~~TOP SECRET~~

HANDLE VIA
BYEMAN
CONTROL SYSTEM

~~(C)~~ NATIONAL RECONNAISSANCE OFFICE
WASHINGTON, D.C.

THE NRO STAFF

27 February 1976

MEMORANDUM FOR LT COLONEL STORCH, SAFSP

SUBJECT: NRO History

Attached are Chapters XVII and XVIII of the NRO history. They have been reviewed by Paul Worthman and Ralph Ford, who appreciated the opportunity. We have no comments to make on the draft chapters and are returning them for your action.

FREDERICK L. HOFMANN
Colonel, USAF
Deputy Director for DOD
and Interagency Policy

2 Attachments
1. Chapter XVII (BYE-15649-75) Copy #2
2. Chapter XVIII (BYE-15649-75) Copy #2

HANDLE VIA
BYEMAN
CONTROL SYSTEM

CLASSIFIED BY BYEMAN - 1 EXEMPT FROM GENERAL DECLASSIFICATION SCHEDULE OF EXECUTIVE ORDER 11652 EXEMPTION CATEGORY 5B2 DECLASSIFY ON IMP DET.

~~TOP SECRET~~

CONTROL NO BYE-12657-76
COPY 1 OF ____ COPIES
PAGE 1 OF 1 PAGES

XVIII PROJECT UPWARD: THE NRO AND NASA

In 1962, John H. Rubel, then Deputy Director for Defense Research and Engineering suggested to Dr. Robert Seamans, Deputy Administrator of NASA, that "a number of Air Force developments in launch vehicles, spacecraft, instrumentation and data reduction and processing, would be utilized with some modification for reconnaissance and mapping of the moon as part of NASA's Apollo Program. Both Rubel and Seamans recognized that NASA would need accurate mapping and geodetic information covering the moon in order to choose landing sites. They also acknowledged that an independent NASA reconnaissance and mapping program would represent unnecessary duplication and would lead to other complications. In February 1963, concerned because little progress had been made toward involving the Air Force in a lunar reconnaissance program. Rubel wrote Joseph W. Charyk, Undersecretary of the Air Force, and DNRO, to solicit his views. Specifically, Rubel asked if Charyk felt that "the Air Force has developed or has under development, equipment facilities and techniques that could be applied with minimum modification to the NASA mission?"[1]

NASA, as it developed subsequently, did not have quite the same view of the problem as did John Rubel. Seamans had earlier proposed to James Webb, NASA Administrator, that NASA contract independently for an unclassified camera to be carried in the Apollo capsule and to be built from specifications supplied by the NRO. (Actually, Seamans suggested that CIA specifications be used, which implied the Corona camera.) By mid-1963, Webb and Seamans were seriously thinking about an arrangement which would allow flying "unclassified" cameras in Apollo in some applications and a "classified" camera in the same space for other applications, those presumably designed to enhance the retrieval of intelligence information. John McCone, Director of Central Intelligence, and Webb and Seamans also considered having NASA develop an unmanned lunar reconnaissance vehicle which would relay information to the earth by electronic means. That program apparently had begun without any direct input from any NRO source. Somewhat to the astonishment of Dr. Eugene Fubini of DDR&E, Webb concluded "that manned space flights would produce much better pictures and much better electronic intelligence than unmanned flights." Characteristically, Fubini categorized that assessment as "not based on any concrete information of which I am aware; I believe my knowledge

to be complete in this area." In passing, Fubini indirectly claimed credit for originating the notion of developing an unclassified camera which, for some missions, could be replaced by a "classified" camera separately developed.[2]

Lunar Orbiter, as such could trace its origin to a 24 July 1963 meeting between Col. John Martin of the DNRO staff, Dr. Fritz Oder of Eastman Kodak (formerly a member of the Air Force Samos development team), Eugene Kiefer of the CIA, and Myron Krueger of NASA. Fubini's notion was that an unmanned reconnaissance of the lunar surface should be conducted at the earliest possible date making maximum use of hardware and techniques already developed by the NRO. As he saw the mission, it would involve photographing "a reasonable sample of the lunar surface" at a resolution of about five feet, using an NRO camera for a single pass at a twenty-nautical-mile altitude. He anticipated a one-pass mission with the vehicle proceeding around the moon and back toward the earth, electronic readout of the photography occurring as close as possible to the earth in order to improve the signal-to-noise ratio and obtain the best quality photography.

Dr. Oder immediately proposed the use of the equipment developed by Kodak for the Samos E-1, E-2 program. In Oder's view, Eastman Kodak could build a payload including camera, film, web processing, and scanning unit for a total weight of about 120 pounds. Oder believed that the equipment could resolve details at about the seven-foot level from an altitude of 20 miles. Fubini also emphasized that the mission ". . . is desired as soon as possible, within the next year rather than several years from now."[3]

Early in November 1963, Major General Robert E. Greer's element of the National Reconnaissance Office (SAFSP, Office of the Secretary of the Air Force, Directorate of Special Projects) completed a preliminary study of NASA's plans to conduct a lunar reconnaissance program that would precede the initial Apollo landing. Given the uncertainty of requirements for detail and scope of coverage, SAFSP was unable to recommend any of the camera systems developed or in development for the NRO. In order to make the best decision, SAFSP concluded, it would be necessary to solicit preliminary engineering design proposals from the contractors for the Gambit, Corona-Mural or Lanyard, and Argon camera systems--respectively Eastman Kodak, Itek, and Fairchild. Greer recommended that each contractor be

told that NASA and the Department of Defense were studying the use of his camera system in conjunction with Apollo and would be interested in receiving a proposal. The work was to be conducted under the cover of existing security arrangements. (At that time the later Byeman system had not been installed; "Special Handling" stamps in combination with Secret or Top Secret classifications constituted the document designators, and exclusive handling channels protected access.)

Greer's organization concluded that the several principals would complete preliminary work in about six weeks. During that period there was to be no direct contact between the various camera design groups and North American's Space and Information Division, responsible for design and fabrication of the principal Apollo service vehicles.[4]

Although technology seemed unlikely to be troublesome, the administrative difficulties of such an approach were considerable. For practical purposes, the existence of the Gambit, Corona, Lanyard, and Argon satellite reconnaissance systems was unknown to outside the select group that developed and operated them. The possibility that reconnaissance operations of the chosen system could be compromised by its use in conjunction with Apollo could scarcely be ignored.

BYE-15649-75

The resulting harm might be substantial. On the other hand, developing a new camera system for NASA would constitute a massive and costly duplication of effort, while assigning such a development to one of the experienced contractors could have an adverse influence on the program of the crutial National Reconnaissance Program. With the Samos E-1 system being used in the Lunar Survey project, the Itek, Eastman, and Fairchild camera systems proposed for use in Apollo represented the product of a design and development effort that had cost nearly one billion dollars. Of the four systems, only Corona was well seasoned. Gambit had first flown the previous July and Lanyard and Argon still had not yet demonstrated their full capabilities.

The November decision to invite contractor proposals for a lunar reconnaissance system was the product of meetings with NASA representatives (chiefly William Taylor, Assistant Director for Engineering Studies, Office of Manned Space Flight) that opened on 24 October 1963. Although the NASA objectives could not then be defined with precision, NASA evidently wanted a photographic system that integrated mapping and high-resolution cameras in one composite payload able to identify and verify the suitability of proposed Apollo landing sites. NASA assumed that the mission could be performed

from an orbit 80 miles above the surface of the moon and that carriage of camera systems would not interfere with the prime lunar landing operations assigned to Apollo.

General Greer had responded to the initial NASA approach by establishing a special study group to define the photogrametric characteristics of the lunar surface and to establish the parameters of a suitable reconnaissance system. NASA had somewhat arbitrarily and unrealistically called for ground resolution of two inches in the high resolution system, a requirement unlikely to be satisfied given the performance available in existing systems and the orbital constraints NASA had also specified. Nevertheless, it appeared to Greer that any of the "high resolution" NRP systems in combination with the Argon mapping camera could probably satisfy NASA needs. Deciding which was the best combination was a matter of evaluating tradeoffs between weight and resolution potential. Greer was confident that a sound, supportable choice could be made by 1 April 1964, the date NASA had identified for a final reconnaissance system decision.[5]

Well before the start of any NASA-SAFSP discussions, it had been necessary to secure Department of Defense (DoD) agreement to the feasibility and desirability of the basic undertaking. Negotiations to

that end had begun during the first half of 1963 and had culminated in a formal "DoD/CIA/NASA Agreement on NASA's Reconnaissance Program" dated 28 August 1963. CIA participation was to be exercised through the National Reconnaissance Office. The core of the document was the acknowledgement ". . . that NASA has a requirement to perform both unmanned and manned lunar reconnaissance operations, and will in some cases be required to test equipments in earth orbits prior to engaging in* lunar operations . . ." The counterpoint was recognition that the NRO, ". . . by virtue of its capabilities in on-going reconnaissance satellite programs, have [sic] developed the necessary technology contractual resources and management skills to produce satisfactory equipment, and appropriate security methods to preserve these capabilities, which are currently covert and highly sensitive . . ."

The general arrangement for starting the program provided that the NRO would review and verify the compatibility of NASA requirements and NRO equipments, would select a reconnaissance system contractor, and would oversee the secure development of the requisite equipment for NASA. The original plan called for NASA to issue a

---

* Written "on" in the copy filed at SAFSP, but apparently meant to read "in."

"white" contract to provide a plausible "cover" for the development and procurement actions that ultimately would lead to delivery of a system for installation in the Apollo service module.* The agreement also assumed that the program be co-managed by an NRO and a NASA senior staff member, with the NRO member of the duo providing the development management function and the NASA member overseeing liaison and interface matters. All three of those premises were to cause management difficulties as the program proceeded.

NASA funds were to be used for all but minor elements of the total program, "black" as well as "white." Notwithstanding, NRO control over and responsibility for the reconnaissance systems, any NRO vehicles or vehicle elements used by NASA, and all product photography would remain unimpaired. The only exception to that arrangement was to be equipment ". . . which does not require performance equivalent to classified NRO developed hardware . . ."[6]

* The Service module was the element of Apollo that remained attached to the Command module in lunar orbit while the landing module performed its assignment. The Command module, with exposed film, would return the astronauts to earth.

In practice, the phrase was all but meaningless and would remain so until or unless the national administration decided to declassify satellite photography that displayed resolution equivalent to 100 feet or better. In the climate of the times, such a decision was not credible.

As compared to the usual NRO schedules for development and operation of reconnaissance systems, the Apollo reconnaissance system had relatively little urgency. Not until the second week of December 1963 were the contractors to be briefed, SAFSP recommendations would go forward in mid-February 1964, and NASA's decision was due not later than 1 April (Even as early as December 1963 the premise that the NRO would select the system was being abandoned; the plans laid out that month assumed that NASA would make the final selection on the strength of NRO recommendations.) Contract award was scheduled for May 1964, delivery of engineering and cost models by January 1966, and delivery of the first payload to NASA by January 1967. Three years seemed a wholly reasonable development period in light of the current availability of fully tested (though not wholly operational) systems in each of the four proposed configurations.

In a 6 December advisory to Colonel Martin, in Washington, General Greer took exception to several points of the original agreement. He particularly objected to the notion of a counterpart "white" NASA contract with the selected camera system developer. In Greer's view, such an arrangement would offer ". . . no advantages to either NASA or DoD . . ." and would create an opportunity "for inadvertent but serious violations of procurement regulations and fiscal control policies by creating a situation whereby the contractor must be responsive to both the NASA program manager and the SAFSP program manager." Greer contended that ". . . NASA participation in this . . . procurement is clearly recognized and encouraged, [but] that participation which concerns direction or guidance to the . . . contractor must be through the responsible contracting organization." Therefore, Greer added, "In briefing the . . . contractors the week of 9-13 December, SAFSP will indicate that . . . contracts resulting from Phase I studies will be controlled and administered by SAFSP under the single point management concept."[7]

Briefing of EK Itek, and Fairchild was delayed by scheduling conflicts but by 17 December all had been appraised of the situation and invited to propose on a no-cost-to-the-government basis. All

BYE-15C495-75

three accepted the invitations. The ground rules for proceeding specified maximum use of existing hardware, lunar reconnaissance and landing on the same mission (which represented a significant weight constraint in that landing disposables might have been excluded from a reconnaissance-only system), a nominal 80-mile orbital altitude (dictated by the requirements of the landing and rendezvous operation), and a nominal seven-day mission with a single system. The system was to incorporate both a high resolution camera and independent mapping and indexing capabilities. Apart from the "hazard measurement" requirement defined by NASA, which implied resolutions of about two inches, all of the NASA specifications seemed achievable. (SAFSP program specialists commented that the two-inch-resolution requirement should be reevaluated, which was an adequately placed response to a technological specification that was not achievable by any combination of film and optics achievable then [redacted] Weight seemed dominant constraint on design. Each additional pound of payload would require the addition of 2.5 to 3.0 pounds of fuel to the boost vehicle.

On 13 February, Greer appointed an evaluation board to consider and rate the contractor submissions.* Findings reached him in mid-March. Somewhat surprisingly, the evaluators concluded that none of the NRO-developed systems could satisfy the NASA specifications. The Gambit optics most nearly approached the desired optimum for 80-mile orbits, but at lower altitudes a modification of the Lanyard afforded advantages. (Lanyard incorporated a panning system and Gambit a strip camera. Some system with attributes of both seemed necessary to perform the mission NASA had defined.) The report to Greer concluded that "Operations over a wider profile range than can reasonably be associated with acceptable performance from any existing system may require a new camera development. An optimum camera configuration could better meet NASA requirements than the NRO systems evaluated." The evaluation team estimated that 18 to 24 months would be required to develop such a system.[9] NASA's schedule could readily accommodate that delay.

* Board members included Lieutenant Colonel John R. Hansen (Chairman), who subsequently became the program manager, Lieutenant Colonels E. J. Conway and John Pietz, and Majors M. G. Burnett and H. A. Courtney. Aerospace Corporation technical specialists provided evaluative assistance.

In separate correspondence with Martin (now a Brigadier General), Greer remarked that the uncertainty of the Apollo reconnaissance profile precluded any clearcut payload recommendations. But he had no doubt that any of the available large systems (Corona-Mural, Lanyard, or Gambit-1) could be integrated with Itek or Fairchild stellar-indexing cameras in the Apollo command and service modules.[10] The evaluating group had concluded that EK's estimate of Gambit capabilities was realistic while Itek's proposals for use of either Corona-Mural or Lanyard were optimistic by a factor of two. The SAFSP evaluation took that optimism into account in rating the three systems. The key finding was that none of the systems could satisfy NASA definition and resolution requirements from an 80-mile orbit, even if the specification of two-inch resolution were ignored. In the view of the SAFSP team, an orbit as low as 23 miles might be required if either Lanyard or Gambit were modified for Apollo landing survey purposes--and even then resolution would not approach two inches. The most desirable camera system, the group concluded, would be one that incorporated a relatively high resolution strip camera in a Lunar Excursion Module (landing module) installation for passes at altitudes of about ten miles.[11]

BYE-15249-75

Such an approach would, of course, require a complete revision of existing concepts: NASA wanted the cameras in the service module, not the landing module. Perhaps for that reason, NASA proved no more ready than SAFSP to select one system or some system composite on the strength of the initial study. In April, the space agency decided to sponsor a six-month engineering evaluation of Lanyard, Gambit, and "a small mapping camera" to provide an engineering basis for selecting the elements of an Apollo Mapping and Survey System.[12] That decision effectively brought into being the Upward project which was to concern NRO and NASA for the next three years.

Shortly after SAFSP concluded that none of the available cameras was fully appropriate for the Apollo mission, the original schedule was abandoned. In its stead, NASA adopted an approach which assumed that system selection would occupy the balance of 1964. The general premises of the effort were specified in NASA/DoD agreement dated 20 April 1964, and a statement of work forwarded to the NRO early in May 1964. For practical purposes, NASA proposed to sponsor detailed engineering studies by Itek (covering the Lanyard camera) and by EK (covering Gambit) at a total cost of $850,000. Separately, NASA proposed contracting with North American for studies on the

BYE-13649-75

integration of each of the candidate camera systems into the Apollo spacecraft. The product of the study effort was intended to be a preliminary design and system specifications for each of the candidate systems, interface specifications, a statement of detailed photographic requirements, cost and schedule estimates, non-functional mockups of each camera system, and an NRO evaluation of the studies which would include recommendations for further development if appropriate. Although the specifications for the Apollo lunar survey camera were not greatly different from thos earlier conceived, it was notable that the rewritten requirement for high resolution photography could be satisfied by pictures which adequately displayed protuberances or holes having 18-inch diameters. Further, NASA abandoned the requirement that the cameras be designed for full compatibility with an Apollo that included a fully capable landing module. It appeared that NASA had somewhat reluctantly accepted the weight and orbital constraint realities which had become obvious to the SAFSP evaluators earlier that year. Although NASA wished to provide for the simultaneous carriage of the lunar excursion module and for its possible use in an unmanned descent-only operations during a survey flight, the cameras were to be installed in the service module. Following

operation of the camera system, the cannister of exposed film was to be transferred to command module and the cameras jettisoned in lunar orbit. As provided for in the basic Apollo operations plan, the service module itself would be jettisoned before the command module entered the earth's atmosphere. Some aspects of the proposed mission--or missions--retained large elements of ambition: transfer of film cannisters from one module to another conceivably could require an extra-vehiclular astronaut excursion, and jettisoning the cameras implied the provision of a complex disconnect and eject mechanism in the service module.

Although NASA still expressed a perference for an operating orbital altitude of 80 nautical miles during mapping operations, altitudes as low as 20 miles were classed as acceptable.

As an alternative plan, NASA proposed that the camera systems be operated from the conjoined command and service modules in the course of a mission which would include a manned lunar landing and subsequent recovery. Feasibility was contingent on the weight margins available, which as yet could not be defined. July 1968 was chosen as the target date for the first qualification test flight in earth orbit, and September 1968 as an operational readiness date for lunar operations.

BYE-15249-75

George E. Mueller, NASA's associate administrator for manned space flight, forwarded the NASA work statements to Dr. McMillan on 13 May 1964. On 22 May, General Martin formally sent it on to General Greer with a statement of McMillan's approval and direction that the undertaking "proceed immediately . . ."[13]

By mid-June the bulk of the $850,000 fund made available by NASA had been obligated on contracts with ($289,600), Fairchild ($128,560) and Eastman Kodak ($312,000). SAFSP estimated that about $75,000 would be needed in the following fiscal year to support work performed by the Aerospace Corporation; thus it appeared that $1 million estimate earlier accepted by NASA would be more than adequate for the design and system definition aspects of Upward.[14]

The first major change in the approved program became necessary--almost predictably--less than three months after the schedule had been approved. In July, NASA concluded that it would be necessary to complete design reviews for the service module in September 1964 rather than in December. It therefore became essential to obtain the wooden mockups of the candidate mapping and survey camera systems some 15 weeks earlier than the original schedule had contemplated. William Taylor, who had become the senior NASA member of the

project team, also specified the preliminary reports from the three contractors would have to be available to NASA and North American by 30 September 1964. Given that schedule, NASA expected to select the preferred camera system concept early in October rather than late in December. Although the changes were somewhat awkward and required an undesirable acceleration of study effort, SAFSP arranged for the completion of presentations by 29 September (in Los Angeles); the required mockups were to be delivered approximately two weeks earlier.

One of the problems which most troubled John Hanson was that jettison techniques for the camera had not been well worked out and that it might be necessary to forego a demonstration of techniques for a feasibility description. Hanson proposed to make his evaluation of the payload contractor studies available to NASA no later than 15 October. Assuming that delay, Hanson suggested that a decision on payload selection would not be feasible before 15 November. Given that two to four months would be required to complete planning and scheduling arrangements for development and test of the selected system, Hansen did not expect to be able to put the total system on contract until about mid-March of 1965. Although he did not seem

particularly uneasy about the capability of the chosen system to satisfy NASA needs, Hansen expressed some nervousness about the compatibility of the Apollo guidance and navigation system with the camera equipment.[15]

The 29 September presentation of findings proceeded on schedule, somewhat simplified by the late deletion of the Itek mapping camera from consideration, and in October NASA began evaluating the submissions. By that time it was perfectly clear to all concerned that SAFSP and the NRO would not make explicit system recommendations to NASA. The selection of the eventual system would be solely NASA's concern. The results of the presentations indicated to General Martin (who in July had become Greer's deputy at SAFSP) that either Lanyard or the Gambit system would be capable of meeting and even of bettering the released NASA requirement for resolution. In Martin's view there was no significant difference between the candidate system in terms of their complexity or compatibility with Apollo subsystems. The Gambit system had to be preferred from a resolution standpoint, but it was 500 pounds heavier than Lanyard. Either system could provide the coverage required by NASA, and it seemed feasible to modify the Gambit system to a panoramic mode of operation, which would

enhance the feasibility of satisfying the area coverage requirement
16
in less than four days.

Although NASA did not quite meet its intended 15 November deadline for selection of an Apollo camera system, on 20 November Dr. Mueller advised Dr. McMillan that the space agency had decided to proceed with the development of the mapping system in combination with an adaptation of the Gambit camera. On 27 November, General Greer informed Itek of the decision to proceed with the development of the Gambit camera for an Apollo application. He concurrently instructed Eastman Kodak that a detailed development plan would be needed by 30 April 1965, approval of that plan by NASA being expected to signal a firm commitment to development of the hardware. In response to Itek's request for a debriefing on the system selection process, General Greer explained that the selection had been made wholly by NASA, SAFSP's contribution being only to provide a technical
17
evaluation of each candidate system.

The relatively slow pace of the NASA approach to development of Apollo camera system was in part a reflection of NASA's earlier committment to three other programs which in one respect or another were intended to collect data on lunar landing sites. Ranger, Surveyor,

Lunar Orbitor programs were proceeding toward operation in the 1964-1967 period. Surveyor was a landing vehcile intended to perform a limited survey of the lunar service and environment, but Ranger and Orbitor were photographic systems. Ranger was intended to return only relatively low-resolution photographs, but the Lunar Orbitor incorporated a combination of medium and short focal length cameras and a modification of the Samos E-1 film readout system.

SAFSP studies had indicated that the 24-inch E-1 camera incorporated in the Lunar Orbitor vehicle would have to orbit at about 20 nautical miles in order to satisfy the [redacted] resolution requirement for hazard detection on which NASA had finally settled. For practical purposes, sending Lunar Orbitor much below 30 to 35 nautical miles was not feasible. In the view of John Hansen, who had now served with the Lunar survey program for more than a year ". . . the decision for an attempted manned landing based on conclusions extrapolated from Lunar Orbitor . . . data is open to severe scientific, public and congressional criticism." That at least some senior NASA people were apprehensive of precisely that outcome was signoted by the decision to begin development of a camera system for installation in the Apollo spacecraft. The principal uncertainty which seemed to influence

in deciding whatever to proceed with development of the Apollo survey system was the validity of NASA's hazard assumptions. Hansen believed that if the detection of objects 18 inches on a side (or holes 18 inches in diameter) remained a fundamental NASA requirement and the performance of Lunar Orbitor was no better than that predicted from preflight system studies, it would become essential to fly a high resolution camera in a prelanding Apollo operation.

Colonel Hansen did not believe that either the Lunar Orbiter or the Surveyor, "individually or in combination" would be able to certify a landing site. He was convinced, therefore, that an Apollo Mapping and Survey System was an essential requirement. Further, Hansen argued in an October exchange of letters with Taylor of NASA that because a Lunar Mapping and Survey System in an Apollo vehicle would be required to locate and validate landing sites, there was no point in designing for a dual mission (both man landing and mapping survey)--on which NASA has originally insisted and which remained a major option in the on-going Apollo camera system selection process. Hansen pointed out that including a 1,215-pound mapping and survey system in the equipment of a lunar landing mission could do no more than create "a non-essential encumberance jeopardizing attainment

of the primary landing objective." If the landing sites had not been certified, which seemed highly probable, then the primary objective of the initial lunar mission would be to conduct recomaissance. Carrying his arguments to their logical conclusions, Hanson contended that the most sensible course for NASA would be to develop one camera system optimized for a survey of appropriate landing sites and another for the performance of lunar mapping operations as an adjunct to a landing on the moon. The arguments were wholly sound, but as Hansen conceded to Taylor, "I am . . . certain those conclusions . . . do not, as yet, reflect the official NASA position."[18]

Hansen was entirely correct. NASA officials were far from agreement that landing site survey via Apollo was a prerequisite to lunar landing, or that earth-orbital flight qualifications was a prerequisite to site survey, and did not propose to make a decision on the final need for an Apollo-conducted landing site survey sooner than 18 months before the intended flight date of the proposed mapping and survey system.* The only generally accepted NASA position by June 1965 was that a combined survey flight and manned landing was a very

* It later became apparent that Mueller, in NASA headquarters, was the main proponent of Upward and that the Apollo program managers, in Houston anticipated slight need for the Upward equipment in pre-landing operations.

unlikely initial operation. To that extent Hansen's reasoning was impeccable. But there wes as yet no indication that NASA had abandoned the notion of combining a lunar landing with a continuing detailed survey of the lunar surface at some later date. Such a mission, should it eventuate, would almost surely require a survey system significantly different from that initially proposed for site survey purposes.[19]

For practical purposes, nearly a year elapsed between the original presentation of the data which led to the selection of the Gambit system for Upward and the time at which detailed design studies were reviewed as a prelude to the issuance of hardware contracts. A great many matters involving detailed coordination of effort between Eastman Kodak, Fairchild, and North American had to be resolved, but no major issues arose in the period and no significant decisions were announced.

SAFSP (which after July 1965 was headed by General Martin) estimated in May 1965 that the total cost of the program through the end of fiscal 1968 would be about 31.5 million dollars (about 1.7 million had been spent in the period before July 1965).

BYE-15649-75

On 28 September 1965 the design studies produced by Eastman, North American and Fairchild were reviewed in detail by NASA and SAFSP people at NASA headquarters, and on 13 October at the Manned Space Flight Center in Houston. The principal purpose of those meetings was to review camera modifications which had been proposed in the course of the design studies and to evaluate performance-versus-cost tradeoffs.

Although a great many "improvements" had been advanced and considered at some point between January and November 1965, NASA generally adhered to its original premise that the only modifications which would be approved were those required to accommodate the cameras to spacecraft constraints and to adapt them to the conditions that would be encountered in lunar orbit.

In June of 1965, even before final decisions on what modifications would be accepted had been made, NASA forwarded a purchase request for $4 million to the Special Projects Office to cover the design and fabrication of test model hardware for the Apollo landing and survey system. That sum was intended to cover about 40 percent of the cost of activity between June 1965 and July 1966.

20

Although the fundamental requirements for a mapping and survey system associated with Apollo did not change substantially after their initial approval, by mid-1965 NASA had refined its understanding of some of the desired performance attributes of Upward. One of NASA's primary objectives was to avoid the emergence of any requirement for two systems, or for one system with two distinct models. Thus, for example, although NASA still viewed the mapping and survey system as a device primarily intended to verify the adequacy of potential landing sites, a major secondary objective was to develop a system which would have continued application for scientific missions subsequent to the initial landing. A second element of flexibility that NASA considered essential was to provide for camera operation over a wide band of altitudes between 30 and 80 nautical miles and for a secondary capability of performing survey missions at an altitude of 200 nautical miles. Excepting the probability that the site survey mission would not involve a manned landing, NASA also insisted that the survey mission provide for the complete exhaustion of all film carried. That meant, in some circumstances, that it would be desirable to carry from 10 to 30 pounds of mapping film rather than 6 to 8 pounds of film originally proposed when Fairchild designed the mapping camera

system. NASA also wanted the mapping camera to be designed so that it could be carried as separate instrumentation independent of the Gambit camera, and serve as the sole photographic instrumentation on lunar missions subsequent to the initial landing. However, whenever the survey camera was used NASA wanted the mapping camera to be simultaneously operated. Finally, NASA wanted the radar altimeter element of the complete camera system to be aligned so that it would show absolute altitude over terrain rather than distance to the center of mass of the moon--and wanted a radar resolution of about ten feet. Precise altitude measurements, which implied precision radar operation, was essential to determining image-motion compensation data to be used for camera system calibration. An additional requirement imposed on the radar system was that of obtaining data which could be used to determine the precise scale of lunar photography. In earth photography some man-made object or some natural object with known measurements was invariably reproduced in a sequence of photography. No such fortituous scale factors could be expected to appear in lunar photography.[21]

Such desires adequately expressed the intentions and wants of the Apollo Project Office. They were not necessarily compatible

BYE-15249-75

with the objectives of senior NASA management, which had to cope with problems considerably different from those encountered in the design and development of a mapping and survey camera system for an Apollo mission. In November 1965, George Mueller advised the new director of the National Reconnaissance Office, Dr. A. H. Flax, that ". . . the demands of other programs require that we take a very conservative approach to M&SS development. The design should be simplified as much as possible, keeping in mind the Apollo photographic requirements and not what the basic system design may be capable of providing." In Mueller's view, "the original estimated M&SS development costs would have been difficult to fund, and the current, tentative contractor estimates are significantly higher." Mueller asked Flax to "do everything possible" to restore required funding levels to those contemplated in the original estimate.[22]

Although Dr. Mueller could have had no more than the preliminary estimate in hand when he advised Dr. Flax of his concern about funding, by early December 1965 it was apparent that his apprehension was well founded. In April 1965, the estimate for completion of the mapping and survey system program has totaled slightly more than $30 million. By December the estimate was $50.4 million, and that

figure did not include expenditures before July 1965. Of the total, $43.5 million would have been expended through the first flight and an additional $7 million in the period between July of 1968 and June 1971, primarily for support of flights subsequent to the initial landing. Eastman and the Gambit Project Office estimated that the modified Gambit cameras delivered to NASA (four test units and two flight units) would account for $36.4 million of the total, and the Fairchild mapping camera another $4.1 million. About $1.5 million would be spent on technical support of SAFSP by the Aerospace Corporation. The greatest expenditure would occur in fiscal year 1967, when Eastman expected to spend very nearly $17 million on completion of development and fabrication of the necessary flight and test equipment. By December 1965, NASA actually had provided somewhat less than $6 million in hard funding.

23

One of the lesser changes in a fairly traumatic year involved resolution of various earlier uncertainties concerning program security. The relationship between the "Special Handling" category assigned to project Upwards and the normal Byeman system had not been clear for several months. Agreement between NRO, NASA, and the various participating contractors had by February 1966 ensured that "Special

BYE-1249-75

Handling" material generated by NASA would be controlled in the Byeman system while in Air Force custody, and would be managed by Byeman procedures, though not necessarily in the Byeman system, at the various contractor facilities. Although a variety of minor problems arose from time to time, controlling access to the Upwards project generally presented no great difficulties. The objective of confining to a relatively small circle knowledge about the prior and current use of Apollo mapping and survey system cameras in DoD reconnaissance programs was never threatened.

24

A matter of far greater significance than the resolution of some security uncertainties began to unfold early in February 1966. On 11 February, Dr. Mueller visited the Special Projects facility in Los Angeles for a review of the Upward project. As could have been predicted from his earlier correspondence with Dr. Flax, he expressed considerable concern about total system cost. Given that integration seemed likely to be one of the major elements of that cost, Dr. Mueller asked General Martin to examine the feasibility of flying the Gambit camera in a separate module essentially like that normally used in Gambit operations for the NRO. He also asked Martin to have Eastman conduct a review of the cost of the command module installation

of the Gambit camera, given that it appeared to be substantially more expensive than the installation of Gambit cameras in the Orbital Control Vehicle (OCV) than used for Gambit-1 operations.

In response to Dr. Mueller's inquiries, General Martin set afoot a study of using Gambit hardware in an NRO configuration for Apollo flights. The results indicated that five configurations were conceivable. The least feasible was an arrangement which would require mounting the Gambit OCV under the lunar excursion module in a position perpendicular to the launch trajectory. It appeared extremely doubtful that either the camera or the OCV could withstand the forces generated by launch in that orientation. A second and far more attractive arrangement involved mounting the Gambit OCV upright in place of the lunar excursion module and attached to the command module in much the fashion of the lunar excursion module. That arrangement would be feasible only if NASA were willing to fly an Apollo lunar survey mission without the lunar excursion module. A third configuration envisaged using the Gambit-1 camera and the Gambit-3 payload container, the whole being mounted in place of the lunar excursion module. A fourth option was to carry the OCV into lunar orbit in place of the lunar excursion module, and then operate it in independent flight. Recovering

BYE-15249-75

the OCV would, of course, require second docking maneuver involving the OCV and the command module. The fifth configuration, and the only one that permitted flying with the existing lunar excursion module attached, involved mounting the Gambit camera in a new container small enough to be carried within the lunar excursion module, thus converting the lunar excursion module into a camera carrier. None of the arrangements would permit flying an equipment, mission-capable lunar excursion module on the same mission as the camera systems.

Colonel Hansen reviewed the results of the SAFSP feasibility with Dr. Mueller. Mounting the Gambit camera in the existing Gambit OCV in place of the LEM (Lunar Excursion Module) attracted more favorable comment from Dr. Mueller than any of the other configurations. Hansen told Mueller that hardware modification for such an application would have to start by December 1966 to meet a December 1967 launch date (a new NASA schedule requirement not earlier communicated to the NRO), and that the Gambit-OCV combination could be available to NASA in late 1966 only if Dr. Flax explicitly agreed to that arrangement. Colonel Hansen also cautioned Dr. Mueller that the feasibility study had been conducted within SAFSP without extensive spacecraft

contractor inputs and that a further study effort by the spacecraft contractors would be required to ensure that there were no hidden obstacles to proposed arrangement. SAFSP estimated that five flight versions of the Gambit-OCV configurations could be delivered to NASA for $48.5 million, a figure that did not include "white" NASA costs.

Although Dr. Mueller's request had originally been designed to save money, the preliminary results indicated that the alternative approach would require about $15 million more than the approach then being pursued. Even though his original objective seemed largely unobtainable, Dr. Mueller was interested in the alternate approach because it provided a simplified interface between the Upward system and the remaining Apollo systems, simplifying both program management and security procedures. Further, using the existing Gambit-OCV required less new hardware development and made maximum use of existing hardware, with appreciable benefits for reliability of operation. Further, should NASA subsequently decide to continue operations using Gambit camera, it would be a relatively simple matter to obtain additional Gambit-OCV combinations from the NRO.

In reporting on these developments to Dr. Flax, General Martin observed that neither the Gambit-1 nor the Gambit-3 configurations

proposed to NASA would represent complete vehicles as then flown by the NRO. In the Gambit-1 arrangement, using the existing OCV, the vehicle stabilization system and much of the contained electronics would be omitted. In particular the power supply, batteries and command system would not be needed. For the Gambit-3 configuration, systems not necessary to the Apollo mission included the stabilization subsystem, the programmer, and the power supply. What would essentially be needed in each case was a shell to contain the camera system, an adequate thermal control system, and an interface to provide stabilization, maneuvering, power, and command from the Apollo command module.

General Martin also cautioned Dr. Flax that the use of the Gambit-OCV for Upward could not be arranged without disrupting the existing Gambit flight program. He was particularly concerned about the possibility that imposing new production requirements on General Electric would further disrupt the development and refinement of the OCV for Gambit-1. (For several months, General Electric's difficulties in delivering flight capable OCV's had represented the principal pacing constraint on the Gambit-1 program.) If, however, the Lockheed payload vehicle designed for Gambit-3 were used in conjunction with

BYE-15249-75

the Apollo command module, there would in Martin's view occur no major disruption of the on-going Gambit-3 program. In passing, General Martin observed that Gambit camera production was no great problem owing to the earlier mismatch of camera and OCV deliveries resulting from GE's difficulties with OCV production.

If NASA were willing to pay the additional cost, General Martin suggested, then the best approach would be to abandon the existence Upward configuration in favor of an installation combining the Gambit-1 camera with a modified Gambit-3 shell.

25

Shortly after advising Dr. Flax of the increasingly confusing situation of project Upward, General Martin received an informal request from NASA to examine in greater detail Dr. Mueller's approach; substituting Gambit camera in either an OCV or the Gambit-3 package for the lunar excursion module. Preliminary cost estimates for a "bargain-basement austere but feasible system" indicated that it would cost about $25 million. Adopting such an approach would also have the effect of substantially increasing requirements for manpower support from SAFSP, from Lockheed Missiles and Space Systems, and probably from Eastman Kodak.

BYE-15245-75

After receiving the results of the preliminary SAFSP studies, Dr. Mueller arranged a personal meeting with Dr. Flax for 25 March 1965 to discuss the issues involved and, if possible, to reach a decision on the future course of project Upward. Given that there was considerable uncertainty about the technical difficulties, cost, and schedules for a system configuration involving the use of a separate Gambit payload module, the first agreement of the meeting was to have Lockheed and General Electric conduct configuration investigations. Dr. Flax indicated that he would be willing to support Dr. Mueller's eventual choice of a best confuguration once the competitive study-proposal phase had been completed. The Gambit camera system incorporated a stellar indexing camera as part of its configuration, so there appeared to be a reasonable possibility that the Fairchild mapping camera then in development might not be required in a new camera payload package configuration. Alternatively, of course, the Fairchild mapping camera might be incorporated in either the lunar module or the command module for use independent of the Gambit cameras.

Dr. Mueller expressed surpris upon learning that the mapping camera being developed for Apollo applications had no background of

flight history under NRO auspices. In Colonel Hansen's view, incorporating the Fairchild camera in the Apollo as a permanent subsystem was the best course NASA could choose, chiefly because it would be the only "lunarized" mapping camera in existence at the time Apollo flights first were conducted. Mueller was not opposed to the idea but remarked that his NASA staff would have to convince him that a requirement for mapping existed that could not be met with the Gambit-system stellar indexing camera. Because continuation of the Fairchild camera project involved expenses of $10,000 a day, Dr. Mueller proposed to make his decision very promptly.

Following the meeting of Dr. Mueller and Dr. Flax, NASA and SAFSP people (principally Colonel Hansen) met in a series of afternoon and evening meetings. At their conclusion, Colonel Hansen reported to General Martin that NASA had definitely decided to abandon the existing approach and to adopt the payload module concept in place of the integrated system concept earlier selected. The NASA people also approved the prompt start of a competitive study and cost proposal effort involving General Electric and Lockheed, the product to be a proposal for developing two separate payload modules plus camera and command system elements. Use of the stellar indexing camera then associated

with Gambit also received NASA approval; a final decision on continuation of the separate Fairchild camera development for the original project Upward application could not be provided to Colonel Hansen at the time. However, NASA agreed to a variety of supportive studies necessary to define an acceptable interface between a separate payload module configuration for project Upward. 26

The matter of the Fairchild mapping camera became more complicated when NASA concluded that although the stellar integrating camera that was an element of the Gambit system would adequately satisfy mapping requirements for the lunar survey mission, it might be advisable to continue the Fairchild camera for later and different applications to other NASA requirements.

The proposed Fairchild lunar mapping camera was a development of one originally created for the National Reconnaisance Program and was being developed and built in a "black" facility. However, if the Fairchild camera development program were to be continued, NASA wanted it reoriented toward a configuration more appropriate to long-term NASA needs. (Although nowhere admitted, the "needs" obviously included earth survey as well as lunar applications.) To those ends, Dr. Mueller in May asked Dr. Flax to approve a redirection of the

BYE-157 75-75

Fairchild effort to assure that camera products could be made available in an unclassified form and that the camera could be used in any application to which DoD and NASA agreed. Were that not possible, Dr. Mueller added, NASA would be obliged to terminate the Fairchild effort before the end of the current fiscal year.

27

The matter of what should be done with the Fairchild camera development concerned a number of people both in NASA and the NRO. In General Martin's opinion, the Fairchild mapping camera was functionally capable of satisfying all of the specifiable NASA requirements for both lunar and earth scientific survey purposes at a cost that could not be approached by any other existing or proposed camera system. However, as General Martin pointed out in an exchange with Colonel Paul Worthman of the NRO staff, although the Fairchild camera was "...in certain respects... different from other NRO procurements from the same contractor, ... any such difference is academic and does not alter the basic fact that this camera reflects the actual state-of-the-art in regard to the production and use of this type of camera and satellite photography."

Perhaps because the classification issue was impossible to resolve to the satisfaction of all, perhaps because NASA ultimately

changed its views on the desirability of the Fairchild camera, on 1 July Dr. Mueller advised Dr. Flax of his wish to cancel the development of the Fairchild mapping camera.[28]

Some six weeks earlier, on 13 May, General Martin had named a special evaluation board to weigh the technical and cost proposals submitted by General Electric and Lockheed for the Apollo Payload Module. The board, chaired by Colonel Hansen, reported to General Martin on 2 June that the Lockheed proposal had scored appreciably higher than the GE proposal in all four areas of consideration (cost; interface; management, production and logistics; and technical and scientific). The board's judgment, promptly concurred in by General Martin, was predicated on an assessment which rated Lockheed as generally superior in tradeoff considerations and in cost effectivenes . A major consideration was how the two ranked in terms of program risk factors. For GE, the risk was that associated with achieving an acceptable level of payload performance in an environment for which the camera-payload module-command module could not be optimized. The risk associated with Lockheed involved the integration of flight-proven (or to-be-flight-proven) hardware into a new container configuration.

On 5 June, Colonel Hansen briefed Dr. Mueller on the board's findings and conclusions at the Manned Space Flight Center in Houston. On the basis of the resume (and funding and scheduling estimates carried forward by Colonel Hansen), NASA on 15 June agreed that Lockheed should be the prime contractor for the Payload Module. Even at the onset of the program, it was apparent that cost would be a dominant consideration. In particular, NASA requested that major costs be deferred beyond fiscal year 1967 "to the maximum extent pos ible" subject only to the necessity of meeting project schedules. 29

In the judgment of SAFSP, the choice of the Lockheed approach to development of a payload module would have a smaller impact on the Gambit program than would the choice of the GE OCV. Merely going to the payload module approach promised a significant improvement in the management of the mapping and survey system program. Although SAFSP had enjoyed "excellent" cooperation from the engineering level of NASA and with those directly engaged in the mapping program management effort, some of the peripheral supporting activities within NASA were less responsive to the "undocumented special activity" and progress had occasionally been impeded by "costly, time-consuming delays involving contractual matters and uncleared

upper management personnel." It was obvious that the new payload module program would require more intense effort and more rapid progress than the earlier survey camera activity. For practical purposes, the Lockheed payload module approach was in May 1966 at the same point in the procurement cycle that the now abandoned approach had been 12 months earlier. Thus actions which had previously been allowed nine months for completion would have to be finished in three months. In the view of Colonel Gerald Smith, General Martin's procurement chief, there was "... no, repeat no, possibility of meeting Dr. Mueller's schedule or living within estimated costs if we are exposed to the same administrative delays" that marked the earlier program. Colonel Hansen had discussed the problem with NASA and had received assurances that it would be corrected.

In terms of security provisions, there was no doubt in General Martin's mind that the redirection of the effort would substantially improve the overall situation. In the new arrangement, SAFSP would deal with contractors who were skilled and experienced in covert work. SAFSP could carry out the integration of the camera into the payload module in "... a tightly controlled environment"

BYE-1526-75

and then deliver a "buttoned-up unit" to NASA at Kennedy Space Flight Center. That arrangement was much better from a security standpoint than the original scheme of delivering an unconcealed camera for integration into the Apollo service module by a contractor who did not even have a contract with SAFSP. In order to complete the formal arrangements, General Martin had only to [redacted]

In larger terms, the new arrangement derived from an Apollo program directive issued in February 1966 which assigned responsibility for the mapping and survey system to the Manned Spacecraft Center rather than to NASA headquarters. The decision to develop a separate payload module, the decision to cancel the Fairchild mapping camera development program, the decision to have the Manned Spacecraft Center develop the rack that would support the payload

BYE-15C47-75

module during launch all developed from actions resulting from the issuance of that February directive. NASA now assumed that five flight-qualified camera systems would be required. The first was scheduled to be delivered to Kennedy by 1 July 1967 for use in an earth-orbit test mission.[31]

To avoid the delays that would arise from the immediate negotiation of a definitive contract, SAFSP issued a letter contract to Lockheed covering initial actions required to meet NASA's proposed first launch schedule date of December 1967.

The final element of that sequence of actions, the unilateral NASA decision to fabricate the hardware that interfaced with the Upward payload module, raised hackles and created problems within SAFSP. Early in September 1966, General Martin appealed to Dr. Flax to persuade NASA to procure the "payload rack" by way of a "white" contract with Lockheed which could be administered by SAFSP. In June, shortly after Dr. Mueller had approved proceeding with the procurement of the five payload modules and camera systems, Houston had asked the Marshall Flight Space Center at Huntsville to submit a cost and technical proposal for a "rack" which would meet the requirements of the Upward program. Concurrently, but unknown to

BYE-15549-95

Huntsville, Houston "unofficially" invited Lockheed to submit a "unsolicited proposal" covering the same effort. The Houston office of the Upward program subsequentially reported to SAFSP that they favored the Lockheed approach because it eliminated an extraneous participant from the rack-payload module interface. General Martin's people favored that approach because it would eliminate some security problems they anticipated if Marshall became involved. The Houston Program Office accepted the SAFSP proposal on the condition that Houston be permitted to access to all technical aspects of the rack procurement at Lockheed.

On 31 August, however, the Houston program office advised General Martin that NASA senior managers had rejected the agreed approach and that the rack would be developed by Huntsville under the terms of an inter-center arrangement between Huntsville and Houston. On the strength of the information available to him, General Martin concluded that the decision to ignore the recommendation for rack development by Lockheed was "... not based on technical or managerial considerations but prompted by the desire to smooth some feathers which became ruffled when Huntsville in advertently became aware of the fact that Lockheed was being

offered the opportunity to swim in their pond."

There was no technical reason why Huntsville should not be responsible for the rack but there were several reasons for General Martin's reluctance to create "... new and unnecessary interfaces with another NASA organization." First, the Upward program was demanding a "grossly disproportionate" share of SAFSP security resources. The interposition of another NASA center (and its contractors) in combination with an established NASA habit of "turnover of people" at a strikingly high rate would further strain SAFSP resources. Each new organizational exposure required that more people be indoctrinated and briefed on NRO covert procedures and communication channels. General Martin said bluntly that he could not meet schedules "... if my resources are expended in defining interfaces rather than resolving them." He had concluded that the introduction of any new payload module configuration changes would cause a schedule slip that would make it difficult if not impossible to meet the 1 December 1967 launch date. And, he said, "... I have absolutely no confidence in any judgment which claims there will be no change to the [payload module] ... configuration prior to the time 'rack'-PM interface is completely defined if there is more than one party to this interface."

BYE-15249-75

Finally, General Martin emphasized the technical and managerial advantages of having a single contractor for the 60th payload module and the rack.

Project-office-to-project-office exchanges failed to resolve the problem. Late in October, therefore, Dr. Flax advised Dr. Mueller that he was "... willing to accept the increase in security and management burdens resulting from this new interface with another NASA center only if you can assure me that there are overriding NASA management considerations vital to the success of the program and, if you will accept the risks of increased cost and schedule slippage of the DoD hardware effort which may result." On 18 November 1966, Dr. Mueller replied that NASA "strongly" favored development of the rack by Huntsville "... even when weighted against the possibly more complex engineering interface." He added, "I know of no schedule problems precipitated by our decision to date and I understand that SASFP is preparing to handle the cover story for the LSMSC contracts without reference to flight hardware produced by LSMSC. In summary, he added, "I want to assure you of our strong desire to continue the 'rack' development at MSFC. We are aware of and do appreciate your concern regarding potential cost, schedule and security

BYE-15C4275

32

implications, and we thoroughly intend to proceed as agreed with our staff on September 14."

In many respects the new approach represented a wholly new effort to integrate the Gambit payload with the Apollo vehicles. General Martin's organization was all too aware of the difficulty and complexity of that assignment. Colonel Hansen aptly summarized the situation in his opening remarks to a conference which for the first time brought together the Lockheed, Air Force, and NASA participants in an effort

33

to design the whole program.

> "We are faced with a challenge of assembling a reconnaissance system which will be operational by December 1967 and capable of operating successfully as either a scientific or primary mission support tool for the Apollo and/or the Apollo applications program missions through 1971.
>
> Just 13 days ago the senior members of our organizations, - Dr. Mueller for NASA and Dr. Flax for the Dod-jointly and unequicovally committed their resources to making the Lunar Mapping and Survey System a reality with implied confidence that this system could and would meet program objectives. Just 97 days ago those same gentlemen agreed to consider the technical, operational and fiscal feasibility of the LMSS configuration as it will be presented to you today and with a few significant exceptions is indeed now essentially cast in concrete. Less than 9 months ago this configuration existed only in the lustful eye(s) of a few engineers in the joint AF/NASA LMSS Program Office. In one sense you might say this system is premature and the product of some midnight liaison, but actually it was conceived of an unorthodox though covert marriage in August of 1963 when our respective

BYE-15242-75

organizations joined forces, so to speak, for the accomplishment of purposes in the interest of national policy. This union provided for the merger of what has proven to be a highly successful though highly clas ified and covert Air Force satellite reconnaissance program and NASA requirements for advanced state-of-the-art photo systems in its Apollo program. It unfortunately or fortunately, depending on your point of view, brought along a set of ground rules under which the marriage must survive. These cover security, hardware procurement practices, modification restrictions, organizational policies, and a minimum budget. In spite of these constraints to two people whose decision iniated this activity were convinced of its ultimate success and predicated their position on two factors.

1. The first is the proven operational capability of the basic hardware subsystems.

2. The second is that rational people working together can accomplish anything they cooperatively attempt.

This is where we come into the picture.

Lockheed has been selected to shoulder a major portion of the LMSS sy tem integration activity and share with ED and Huntsville the hardware subsystem fabrication tasks. The AF and MSC Program Offices have the responsibility for creating the environment and establishing the criteria which will permit all the LMSS contractors to function efficiently. Our task today is that of defining to you the mold into which the LMSS has been cast, but not completely set, solicit your identification of points of interface, responsibilities and requirements which we may have overlooked, and set a course of action leading to a succes ful program.

Before introducing the LMSS Project Manager, let me remind you that reconnaissance is the second oldest profession in the world and unfortunately though probably correctly is oftentimes confused with the first. Second, and this is a reminder to myself as well as a caution to you, let's us not swat the flies buzzing around our heads while the buzzards are pecking at our butts.

BYE-15649-75

New security arrangements had to be designed to cover the new circumstances, although in many respects the exposure of NRO programs was significantly reduced by the arrangements completed in July 1966. Nevertheless, in the expectation that NASA eventually would be obliged to release public information on the camera-related aspect of any Apollo missions which carried Upward equipment, SAFSP and NASA agreed in July to continue the "Special Handling" security system until a public information plan could be approved by both. It was contemplated that the existence of an agreement between the NRO and NASA regarding lunar reconnaissance would ever fall below the Top Secret category, but many other aspects of the activity would eventually be reduced in classification. Thus, for example, NASA eventually would be obliged to make a public statement that the Apollo camera was being developed under an Air Force contract, and to reveal the name of the contractors. Details and specifications of the camera hardware would remain classified but that fact, of itself, would not be classified. Details of the lunar reconnaissance operation, if conducted, would generally be unclassified, but specifications of the equipment would not. That a lunar reconnaissance payload existed would ultimately have to be revealed. Access to

the assembled camera, even by those who were obliged only to check out such items as lead-in circuitry connections, would remain a classified activity although not at the "special handling" level. Obviously, references to the fact that the Apollo survey camera had previously been used or currently was being used in earth reconnaissance activities would remain in the "special handling" category. That approach was thoroughly consistent with various agreements between NASA and the Department of the Defense and conformed to a general statement of national policy approved by the National Security Council in July 1966.[34]

One singularity which had existed for a matter of years was officially acknowledged in September of 1966. In effect, Eastman Kodak was developing not only the Gambit payload specialized for application to an Apollo lunar mapping and survey system, but also the payload for the Lunar Orbiter, which if successful would obviate any requirement for flying the Upward payload in a survey mission. Apprehensive that some conflict of interest might ultimately be alleged, Kodak reassured General Martin that the two activities were being conducted separately and were receiving equal attention from senior Kodak management. Kodak assured General Martin that "in

accordance with long-standing company policy, it is our intention to produce high quality and fully operative units under both projects with neither project affecting the other."

Notably, although the technical details and configuration of the lunar mapping and survey system had matured appreciably over the three years since it had first been proposed, the objectives of the program remained substantially as they had earlier been defined. Ground resolution for the Gambit camera still remained at the [redacted] level, although the altitude range had become 25 to 44 miles rather than 30 to 80 miles. Any notion that the film might be taken up in cassettes contained within the command module had been abandoned, however, the proposed procedure having reverted to retrieval of the cassettes by Apollo astronauts. As of late 1966, the anticipated first-flight date (of a back-up payload) still was scheduled for December of 1967, although Upward project people were aware that the schedule might have to be rearranged to accommodate primary Apollo program objectives which were being squeezed by delays in the basic Apollo program.

35

Although the primary objectives of the Upward program had remained reasonably stable, in the late months of 1966 it became

evident that NASA was beginning to put greater emphasis on the earth-orbit testing of the system than earlier. In the original schematic, earth-orbit testing had been considered a potential back-up operation to the first lunar flight. SAFSP held that the earth orbit operation would undoubtedly generate highly useful engineering data and would afford an opportunity to exercise any engineering change that resulted from the initial lunar mission. However, security was a major problem. Plainly, security considerations could conceivably constrain the merit of any test. Because the late-1966 estimate for the cost of NRO involvement in the lunar mapping and survey program approached [redacted] it was obviously essential to resolve any uncertainties about the use or utility of the resulting system.[36]

Increasing NASA interest in the earth rather than the lunar elements of the development program was partly explained NASA's decision in December 1966 that the Surveyor and Lunar Orbiter data would alone support the selection of safe sites for the initial lunar landings. Thus payload module and camera development no longer had their earlier urgency. Having concluded that the lunar survey mission for Upward was not essential, Dr. Mueller and the Houston team began to emphasize the further development of the Upward

BVE-1S245-75

equipment for later scientific surveys of the moon surface and also for generally unspecified application to earth orbiting missions.

Further, NASA began to express interest in pos ible reuse of the payload module. That implied the exhaustion and recovery of an initial film payload with the completion of the initital mission, whether earth or lunar, and subsequent reloading of the payload module and its reuse after the module itself had remained in orbit for several months. Initially, NASA proposed to exercise that desired capability in an earth-orbiting mission and subsequently to utilize it in a continuing survey of the moon. Obviously, if the operation could be successfully conducted it would lessen the requirement

for buying quantities of Upward equipment.

The decision to forego the use of the Upward equipment on a pre-landing lunar survey mission may in some part been participated by increasing costs of the program and by increasing schedule uncertainties. Early in December 1966, General Martin had pointed out to Dr. Flax that the mission scheduled to carry the first Upward payload had not been formally certified and that there existed considerable uncertainty about whether a lunar operation or an earth-orbit test would first use Upward equipment. Martin was convinced that the

December 1967 launch schedule was unrealistic. Principal NRO emphasis was being placed on the lunar site survey mission, while NASA resources appeared to be more heavily concentrated on the earth orbit test mission. Those missions were not mutually supporting, so some portion of the joint effort was being "needlessly dissipated." Martin predicted to Dr. Flax that from $2 to $3 million in additional funds would be required in fiscal 1967 if both operations remained on their existent schedule. Additional cost increase would arise, Martin added, because the original contractor estimates had been somewhat optimistic and because the requirement to fragment the hardware development program into a series of "black" and "white" contracts had not been anticipated when the early estimates were approved. The ultimate confusion and uncertainty arose however, in the fact that the NRO organization was attempting to develop hardware and software for a December 1967 lunar mission launch while the Manned Spacecraft Center program office was formally authorized only to procure software support for the earth orbiter mission in June 1968. NASA headquarters was the prime supporter of the site certification mission; the Apollo Program Office, located in Houston, had never really accepted the existence and validity of that requirement. Those

organizations were not basically in disagreement about the utility of the Upward hardware for subsequent scientific survey and mapping missions in lunar orbit, but formal documentation supporting the site certification mission had not emerged from the Apollo Program Office at all. In General Martin's opinion, a dispute concerning objectives and authorities internal to NASA was largely responsible for the confusion. He had concluded from information available to him that NASA headquarters expected the site certification mission to be approved rather close to the scheduled launch date, and he was quite certain in his own mind that completing the development and assembling the essential hardware would not be possible on a crash basis. Thus the combination of increasing cost, lukewarm support of the lunar survey mission by the Apollo Program Office, and a subdued bureaucratic conflict within NASA appeared to be partly responsible for the December decision to forego use of the Upward payload in a pre-landing Apollo mission. In any event it was apparent that use of the Upward equipment on any Apollo launch would be confined to an earth orbit. Finally, increasing interest in the application of Upward equipment to post-lunar operations by the Apollo spacecraft--the so-called Apollo Applications Program--suggested that there were some elements of NASA which

BYE-15249-75

looked upon the modified Gambit equipment as a highly useful device for guaranteeing the continuation of Apollo launches once the lunar landing objective had been satisfied.

38

Formally, Mueller had merely relaxed the program schedule to accommodate a potential lunar launch in June of 1968 rather than in December of 1967. In another sense, however, the concurrent scheduling of an earth orbit test mission in June 1968 suggested that the earth orbit mission might well have priority. Certainly the objections that General Martin had earlier expressed to a crash program leading in six months or less to a lunar mission could not be overcome by merely slipping the date by six months. Further, within NASA the emphasis on development had suddenly shifted to an Apollo Applications Program which involved operating a "workshop" in conjunction with Apollo vehicles in earth orbit. That in essence was the impulse for renewed emphasis on the possibility of storing, reloading, and subsequently reusing the Upward Payload Module. NASA conceded that $15 to $18 million in costs additional to the original program cost estimate would result from reconfiguration of the Upward payload to permit reuse. For the moment however, all NASA proposed to fund was a low-cost ($125,000) Air Force study of the feasibility of reusing the Upward payload module.

BYE-15249-75

Although the Air Force did not become even informally aware of such developments at the time, a decision to redirect the Upward project was reached within NASA at least as early as 19 December 1966.[39] Differences within NASA may have contributed ultimately to the decision to abandon plans for using Upward as a landing site verification device, but the immediate excuse was the relatively successful outcome of a Lunar survey mission by Orbiter, the products of which became available for evaluation in December. Throughout the period of Upward development, the Apollo program office at Houston had maintained that the cameras of Lunar Orbiter would adequately satisfy requirements for data on landing sites. Even if the resolution was somewhat below that of Upward, Orbiter did indeed satisfy basic needs. Additional information on the characteristics of the lunar surface had been obtained from the Surveyor missions of 1966. In particular, the possibility that the surface of the moon might be covered by fine dust, to a depth of several feet, was excluded. Most scientists had dismissed that concept as preposterously unlikely, but some reputable NASA advisors had stubbornly insisted that it had to be disproved before a manned landing was attempted--and it was. By December 1966, therefore, the

BYE-15649-75

principal Apollo managers were sufficiently certain of their grounds to induce abandonment of the relatively costly and--in their view--wholly redundant mapping and survey mission for which the Upward system had originally been designed. Whether some other application might be found for the marvelous machinery assembled in the course of Upward development remained to be determined; in the event, it would never be applied to the purpose for which it had been designed.[40]

Upward and Earth Applications

The creation of the lunar landing project by President John F. Kennedy in 1962 affectively transformed NASA from an agency concerned with relatively mundane and small-scale scientific satellite projects to a very heavily funded project organization aimed at the lunar landing program. As inevitably happens in such circumstances, the normal bureaucratic impulse to transform a project activity into a continuing program probably seized NASA. The question of what might follow an Apollo program was of primary concern to NASA officials who looked more than six or eight years into the future. As early as 1963, for example, NASA had asked several contractors who were then working on the NASA Manned Orbital Research Laboratory

(MORL) studies to look into optical reconnaissance studies. One study conducted by Boeing became evident to the Air Force in March 1964. It explicitly considered an earth reconnaissance mission. Notwithstanding low-key NRO objections to such activity, the fiscal year 1965 MORL work statement to Douglas Aircraft Corporation listed such objectives as research and development in surveillance and reconnaissance as well as "other purely military domains" such as command and control, antiballistic missile technology, and anti-satellite work. The MORL project subsequently disappeared, the Air Force's Manned Orbiting Laboratory (MOL) program essentially replacing it. However, NASA proceeded along the same lines with what was subsequently called the Apollo Applications Program (AAP). By 1965, NASA was able to list 28 technical items in the Apollo applications program which would be of "current or prospective interest to the Navy." Of those, eight fell into the category of electronic surveillance of ocean areas.

By April 1965, NASA had refined its goals to the point of proposing tentatively a program of ~5 earth-orbital Apollo missions, extraneous to the lunar program, that included five primary experiments "... identified as being earth-mapping or other remote sensing

BYE-15249-75

of the earth's surface by image-forming devices." Such devices included radar, optical cameras and infrared cameras. NASA at that time was thinking in terms of fifteen to twenty-foot ground resolution. In supporting their intentions in that area, NASA established a series of basic research and feasibility studies on advanced sensing instrumentation. NASA also created two special committees to inquire into "remote sensor" considerations. As an adjunct to the lunar mapping program, NASA also explicitly identified earth mapping as an objective. Although earth mapping also included "cultural features" and other nominally non-military objectives, it was noted that NASA had asked the United States Army to declassify its APQ-97 radar, the most advanced side-looking radar developed for mapping-surveillance. NASA had also asked several companies to prepare "parametric studies" of photographic systems that could be used in Apollo applications missions. Further, NASA had directly contacted several NRO contractors regarding advanced reconnaissance camera systems and had placed two contracts with Itek for studies and specifications missions covering earth orbit. NASA had also proposed to the Arms Control and Disarmament Agency the use of Nimbus satellites with "better cameras" in an arms control and inspection role.

BYE-15245-75

By August 1965, such actions had become of sufficient concern to stimulate a semi-formal protest from the director of the National Reconnaissance Organization. Brockway McMillan wrote the President's Science Advisor that he saw such actions by NASA as "... more than merely formal departures from policy and approved procedures." He continued, "they frankly commit the U.S. to reconnaissance-like activities from orbit and expose us to a confrontation by the Soviets or some third party. They also develop and disseminate a body of information about--and ultimately if continued, a body of experience with--the capabilities of various sensors to accomplish various capabilities." McMillan and the NRO staff were very concerned about the possibility that such activity might reveal "much more about the potentialities of satellite reconnaissance than is now openly available for our enemies to exploit." McMillan was particularly concerned because the activities of the "NASA remote sensor coordination panel" and supporting teams had not been coordinated with the Department of Defense through any regularly established channels.[41]

The problems created by NASA's independent development of what would ultimately become high-resolution, optical sensors for earth applications were essentially resolved at the end of August 1965,

BYE-1572-73

when Cyrus Vance, Deputy Secretary of Defense, issued a memorandum to the Secretaries of the Service specifying that all agencies concerned with the study, development, test or use of satellite-borne, image forming earth sensors should deal directly and exclusively with the NRO on such matters. For practical purposes that prevented NASA from supporting any of the defense services in areas concerned with earth reconnaissance.

The informal arrangements that attended the formal directive permitted for the establishment of a committee of "perhaps three members" within NASA, all cleared for Byeman, who were to identify and keep informed about reconnaissance-related activities in NASA that fall within the scope of the definition previously agreed to. Such matters were to be immediately brought to the attention of the NRO and when appropriate thereafter relegated to the attention of working level people in the NRO. Apart from the relationship with DoD activities covered by the Vance memorandum later that month, McMillan early in August of 1965 defined the activities to be covered by the new arrangement as including "... the expenditure of NASA re earch and development money with a university or industry, or the transfer of NASA money to another government

agency for spending..." on any reconnaissance-related activity. McMillan wanted to be advised of any activities involving "... the study, design, development, fabrication, or test of reconnaissance-like symptoms or significant components thereof, for use in orbital systems, or studies of the use of such sensors in orbital systems." McMillan and the NRO staff had defined "reconnaissance-like sensors" to include any sensor having an angular resolution of 0.1 milliradians or finer, or "... an optical infrared forming image system with a physical aperture greater than 30 cm and an optical figure controlled to better than 1/4 wavelength." McMillan also asked Seamans to advise him of the development or test of any subsystems leading to pointing, tracking, or stabilizing techniques to be used "... with satellite-sparing high resolution sensors, in which the planing accuracy is better than 20 microradians or the unstabilized rate is less than 20 microradians per second." Seamans, an Associate Administrator of NASA, was fully agreeable to that arrangement.[43]

The activities which had stimulated the August/September 1965 agreements stemmed from a series of requirements generated by NASA and transformed into request for support of activity by a variety of DoD and other governmental agencies. NASA intended to investigate

BYE. 15749.75

by near-earth orbital flights remote sensing of the earth atmosphere, remote sensing of the earth's surface, and electromagnetic propagation in transmission. In the view of Dr. A. H. Hall, Space Coordinator for DDR&E, such experiments involved "in whole or in part image forming sensors used for accomplishing the gathering of intelligence information from space." Hall believed that continuing activity by NASA in that area "by whatever name it is called," would subject the government to "international and national criticism, tarnish the image of a single "peaceful" NASA, jeopardize the security" of the NRO program and inflict severe harm on most NRO activities. In Hall's view, and in the view of a great many senior Air Force members, it might be possible to resolve the issue of reassigning such mis ions to the MOL program rather than the Apollo program.[44]

The matter had become of sufficient concern by April 1965 to stimulate McMillan to write a memo directly to Secretary of Defense Robert MacNamara. In McMillan's view, NASA was then accelerating its efforts to "establish an exclusive manned satellite franchise, even going so far as to announce its intention to make new-earth manned observation flights." McMillan was seriously concerned about

the potential degeneration of the NRO activity as well as security surrounding the reconnaissance effort en toto.

In a formal memorandum to MacNamara toward the end of April 1965, McMillan cited the establishment of national policy based upon National Security Council action in June 1962. McMillan's goal, in the end, was to "prevent accidental or forced disclosures of the operations or end products of the U.S. Satellite Reconnaissance Program," and to "avoid situations, statements, or actions which, in the context of our satellite reconnaissance program, could later be exploited as evidence of alleged U. S. aggressiveness or duplicity." McMillan also cited National Security Council actions of June 1963 and January 1964 which reinforced earlier actions that prevented dissemenation of knowledge of satellite reconnaissance capability. McMillan continued, "in the presence of this background, I consider that open statements by the NASA that their missions include earth mapping and reconnaissance from orbit are contrary to the intent of current policy, and to express provisions of that policy." Such actions, McMillan argued, violated the spirit of security practices established to cover technology related to satellite reconnaissance and contained with them "real threats to the kind of security which has

been maintained since 1962." What McMillan wanted, indeed felt essential, was a new agreement with NASA which imposed on that agency a requirement to obtain the approval of the NRO or activities involving sensors of military application potential.[45]

MacNamara's letter to James E. Webb, NASA administrator, on 6 May 1965, faithfully reflected the viewpoints McMillan had earlier expressed. To that end, MacNamara enclosed a copy of an agreement, which he had signed for the Department of Defense specifying that the associate administrator of NASA and the Undersecretary of the Air Force would jointly review NASA requirements for study, development, or test in earth orbit, "... of devices or methods for forming or recording high resolution images of the surface or atmospheric features of planets and other bodies." Webb provided an interim reply whhle agreeing that security considerations were of paramount importance expressed reservations about the mechanics MacNamara had proposed.

It became apparent shortly thereafter that one of the basic reasons for Webb's caution was a fundamental lack of knowledge within NASA about the agreements that McMillan had cited and which had so concerned MacNamara in advising Webb. McMillan privately advised

BYE-152492-75

Dr. Harold Brown, Secretary of the Air Force, early in June, of a eries of inquiries from NASA to the NRO staff concerning the content and implications of variousnational security council policy papers on reconnaissance, McMillan advised Brown, tongue in cheek, that he "... was surprised to learn how the apparent lack of information on this basic policy paper at the top level of NASA management."[46] In the end, it developed that Webb was not eager to execute a further detailed agreement defining the degree of participation and coordination required for NASA-NRO coordinate activities, but was quite willing to delegate to the Associate Administrator of NASA and the Director of the NRO, "... the responsibility of executing a memorandum prescribing the detailed arrangements," for any future activities of NASA involving reconnaissance activities. Both DD&RE and NRO took exceptions to the direction of Webb's suggestion and induced Secretary MacNamara to reply late in July that the requirements Webb had expressed overlapped the performance range of classifying NRO programs. MacNamara explicitly requested that NASA advise the DoD of progress on studies of optic l technology applications for the Apollo program (which in effect meant reconnaissance cameras in Apollo vehicles).[47] Thereafter, MacNamara and Webb delegated

BYE-15245-71

the responsibility of working out the details of the agreement to Seamans and McMillan. Their agreement, worked out in a meeting of 27 July, was formalized in a McMillan to Seamans letter dated 5 August 1965. That letter explicitly set up the committee designed to ensure that NASA reconnaissance-related activities were coordinated with the DoD (and expressedly with the NRO) before proceeding to the point of either studies or procurement.

48

The issue would not go away notwithstanding informal agreements and directives from various elements of the DoD and the Central Intelligence Agency. New complications were introduced by NASA's publicly disclosed plan to equip the Gemini and Apollo astronauts with hand-held cameras and relatively long lenses to be used in taking pictures of the earth in earth orbital missions. In December 1965, the Director of Central Intelligence, retired Admiral W. F. Rayborn, advised the NASA administrator of his statutory responsibility to protect intelligence sources which included photography from earth orbit.

Two weeks later, Dr. Alexander Flax, the new director of the NRO, wrote Seamans of his concern about "... NASA program planning activity directed toward earth-sensing (reconnaissance) from satellites." Flax observed that although the NRO had briefed the NASA committee

on NRO programs and in turn had received a general briefing on NASA earth-sensing activities, "... there appears to have been no effect in restraining NASA public and contractor activities in areas affecting the NRP." Flax in effect was requesting that a new basic agreement be drawn up covering "the use to be made by NASA of information and development derived from the NRP."

By late 1965, it appeared to the NRO staff that NASA had more or less forthrightly set out on the separate development of a national reconnaissance capability--nominally for civil applications. At that point, NASA had signed contractual agreements covering the purchase of 24 Apollo spacecraft, 27 Saturn launch vehicles (12 in the "1-B" and 15 in the "V" configuration). Both species of launch vehicles were capable of injecting large Apollo spacecraft payloads into low inclination or synchronous orbits. The NASA plan for operations following initial Apollo flights called for some 20 to 30 Saturn launchings. Any vehicles excess to the Apollo lunar program requirements were assumed to be available for the proposed Apollo applications program. At least four Apollo spacecraft had then been scheduled for initial earth orbital flights. The first camera carrying flights (project Upward) were then scheduled to begin by July 1968.

NASA's studies of devices usable in reconnaissance and mapping roles covered three principal elements. One was a metric mapping camera to provide ground resolutions of about twelve meters, which was about four times better resolution than the Argon camera could provide. The second element was a panoramic, high-resolution search camera to provide ground resolution better than four meters (roughly equivalent to the resolution provided by the contemporary Corona system). Finally an ultra-high resolution camera system was in development to provide ground resolutions of less than two meters (approximately that of the Gambit-1 system then being flown by the NRO). In that none of those systems was assumed to be based on equipment developed by the NRO, it appeared that NASA intended to consider as unclassified all reconnaissance sensors flown on NASA spacecraft, to declassify data acquired on space reconnaissance missions over foreign areas in earth orbit, and to make data acquired on such missions generally available to the international scientific community. In the view of the NRO staff, such proceedings would effectively declassify all of the products and all of the activities of missions carrying medium and high-resolution cameras. Assuming that normal global weather conditions prevailed, and that subsystems operated nominally, the

BYE-158-75

photography that could be obtained from the NASA missions would include: good imagery of Soviet ICBM deployments; good imagery of Soviet airfields including an identifiable count of aircraft, and probably identification of their configuration; good pictures of Soviet nuclear submarine bases; detail on the AICBM installations around Leningrad and Moscow; [redacted] the Chinese nuclear test site; [redacted] good detail on strategic airfields and ICBM sites in the continental United States; and deployment details on U-2 reconnaissance aircraft in the Far East.

In the view of the NRO staff, such NASA activities were more than formal departures from national policies. They publicly committed the United States to announce its engagement in reconnaissance activity in orbit. They would develop and disseminate a body of knowledge and experience covering the capability of U.S. photographic sensors for earth observation, particularly reviewing the status and technology and the quality of NRO operations. Somewhat ironically, most of the "requirements" specified by NASA in justifying such a system could be satisfied by accessing data earlier acquired by the NRO. That fact, although known to NASA, had generally been ignored by NASA top

BVG. 1324275

officials. As the culmination of a long series of negotiations aimed at providing the resolution disagreements arising from disclosure of NASA's plans, the Secretary of Defense on 6 May 1965 had proposed to Mr. Webb the arrangement by which the DNRO and the Associate Administrator of NASA would jointly review the NASA requirements for the study, development of, test or use in earth orbit, of devices or methods forming or recording high-resolution images. MacNamara had further proposed that if the requirements were judged to be of reconnaissance quality, the DoD would serve as an agent to NASA in carrying out such studies, developments, and tests. But on 23 June 1965, Mr. Webb had replied that he considered non-military terrestrial surveys utilizing satellite technology to be a proper function of NASA, citing policy expressed in an earlier National Security Council direction. (In actuality, the Webb reference was largely out of context.)

Webb had told Mac Namara that the arrangement proposed by the Department of Defense would "not meet NASA's responsibility" and had suggested that in lieu of executing a formal agreement, the associate Administrator of NASA and the DNRO should be assigned the responsibility of drawing up a memorandum of understanding against

BVG. 15745-75

the possibility that NASA might at some later date desire to proceed beyond the "exploratory study phase." It was that exchange that prompted MacNamara in July 1965 to state his concern about the "... grave possibility of endangering the national security" and his conviction that "... study contracts you have underway should not be carried any further with the industrial and scientific community."[50] For six months, Mr. Webb had not replied to that invitation.

The revised lunar mapping and survey system flight schedule, after abandonment of plans to use that system in a pre-landing lunar flight, essentially involved a series of four earth orbital flights. (The schedule adopted in January did not accommodate subsequent changes arising from the fatal accident in test of the first Apollo spacecraft.) In mid-1968, NASA proposed putting an Apollo applications vehicle in a 120 mile earth orbit, the primary payload being the Gambit and mapping camera in a payload module. The nominal purpose of the flight was to exercise the system and to determine its utility for later lunar flights.

Four or five days later, a second vehicle (AAP-2), unmanned, was to be launched in a 260 nautical-mile orbit. The first vehicle would thereupon increase its orbital altitude to 260 nautical miles and dock

with AAP-2. After remaining in docked orbit for an additional 23 days, the astronauts would return to earth with the accumulated data. The two docked modules would remain in orbit. About 6 months later, the missions would be essentially repeated using vehicles AAP-3 and AAP-4, except that at the end all four vehicles would be joined together to create a workshop in space. Experiments planned for the second series of flights included reexercise of the Gambit and mapping camera system and operation of the manned Apollo telescope. NASA's purpose in reoperating the cameras after a period of 6 months inactivity was to demonstrate the capability of the system to remain in lunar orbit for a long period of time and then to operate. NASA assumed that such an operational approach might ultimately be necessary to get full coverage of the moon. That plan essentially explained NASA's request to the NRO to study the impact and tradeoffs involved in reconfiguring the camera hardware for storage in space and for subsequent reactivation.

The possibility that came as additional to those contained in the payload module for Upward might be carried on one or more of the AAP flights remained current. Additional sensors NASA was considering by early 1967 included a camera from the unmanned lunar

orbiter, a 12-inch focal length panoramic camera, a multispectral experiment earlier but not looked upon favorably by DoD, a 6-inch focal length mapping camera, a telescope using the commerical Questar lens which had a 56-inch focal length), and an imaging radiometer. As of 31 January 1967, no sensor other than those included in the payload module had been approved for the flight on AAP-1.[51]

In March 1966, Dr. Flax commented on a NASA account of earlier interface activities between NASA and the DoD concerning lunar and earth sensors. Severly critisizing the new NASA approach to the development of what could become earth sensors, Flax pointed out that the original DoD/NASA agreement of August 1963 and its 1964 supplement had explicitly referred only to the use of satellite reconnaissance sensors to observe extraterrestrial bodies. MacNamara's letter of 1965, also a policy-influential document in the series, referred only to NASA requirements for mapping and surveillance of "non-terrestrial bodies, including the moon." The possibility that earth orbit of such sensors might be attempted other than for sensor test purposes was not then considered. The agreements then in existence specified that any photography resulting from earth-orbital testing was to be classified in the Talent/Keyhole system. It was not until James Webb wrote MacNamara in June 1965 of NASA's intention to study a broad range of earth reconnaissance programs that the problem became obvious. Fundamentally, Webb had suggested that the programs by nature and by virtue

of the way NASA was approaching them could not and would not be subject to any classification restrictions. Webb's justification for the NASA satellite earth-sensing programs was a single provision of the National Security Council Action Paper 2454, of July 1962, which stated in part that NASA should work toward achieving international acceptability of earth observations through its activities, "perhaps including photography." In Flax's view, Webb had either ignored the impact of the planned NASA programs on the other provisions and objectives of the National Security Council actions"... or presumed that it was appropriate for NASA to make a unilateral determination that such impact would be negligible or tolerable." That, in Flax's view, was "the real issue to be resolved." Flax argued that unless that issue were directly faced, "no amount of discussion and committee action between DoD and NASA will be effective in solving our current problem."[52]

The fundamental change in NASA's plants to use the Upward equipment continued to cause uneasiness in the NRO. Early in February 1967, Dr. Donald F. Hornig, Special Assistant to the President for Science and Technology, expressed concern about the necessity of acknowledging that camera flights would be part of 1968 program, suggesting that one consequence might be a great deal of public pressure to release the photographs when the flights were actually made. In that circumstance, Hornig suggested it might not be possible to maintain the classification of the photographs or even of the camera.

BYE-1526-75

Hornig proposed the same questions to NASA. One of his first responses was from the acting director of the Central Intelligence Agency, Vice Admiral Rufus Taylor, who expressed equally great concern about the possibility that classification of either the camera or the photography might be compromised by NASA's plan.

The issues Hornig had raised were discussed during a meeting of the Manned Space Flight Policy Board on 9 February 1967. No policy changes resulted, but it became apparent from the discussion that NASA's existing plans were "... considerably different from those contemplated at the time this agreement (the DoD/CIA/NASA agreement on NASA reconnaissance programs of August 28, 1963) was drawn up so that while the general security criteria remained applicable we need to give greater detailed implementation ..."

Flax expressed considerable anxiety because although the original program envisioned no more than a brief period of earth orbit checkout of equipment intended for use primarily in lunar orbit, the 1967 program proposed a tie in of lunar mapping and survey equipment checkout with other Apollo applications payloads and ultimately would entail a protracted period of continuing earth orbit operations, all of them, in Flax's view "... conducted in the whitest of white lights of publicity."[53] NASA did not disagree with the NRO and CIA proposal to keep the products of the Gambit's camera operations in the TALENT KEYHOLE system, merely pointing out in response to the Hornig memo

that so many changes had occured in the Gambit system in converting it to Upward applications that earth orbit checkout was essential. Seamans assured Hornig that new and alternative "cover" plans for the procedural handling of information related to and products resulting from the Upward operations would be developed well before any flight was attempted.[54]

One wholly unexpected product of the exchange of correspondence among Hornig, Flax, and Seamona in February 1967 was Flax's receipt in early March of a memorandum which expressed Cyrus Vance's "very strong reservations against the use of Gambit in the Apollo applications program."[55]

One of the difficulties of proceeding the Upward after abandonment of the plan to use the equipment first in lunar orbit, was that an earth applications program promised extreme difficulties for security. NASA's objectives were somewhat unclear from time to time. In particular, a conflict between potential MOL/Dorian and Upward applications began to bother members of the NRO staff. As early as October 1966 Dr. Hornig had pointed out that astronomers had "... traditionally pioneered in the field of high-precision optical instruments." And he added, "they would be certain to recognize the MOL astronomical data as having come from a very long focal length, high-quality optical system." In those circumstances, Hornig expressed "... substantial reservations as to the prudence of any attempt to accomplish scientific astronomy with MOL."[56]

MYE-15249-75

The whole question of what NASA might do following the successful landing of astronauts on the moon had become of interest to the intelligence community, as well as to the scientific community at large by 1967. In an appreciation written in March 1967, following his attendance of a meeting of the President's scientific advisory committee, Colonel Lew Allen suggested that following the Apollo landings there was no obvious national goal of any urgency for NASA but that NASA would continue. He pointed out that there was a likely pending surplus of Saturn boosters in the 1969-1970 period, following what all assumed would be a successful attempt to land astronatus on the moon, and that in all likelihood the Apollo applications and MOL programs would be combined if continued into that period. The President's Scientific Advisory Committee, he noted, had strongly recommended the continuation of an astronomical program but had doubts about the worth and advisability of conducting an earth resources program, particularly a manned program. At that point the CIA was expressing doubts about the needs for very-high-resolution optics in orbit, although it was not until 1969 that CIA objections to continuance of MOL/Dorian became well entrenched. Yet as early as 1967, Colonel Allen predicted that schedule slips in MOL, funding problems in both MOL and Apollo, CIA lukewarmness toward the MOL/Dorian approach, the cost of the Viet Nam war, and the competition offered to MOL by the Apollo applications program, made it likely that MOL would not

survive. He felt that the appropriate solution was to begin an unmanned program using boosters and to overtly recast the MOL into a joint Air Force-NASA program along different lines. The nominal objective would be operations for earth resources survey work, but one of the secondary goals would be to retain the capability of operating a manned MOL in conjunction with the Apollo applications program if later needed.[57]

Implicit in Colonel Allen's appreciation of the situation with an understanding that the NASA goals might well be heading toward direct confrontation with the goals of the NRO. That the CIA was also nervous about that possibility became concurrently apparent. Colonel Paul Worthman advised Dr. Flax late in March that some CIA officials were convinced that the possible conflict of NASA and NRO goals would ultimately lead to a confrontation between the Department of Defense and NASA at the White House level. CIA's concern was derived partly from an expectation that the NASA use of Upward in earth orbit might ultimately lead to a conflict with the NRO.[58]

On 20 April 1967, a special DoD/NASA working group reported to the Manned Space Flight Policy Committee recommendations for handling the security public information problems associated with NASA's proposed flight test or use of the Upward system in earth orbit. The committee determined those alternatives to be "... unacceptable when assessed against the risk to the national reconnaissance

BYE - 15875

program and the possible adverse international reactions to NASA and the U. S." The committee decided that a new review of security and public information aspects of the earth-orbit operation of the Upward system were necessary and suggested that NASA considered in its review three principal options: cancellation of the lunar mapping and survey system program; continuation of the program but dispensation with the earth-orbital test; continuation of the program including an earth-orbital test.

NASA was asked to define explicitly the system configuration and hardware it would propose to fly in an earth-orbit test of Upward and to consider that an entirely satisfactory security and public information plan had yet to be defined. In reporting those conclusions to the NRP ExCom, Dr. Flax reminded the group that additional problems related to extended use of Upward by NASA had arisen in the recent past. Most important, NRO was going to close out the original Gambit-1 program at the end of June 1967. If the Upward program continued past that point it would be necessary to maintain an Eastman Kodak capability to support Gambit on behalf of NASA for an extended period. That expedient would inevidably increase the costs of the Upward program over those originally estimated. Further, Dr. Flax pointed out, because Gambit hardware had been designed specifically to flow directly from the factory to the launch pad, the development of new and probably costly procedures would be essential in order to meet NASA requirement for long period on-the-shelf storage of the equipment.[59]

BYE-15 CYS 25

Although use of the Lockheed Gambit-3 vehicle for Upward had long been the core of the Upward program, General Electric had never really given up its ambition to provide spacecraft for continued use. In the fall of 1966 G.E. approached the Special Projects office of the NRO with a proposal to explore the possible interest of other Government agencies in continued use of the Gambit-1 OCV. (The OCV for that purpose was known as Percheron.)

The G.E. proposal was based upon the expected completion of Gambit-1 program in the near future. G.E. asked SAFSP permission to prepare a briefing for prior approval in advance of any outside contracts. The material reviewed, revised and presented to General Martin on 26 October 1966 (as the Percheron vehicle) consisted of a general description of the vehicle, assembly of performance capabilities, a resume of suggested possible applications, and the "message" that G.E. was experienced and competent in spacecraft work. SAFSP approved the use of that briefing provided that General Martin's office was notified in advance of who was to receive the briefing and that everyone in the audience had at least a secret clearance. General Martin did not authorize G.E. to leave hadnouts of charts or other data, and he specifically instructed G.E. not to refer to "Program 206" or SAFSP in the discussions and not to discuss Gambit matters under any circumstances--without regard to the fact that individuals involved had the necessary clearances.

Some weeks later, following preliminary meetings with NASA, G. E. requested permission to provide Percheron vehicle specifications to potential customers as Secret classified documents. Martin approved that request with the instructions that a list of all copies so distributed would be maintained together with the names of all the recipients.

Such a mode of operation continued until early April 1967, at which time G. E. proposed a revised briefing titled "Percheron suitability applications and payloads." SAFSP reviewed the charts, which were designed to show the usefulness of Percheron to meet NASA's needs. The charts did not refer to Air Force activities such as the launch base, the satellite control facility, recovery operations and so on. The main point of the briefing was the match of vehicle capabilities with NASA payload requirements. A copy of the approved briefing reached SAFSP by letter dated 6 March 1967. In the interim SAFSP had received other versions of the briefing in a large volume on the subject from G. E. In April 1967 G. E. asked SAFSP to approve a request for the use of the residual Gambit-1 inventory for application to their Percheron proposals. The immediate SAFSP response was to ask G. E. to inventory the material for the purposes proposed. 60

On 28 April 1967, G. E., supported by Lockheed, made the Percheron presentation to the NASA photo working group (which was composed of representatives from NASA, DoD, and the scientific community). As

BYE-1564-75

~~SECRET~~

part of its presentation, G.E. indicated to the group that the spacecraft were available and the Air Force could and would launch this spacecraft for NASA from Vandenberg into total orbit and would operate the satellites through the satellite control facility and recover capsules upon reentry. NASA in general and the NASA photo working group in particular were very interested in the G.E. proposal because it offered the possibility of starting a near-earth survey program without having to await the availability of Apollo or Upward equipment, and because it promised a considerable saving in the purchase of already developed spacecraft. (On 1 May 1967, NASA contacted the NRO with three questions: was there any reason why a decision had to be made on Pergeron immediately, were there security complications in NASA's use of the spacecraft, and would any problems arise getting the spacecraft launched or its film recovered for NASA?

SAFSP responded that DoD had nothing to do with the G.E. selection of the deadline for a response by NASA and really did not know G.E.'s objectives in postulating such a deadline. The security problems were complicated. Four complete OCV's remained at Vandenberg plus two incomplete OCV's at G.E. (which were intended for use to supply spare parts if required). G.E. had estimated that it would cost $260,000 to sanitize the 6 vehicles to prevent their being moved to a non-Gambit area for complete destruction. There was available no G.E. estimate on the cost of sanitizing the vehicles for further use. SAFSP assumed

~~SECRET~~

that the cost would significantly exceed the $260,000 estimate for destruction. SAFSP further volunteered that it would not pay to have the vehicles sanitized for NASA use.

The second complication was NASA's request for historical flight performance and flight qualification data. With regard to launch and recovery operations there were too many unknowns involved to supply an estimate of the security complications.

The Air Force was not sure what resourses would be required and who would pay for them, how many Atlas vehicles would be available and what lead time would be required, and the availability of launch pads and launch crews.[61] One of the ways out of the Upward program complication which arose after cancellation of the requirement for a lunar landing survey per se, was an informal dissolution of the program. Dr. Hornig suggested such a solution to Dr. Seaman's in June 1967. At that point, Seamans was still awaiting a report from a NASA task force on the future needs for Upward. He assured Dr. Hornig that he would discuss the results informally with him before making any decision on reaffirming the program requirement, if that should be the task force recommendation.[62]

G.E.'s effort to secure adoption of the Percheron approach in lieu of the Upward approach became less attractive in June of 1967 when NASA learned from the NRO of the real circumstances ("facts of life") on Percheron. First, only two OCV's really were available and they

BYE-156 49.75

would have to be "sanitized" before being turned over to NASA. Second, NASA would have to supply it's own Atlas boosters; the Air Force had no provisions for obtaining them. Third, no launching pad for Percheron existed at Vandenberg. And finally, the launching and recovering services which G. E. had referred to "so casually," were not G. E.'s to negotiate. In the circumstances the NASA representatives who received that information indicated that they were losing interest in G. E.'s proposal. Lockheed's proposals (the Upwards schematic) sounded better. 63 But by that time the whole question of high resolution earth photography from NASA satellites was becoming a major national issue.

Starting in January 1966, at the first meeting of a Manned Space Flight Policy Council, considerable time was devoted to discussing the remote sensing activities of the Apollo applications program and particularly the possible political and security sensitivity of earth-sensing. In April 1966, the Director of the Budget and the President's Science Advisor co-signed a letter to the Secretary of State (Dean Rusk) asking for a study of the relationship between the DoD's national recomaissance program and NASA's earth-sensing program. They wanted an inquiry into such questions as whether a national plan should be created, what NASA's role should be, and should earth-sensing hardware development be centralized in DoD or in part be delegated to NASA. A Special National Security Council ad hoc committee was reconvened under Ambassador U. A. Johnson (the 156 Committee) to study the problem.

On 11 July 1966 it reported that the national security required continued protection of the National Reconnaissance Program; that a program of natural resource surveys and other scientific and economic exploitation of satellite earth observation should be sponsored by the U. S. provided that the basis had been properly laid; that there was no objection to NASA's proceeding with its plan for an experimental program if it complied with the previously established limits on resolution (0.1 milliradian); that a National Security Council directive should be issued instructing all civil agencies to make their satellite earth-sensing interests known through NASA; that NASA should consider carefully the relative merits and costs of aircraft and other possible alternatives to satellite-borne earth-sensing programs in terms of practical political interests as well as cost effectiveness; and that the NRO should ensure that appropriately cleared NASA personnel had access to what was already available in satellite reconnaissance products.

In February 1967 the President's scientific advisory committee issued a report, "The Space Program in the Post-Apollo Period," which urged among other things that "... a reasonably good case of potential utility must be made, which includes an assessment of potential economic benefit," before any significant development costs were assumed. The report also urged detailed cost-benefits studies of alternatives to the Apollo applications program.

BYE-1C6 45.75

In May and June of 1967 NASA also began to show an interest in non-Apollo earth-sensing--using unmanned satellites to conduct earth surveys.

The difficulties of acquiring international acceptance of earth-sensing by NASA were compelling. In the view of the NRO, it might be entirely acceptable to carry out global reconnaissance over another nation but it was never acceptable to talk about it. If challenged in an international forum, the U.S. could well find itself standing alone, for no other nation would be willing in open debate to admit its territories to inspection by a foreign power. The NRO believed the protest from allies would probably be more vehement than those from the Soviet Union. Any praise of "beneficial uses" and the "desire to benefit mankind generally" probably would be summarily dismissed with the flat rejoinder, "you are conducting economic espionage" and in the NRO view, "by all definitions, that would be the truth." The State Department had no hope of securing such agreements. A case in point cited by the State Department was NASA's attempt to negotiate over-flight agreements with one country--Brazil--which by 1967 had been underway without any prospect of final success for more than three years.

Whenever a discussion of over-flight by a satellite observation had been opened in the U.N. or in the disarmament negotiations at Geneva, objections were raised by third parties. For example, the French had requested discussion on "the right of states to be protected against

BYE. 15649-75

certain effects on their territories of the space activities of other states." The French admittedly wished to discuss space observation as an infringement of national sovereignty.

It was also notable that NASA had permission to build an earth-sensing satellite within the 0.1 milliradian restriction but did not yet have permission to fly it. Who might issue that permission was still uncertain.

The NRO found it somewhat surprising that NASA had not proposed a strategy of beginning flight observations with something like meteorological satellites, which so far had been completely acceptable, moving to a flight series with resolutions 500 feet, then perhaps to 200 feet, and so on toward the 0.1 milliradian limit.

The NRO did not believe that NASA had developed a sound rationale for the project. The President's Science Advisory Committee had dismissed the NASA program with a phrase "unconvincing," and had argued that NASA had relied almost exclusively on the groundswell of scientific interest generated by its 'free-ride' offer in 1965 to promote its satellite approach to earth sensing. Finally, for the purposes NASA sponsored, it seemed to the NRO that all the cost preferences favored using aircraft. The NRO observed, for example, that 25 high-flying aircraft could easily deliver 12 million square miles of cloud-free stereo photography coverage at 5-foot ground resolutions every two months at a cost, including capital investment, of 26 cents per square mile. At least

BYE-15549-75

three satellites would be needed to deliver the same stereo coverage at a resolution of about 10 feet, and at a cost of $2.08 per square mile.[64]

DoD's increasing distress at the course of development in the Apollo applications program was expressed by John S. Foster, Director of Defense, Research and Engineering in a memorandum to Dr. Seamans on 17 July 1967. After reviewing the complex and lengthly history of NASA objectives and the departues from agreed security procedures, Foster added the terse comment that he did "... not like to see the DoD placed in the role of chasing NASA, trying to find out what is going on, and consistently finding out only after the damage is done."

Foster added, "I hope you can get me out of that role as quickly as possible." And he ended, rather bluntly, "I have tried to convey my disappointment over the present output of our coordinating mechanism. If I had your assurance of NASA top management directive action, I would be willing to give the SAFSC another change; however, if it fails that opportunity, I think we will find ourselves forced to move the monitoring to an independent body."[65]

On 25 July 1967, Seamans formally issued instructions terminating the lunar mapping and survey system. Upwards was effectively dead at that period. Seamans explained that requirements for the lunar mapping and survey system program had been under review for some time and that upon consideration he had concluded that there were "no

BYE. 157 49-75

requirements . . . sufficiently realistic to warrant continuation of this development effort." He explained that the justification for the Upward program--to provide a backup Apollo site certification capability in the event that Surveyor or Lunar Orbiter were inadequate--had become invalid since at least four Apollo sites had been certified and the final Lunar Orbiter operation would presumably increase that number to eight. Planning for the Apollo applications program was not firm enough to enable NASA to specify sites for certification requirements; Apollo mission experience promised to be the largest contributor to that question. Other scientific needs for photo mapping of the lunar surface were being met by the current Surveyor and Orbiter series and of themselves did not warrant major hardware developments or manned lunar orbital missions. The Upward program did not have the flexibility needed to provide quick reaction photographic coverage of accidents that might occur on the lunar surface. Finally Upward would require a separate Saturn V flight at a considerable interval from the lunar event being investigated; about 45 million dollars had yet to be spent in fiscal year 1968 and 1969 monies to complete development; and as yet the question of whether effective long-term storage was feasible had not been determined. At the end, Seamans also suggested to Dr. Mueller that it would be wise to examine alternative low-cost approaches to the problem of photographing equipment on the lunar surface.

66

~~SECRET~~

BYE-15749-75

One of the interesting offshoots of the entire exercise was the "Woods Hole Summer Study Group on Earth Sensing" sponsored by the National Academy of Sciences and NASA in the Spring of 1967. One of the topics specifically intended to be discussed there involved the economic tradeoff of providing for earth surveys with space systems, with aircraft, or not providing them at all. During the first two weeks of the panel meeting it became apparent that the NASA briefing overwhelmingly supported the case for satellites. A basic document prepared by NASA for the purposes of analysis pointed out for example that mapping the earth by aircraft would cost $174 million while satellite coverage "adequate for the production of useful photographic products entirely suitable for revision of published maps," would cost approximately $17 million.

After listening for some two weeks to discussions which skirted the issue of cost effectiveness of various sensor platforms, Amrom Katz, a member of the Rand staff who was on the earth-sensing panel, began to raise questions about the relative costs and advantages of aircraft as against satellites. When his initial overtures were discouraged, he characteristically became more interested than ever and ran some calculations on the subject--drawing on his earlier association with the NRO Washington staff for data. He found the cost difference so striking that he insisted on briefing the study group. In a resume of the matter an interested and knowledgeable observer suggested that "the advantage

~~SECRET~~

BYE-15C 49-71

of satellites lies almost exclusively in their ability to overfly denied areas discreetly, an advantage which looks logical in a defense budget, but which fits very awkwardly into a NASA plan."[67]

Following the arrival at NASA of Dr. Foster's 17 July memorandum to Dr. Seamans, there occured what was subsequently described as "a remarkable change in attitude concerning the amount of data on NASA's earth-sensing activity made available to the NRO and the Survey Applications Coordinating Committee." At the 11 July meeting of the SACC, the items openly discussed included General Electric Percheron proposal, the NASA work statement on physical recovery of earth oriented applications experiments, and the Woods Hole Summer Study.* Subsequent to those discussions NASA formally agreed to have DoD member of the SAFSP review all documents comprising the draft work statement on earth applications to institute procedures to ensure that the sources of information and statements contained in printed NASA documents relating to earth surveys were clearly indicated, and to see to the institution of procedures that would ensure that all drafts of documents and work statements dealing with earth resources survey programs and referring to reconnaissance quality sensors were brought to the attention of the SAFSP "on a timely basis."[68]

* Amrom Katz's studies on the economic advantages of aircraft as against satellites for surveys was not mentioned at all in the final published paper on the Woods Hole Summer Study effort.

~~SECRET~~

RYE-15[illegible]

On 12 October 1967, Dr. Seamans formally asked Dr. Flax to declassify the mapping camera developed for use in the lunar mapping and survey system project. The equuupment covered by his request included two flight articles, one engineering article that could be used as a flight article with some reconfiguration, ground support equipment, and documentation. The total occupied ten wooden boxes, each 3 feet on a side, stored at the Itek plant. Seamans acknowledged that the final disposition of those cameras and equipments depended upon whether they could be completely declassified. If that were possible, NASA would consider them "valuable assets for future possible use in either aircraft or spacecraft research programs." He pointed out that ground resolution of the mapping camera was well within the 0.1 milliradians limit earlier set, that all documentation had already been prepared and sanitized for him, the the Upward project office had agreed that total declassification was wholly feasible, and that the NRO was fully briefed on the situation of the problem.

69

In December 1967, Dr. Flax passed along to Dr. Seamans notification that his request for declassification of the Upward mapping camera had been approved--with the provisos that it could be used only in accordance with the basic resolution limitation earlier specified by the National Security Council and that the covert development and the earlier intelligence applications of the camera were not disclosed. Appreciating that the value of the camera hardware was

~~SECRET~~

BYE-155249-73

enhanced by knowledge of the flight qualification record, Flax volunteered that he would supply those data to two or three NASA officials whose positions of authority would permit them to use the data advantageously, but who would be able to prevent queries by NASA personnel to Itek for development or flight qualification information.[70]

Although the decision to terminate Upward had been taken within NASA one or before 25 July, it was not until 2 August that a formal notice to that effect went to Houston and to SAFSP. Disposition of the residual hardware and "cost-effective" discontinuance of all ongoing work was all that remained to be done. The necessary actions included closing the various special centers at Houston and North American, retrieving sensitive documents, arranging for disposition of hardware, and debriefing personnel. Dr. Mueller wanted to keep the completed Upward materials in classified storage; Dr. Seamans disapproved that option but advised Mueller of his intention to request partial declassification (as he later actually did for the Itek mapping camera, which in variant form became the principal element in the later NASA Earth Resources Survey System).[71]

In the course of the Upward program, NASA provided to the NRO funds totaling $30,845 million, of which some $5.8 million were unliquidated by January 1968. In that total, $23.4 million were "black dollars." The actual costs, including termination costs, were about $29.8 million, most of the residual being recoverable subsequent to

BYE-15249-75

cancellation. Survey camera development and fabrication had cost $12.4 million, mapping camera work about $720 thousand, the payload module about $10.1 million, and work terminated upon selection of the payload module configuration about $3.8 million.[72]

All of that was additional to--or separate from--costs incurred by NASA and funded directly. In the total of about $29.5 million Upward costs, roughly $19.7 million had been spent by the NRO on development, studies, mockups, mission planning, documentation, and like items, and about $9.3 million on hardware procurement. The residual hardware went to classified storage ($4 million worth), surplus or scrap ($2.5 million), or other government programs ($2.2 million) and universities ($500,000). By 22 May 1968, all necessary debriefings had been completed and all but historical documentation within NASA destroyed. In its final review of costs, the NRO calculated that in the course of Upward the DoD had contributed about 25 manyears of support and about $50 million ("shelf price") of facilities and support equipment. In "out of treasury dollars," therefore, Upward had cost on the order of $80 million.[73]

~~SECRET~~

BYE- 15645-25

NOTES ON SOURCES

1. Memo, J.H. Rubel, D/DDR&R to SAFUS (J.V. Charyk), 21 Feb 63, subj: Mapping and Photo Reconnaissance of the Moon.

2. MFR, J. McCone, DCI, 21 Jun 63, subj: NASA Rocket Potential; memo, E.G. Fubini, DDR&E, to SecDef, 25 Jun 63, no subj.

3. TWX DE7922, Col. J. Martin, Dir NRO Staff to MajGen R.E. Greer, Dir/SP, 25 Jun 63.

4. Msg, [redacted]3812, SAFSP to CIA and SAFSS, 3 Nov 63.

5. Msg, [redacted]3844, MajGen R.E. Greer, Dir/SP, to Col J. Martin, Dir/NRO Staff, 6 Nov 63.

6. "DoD/CIA/NASA Agreement on NASA's Reconnaissance Program," signed by R.S. MacNamara, SoD, and J.E. Webb, Administrator, NASA, 28 Aug 63, typed copy in SAFSP files.

7. Msg, [redacted]3844, MajGen R.E. Greer, Dir/SP, to Col J.L. Martin, Dir/NRO Staff, cy to Wm Taylor, NASA, 6 Dec 63.

8. Briefing records, 13-17 Dec 63, in SAFSP files; mission requirements defined by NASA work statement MWE 8020.006, 4 Oct 63; preliminary work statement MWE 8020.005, 19 Sep 63. The requirement for two-inch resolution apparently emerged in the process of converting the Sep statement into its final (Oct) version.

9. Lunar Reconnaissance Report, prep by LtCol J.R. Hansen, et al, 20 Mar 64; ltr, MajGen R.E. Greer, Dir/SP, to BrigGen J.L. Martin, Jr., Dir/NRO Staff, 25 Mar 64, subj: Apollo Lunar Reconnaissance Program.

10. Msg, [redacted]4493, MajGen R.E. Greer, Dir/SP, to BGen J.L. Martin, Dir/NRO Staff, 23 Mar 64.

~~SECRET~~

B4E-1SC49-75

11. Lunar Reconnaissance Rpt, 20 Mar 64, Tab A.

12. Msg, Whig 1163, Col J. Lowe, NRO Staff, to MajGen R.E. Greer, Dir/SP, et al, 16 Apr 64.

13. "Statement of Work for Engineering Studies on Apollo Mapping and Survey Cameras," NASA, 4 May 64; ltr, G.E. Mueller, Assoc Adm for MSF, NASA, to B. McMillan, USAF, 13 May 64, no subj; memo, BGen J.L. Martin, Jr., Dir/NRO Staff to Dir/NRO Program A (MajGen R.E. Greer), 22 May 64, subj: NASA Apollo Mapping and Survey Camera Studies.

14. Ltr, Col G.T. Smith D/Dir/SAFSP, to W.B. Taylor, NASA, 26 Jun 64, subj: Obligation of Funds.

15. Memo, W.B. Taylor, NASA, to J. Hansen, SAFSP, 27 Jul 64, subj: Apollo Mapping and Survey System Studies; memo, Taylor, Dir/Spec Manned Space Flt Studies, NASA, to Assoc Adm for Manned Space Flt, NASA, 17 Aug 64, subj: Design Study Review, Apollo Mapping and Survey Cameras; holograph ltr, LtCol J. Hansen, SAFSP, to W. Taylor, NASA, 21 Aug 64, no subj; msg, [redacted]5365, SAFSP to Itek, 24 Jul 64; msg, [redacted]5364, SAFSP to EK, 24 Jul 64; msg, [redacted]5363, SAFSP to Fairchild, 24 Jul 64.

16. Msg, [redacted]5383, SAFSP to CIA, 27 Jul 64; msg, [redacted]6128, BGen J.L. Martin, Dir/SP, to BGen J. Steward, Dir NRO Staff, 20 Oct 64.

17. Ltr, G.E. Mueller, Assoc Adm for MSF, NASA, to B. McMillan, USAF, 20 Nov 64, no subj, quoted in msg, Whig 2036, McMillan to MajGen R.E. Greer, Dir/SP, 26 Nov 64; msg, [redacted]6446, Greer to Itek, 27 Nov 64; msg, [redacted]535, Itek to Greer, 1 Dec 64; msg, [redacted]6519, Greer to Itek, 7 Dec 64.

18. Ltr, LtCol J. R. Hansen, SAFSP, to W. Taylor, NASA, 29 Oct 64, no subj, with encl, untitled paper, topic: discussion of lunar landing problem.

~~SECRET~~

BYE-15645-71

19. Ltr, C.C. Johnson, AsstChf for Spacecraft Design, MSFC, to J.M. Mansfield, SAID, NAA, 29 Jun 65; ltr, LtCol J.R. Hansen, SAFSP, to Johnson, 8 Jul 65, no subjs.

20. Ltr, Col T.S. McGuire, Comptroller, AFSSD, to W.M. Collins, NASA Hq, 14 Sep 65, subj: Project GEM; NASA-Defense PR #W-12112, 21 Jun 65; msg, [redacted]7795, SAFSP to SAFSS, 11 May 65.

21. MFR, M.W. Krueger, Apollo Prg Ofc, 10 May 65, subj: "Ground Rules" for the M&SS Design; MFR, Krueger, 28 Jun 65, subj: M&SS Radar Altimeter.

22. Ltr, G.E. Mueller, Assc Adm for MSF, NASA, to Dr. A.H. Flax, ASAF(R&D), 16 Nov 65, no subj, quoted in msg, Whig 4274, SAFSS to BGen J.L. Martin, Dir/SP, 22 Nov 65.

23. Rpt, CFE Funding Estimates for M&SS, 1 Dec 65, prep by SAFSP; MFR, LtCol J.R. Hansen, M&SS Prg Mgr, SAFSP, 3 Dec 65, no subj.

24. MFR, LtCol J. Hansen, SAFSP, and B. Jackson, NASA MSFC, 25 Feb 66, subj: Mapping and Survey System Security Agreements; undtd doc, approx Mar 66, "Project Upward Security Control System; MFR (informal), LtCol R.J. Ford, SP-3, 17 Jan 66, subj: Security Documentation Guidelines.

25. Msg, [redacted]0383, BGen J.L. Martin, Dir/SP, to Dr. A.H. Flax, DNRO, 10 Mar 66.

26. Msg, Whig 4968, SAFSS to SAFSP, 16 Mar 66; msg, [redacted]0551, Gen J.L. Martin, Dir/SP, to Dr. A.H. Flax, DNRO, 24 Mar 66, MFR, LtCol J.R. Hansen, Dir/Upward, 25 Mar 66, subj: Lunar Mapping and Survey Program; holograph note and attached briefing chart prep by Hansen for Martin and Flax, 28 Mar 66.

27. Ltr, G.R. Mueller, Assc Adm MSF, NASA, to A.H. Flax, ASAF(R&D), 20 May 66, no subj; msg, Whig 5298, Col P.E. Worthman, NRO Staff, to LtCol J.R. Hansen, SAFSP, 20 May 66; msg, [redacted]1200, BGen J.R. Martin, Dir/SP, to BGen J. Steward, Dir NRO Staff, 18 Mar 66.

~~SECRET~~

BVE-15245-75

28. Msg, [redacted]1289, MajGen J.R. Martin, Dir/SP, to Col P.E. Worthman, Dir/Plans, NRO Staff, 26 May 66; msg, Whig 5462, BGen J. Steward, Dir NRO Staff to Martin, 5 Jul 66, quoting ltr, C. Mueller, NASA, to A.H. Flax, ASAF(R&D), 1 Jul 66. (The ltr notes that the action was in confirmation of a telcon that day.)

29. "Rpt of Special Evaluation Board, Study No. 660120," LtCol J.R. Hansen, Chmn, 2 Jun 66; msg, [redacted]1360, Col G. Smith, Dir/Proc, SAFSP, to Dr A.H. Flax, DNRO, 2 Jun 66; msg, Whig 5414, Flax to BGen J.L. Martin, Dir/SP, 15 Jun 66; msg, [redacted]1502, Martin to H. Paige, GE, 16 Jun 66; ltr, Flax to Dr G.E. Mueller, Asst Adm MSF, NASA, 17 Jun 66, no subj.

30. Msg, [redacted]1360, 2 Jun 66, msg, [redacted]1887, BGen J.L. Martin, Dir/SP, to Dr. A.H. Flax, DNRO, 26 Jun 66; msg, Whig 5597, Flax to Martin, 1 Aug 66.

31. Apollo Program Directive No. 16, MGen S.C. Phillips, Dir/Apollo Prgm, 11 Feb 66; Apollo Program Directive No. 16A, Phillips, Jul 66.

32. Holograph notes, "Opening remarks by JRH to First LMSS Joint Meeting," Jul 66, prep by LtCol J.R. Hansen, Dir/Upwards Program.

34. "Agreement Between the Department of Defense and the National Aeronautics and Space Administration Concerning Extraterrestrial Mapping, Charting, and Geodesy Support," signed R.C. Seamans, DepAdm, NASA, 20 Feb 66, and J.S. Foster, Dir/DefRes and Eng, 8 Mar 66; ltr, Foster to Seamans, 9 Mar 66, no subj; memo, A.H. Flax, DNRO to Sec/Army, Sec/Nav, CS/USAF, 11 Oct 66, subj: DoD Participation in NASA Earth Sensing Programs; ltr, Seamans to Flax, 23 Jun 66, no subj; ltr, Flax to Seamans, 13 Sep 66; rpt of NSAM 156 Ad Hoc Cmte, 11 Jul 66, Recommendation No. 1; "Proposed Air Force/NASA LM5S Program Management Agreement, 8 Jul 66 and attached Memo of Understanding, same date.

~~SECRET~~

~~SECRET~~

BYE-15649-75

35. Ltr, H.H. Waggershauser, EK, to BGen J.L. Martin, Jr., Dir/SP, 12 Sep 66, subj: Contract AF 18(600)-2834, Mission AS-504B (Upward), ltr, J.H. Turlock, SpecAsst to Apollo Prgm Dir/Programs, to R.O. Piland, Mgr, Experimental Prgm Ofc, MSC, NASA, 31 Aug 66, with encl, "LM&SS Mission Objectives and Performance Requirements, Aug 66.

36. Msg, [redacted] 2770, LtCol J. Hansen, Dir/Upwards Proj, to Col J. Carter, SAFSS, et al, 4 Oct 66; msg, [redacted] 3371, SAFSP to [redacted] NRO Compt, 8 Nov 66.

37. Ltr, G. Mueller, Assoc Adm, MSF, NASA to Dr. R.R. Gilruth, Dir/MSFC, NASA, 23 Dec 66, cited and quoted in msg, Whig 6047, SAFSS to SAFSP, 5 Jan 67; msg, Charge 4261, BGen J.L. Martin, Dir/SP, to Dr A.H. Flax, DNRO, 12 Jan 67.

38. Memo, BGen J.R. Martin, Dir/SP, to Dr A.H. Flax, DNRO, 8 Dec 66, subj: LMSS Program.

39. Ltr, J.H. Disher, D/Dir, Saturn/Apollo Applns, to R.F. Thompson, AsstPrgmMgr, Apollo Applns Progrm Off, 3 Dec 66, no subj; [illegible] draft ltrs, C.W. Mathews, Dir, Saturn/Apollo Applns, to Thompson, subjs: (a) Completion of LMSS Action Items, and (b) AAP Documentation (about 28 Dec 66).

40. Interview, W.D. Putnam, former NASA historian for manned space flight, by R. Perry, 23 October 1974.

41. Memo (draft), B. McMillan, DNRO to Dr D.F. Hornig, SpecAsst for Sci&Tech, the White House, 27 Aug 65, subj: NASA Activities related to Earth Reconnaissance (prepared in draft but apparently not sent); ltr, BrigGen J.T. Stewart, Dir/NRO Staff, to Hornig, 2 Sep 65, no subj (forwarding a copy of the 27 Aug 65 draft memo, actually prepared by Col P.E. Worthman, NRO staff); ltr, Stewart to J.P. Coyne, ExSec, PFIAB, 2 Sep 65, no subj.

42. Memo, C. Vance, DepSecDef, to Sec/Army, Sec/Nav, SAF, 30 Aug 65, subj: Dept. of Defense Needs for Earth Sensing from Satellites; memo, BrigGen J.C. Steward, Dir/NRO staff, to LtGen P. Caroll, DIA, 28 Sep 65, subj: DoD Needs for Earth Sensing from Satellites.

~~SECRET~~

~~SECRET~~

BYE-1564-75

43. Ltr, B. McMillan, DNRO to Dr R.C. Seamans, AsscAdm NASA, 5 Aug 65, no subj; ltr, Seamans to McMillan, 24 Aug 65, no subj.

44. MFR, Dr. A.H. Hall, DepDir (DDR&E), 15 Apr 65, subj: Space Budget Coordination Mtg, 12 Apr 65.

45. Memo, B. MacMillan, SAFUS, to SecDef, 28 Apr 65, subject: NASA Activities Related to Earth Reconnaissance.

46. Memo, B. MacMillan, SAFUS, to Dr H. Brown, SAF, 3 Jun 65, subject: NASA Reconnaissance Ventures; ltr, James E. Webb, Adm, NASA, to R.S. MacNamara, SecDef, 19 May 65, no subj; ltr, MacNamara to Webb, 6 May 65, no subj; memo, MacMillan to MacNamara, 28 Apr 65.

47. Ltr, R. MacNamara, SecDef, to J.E. Webb, Adm/NASA, 31 Jul 65, no subj; draft, MacNamara to Webb ltrs, prepared by DDR&E and NRO, 13 Jul 65.

48. Ltr, MacMillan to Seamans, 5 Aug 65.

49. Memo, W.F. Rayborn, DCI, to Adm/NASA, 16 Dec 65, subj: NASA Space Photography/ ltr, A.H. Flax, DNRO, to R.C. Seamans, Deputy Adm, NASA, 27 Dec 65, no subj.

50. Study, "DoD Response to NASA Activities in Satellite Reconnaissance," 1 Feb 66, prep by NRO staff; memo, Col P.E. Worthman, NRO staff, to Dr A.H. Flax, DNRO, 28 Jan 66, subj: DoD Response to NASA Activities in Satellite Reconnaissance.

51. Memo, Col. D.L. Carter, Dir/NRO staff, to Dr J. Foster, B. Fink, 3 Feb 67, subj: NASA Plans Regarding Upward.

52. Memo, A.H. Flax, AsstSec AF(R&D), to Dir/DR&E, 14 Mar 66, subj: NASA Chronology on Lunar and Earth Sensors.

~~SECRET~~

BYE-15249-75

53. Memo, D. V. Hornig, SpecAsst to the Pres for Sci&Tech, to R.C. Seamans, DepAdm/NASA, 9 Feb 67, no subj; ltr, Hornig to Dr A.H. Flax, ASAF(R&D), 9 Feb 67, no subj; ltr, VAdm R. Taylor, ActgDir/CIA to Flax, 13 Feb 67, no subj; ltr, Flax to Hornig, 16 Feb 67, no subj.

54. Ltr, R.C. Seamans, DepAdm/NASA, to D.F. Hornig, Spec Ast to the Pres for Sci&Tech, 21 Feb 67, no subj; memo, LtCol Yost to Dr A.J. Flax, DNRO, 23 Feb 67, no subj.

55. Memo, Col A.C. Greenlief, MilAsst to the SecDef to Dr A.H. Flax, DNRO, 11 Mar 67, no subj.

56. Draft memo, prep by Col J. Carter, NRO staff, for sig of A.H. Flax, NRO, to NRO ExCom, prep 17 Mar 67.

57. Informal notes prepared by Col L. Allen, Dir/NRO staff, Mar 67.

58. Memo, Col P.E. Worthman, NRO staff, to Dr A.H. Flax, DNRO, 20 Mar 67, subj: Conference with Mr. Sheldon on NASA Matters.

59. Memo, Dr A.H. Flax, DNRO, to C. Vance, R. Helms, and D. Hornig, ExCom members, 28 Apr 67, subj: NASA Lunar Mapping and Survey Systems (LM&SS).

60. Msg, Charge 7632, Col. R. Ford, SAFSP, to LtCol W. Yost, NRO staff, 18 May 67.

61. "Percheron Chronology," prep by LtCol W. Yost, NRO staff, 19 May 67.

62. Memo, D.F. Hornig, SpecAsst to the Pres for Sci&Tech, to R. Helms, CIA, (ExCom), 1 Jun 67.

63. MFR, Col P.E. Worthman, 20 Jun 67, subj: PERCHERON Conference with Mr. Jaffe.

DYE-15649-71

64. MFR, Col P.E. Worthman, 21 Jun 67, subj: NASA Earth Sensing Satellite Presentation to the National Aeronautics and Space Council.

65. Ltr, J.F. Foster, DDR&E, to R.C. Seamans, AssocAdm/NASA, 17 Jul 67, no subj.

66. Ltr, R.C. Seamans, DepAdm/NASA, to Dr. G.E. Mueller, 25 Jul 67, subj: Termination of the Lunar Mapping and Survey System.

67. Memo, Col P.E. Worthman, NRO Staff, to Dr. A.H. Flax, DNRO, 28 Jul 67, subj: NAS-NASA Woodshole Summer Study Group on Earth Sensing.

68. Memo, Col P.E. Worthman to J.Kirk, DDR&E, 21 Aug 67, subj: Improvement in NASA/DoD Interface on Earth-Sensing Activities.

69. Dr. R.C. Seamans, DepAdm/NASA, to A.H. Flax, SAF(R&D), 2 Oct 1967, no subj.

70. Ltr, A.H. Flax, DNRO, to R.C. Seamans, DepAdm/NASA, 1 Dec 67, no subj.

71. Ltr, C.W. Mathews, Dir/Saturn Apollo Applns, NASA, to MSC, Houston, attn R.F. Thompson, et al, 2 Aug 67, no subj; TWX, MSC to SAFSP (Hansen), 3 Aug 67; R.S. Seamans, DepAdm/NASA, to G.E. Mueller, AssocAdm MSF, NASA, about 3 Oct 67, subj: Termination of the Lunar Mapping and Survey System.

72. Draft rpts, 10 Jan 68, in SAFSP files.

73. "Final Report" on Termination of LMSS Program, 24 May 68, SAFSP; Manyear Costs Estimated at $40,000/year.