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[redacted]

APR 15 1963

MEMORANDUM FOR DIRECTOR, NATIONAL RECONNAISSANCE OFFICE

SUBJECT: Comparative Evaluation

1. Reference is made to message from Office of the Under Secretary, 20 March 1963, concerning a comparative evaluation of the possibilities of an improved search type satellite reconnaissance system.

2. The attached draft report is submitted per our conversation 11 Apr 63. The committee is in solid agreement on the recommendations; various members may want to suggest word or emphasis changes to the body of the report.

3. I concur in the recommendations and recommend immediate approval and funding. With regard to funding, it is my strong personal feeling that within the NRP there are lower priority efforts such as [redacted] that can be reduced to provide a portion of the required funds. Within the overall DOD effort there are numerous areas of far less importance that can be considered for reduction to provide the remainder of the required funds.

4. With regard to the question you raised on the selection of the 45" RV, the story is that this is the maximum size/weight that goes with the Gemini single deorbit engine. While a 60" RV is certainly feasible, it would require a new engine development with attendant loss of time and increase in cost or alternatively a clustering of Gemini engines with complications and loss of reliability. A spectrum of sizes were examined. On balance the committee felt 45" was the best choice and I concur.

ROBERT E. GREER
Major General, USAF
Director, Program A

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Rpt of Comparative
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COMPARISON EVALUATION

APRIL 1963
SAFSP

James A. Cyl
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DEPARTMENT OF THE AIR FORCE
SAFSP
Air Force Unit Post Office, Los Angeles 45, California

REPLY TO ATTN OF:

SUBJECT: Report of the Findings of the Ad Hoc Group Appointed to Evaluate Potential Systems for an Improved Search Type Satellite Reconnaissance System

TO: Director of Special Projects

1. The Ad Hoc Group established by your memorandum (Tab A) has met and completed its deliberations on the following task:

a. General.

Study and evaluate alternate courses of action to obtain a collection system providing:

(1) Large area coverage.

(2) Ground resolution of 6 ft at 2:1 contrast.

(3) All stereoscopic coverage.

(4) On-orbit command programming to permit maximum flexibility to select area for coverage after launch.

b. Specific.

Study, evaluate and make recommendations considering the merits of three courses of action:

(1) Initiate development of an LMSC/ITEK proposed gross coverage system.

(2) Reactivate 698 BJ Program or a modification thereof.

(3) Hold a competition to select a new contractor team to satisfy the USIB gross coverage requirement.

2. Conclusions reached were:

a. Three courses of action are feasible to provide a collection system for FY 1965. These are:

(1) Minimum improvements to Corona M.

(2) Reactivate 698 BJ Project.

(3) Develop and procure scale-up of Corona M to M_2.

b. No other possibilities exist to satisfy the new resolution requirement on the desired schedule. not specified by DNRA req.

3. The Ad Hoc Group recommends:

a. Reactivate the 698 BJ Project to meet the earliest possible schedule with a dual MK-5A thirty three inch (33") recovery system to fly low altitude missions. Continue to use 698 BJ programmers.

b. Initiate development of the scale-up of Corona M to M_2 as proposed by LMSC/ITEK for a dual MK-8 forty five inch (45") recovery vehicle. The M_2 is to be interchangeable for either TAT/Agena D or Atlas/Agena D.

c. Initiate the development of the MK-8 forty five inch (45") recovery vehicle for use with either 698 BJ or M_2 to provide more gross coverage per mission.

d. Decide to continue 698 BJ or M_2 based upon results of 698 BJ flight performance and product improvement program in comparison with development test of the M_2.

FORMATION OF THE AD HOC GROUP

1. The requirement for the Ad Hoc Group was established by a message, dated 20 March 1963, from the Office of the Under Secretary to the CIA and SAFSP. The Ad Hoc Group was appointed by the Director of Special Projects in a memorandum to Colonel Berg, dated 21 March 1963, subject: Comparison Study. Copies of the message and the memorandum are attached to this TAB as Exhibits A-1 and A-2.

2. The membership of the Ad Hoc Group is set forth in the appointing memorandum. Organizations represented in its membership who were active in the proceedings were CIA, SAFSP, Aerospace, SAFSS, and NPIC. The Ad Hoc Group held its first meeting on 25 March 1963 and met in continuous session, completing its final action on 10 April 1963. All of the meetings were held at the Research and Development Center, and formal minutes were prepared which are available for examination upon request.

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20 MAR 63

TO: CIA, SAFSP

FROM: OFFICE OF UNDERSECRETARY

CIA FOR DR. SCOVILLE; SAFSP FOR GEN GREER

THIS MESSAGE IN TWO PARTS. SUBJECT IS IMPROVED SEARCH TYPE SATELLITE RECONNAISSANCE SYSTEM.

PART I. DNRO DESIRES EARLIEST COMPARATIVE EVALUATION OF THE POSSIBILITIES FOR DEVELOPMENT OF AN IMPROVED SEARCH TYPE SATELLITE RECONNAISSANCE SYSTEM CAPABLE OF LARGE AREA COVERAGE WITH GROUND RESOLUTION OF 6 FEET FOR TARGET CONTRAST OF 2:1. ACCORDINGLY, HE DIRECTS THE FOLLOWING ACTION:

A. GEN GREER IS TO ESTABLISH A SMALL AD HOC GROUP OF TECHNICALLY COMPETENT PERSONNEL AND SUPERVISE THEIR CONDUCT OF AN ACCELERATED EVALUATION OF POTENTIAL SYSTEMS WHICH CAN MEET THIS GENERAL REQUIREMENT.

B. DR. SCOVILLE IS TO PROVIDE ONE OR TWO TECHNICALLY COMPETENT INDIVIDUALS TO SERVE AS MEMBERS OF THIS GROUP.

C. THIS EVALUATION IS TO INCLUDE THE ITEK PROPOSAL KNOWN AS M-2 AND ALL APPLICABLE VARIATIONS OF THE 698BJ (E6) PROJECT.

D. ALL ASPECTS OF THE EVALUATION ARE TO BE CARRIED OUT ON A COMMON BASIS TO PERMIT READY COMPARISONS BETWEEN OPTIONS.

E. THE ANALYSIS SHOULD INCLUDE COSTS TO DEVELOP AS WELL AS COST EFFECTIVENESS AFTER DEVELOPMENT.

F. THE ANALYSIS SHALL BE CONDUCTED ON THE BASIS THAT THE CAPABILITY TO PROGRAM TARGETS ON ORBIT WILL BE DEVELOPED INTO EITHER SYSTEM SELECTED, AND THIS FACTOR SHALL BE INCLUDED IN DETERMINATION OF WEIGHT, SPACE, AND COSTS OF BOTH SYSTEMS.

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.G. THE ANALYSIS SHALL BE CONDUCTED ON THE BASIS THAT CAPABILITY FOR COMPLETE STEREO COVERAGE IS REQUIRED.

PART II. FOR GEN GREER.

DNRO REQUESTS YOUR ESTIMATE OF EARLIEST DATE THAT A MEANINGFUL ANALYSIS CAN BE COMPLETED WITH SUFFICIENT THOROUGHNESS TO SERVE AS THE BASIS OF DECISION TO PROCEED WITH SYSTEM DEVELOPMENT.

EXHIBIT A-1
Page 2

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SP-1 21 March 1963

MEMORANDUM FOR COLONEL BERG

SUBJECT: Comparison Study

1. I am appointing an Ad Hoc group to study and evaluate the merits of three courses of action:

a. Initiate development of a LMSC/ITEK proposed gross coverage system based on the TAT.

b. Reinstate the BJ program or some modification thereof.

c. Hold a competition to select a new contractor team to satisfy the USIB gross coverage requirement.

2. The gross coverage requirement to be satisfied has been defined as:

a. Large area coverage.

b. Ground resolution of 6 feet at 2:1 contrast.

c. All stereo.

d. On orbit command programming to permit maximum flexibility to select area for coverage after launch.

3. The comparative analysis should include development costs, average costs per mission, and an over-all cost effectiveness evaluation of each system considered. All aspects of the evaluation are to be carried out on a common basis to permit ready comparisons between options. The analysis should also comment on weight budget, growth potential and compatibility with other known efforts.

EXHIBIT A-2
Page 1

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4. The Ad Hoc team shall consist of:

Colonel King - Chairman, Colonel Berg - Alternate
Colonel Heran
[redacted] Aerospace
[redacted] Aerospace
Mr. Davies, Rand (not present)
Lt Colonel Farnum
Lt Colonel Sides
Lt Colonel Howard
[redacted] - Alternate
Plus two additional NRO representatives [redacted] [redacted]

5. Request every effort be made to complete the study in two weeks. LMSC/ITEK and EKC/GE may be contacted or called before the board for consultation.

ROBERT E. GREER
Major General, USAF
Director of Special Projects

EXHIBIT A-2
Page 2

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PREPARATION

As preliminary to any evaluation action, the Ad Hoc Group spent several days reviewing available information concerning the subject under consideration. In brief, these information-gathering actions included:

Briefing on the comparison of the 698BJ and M Systems.

Presentation by LMSC on the M System.

Briefing by the Director of the BJ Program on the BJ Program.

Briefing on comparative capabilities of available boosters.

Presentation by the Deputy Director for Advance Planning, SAFSP, on new thinking in the field.

Presentation by ITEK/LMSC on the M_2.

Briefing by EK/GE on the 698BJ and modifications thereto.

BACKGROUND

1. The National Reconnaissance Program (NRP) is responsive only to the requirements stated by the United States Intelligence Board (USIB). The current USIB requirement (as modified by the National Security Council prior to establishment of the NRO) for general search is for 10 foot resolution with coverage being provided stereoscopically. The resolution is that defined in MIL-STD-150 at 2:1 contrast ratio. The 698BJ Project was initiated in November 1960 to satisfy this requirement. The Corona Project was then approximating the USIB requirement of 20 foot resolution a small percent of the time.

2. The Corona Project, through product improvement, became a stereoscopic system in early 1962 providing resolution of approximately 13 feet for 15% of the usable take throughout CY 1962 (total mission performance). In response to DNRO query of July 1962, the Deputy Director, National Photographic Interpretation Center (NPIC) stated that there was no interest in a different system unless it offered a substantial improvement over the Corona system. In the evaluation of the Corona system at that time, the potential resolution of 6-8 feet which could be achieved by 698BJ was not estimated to provide a significantly

great improvement in take over that of Corona M to justify its continuation, although it had a greater growth potential and more coverage per mission. When this was coupled with the lack of success and the budgetary considerations, the 698BJ was terminated in November 1962.

3. At the instigation of the NRO Staff for a careful review, a proposed restatement of this requirement for stereoscopic, 5 foot resolution has been forwarded by the Director, NPIC, to DNRO, through USIB (Comar). It is anticipated that USIB will validate this new requirement to DNRO. The General Search Satellite Reconnaissance schedule is approved and funded with sufficient number of launches to provide the frequency of coverage desired by USIB (Comar) through June 1964. This coverage will not meet the new resolution requirement. This new requirement and the necessity to provide general search coverage for FY 1965, dictates that action be taken immediately to provide this capability.

CAMERA SYSTEM CONSIDERATIONS

1. Ground Measurements

The Committee received reasonably consistent data for lens/film measured dynamic resolution for the M and BJ camera systems. While there are differences in measurement techniques, there is no reason to attribute greater accuracy to one or the other of the test procedures. It was felt, however, that the measurements included at least ten lines per millimeter of degradation introduced by the test setup. The data given in the following Table reflects the ground-measured performance of these systems at 2:1 contrast.

	LPM	R at 100 NM (ft)	R at 120 NM (ft)
test results M	135	7.3	9.0
test results 2 + 10 lines Present BJ	110	5.9	7.2

2. Degradation in Flight

Subjective analysis of M product by NPIC indicates that the resolution predictions in the above Table are achieved in flight less than 15% of the time for M. This degradation is caused by: (See Exhibit D-1)

a. Vehicle motion.

b. IMC errors.

c. Illumination, atmosphere, etc.

d. Processing, etc.

e. Thermal environment.

The amounts contributed by b. through d. should be roughly the same for any of the systems considered. Vehicle motion, on the other hand, may be seriously affected by payload operation. Telemetry from BJ flights indicates that these effects are negligible for that system. No data was available on the effect of M payload operation on vehicle motion. Not true

In addition, the active control of thermal environment by BJ should provide improved resolution over the passive M system. Therefore, it might be expected that some improvement in percentage of useful take might be achieved by BJ, further widening the resolution difference shown in the Table above.

The EK proposal included elimination of the active thermal control. See E2 Block 2, d.

3. System Improvements

a. Two systems were proposed to achieve the six foot resolution at 120 nautical mile altitude:

(1) A product improvement program for BJ, including reduction of T-stop, simplified film handling, and variable exposure.

(2) A scale-up of M (24" focal length) to M_2 (40") including improvements in IMC and synchronization.

Both systems are judged to be feasible, and both can be available in about 18 months.

b. The following table shows predicted ground-measured resolution for improved BJ and for M_2.

	LPM	R at 100 NM (ft)	R at 120 NM (ft)
		4.25	
M_2	140	4.3	5.1
Improved BJ	120	5.5	(6.6) not quite 6'

The M_2 resolution is considered optimistic because:

(1) Problems in achieving 68% increase in angular acuity over M.

(2) Large angular momentum of payload.

(With regard to (2) above, some of the uncertainty might be removed by measurements on future M flights.)

The improved BJ resolution is considered somewhat conservative since it constitutes only an 8% increase in angular acuity over that of the present BJ. In addition, the contractor has a history of restraint in making claims for his yes equipment.

c. These comments suggest that the two systems are

comparable on a ground-measured basis. With proper R&D measurements on systems flying during the 18 months of development, an improvement in product-use percentage can be anticipated. (Also above the 130 e/mm BJ and 140 MZ?)

4. Exposure

a. There is a significant difference in T-stop for M_2 and BJ, and in the corresponding exposure. This becomes important at low sun angles. The following Table compares systems for a 7° sun angle.

	T-Stop	Exposure at 7° Angle
M and M_2	3.8	1/350
Present BJ	5.6	1/162

The BJ T-stop can be achieved for systems presently in inventory by straightforward multilayer coating of the reflector surfaces. Also for image motion tolerance.

b. A programable slit can be included on the fifth BJ flight, making the various systems roughly equivalent with regard to low sun angle conditions.

5. Camera System Conclusions

a. The M system cannot achieve the six-foot requirement for more than about 5% of the take. Although it has shown good growth, it has probably reached saturation, and further improvement is unlikely. ?

b. The M_2 and improved BJ systems are considered comparable in theoretical resolution, although the product-use percentage might be better for BJ. Either system can exceed the six-foot requirement for a percentage of the take in excess of 15%.

c. Time is a factor and it overrides the small theoretical advantages of the M_2 over an improved BJ camera system. Attainment of the required performance appears more probable within the development time for the M_2 system by immediate initiation of a BJ flight program including certain product improvements rather than initiating a flight program with a new M_2 system when it becoms s available.

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"QUALITY" - FROM INTERROGATION OF PIs 24" F.L.

OF TIME	DETECT	FACTOR	IDENTIFY MONO	FACTOR	STEREO	
		5		½		
RARELY	3'		9'		5'	2
15	10'		30'		15'	6
50	30'		90'		45'	20
100	100'		300'		150'	50

10

Not 12 mi.

EXHIBIT D-1

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PRODUCT IMPROVEMENT ON BJ

1. Inherent in the Committee recommendation to reactivate 698BJ is the conclusion that an active product improvement program through the recommended eight flights could produce an operational system comparable in performance to the proposed M_2 system.

2. In realization of the weight the time factor exerted on the decision to recommend reactivation of 698BJ, the recommendation includes a philosophy applying to design changes to the system as follows: Incorporate changes only when there is a demonstrated requirement, holding vehicle configurations to blocks of four vehicles.

Block 1, First four flights -

a. Use existing hardware.

b. Recoated mirrors to improve the lens speed.

c. Take-up redesign for the new re-entry vehicle.
no improvement in performance

Block 2, Flights five through eight -

a. Programmable slit to permit variation of exposure on orbit.

b. Improved optical mounting for resolution improvement.

c. Improved dynamics for the camera drive to reduce image smear.

d. Passive thermal control to reduce environmental control requirements and reduce power demands with resultant weight reduction. not important on ATLAS.

e. Relocation of optical filter to permit changing at any time up to flight.

f. Incorporation of Stellar Index Unit to improve geometry for measurement.

Block 3, Flight nine through - -

These changes should be reviewed and planned for inclusion, but should not be committed until system capability is demonstrated.

a. Enlarged film supply and lengthened midsection. This would permit maximum utilization of the 45" R/V capability in a J configuration.

b. Improved lens and light weight optics to increase system resolution and reduce weight for growth potential.

c. Modified film transport to handle relocated supply spools and simplify fabrication, assembly and checkout of the camera system.

d. V/H Sensor to improve image synchronization and relieve system or on-orbit programming for IMC after demonstration of the capability.

e. Corrected IMC across scan angle to increase average resolution throughout the format.

DECISION MILESTONES RELATING TO 698BJ VS M_2 CAPABILITY

1. Basic to the recommendations of the Committee are decision points at which, by review and evaluation, future courses of action may be resolved. This method preserves a desirable degree of flexibility in that it retains the options on feasible systems meeting the 1965 general search requirement until comparison of measurable performance is possible.

2. The recommended course is to fix the first decision point with the first successful 698BJ flight. Should the 698BJ demonstrate a significant improvement in quality over the M system, the BJ should be continued and expanded and the design improvements listed in Tab E for the ninth flight should be incorporated. At the same time, the M system should plan to phase out. If BJ conclusively exhibits little or no improvement, then it should be cancelled and M_2 development continued. If it were desirable to retain the Atlas/Agena capability for M_2, then some BJ flights might be continued to supplement M coverage until M_2 would be available.

3. The second decision point would occur about 1 January 1964 when results of the static lens test of M_2 would permit some prediction as to eventual capability. If M_2 promises a signifi-

should be based on capability forecast for BJ to meet requirements.

cant improvement over BJ, then continue M_2. If not, cancel M_2.

4. The third decision point occurs approximately 15 May 1964 when M_2 dynamic camera results will be available. Should M_2 dynamic results still indicate considerable potential, plan to phase out BJ after M_2 flight successes and evaluation.

GENERAL BOOSTER CONSIDERATIONS

1. The attached figures (Exhibit G-1) showing the relative capabilities of TAT and Atlas D in their present state, serves as a reference for the following discussion. It should be noted that these figures are for current TAT/Agena D performance.

a. M_2 with a single MK-VIII R/V can be put into a 100 nautical mile 80° direct orbit with no weight margin at 8 day life. by a TAT/Agena D. An M_2 with 2 R/V's (either MK-V or MK-VIII) cannot be placed in a near-polar orbit by TAT/Agena D.

~100# at 4 days. at 85°.

b. A dual camera BJ cannot be carried into orbit by a TAT/Agena D.

2. Other weight savings can be effected by various decreases in Agena D weight and by dropping the Sergeant boosters on the TAT 25 seconds earlier (the inner range safety limits.) These provide an additional capability of from 400 to 500 pounds which enables an M_2/MK-VIII to be put into a 90° orbit, but with little weight margin. at 8 days. In my opinion, the MK VIII mission is 4-5 days only - like current M. for 4 day, no advantage of 90°

3. The most significant modification involves using Hybalene fuel in the Agena. The purported weight capability increase at 100 nautical miles provided by Hybalene is 630 pounds. The opinion of various authorities in the propulsion field is that this estimate

is optimistic. In addition, there are significant handling and range safety problems produced by Hybalene. In any case, assuming the Hybalene claims prove to be true after an 18-month development program, the following conditions hold:

a. M_2/MK-VIII can be put into a 120° orbit (100 n.m.).

b. M_2/Dual MK-V can be put into a 100° orbit with essentially no weight margin.

c. M_2/Dual MK-VIII cannot be put into a near-polar orbit.

4. As a result of the above considerations, the following recommendations are made:

a. Atlas D/Agena D be used for both BJ and M_2. Insure that the M_2 Agena be compatible with both Atlas and TAT.

b. The forthcoming "Standard Atlas" be examined to insure that it meets the reliability and performance standards of the carefully inspected and tested Atlases which were used for the initial five BJ flights. The option should remain at some later date to institute the quality control procedures used for the Mercury Atlas series, if this proves to be desirable.

c. The possible advantages of an improved Agena IRP (Inertial Reference Package) with Atlas for beyond-line-of-sight

boost guidance and orbit injection should be examined and compared with TAT/Agena/BTL guidance.

d. The possibilities of reduced turn-around time for Atlas should be examined.

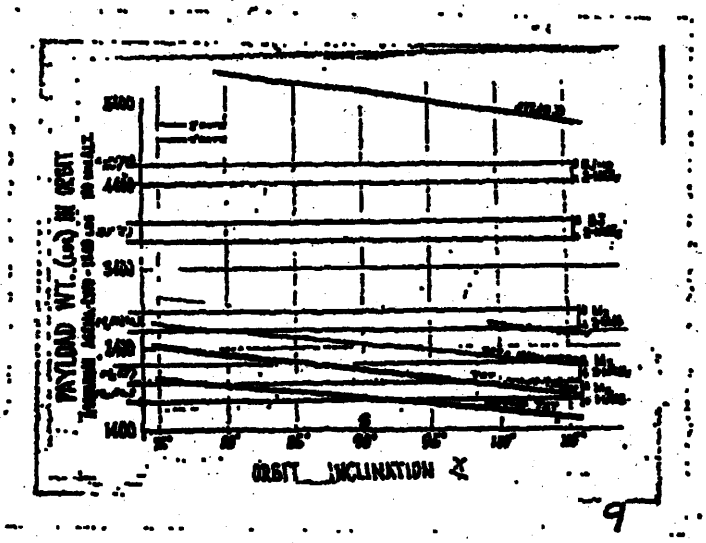

EXHIBIT G-1

BYE-4135-63

RECOVERY VEHICLES

1. Both contractor teams proposed variants based on the current 33 inch diameter recovery vehicle and a scaled-up 45 inch diameter recovery vehicle. The relation of these two recovery vehicles to various film loads and boosters is covered elsewhere in the report. (Exhibit H-1)

2. Since the maximum recoverable film load with the MK-VA 33 inch diameter recovery vehicle is 120 pounds as opposed to 390 pounds for the MK-VIII 45 inch diameter, it was clearly evident that under any assumed booster capability, the use of the 45 inch diameter vehicle was preferable from the standpoint of total recovered film load and that the cost effectiveness of any system would be better by using either one or two 45 inch vehicles. (Exhibit H-2)

3. The question of sizing of the recovery vehicle was examined, it being apparent that a number of choices were available. The reasons for selecting the MK-VIII 45 inch diameter were:

a. It represents the largest size that can be deboosted by the Gemini rocket. A larger size would require development of a new larger retro-rocket (12-18 months and approximately [redacted] or use of multiple retro-rockets with serious

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impact on reliability.

b. The 45 inch diameter is the smallest size capable of taking a full mission tape (four days - approximately 390 pounds).

c. This size is conveniently packaged in the J configuration to achieve mission flexibility.

4. The Committee concluded that the development of the MK-VIII 45 inch vehicles should proceed so as to be available as soon as possible.

	VEHICLE SLV / ATLAS DEV	VEHICLE SLV / ATLAS PER/YR	PAYLOAD INSP DEV	PAYLOAD INSP PER/YR	RECOVERY VEHICLE DEV	RECOVERY VEHICLE PER/YR	PAYLOAD SENSOR DEV	PAYLOAD SENSOR PER/YR	TOTAL DEV	TOTAL PERS	TOTAL 5 YEAR-ON PER/YR
M-2 (Incl S/1)											
Weight Reduction											
Multi-Cycle Dev.											
Mod IX Prog (Stored I-F-L)											
Quest											
IMU Sensor											
MK-8 Capsule											
TOTAL											
OTHER											
Prof. Dep. Retro-Rocket J. Conf.											
Guidance Support											

[redacted]

* Includes [redacted] for Facility
** Includes [redacted] for Facility
*** [redacted] for SHED added - (Not [redacted] for 18 mo.)

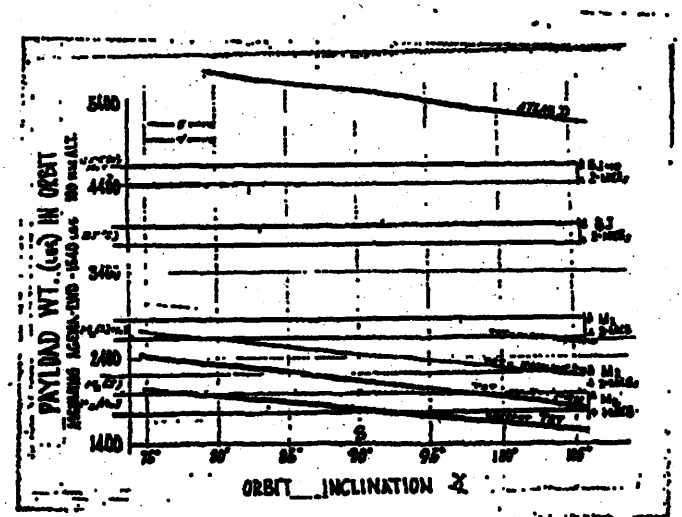

EXHIBIT H-1

RECOVERY VEHICLE COMPARISON

R/V	CAMERA	T/U [illegible]	Film [illegible]	Film Wt.	Frames	Coverage
MK5A	1-HJ	1-19"	7000 ft	85 lb	1-1850	2.5×10^6 [illegible] / 4.3×10^6 [illegible]
33°	M	2-20"	7800	80	2-2950	5.25×10^6 [illegible]
	C-375	2-16½"	5100	125	2-1350	3.3×10^6 [illegible]
	M-2	2-18"	6250	115	2-1750	2.3×10^6 [illegible]
MK-8	1-BJ	1-31"	16,000	195	1-4250	6.2×10^6 [illegible] / 10.4×10^6 [illegible]
45°	M	2-32"	16,500	170	2-6250	7.6×10^6 [illegible]
	C-375	2-30"	16,000	365	2-4000	9.8×10^6 [illegible]
	M-2	2-30½"	15,500	290	2-4350	5.8×10^6 [illegible]

[illegible] .7 [illegible] 10' [illegible]

24

EXHIBIT H-2

LAUNCH PAD CONSIDERATIONS

1. To comply with a new USIB requirement to provide a standby capability for backup in case of mission failure and quicker response for crisis situations, the PALC I (Pad 1 and 2) facility is being converted to TAT/Agena D to launch the Corona M Program beginning October 1963. The stand-by Corona M will be accomplished on Pad 2 and 4 of launch complex 75 to be followed by a stand-by Gambit capability at PALC II (Pad 3 and 4). At such time as Gambit stand-by becomes available, it appears that the Corona M stand-by requirement would be alleviated or reduced to the point where the four pads at Thor Launch Complex 75 could satisfy the residual stand-by requirement.

2. The reactivation of 698 BJ probably could be accomplished (barring catastrophe) at PALC II (Pad 3 and 4) without disruption to Gambit launch schedule until the advent of the Gambit stand-by capability in May 1964. It would then be necessary to move 698 BJ to PALC I (Pad 1 or 2) since Gambit requires 2, (possibly 3) Atlas/Agena D pads to provide the R-7 capability. This would preclude a continued 698 BJ stand-by and regular launch schedule without the addition of new Atlas launch pads (new general search system-

will probably retain a stand-by requirement since it should significantly improve the efficiency of the Gambit targeting as compared to the resolution of the Corona M system.)

3. The common elements of the 698 BJ and Gambit systems are the Atlas Agena boosters and these elements are, and will probably continue to be the pacing items on launch readiness. By specific planning and implementation, it is possible to arrive at an interchangeability permitting the launch of either system from a short stand-by status, alleviating the requirement for new pads.

PROGRAMMERS

1. The instructions from DNRO required that the system have the capability to accept in-flight ground commands to include target areas not programmed prior to launch.

2. There are two systems proposed that would meet the basic requirement. These are:

a. A pre-launch loaded type with provision for modifying the area coverage through an in-flight loaded auxiliary unit. The basic pre-launch loaded unit is digital, using electrostatic tape rather than the analog paper tape system. Both the command and the time of execution of the command are on the tape and the command is executed when the clock time coincides with the stored time of execution. The auxiliary unit uses a ferrite core memory to store similar command/execution words.

b. The other system is the unit used in the 698 BJ program. This system uses delay lines in which commands and their time of execution are stored and may be completely reloaded from the ground at any station passage. The addition of new commands does not necessarily require the complete reloading of the programmer. It is noted that the G programmer is a similar device using the same ground station equipments.

c. Of the two systems, the latter has the greater flexibility and economy of film consumption although there is some question as to whether the area coverage mission requires the greater flexibility. Nevertheless, the Committee concluded that at least as long as the BJ system or some deviant thereof is used, the complete on-orbit loading capability which is a part of that system should be used. The weight, power, and cost differentials are not significant in an Atlas boosted system.

d. It should be noted that there is the possibility of using the electrostatic tape unit with the delay line unit in the event that a backup system is required because of vulnerability (jamming) considerations.

e. The Committee considered the security aspects governing the two systems including the present satisfactory operation of the M system utilizing a pre-launch loaded tape. The minimal activity required in preparation check and orbit operation are desirable; however, it was concluded that by adopting appropriate procedures, a similarly satisfactory operation of the BJ system can be achieved.

A STATEMENT ON CALIBRATION

1. Any evolving reconnaissance camera system should consider an attempt to determine or recover the accurate angular relationships between cameras and between the cameras and the vehicle's ideal inertial reference system. In attempting to design a system that lends itself to calibration, there may well be mechanical difficulties which might lead to costly decisions. In making a decision of this nature, it is worth while to weigh the fact that much specialized human effort and subsequent expense goes into trying to recover these angular relationships, after the fact, in order to determine meaningful measurements.

2. Knowing the dimensions of an object not only assists in the identification of the object, but also reflects its operational capability, and as such, measurements become part and parcel of the photo interpreters discipline.

3. A knowledge of the errors inherent in the system makes the system an accurate recording device. The degree of accuracy to which the errors are known is reflected in the final dimensions of the object. It is therefore important to realize that taking the picture and delivering it to the users is only part of the

production chain (admittedly the most important part) that eventually evolves into a report that can possibly sway government decisions. Because of this critical fact, it is recommended that the achievement of accurate calibration become a serious consideration.

4. In general, the following calibration requirements should be considered during design:

a. Determine the angular relationships between the optical axes of all cameras used.

b. Determine the angular relationship between the optical axes of the cameras and the ideal reference system of the vehicle. (a. and b. above can be accomplished by employing theodolites and autocollimation techniques.)

c. There should be a 29 bit binary block readout for time on every camera complete with reference or index marks.
I unnecessarily restrictive but maybe all right.

d. There should be redundancy of attitude sensors in order to increase the reliability of the system, i.e., there should be horizon cameras, and an S/I (Stellar Index) system. There should also be an IRS (Inertial Reference System) binary readout on film or recoverable magnetic tape.

e. The most accurate sensor is the S/I system provided that the attitude (Pitch, roll, and yaw) derived from the S/I package can be transferred to those of the main system without the loss of the inherent accuracy of the S/I values; the above is true of all other attitude sensors.

f. All camera formats should have non-symmetrical fiducial marks and/or center of format indicators.

g. On each format there should be discrete marks to determine and correct errors due to the dimensional instability of the film.

h. There should be time pulses on the format of any panoramic or strip exposure.

i. Cameras should be calibrated for operational focal length, lens distortion and position of the principal point of exposure.

j. The stellar camera should cycle at approximately the same frequency as the panoramic camera. ?

k. The stellar camera should have a cone angle of approximately 30°.

5. The above calibration recommendations are described in general terms only. There will be a time in the future when more detailed discussions will be required. The above recommendations are intended to impart the philosophy of calibration requirements. Furthermore, the users should have a voice in the discussion of the details when the time arises.

SCHEDULES

1. The recommended number of systems to commit for launch was determined by applying the following considerations:

a. A sufficient number of launches should be programmed to give a reasonable idea of over-all system performance.

b. The launch schedule should be such that it allows for reasonably frequent coverage capability to augment and supplement that provided by M, MJ.

c. The number of launches and scheduling should permit frequent coverage up to the point where either improved BJ or M_2 is selected as the next operational system.

d. A sufficient number of launches should be programmed to allow the currently available four BJ's to be used up and to enable the improved BJ capability to be achieved as part of a normal product improvement program.

e. The number of launches should be high enough to allow at least three or four flights to be made before (because of lead time considerations) it is necessary to decide on continuing the 698BJ Program, or converting to M_2. It should also allow for the possibility of compressing the schedule and increasing the number of launches.

f. The number of launches should preserve a production capability responsive to a possible determination that BJ resolution is mandatory and M/MJ is no longer desired.

2. As a result of 1.a. through 1.f. above, the Committee recommends that the number of BJ flights be eight; first launch in September/October 1963 with subsequent launches at 45-day intervals. This would match the M_2 development schedule and allow for a possible schedule compression to 35-day intervals. Four of the launches would be with the essentially unmodified BJ. The next four would include product improvement modifications. This schedule is attached as Exhibit L-1.

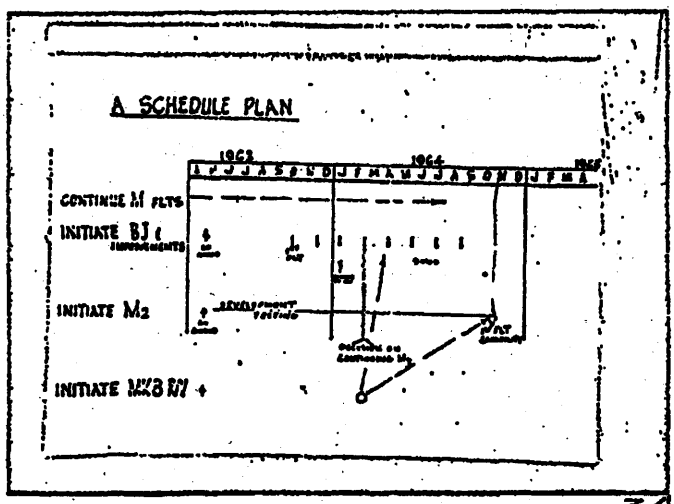

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EXHIBIT L-1

ORBITAL STABILIZATION

1. Since all three systems under consideration (M, M_2, and 698 BJ) use the Agena for in-orbit stabilization, the Committee reviewed Agena performance to determine whether a six foot resolution photographic system could be effectively stabilized by the Agena.

2. Stabilization specification for the 698 BJ Agena was established as:

Pitch	± .35 @ .0065 °/Sec
Roll	± .3 @ .01 °/Sec
Yaw	± .35 @ .008 °/Sec

Post flight analysis verified that stabilization performance was within the specification.

3. Considering the performance cited para. b above, an analysis of image smear values contributed by vehicle stabilization was made. The analysis reveals that at 1/100 exposure smear values in all axes remain less than two feet, (Exhibit M-1). These values are within the smear budget allocated to vehicle stabilization for either system under consideration assuming no large perturbations are caused by payload operation. It was concluded that six foot resolution is achievable using the Agena for on-orbit stabilization.

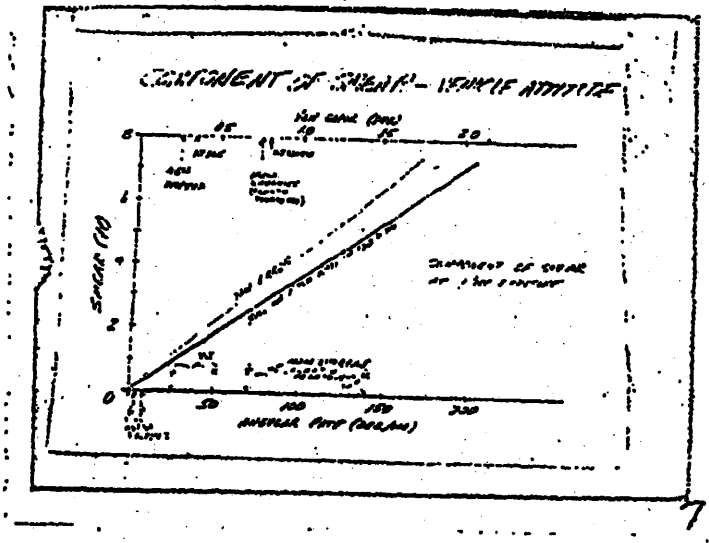


EXHIBIT M-1

COST EVALUATION CONSIDERATIONS

1. The costs presented by the contractors for the development and flight of the M_2 and BJ camera systems were reviewed. Generally, their cost estimates are considered realistic. The difference in government management procedures and philosophy under which the contractors have operated is considered a major factor in explaining the variance in proposed cost between the two payloads considered.

2. The Corona covert development and procurement practices with streamlined technical reviews of design, test procedures, tests, etc., which minimize report requirements and provide for technical decision through a designated working Configuration Change Control Board is believed to account for a significant part of the development cost variances between systems.

See Exhibit N-1. Included in the combined BJ estimates is approximately [redacted] flight vehicle for field support at the launch base to accomplish the check-out and launch preparation for the system whereas the M_2 system cost allowances for field support are negligible since program concepts which have

been effectively applied in the Corona Program require the delivery of a flight-ready system to the launch base. If the Corona development and test philosophy can be effectively incorporated into the BJ system program management, costs may be adjusted to a point where the two payload systems are comparable from a cost standpoint.

3. Approximately [redacted] of cost for the delivery of a BJ flight system is accounted for in the difference in contractor responsibility for providing similar items of equipment. In the M_2 system, the programmer, batteries, payload telemetry, etc., are provided with the Agena D as mission peculiar items and are costed as Agena peculiars whereas in the BJ system, these equipments are provided as part of the payload and are costed as part of the payload system.

4. The significant difference, from a cost standpoint, in the two systems as proposed is the booster cost, [redacted] for Atlas vs. [redacted] for B. T. L) for a thrust augmented Thor. Exhibit N-2 is a comparison of costs to provide a booster, Agena D, Agena D mission peculiar modifications, launch and support charges. The difference of [redacted] in the Agena D

peculiars is accounted for by the configuration arrangement whereby under the BJ concept, some mission peculiar equipment is provided with the payload system that is proposed in the M_2 system as Agena D peculiar, i.e., programmer, batteries, telemetry, etc. There is also a major difference in booster launch cost. For the most part, booster launch costs are of a fixed or semi fixed nature. That is, you must forecast the required launch capability six to twelve months prior to launch for a given launch complex and then man to that level. Thus, the major costs are incurred regardless of the actual number of launches attained. The cost to operate and maintain four pads on a 30 day turn around basis at PMR is estimated to be [redacted] yr TAT and [redacted] Atlas.

5. The Committee attempted to arrive at a standard of comparison between boosters by determining costs associated with placing a pound of payload in orbit with the Atlas, Thor augmented, and Thor augmented Hybalene boosters under various levels of reliability. The assumption was made that the total weight carrying capability of the booster would be efficiently utilized and that each pound of payload woul have equal value. Under these assumptions, from a cost standpoint, a 35% reliable Atlas is equivalent to a 100% reliable TAT and a 55% reliable Atlas is

equivalent to a 100% reliable TAT Hybalene. See Exhibit N-3, and Exhibit N-3a.

6. Exhibits N-4 and N-5 show the cost per pound of film recovered and cost per square mile covered assuming equal reliability for the various proposed systems. The chart shows that the development of the MK-VIII capsule will significantly improve system cost effectiveness, assuming that the more film recovered, the better and that all film recovered is of equal value.

7. Exhibit N-6 shows a cost per flight comparison of various programs. The M_2 and BJ systems appear to fit in cost rank in the same order as system complexity, taking into consideration the difference in vehicle and support costs.

8. Exhibit N-7 represents a summary of costs for accomplishing the recommended developments as indicated. It should be noted that the BJ contractors proposed camera development program has been reduced from [redacted] on a product improvement basis. This reduction is believed feasible if the Corona management philosophy is adopted. The cost per flight after development in the BJ/Atlas configuration is estimated at [redacted]. There is a potential saving from this cost of [redacted] per flight

in incorporating the M_2 system with the Atlas if BJ cost reductions discussed in paragraph 2 are not realized. Costs would be further reduced up to [redacted]/flight if the TAT booster could be effectively utilized.

9. Exhibit N-8 is a presentation of the work sheet utilized to arrive at program costs for the two systems.

10. It was concluded that cost differential was not a significant factor in utilizing Atlas for both 698BJ and M_2 to optimize performance and cost effectiveness.

PROPOSAL COST COMPARISON

	M_2	BJ
Camera Development	[redacted]	
Flight Cameras		
System Development		
Flight Systems		
Agena Mission Peculiars		
Mod IX Programmer with I.F.L.		

COMMON ITEMS

Agena D	[redacted]
MK-8 Recovery Vehicle	
Retro Rocket for Full MK-8 Capability	

EXHIBIT N-1

VEHICLE COSTS

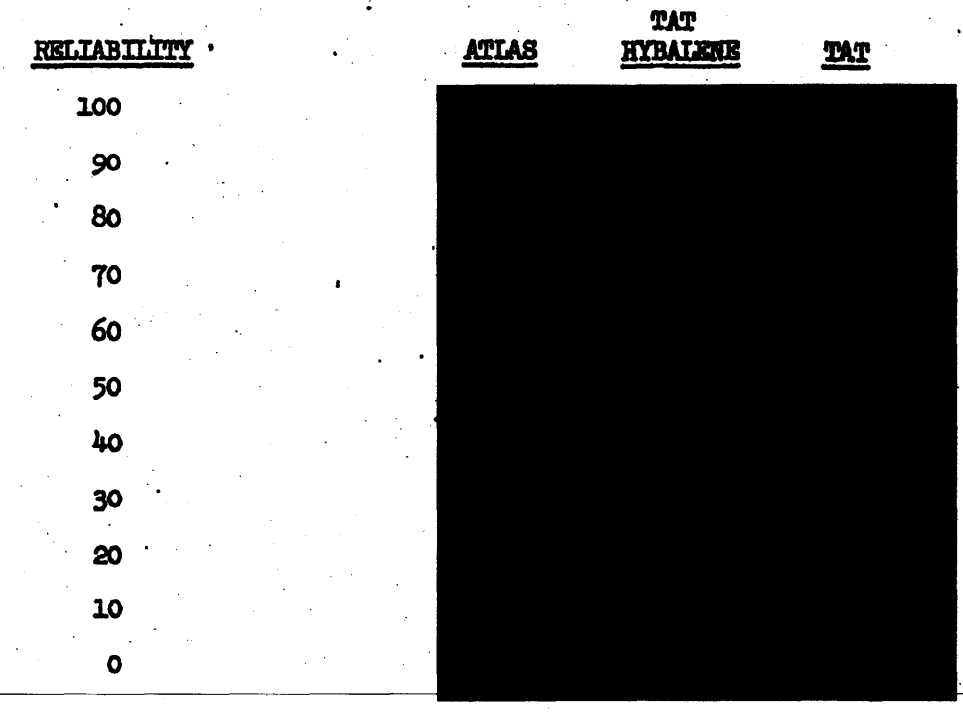
	E-6	M-2
AGENA "D"		
PECULIAR		
BOOSTER		
LAUNCH CHARGES		
BOOSTER		
AGENA		
SUPPORT		
PROP, TRANSP.		
BTL		
SATELLITE CONTROL		Single)

EXHIBIT N-2

TOP SECRET

BYEMAN

COST PER POUND IN ORBIT



WEIGHT CAPABILITY FOR POLAR ORBIT - 100 NAUTICAL MILES PERIGEE

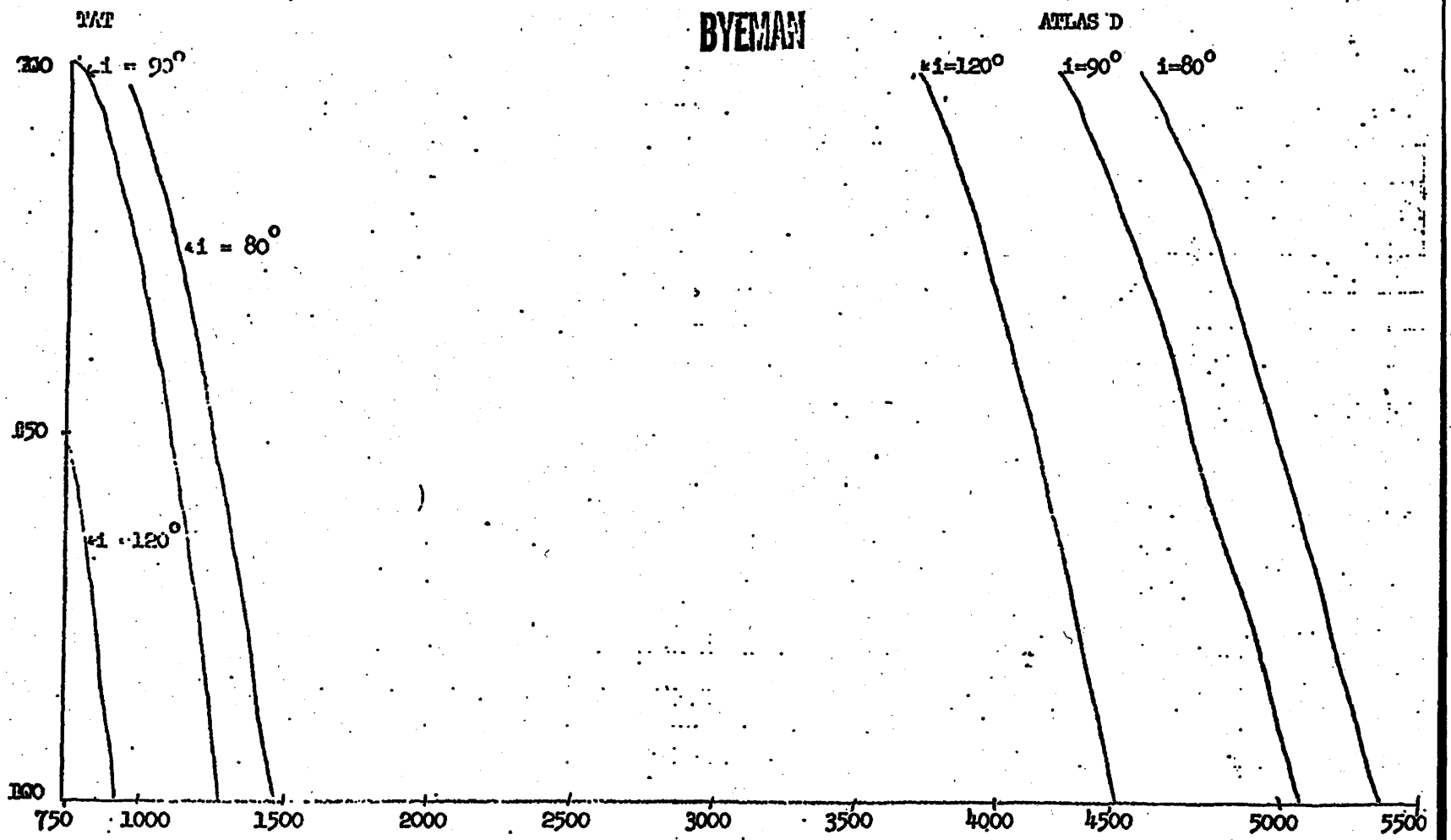
ATLAS/AGENA - - - - - - 5100 pounds

TAT/AGENA - - - - - - 1400 pounds

TAT (HYBALENE) AGENA - - - - 2400 pounds

BYEMAN
TOP SECRET

EXHIBIT N-3



ASSUMING: AGENA D EWO 1946 LBS. (INCLUDING 108 LB. PROPELLANTS)
BOTTLE DROP AT T+70 SEC FOR TAT
PMR LAUNCH, SINGLE BURN FOR AGENA

EXHIBIT N-3a

CONFIGURATION	COST PER FLIGHT	POUNDS OF FILM	COST PER LB OF FILM
ATLAS/BJ - MK V	[redacted]		
ATLAS/BJ - DUAL MK V			
ATLAS/BJ - MK VIII			
ATLAS/BJ - DUAL MK VIII			
ATLAS/M_2 - MK V			
ATLAS/M_2 - DUAL MK V			
ATLAS/M_2 - MK VIII			
ATLAS/M_2 - DUAL MK VIII			
ATLAS/M_2 - DUAL MK VIII (New Retro)			
TAT/M_2 - MK V			
TAT/M_2 - DUAL MK V			
TAT/M_2 - MK VIII			
TAT/M_2 - DUAL MK VIII			
TAT/BJ - MK V			

EXHIBIT N-4

these don't make with H-2 and N-4

CONFIGURATION	COST PER FLIGHT	COVERAGE SQ MILE STEREO	COST PER SQ MILE COVERED
ATLAS/BJ - MK V	[redacted]		
ATLAS/BJ - DUAL MK V			
ATLAS/BJ - MK VIII			
ATLAS/BJ - DUAL MK VIII			
ATLAS/M_2 - MK V			
ATLAS/M_2 - DUAL MK V			
ATLAS/M_2 - MK VIII			
ATLAS/M_2 - DUAL MK VIII			
TAT/M_2 - MK V			
TAT/M_2 - DUAL MK V			
TAT/M_2 - MK VIII			
TAT/M_2 - DUAL MK VIII			
TAT/BJ - MK V			

EXHIBIT N-5

COST COMPARISON

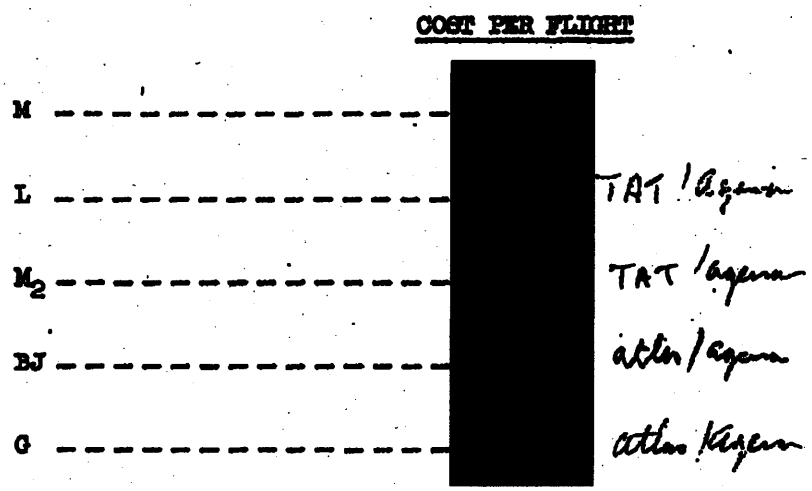


EXHIBIT K-6

DEVELOPMENT COSTS

BJ CAMERA IMPROVEMENTS

BJ SYSTEM AGE

M_2 CAMERA

M_2 CAMERA AGE

M_2 SYSTEM

M_2 SYSTEM AGE

MK-VIII RECOVERY VEHICLE

SYSTEM AGE MODIFICATIONS FOR MK VIII

MOD IX PROGRAMMER

MOD IX MEMORY UNIT (I.F.L.)

[redacted]

COST PER FLIGHT AFTER DEVELOPMENT (BJ)

TOTAL PROGRAM COSTS	FY 63	FY 64	FY 65	TOTAL
8 FLIGHTS	[redacted]			
698BJ, 18 Follow-on Flts.		[redacted]		
M_2/ATLAS		[redacted]		
TAT With Either System				

EXHIBIT M-7

	VEHICLE			PAYLOAD TEST		RECOVERY VEHICLE		PAYLOAD SYSTEM		TOTAL	
	ATLAS		TAT							5	FOLLOW-ON
	DEV	PER/FLT		DEV	PER/FLT	DEV	PER/FLT	DEV	PER/FLT	DEV FLTS	PER/FLT
E-6											
Start & Stop Platen											
C-375											
MK-8 Capsule											
"J" Configuration											
TOTAL											
QUEST											
PAD MOD											
AGENA "D"											
GUIDANCE DEV.											

* Completed boosters and 4 Agena "B" available (Est value booster, Agena Modif)
** BJ hardware available
*** No multi-cycle dev. costs included.

EXHIBIT N-8
Page 1

6 April 1963

REPORT OF SUBCOMMITTEE ON OTHER SOURCES

1. Pursuant to the instructions of the Chairman, on 5 April 1963, the undersigned have looked into the availability of other sources and the advisability of sending out RFP's and establishing a competitive selection procedure.

2. Information Considered -

a. On 28 March 1963, Captain Frank B. Gorman, USN, Deputy Director for Advance Plans (SAFSP) whose responsibilities encompass the screening of all new ideas, proposals and concepts, originating both from within and outside the Government, briefed the entire Group on the latest concepts for the 1965 period. Captain Gorman, as a member of this Subcommittee, has participated further in the appraisal of possible sources.

b. The Subcommittee has also looked into the proceedings of the VALLEY Source Selection Board which met during the period March-July 1962. Although the VALLEY Source Selection Board was interested in the post 1965 time period, it did consider the capability of all of the potential contractors in this field of space environment reconnaissance. Specifically evaluated for total system capability were Aeronutronics, Autometrics, Bill Jack, Bulova, Chicago Aerial, E-K Co., Fairchild, Hycon, Itek, Mourer, Perkin-Elmer and RCA. The VALLEY Board solicited proposals from and proposals were submitted by the E-K Co., Fairchild, Hycon, Itek and Perkin-Elmer. Of some importance is the fact that several of the officers who are assigned to the present group or who have assisted or participated in its proceedings were members or alternates of the VALLEY Source Selection Board, i.e., Colonel King, Captain Gorman - USN, [redacted] and [redacted].

c. The Subcommittee has also drawn liberally upon the experience and comments of all of the members of the group. This matter was discussed extensively at the meeting of the group on 5 April 1963. The Chairman canvassed the group to determine if there were other sources that should be solicited, but none were proposed.

d. The Committee has also considered that the solicitation of proposals from contractors having no real potential of performance would be wastefully expensive to the contractors concerned, and that

many of such costs would be ultimately charged to the Government through overhead allocations.

e. It was the consensus of the group that no sources, other than the contractors designated in the following paragraphs and for the reasons stated therein, should be solicited for proposals.

3. The Selection of the E-K/G.E. Team for the 698BJ.

a. The 698BJ Program, originally planned as an eight foot system, was cancelled after five partially unsuccessful shots. Presently available as hardware in being from this Program are three boosters, four Agenas and four payloads. With reinstatement, flights could start within four months.

b. The 698BJ Program was cancelled because, at the time, it was considered that with the higher resolution of the G/L spotting systems to supplement the resolution being obtained in the then operational M gross coverage system, it would be inadvisable, particularly from a cost effectiveness standpoint, to continue on with the BJ Program and obtain the moderately higher resolution gross coverage then expected of the original BJ system.

c. The criteria set forth in the directives establishing this ad hoc group indicates that higher resolution gross coverage is now required. Only the BJ system offers what is comparatively an immediate capability to satisfy this need. While the present requirement is stated as six foot resolution, it is considered that the BJ system provides strong possibilities of evolving into the desired system by product improvement.

d. It would be impractical to utilize other than the original contractors, i.e., G.E. and E-K to reinstate the terminated BJ Program and accomplish product improvement concurrently with providing flight hardware for useful flights.

4. The Selection of the LMSC/Itek Team for the M_2 Development

a. The back-up against failure of the BJ system to meet requirements is the M_2 development.

b. Essentially, the M_2 is a scale-up of the highly successful M camera system, and its development will utilize personnel, facilities and procedures which have been proven out in connection with the M camera.