be the pacing element in a highly interactive program, then consisted of three potential proposals from two contractors, Perkin-Elmer and Itek. The principal Perkin-Elmer design represented that firm's elaboration on and improvement of a Fulcrum-based conceptual approach and engineering construct originated by Itek between 1964 and early 1966. Perkin-Elmer's own favored design of the early Fulcrum era had always been considered less promising than the CIA-sponsored Itek-Fulcrum approach and was not really in competition. Itek had two designs in process, the earlier NRO-sponsored Eastman S-2 design, transferred to Itek when EK became the [REDACTED] and the native Itek S-2 design (Itek-pancake), which the NRO had earlier considered to be a prime backup to what was by April called the Itek-EK design. Flax characterized the Perkin-Elmer design as "considerably changed and improved from a prior Itek effort." Although Brockway McMillan, Flax's predecessor as NRO director,

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had endorsed and attempted to secure development approval for the Itek-EK design while it still was an Eastman program, and the Itek-EK design approach was generally favored by NRO special projects people over the Perkin-Elmer Hexagon proposal, Flax wisely ignored all such considerations in his 22 April resume. The major problem of the moment, as Flax saw it, was how to conduct an equitable competition among three camera designs at different stages of refinement, composed to satisfy somewhat different technical and operational requirements, and representing an amalgam of studies and engineering effort by seven different groups (General Electric, Lockheed, Itek, Perkin-Elmer, the NRO's Directorate of Special Projects, the NRO's staff, and the CIA's Directorate of Science and Technology). All three surviving design approaches were nominally capable of satisfying the 1964 requirement for Corona-scope coverage at Gambit-level resolutions (given that the Corona and Gambit capabilities of 1964 were treated as baselines--there being no real possibility that any of the optical systems proposed for Hexagon could perform at Gambit-3 resolutions). There was general agreement among USIB, NRO, and CIA authorities that what was wanted was 25-30 day orbital life with single-mission capability for stereo coverage of 20 million square miles, a stellar-indexing camera, and either two

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or four recovery vehicles. The probable launch vehicle was a Titan IIID-class rocket with two 120-inch diameter strap-on three-segment solid rocket accessory boosters, although an alternative five-segment strap-on rocket had determined advocates. Orbit weight of about 12,000 pounds seemed reasonable, although a slightly greater weight was not unlikely, given the growth tendencies of all previous reconnaissance satellites.

Flax had designed the management mode for Hexagon to comply with the provisions of the 11 August 1965 NRO charter and related agreements between the CIA and the Department of Defense. That essentially meant that the CIA would retain responsibility for sensor development and sensor-related activities, and the NRO's Special Projects directorate (in Los Angeles) for all else in the total program. The two agencies would, for each segment of their assigned responsibilities, provide system engineering, system integration, and management.

Given those fundamentals, Flax proposed to distribute a system operational requirement, an RFP (request for proposal) covering the sensor system, a management plan, and a schedule of planned NRO actions. Attached to the submission that went to NRP Executive Committee members on 22 April was a set of five papers that carefully explained the rationale underlying the operational requirement, the RFP, and the management plan.

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Although both the CIA and NRO participants in the S-2 and Fulcrum aspects of the pre-Hexagon program had conducted competitions for the spacecraft element of the total system, and both had settled on General Electric designs, Flax proposed holding a new competition, contending that not all eligible contractors had been offered an opportunity to bid to the same requirements, and noting also that the requirements reflected in his draft system operational requirement differed in some important respects from those earlier specified. * The NRO's director urged that the recovery vehicle contracts should be recompeted for the same reasons. To arguments that recompetition was wasteful of time, Flax responded that even if the most optimistic schedule then suggested proved valid, recompetition would not delay the first launch for more than a few weeks. (He also proposed a competition for the Titan IIID strap-on solid rockets.)²³

Implementing papers went to the CIA and NRO participants in the program on 28 April, two days after Flax received formal notification that his proposal had been approved as submitted. (Some minor points of disagreement on security arrangements remained for clarification, but that did not constitute a significant problem.) Apart from

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In the event, General Electric won neither the satellite vehicle nor the reentry body competition for Hexagon.

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the set of papers submitted to the Executive Committee, the 28 April directives included directions for the assembly of a sensor source selection board, preliminary budget guidance, and a memorandum to the Air Force authorizing the start of a competition for the Titan IIID and the preparation of system package plans for both the Titan IIIC and IIID. (As with the spacecraft and recovery vehicles, a final decision on configuration and design of the launch vehicle still had not been made.)

Sensor source selection, the first order of business, was assigned to a board headed by L. C. Dirks of the CIA and composed of four additional members, two from the CIA and two from the Directorate of Special Projects. They were scheduled to receive formal inputs from Itek and Perkin-Elmer by 22 July. * Booster source selection was entrusted to a similarly constituted board chaired by [REDACTED] [REDACTED] of the Titan III System Program Office. Booster proposals were due by 1 September; Flax expected contract negotiations to be completed by early November 1966.²⁴

On 30 April 1966, both the Special Projects Directorate and the CIA officially established Hexagon project offices in their respective organizations. Flax confirmed the nomination of [REDACTED]

* The proposals had been in preparation since February and the technical aspects of the three principal submissions were well known to the evaluators.

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of the CIA to direct sensor development and named Colonel F.S. Buzard to head the Hexagon System Program Office on the West Coast. In what was assumed to be a temporary measure, Buzard arranged to have the Hexagon office physically collocated with the existing Corona program office, sharing command of the composite organization with the Corona chief. The purpose of the arrangement was to permit Buzard to draw on the experienced Corona people to supplement his own relatively small staff resources. With the start of Hexagon development, there seemed little doubt that Corona would cease operations in the reasonably close future. Obvious advantages resided in an orderly transfer of search-system responsibility from the existing system to its successor. In the event, Hexagon became operational five years after program start, rather than two, as had originally been proposed, and the transition was much more gradual than Buzard had anticipated. The consequence was that at the end of three years the core of the Hexagon office was composed of people who had varied earlier experience with Corona but who had also accumulated considerable Hexagon experience.

With the approval of a Hexagon program and assignment of sensor subsystem responsibility to the CIA, existing S-2 contracts with Itek had to be terminated. Colonel Buzard negotiated the essential

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contract agreements with Itek between 6 May and 23 May 1966, and on the latter date Itek formally began work preliminary to a proposal for Hexagon camera system development. With issuance of the request for proposals on 23 May, both Itek and Perkin-Elmer became contractors to the CIA's newly created Sensor Subsystem Project Office.²⁵

The matter of how many film capsules Hexagon would carry became the concern of a special study group on 24 May. The CIA's earlier Fulcrum schematic had been organized around the premise of one very large recovery vehicle; the S-2 proposal had never envisaged use of fewer than two capsules--and as many as four had been urged by members of both Fulcrum and S-2 study groups at one time or another.

On 25 May, Flax authorized the creation of a source selection board for the Satellite Basic Assembly (SBA) under Buzard's direction. The board included four NRO and two CIA members. By 8 June the formal Request for Proposal had received Flax's endorsement and eight days later it went to Lockheed, General Electric, McDonnell-Douglas, North American, and Hughes. (Hughes decided against participating in the competition.) Proposals were due by 22 August, one month after the scheduled receipt of sensor system proposals.

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As could have been predicted, a renewed space vehicle competition was not welcomed by General Electric, which had won both the Fulcrum and S-2 "competitions" of the previous year. H. W. Paige, general manager of GE's space program organization, protested to Flax that it was basically unfair to GE to be forced to compete a third time, given that GE had originated the concept then being competed, had twice won competitions, had a skilled but unemployed space vehicle team available (unemployed because with the transition from Gambit-1 to Gambit-3 the orbital control vehicle around which Gambit had first been designed was no longer being used), and represented the only experienced alternative to Lockheed. Flax, who was aware of the problems created by his decision to recompile the space vehicle part of Hexagon, could but point out that Hexagon was neither Fulcrum nor S-2, that conditions had changed, and that he would give consideration to GE's experience when selection board recommendations were submitted.²⁶

Although the final report of the recovery vehicle study committee had not yet been prepared, Buzard's people began writing the proposal guidelines for the recovery vehicle in June 1966. Because the number of recovery vehicles had not yet been decided, three designs were specified, providing for loaded film weights of 250, 525, and 1050 pounds.

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On 21 June Buzard urged Dr. Flax to approve a four-bucket configuration, but Flax decided to postpone a final decision until booster configuration and weight budget were better defined. Nonetheless, on 6 July, Flax agreed to the commencement of reviews of recovery vehicle proposals and agreed to issuance of requests for proposals by 19 July. The issuance of a Request for Proposal for the Stellar Terrain camera in late August completed the formal actions needed to get Hexagon development underway, but hopes that the development itself could proceed as expeditiously were to prove unduly optimistic. Almost two years were to pass before the recovery vehicles were at last put on contract although initial estimates of first launch date for the new system postulated availability of all subsystems within 18 months of program start.²⁷

On 30 August--precisely as scheduled--the sensor source selection board reported its findings to Flax. The evaluators unanimously concluded that Perkin-Elmer had the better proposal and recommended that sensor development be assigned to that contractor. The preferred design was an outgrowth of the much earlier Itek-Fulcrum approach; the loser was the Itek-EK design of S-2 vintage.

Proposals had been evaluated in two categories: technical and operational qualities, and management, production, and logistics.

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In a scoring system that permitted a maximum possible score of 100, Perkin-Elmer accumulated a total of 69.3 points and Itek 54.7. Although the differences could be accounted for by many details of quality and resources, the board was influenced by Itek's emphasis on design for maximum resolution on the film as against Perkin-Elmer's approach of minimizing optical errors. Itek had larger and more complex optics; Perkin-Elmer emphasized other than optical considerations. The Itek design was based on use of a 48-inch Schmidt lens system with a maximum aperture of $f/2.0$; the Perkin-Elmer system on a 60-inch focal length lens with an aperture of $f/3.0$. In order to provide the desired ground resolution capability of 2.7 feet, the Itek system would have to be flown at an altitude of 84 miles as against the 92.5 nautical mile altitude required of the Perkin-Elmer optics for the same resolution. Optical design was also a factor in the weight characteristics of the two designs. For a 30-day mission, the on-orbit spacecraft weight of a Hexagon carrying a Perkin-Elmer camera system promised to be about 1000 pounds less than the comparable weight of a spacecraft carrying the Itek camera. Although there was little doubt that a booster-spacecraft combination capable of putting the heavier system in orbit could be obtained, it was difficult to ignore the obvious advantages of a weight differential so greatly

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