15 June 1964

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. The Drell Report was pigeon-holed when the National Reconnaissance Office suggested to refer 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 several inches 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 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.

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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, micro-wave, 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 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 (Petzval) lens with 60-inch focal length employing a corrective lens, beryllium mirror and egg-crate 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 mile altitude. Lower orbits would improve the resolution proportionately but reduce swath coverage. The film is 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 straight-forward 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 ten 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:

FY - 65	54.3	
FY - 66	156.9 # 124.2	
FY - 67	148.8 # 130.8	3 test and 10 ops launches
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 498.5 M and 575.5 M, 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 between 182 and 257 million dollars by the end of FY-69.

First Year's Cost:

Camera		18.8
Design and Dev.	- 15.8	
Facilities	- 3.0	
Spacecraft		17.5
Design and Dev.	- 17.0	
Facilities	- .5	
Booster		8.0
Recovery Vehicle		5.0
Launch Facilities		4.0
Integration and checkout		1.0
	TOTAL	54.3

Should FY-64 yearend funds now be available to commence development of the FULCRUM system, we propose the following immediate expenditures:

Detail Lens Design	$ 50,000
Detail Design and Brassboard of film transport	$800,000
Lens Development	$500,000
Detail Design Recovery Vehicle	$500,000

Project FULCRUM Fact Sheet

CAMERA - Itek Corporation

Two F 3 60-inch focal length 120° scan angle
Resolution: 2.7 to 4 feet (100 miles alt.)
Swath: 360 nautical miles (100 miles alt.)
34,000 ft. of 7-inch film each camera
Coverage: 11.6 million square miles in stereo
(CORONA - 10.8 million sq. mi.)
(GAMBIT - .5 million sq. mi.)

BOOSTER - Martin Titan II (5000 pound payload)

RECOVERY VEHICLE - AVCO or General Electric (aerial/water recovery)

SPACECRAFT - Space Technology Laboratories
Consists of hardware basically developed for other programs

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	FY-66	156.9 - 124.2	
	FY-67	148.8 - 130.8	3 test 10 ops
	FY-68	149.0 - 128.6	12 ops
	FY-69	66.5 - 60.6	12 ops

Comparing FULCRUM phasing out C and G midway through FY 67 with continuing C and G for the next five years, FULCRUM should save the Government enough money to amortize the development costs by the turn of FY 68-69 and actually save between 182 and 257 million by the end of FY 69.