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BYE-0223-64

Copy 1 of 6

MEMORANDUM FOR: Director of Central Intelligence  
SUBJECT : ITEK Activities on Project FULCRUM

1. This memorandum contains a recommendation for the approval of the Director of Central Intelligence. Such recommendation is contained in paragraph 8.

2. You may recall that during the latter part of June, the DD/S&T sought year-end Agency funds to commence the FULCRUM Project. At that time we were particularly anxious to explore the techniques for fast film handling; and with the possibility that \$850,000 of Agency funds could be made available, we sought Agency authorization (BYE-0152-64, Attachment I) to contract with ITEK for brassboard models of two separate film drive systems, as well as a paper lens design.

3. While this paper was under review, the Land Panel met and recommended that we not only examine the high-speed film transport system, but also the stability and "noise" of the camera bearings; the overall system weight; the general dynamics and interaction of the camera; and similar associated problems. Dr. Land opined that the system looked encouraging enough to merit the investment of several million dollars as soon as possible.

4. As an outgrowth of the Land Panel, the FULCRUM Project took on a new dimension in that it was broken into two phases - Phase I being concerned with examining those particular areas that the Land Panel had identified as meriting immediate attention and Phase II, a full-scale development program. The DD/S&T prepared a schedule of activity for Phase I which would last six months and which, when completed, would provide sufficient technical data and facts to permit an overall evaluation of the entire program with a high-confidence factor. The Phase I effort

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was estimated at \$5.35M, however with \$850,000 made available from the Agency year-end funds, the NRO was requested to provide the \$4.5M balance.

5. On 2 July, I tabled a paper with Dr. McMillan (BYE-0162-64, Attachment II) which itemized the tasks and required funding for the Phase I period. At this time, it was called to Dr. McMillan's attention, in writing, that \$850,000 had been made available from Agency funds, although this point had been discussed with him on several occasions by General Carter and myself.

6. In the press to encourage the ITEK Corporation to place its best talent on the FULCRUM Project and to plan organizationally to meet the requirements of a full-scale FULCRUM Program, we asked the ITEK Corporation to prepare a proposal which would be responsive to the Land Panel's recommendations and, in addition, provide for a detailed optical design, a facility study, and a general program analysis for a full-scale development and procurement program. With the oral assurances from Dr. McMillan that the \$4.5M would be made available and in order not to delay the project further, the DD/S&T staff members orally requested the ITEK Corporation to begin exploratory work in satisfying the six tasks incorporated in the proposal. Although the \$4.5M was not in hand, it was felt that initial charges against these six tasks could be charged against the \$850,000 which had been specifically authorized for the fast film transport and lens design alone.

7. We are now prepared to sign a contract with the ITEK Corporation for the accomplishment of the six tasks. Before signing, however, I wish to affirm that it is your desire that we continue to spend the \$850,000 against those several tasks which were suggested by the Land Panel as well as the studies and analyses that we have asked of them, and that, by your approval of this memorandum, the initial authorization for the \$850,000 be expanded to include these efforts.

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8. It is recommended that you approve the use of the \$850,000 as described in paragraph seven above.

*Albert D. Wheelon*  
ALBERT D. WHEELON  
Deputy Director  
for  
Science and Technology

The recommendation contained in paragraph 8 is approved:

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Director of Central Intelligence

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BYE-0223-64BYE-0152-64/A  
Copy 1 of 3

23 JUN 1964

MEMORANDUM FOR: Deputy Director of Central Intelligence  
 THROUGH : Executive Director-Comptroller  
 SUBJECT : Project FULCRUM

1. This memorandum contains a recommendation for your approval. Such recommendation is contained in paragraph 5.

2. The attached history of Project FULCRUM traces the sequence of the studies, experiments and determinations which have culminated in the proposal for developing a three foot resolution satellite photographic system with large swath width coverage.

3. To develop a complete satellite system and commence operational procurement will require \$54.3 million in Fiscal Year 1965 and between \$124 and \$157 million in FY-1966, depending upon booster costs and availability of launch facilities. The Agency has prepared an addendum to its NRO budget to accommodate the costs reflected above, however, we can commence this program immediately should sufficient year-end funds be available to the Agency.

4. Specifically, we propose that \$50,000 be granted to commence detailed lens design, and additional \$800,000 be earmarked to produce detailed design and actual brass-board working models of two separate film drive systems. One model will move film at a constant rate now estimated at 155 inches per second, the other model will allow exposure of the film frame after frame but necessitate storage of film loops to account for the periods during which no exposure is made. The Itek Corporation will be the contractor for both the lens and film drive efforts.

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BYE-0152-64

5. It is recommended that you approve the expenditure of the \$850,000 of Fiscal Year 1964 funds as stated above for Project FULCRUM.

*Albert D. Wheelon*

ALBERT D. WHEELON  
Deputy Director  
for  
Science and Technology

CONCUR:

~~Executive Director-Comptroller~~

APPROVED:

*for Lyman Kirkpatrick* 30 JUN 1964  
Deputy Director of Central Intelligence

Attachment: History of Project FULCRUM

Distribution:

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BYE-0152-64 -1

## Project FULCRUM

In May 1963 the Director of Central Intelligence convened a panel of scientific and technical experts, chaired by Dr. Edwin Purcell, to determine the future role and posture of the United States Reconnaissance Program. By June of the same year, the Panel had submitted its report which, among several recommendations, suggested that an improvement program be undertaken in the CORONA Project to optimize the performance of that system throughout the duration of a mission. A study was conducted to identify measures which could be taken to improve CORONA; however, there was little effort made to solicit Agency participation or advice. Shortly thereafter, the Agency independently prepared its own critique of the Air Force's CORONA improvement plan and this critique led to the establishment of the Drell Committee which again reviewed measures to improve CORONA, but this time with joint Agency/Air Force membership. Action on the Drell Report was delayed when the National Reconnaissance Office proposed to refer the Drell recommendations to yet another committee.

Shortly thereafter, the Agency independently generated internal efforts to assess the United States satellite reconnaissance needs. In cooperation with various Agency components, the DD/S&T reviewed the type and characteristics of USIB reconnaissance targets and requirements and the kinds of coverage necessary to satisfy our intelligence needs.

A rather detailed experiment was conducted with twenty-five photo interpreters from the National Photographic Interpretation Center to ascertain the resolution required to identify the various targets comprised in the USIB requirements. During the experiment, targets were interpreted under varying resolution from  to ten feet. The pure analysis of a photographed target was considered also against the type of target, the number of targets, weather conditions, the weight of payloads and finally boosters, economically available.

The result of this experiment demonstrated that the majority of targets could be properly identified with

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resolution in the two to four foot category. It was also evident that with booster capabilities economically limiting payload to the five-thousand pound, or that of the Atlas/ Agena or Titan II, the camera system had to provide for large swath width coverage.

To augment the in-house CIA effort then underway, a study with the Itek Corporation was initiated in February 1964 to determine the feasibility and potential intelligence value of using various individual sensors or combinations thereof in a satellite system. Heretofore, little attention had been devoted in the exploration of sensing devices other than with a black and white film system. Under this study, titled Project FULCRUM, Itek analyzed the various sensing techniques such as infra-red, ultra-violet, color, microwave, etc. and evaluated each by itself and in combination with one another, against performance capabilities, environment, size and cost, processing and interpretation, and atmospheric limitations.

The Itek study concluded that black and white photography can still satisfy the majority of USIB reconnaissance requirements, but to do so properly, efficiently and economically, large swath width coverage with at least four foot resolution would be required. It was obvious to the Agency that the next satellite system, although presently limited by state of the art developments to black and white photography, should possess the inherent potential to accommodate technological advancements in color photography, infra-red, image intensifiers and readout capabilities.

Paralleling the Itek effort, the Space Technology Laboratories under Agency contract explored the feasibility of spin stabilizing satellites, thereby permitting fixed optics to sweep or pan the entire earth's surface beneath, or in effect produce an horizon-to-horizon swath. In spinning the entire spacecraft, STL felt that it could be feasible to permit total target area coverage in low resolution with a payload system in the five-thousand pound category.

In essence then, each effort, the Agency's as well as Itek's and STL's, independently concluded that we needed CORONA-type coverage with consistent GAMBIT-type resolution.

During the latter half of May, the DD/S&T decided to prepare a proposal for a satellite which could demonstrate the technical feasibilities of developing a 5000-pound payload package which could provide large swath width

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coverage with four foot or better resolution, thereby replacing the present CORONA and GAMBIT programs with a single system.

Under DD/S&T direction, the Itek Corporation and STL joined forces to demonstrate with sufficient engineering design and computations the feasibility of such a system. The system devised employed two Itek cameras in an STL stabilized spacecraft with a simple recovery system and placed in orbit by a modified Titan II booster. The camera optics suggested are a relatively simple Maksutov reflective system F-3 lens with 60-inch focal length employing a corrective lens, beryllium mirror and eggcrate quartz main plate. The cameras are designed to allow the addition of image intensifiers and a readout system and are so mounted to permit one to look 15° forward of the nadir and the other 15° aft, thereby producing stereo photography. The cameras spin within the spacecraft counter to one another along the flight axis over a 120° scan angle with a swath width of 360 nautical miles and resolution from 2.7 to 4 feet from 100 miles altitude. Lower orbits would improve the resolution proportionately but reduce swath coverage. As now proposed, the film will be moved at a constant rate of 155 inches per second. Since the camera will be looking inside of the spacecraft during 2/3 of its revolution, the film, because of its continuous movement, will only be exposed for 1/3 of the time. As a result, the film passes through the camera system three times during each mission, exposing 1/3 of the film each time. Upon completion of the mission, the film will then be fed by a leader from the camera into the spool in the recovery vehicle. The spacecraft used for housing the payload and performing attitude and program control can be one of straightforward design employing hardware from the Vela Hotel, POGO and OGO programs. The cameras will each carry 34,000 ft. of seven-inch film producing 11.6 million square miles of stereo photography or about 23 times the amount of all the film carried in the GAMBIT system.

Conservative estimates suggest a twenty-four month development program with first operational flight some twenty-seven months following program go-ahead. Based upon this schedule, and assuming a July 1964 go-ahead, a five-year program of 34 operational launches is as follows:

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FY-65	54.3	
FY-66	156.9 # 124.2	
FY-67	148.8	3 test and 10 ops launches
	130.8	
FY-68	149.0 # 128.6	12 operational launches
FY-69	66.5 # 60.6	12 operational launches

# Depends upon booster costs and modifications.  
(5.2 vs 3.5 for each Titan II)

Cumulative costs over the five-year period should run between \$498.5m and \$575.5m, depending upon booster costs. By replacing the CORONA and GAMBIT programs at their current launch rate mid-way through FY-67, FULCRUM is projected as amortizing its own development costs by the turn of FY 68-69 and actually saving the Government at least \$100 to \$177 million by the end of FY-69.

Detailed Fiscal Year 1965 and 1966 Summary:

	<u>FY-65</u>	<u>FY-66</u>
a. <u>Camera</u>		
Design & Dev.	\$15.8	\$10.6
Production	-0-	12.8
Facilities	3.0	-0-
	<u>\$18.8</u>	<u>\$23.4</u>
b. <u>Spacecraft</u>		
Design & Dev.	\$17.0	\$38.0
Facilities	.5	2.5
Production	-0-	27.0
	<u>\$17.5</u>	<u>\$67.5</u>

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## Detailed Fiscal Year 1965 and 1966 Summary (continued)

c.	<u>Booster</u>		
	Modification & Design	\$ 8.0	\$21.2
	Production & Launch Costs	-0-	24.0
		\$ 8.0	\$45.2
d.	<u>Recovery Vehicle</u>		
	Design & Dev.	\$ 5.0	\$ 6.0
	Production		4.0
		\$ 5.0	\$10.0
e.	<u>Launch Facilities</u>		
	Modification Construction and Equipment	\$ 4.0	\$ 7.0
f.	<u>Engineering for</u> <u>Assembly, Integra-</u> <u>tion, and Checkout</u>	\$ 1.0	\$ 2.8
g.	<u>Film</u>	-0-	\$ 1.0
	GRAND TOTAL	\$54.3	\$156.9

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BYE-0163-64

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2 July 1964

MEMORANDUM FOR: Director, National Reconnaissance Office

SUBJECT : Funding for Project FULCRUM

1. In reference to our previous discussions on this subject, outlined below are the various tasks for which we require immediate NRO funding. We have placed particular emphasis on those areas which the LAND PANEL has identified as meriting immediate attention.

2. Upon the conclusion of this effort, scheduled for six months, we should have amassed a substantial appreciation of the technical aspects of each task which will permit an over-all evaluation of the program with a high confidence factor.

3. The schedule calls for \$5.35 million; however, with \$.350 million made available from Agency year-end funds, our funding requirements from the NRO total \$4.5 million; specifically:

FILM DRIVE AND CONTROL	\$1.650
------------------------	---------

One of the key potential problem areas named by the Land Panel was the handling of film at high speed within prescribed tolerances. We consider this task sufficiently critical to warrant the parallel, yet independent, approach of two contractors. Specifically, we desire the brass-boarding of the film transport system to permit the measurement of film velocity errors, a statistical estimate of image degradation, appropriate environmental testing and evaluation of a high speed system on film, i.e., scratching.

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BYE-0163-04

CAMERA DESIGN, ENGINEERING, \$1.810  
MOCK-UP AND DYNAMICS

This task will permit the detailed analysis of the camera dynamics, bearing loading, gas requirements, perturbation to camera rotation due to spacecraft torquing and the effects of start-up transients and film movement. It will also provide for facility analysis, optical design and exploration of alternate camera composition.

WEIGHT BUDGET AND \$1.0  
DYNAMIC BALANCE

This task includes funded proposal efforts in both the spacecraft and recovery vehicle systems with follow-up design and development efforts by those companies awarded the contracts. Detailed attention will be given to the payload weights and dynamic balance.

ASSEMBLY, INTEGRATION, AND \$ .500  
CHECKOUT

This task provides the basic management housekeeping over the interface control problem, the overall engineering reliability, and the analysis of the AIC facility.

OTHER \$ .390

This item provides for ancillary studies surfaced during the initial FULCRUM effort as well as limited supplemental funding to the tasks listed above.

SUB TOTAL	\$5.350
Less Agency Funding	<u>.350</u>
TOTAL REQUIRED	\$4.500

ALBERT D. WHEELON  
Deputy Director  
Science and Technology

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SIX TASKS AT ITEK

- TASK I High-speed film transport system
- TASK II Camera dynamics study (includes bearings)
- TASK III Optical design
- TASK IV Facility study
- TASK V Design and engineering (including camera mock-up)
- TASK VI Program analysis

Cost incurred through 31 July 1964:

	<u>Expense</u>	<u>Commitment</u>	<u>Total</u>
Project Management	\$27,209	\$ 820	\$28,029
TASK I	17,197	32,353	49,550
TASK II	-0-	-0-	-0-
TASK III	5,454	-0-	5,454
TASK IV	-0-	-0-	-0-
TASK V	9,537	-0-	9,537
TASK VI	-0-	-0-	-0-
<b>TOTAL</b>			<b>\$92,570</b>
		Fee to be negotiated	
		<b>ESTIMATED GRAND TOTAL</b>	<b><u>\$100,000</u></b>

*ADW's Notes on 11 Aug 64 Meeting with McCone*

*31 July  
\$120K*

*31 Aug  
\$525K*

*2nd week left  
\$250K*

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