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

OFFICE OF THE DIRECTOR

July 16, 1968

Dear Ruf:

This memorandum is in response to your June 17, 1968, letter asking for data on the National Reconnaissance Program (NRP) photographic systems for the use of the National Intelligence Resources Board (NIRB). You asked for the anticipated effect on the products of CORONA and GAMBIT-3 of currently planned systems improvements which would take effect over the next several years and estimates of the cost trade-offs if the current program is continued and if a decision were made to cancel HEXAGON in the relatively near future.

GAMBIT

There are two changes planned for the GAMBIT-3 program. The first is the incorporation of a dual recovery capability effective approximately July 1969 (Vehicle 23) and a concurrent extension of the vehicle orbital lifetime to 14 days. We hope to extend the orbital lifetime further to 18 days by Vehicle 33.

The dual recovery capsule will:

- a. reduce the time between the time of exposure and the time the photography is delivered to the photo interpreter when compared with an extended life mission using a single recovery capsule;
- b. permit limited reprogramming of the second portion of the mission based upon first portion results; and
- c. keep the vehicle from being film limited at the longer mission lifetimes.

The increase in mission lifetime will do several things. It will:

- a. increase the probability of successful coverage of high priority targets by providing more accesses to these targets. This is shown graphically in TAB A;
- b. permit more of the lower priority targets in high density target areas to be covered; and

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GAMBIT/CORONA/HEXAGON

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c. increase the total number of targets covered on each mission at an average rate of approximately 230 targets per each additional day.

The second GAMBIT-3 change is a lens modification which will be incorporated in Vehicle 31 (approximately October 1970). The improved lens will provide more uniform imagery across the entire field of view and will incorporate a change in focal length from the present 160 inches to 175 inches. TAB B is a graphic showing the expected resolution across the field of view as well as the reduction in field angle which is caused by the longer focal length. The scale factor will, of course, be reduced in proportion to the focal length. In addition to the redesigned lens, we will continue our quality control efforts to improve the performance of the present lens. As you know, the GAMBIT-3 performance goal is [REDACTED]. The best we have done to date is [REDACTED]. However, we do expect that some improvement in resolution will result from our quality control efforts prior to Vehicle 31.

CORONA

The nominal CORONA mission is now 15 days duration. We plan to extend the J-1 and J-3 lifetime capabilities to 16 and 18 days, respectively, effective in the fall of 1968.

The percentage of cloud-free photography for CORONA missions varies from 58 to 83 percent for the current 15-day missions. The longer lifetime is expected to increase the percentages of cloud-free photography by 5 to 8 percent.

The CORONA J-1 payload is approximately 400 pounds lighter than the CORONA J-3 payload. [REDACTED]

[REDACTED]. All of the J-1 payloads will be used up by July 1970, and we are therefore incorporating a change to the J-3 power supply to provide the [REDACTED]. This change is not primarily designed as an operational improvement to CORONA; however, as a secondary benefit, it is expected to permit extending the CORONA mission lifetimes up to 20 days. The change will only be made to the five missions [REDACTED] and consists of removing approximately 500 pounds of batteries and replacing them with a 115 pound solar cell power supply.

The CORONA 24-inch lens has been redesigned to make it easier to manufacture. This lens is expected to provide more consistent performance, but this change must be considered as a quality control modification rather than a modification designed to enhance the system performance. The first of these lenses was flown on Mission 1103.

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Although there may be some improvement in the area of operational techniques, there are no other approved hardware changes which are expected to have a significant impact upon the CORONA photographic product.

Present Program Costs

The cost estimates for the 1972-1975 time period are strongly influenced by the projected launch rates. These are, of course, subject to USIB adjustments, but for the purpose of this study, the following assumptions pertaining to the launch rates were made:

a. The CORONA launches will terminate as soon as the HEXAGON system is reliably producing intelligence information. Additional CORONA systems will have to be procured in July 1969 if the HEXAGON first launch slips beyond January 1971.

b. Four or five HEXAGON missions/year will be required. The HEXAGON system was designed so that one mission would satisfy the currently defined quarterly search and surveillance requirements. The five missions per year are in accordance with the presently planned launch schedule which is based upon the need for coverage every quarter with one "extra" system scheduled to be launched in sequence during the year to provide a margin to compensate for possible failures.

c. Four or five successful GAMBIT missions per year will be required with HEXAGON. This reflects both the longer GAMBIT orbital lifetime and the fact that the HEXAGON photography will satisfy some of the present GAMBIT surveillance requirements. ~~The GAMBIT procurement and launch rate would be one more than the required successful missions per year in order to insure that the desired number of successful missions are accomplished.~~

Based upon the above assumptions, the program costs are projected as follows:

<u>CORONA</u>	<u>FY 1969</u>	<u>FY 1970</u>	<u>FY 1971</u>	
Launches	7	6	4	
Costs	[REDACTED]			
<u>GAMBIT</u>	<u>FY 1969</u>	<u>FY 1970</u>	<u>FY 1971</u>	<u>FY 1972</u>
Launches	8	7	7	6
Costs	[REDACTED]			

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*It should be noted that FY 1970 and subsequent budgets have not yet been submitted and that these costs are subject to adjustment. Estimates herein are as reported in the latest FY DP (Five Year Defense Program) for FY 1970 and subsequent years.

<u>HEXAGON</u>	<u>FY 1968</u>	<u>FY 1969</u>	<u>FY 1970</u>	<u>FY 1971</u>	<u>FY 1972</u>
Launches				4	5
Costs	[REDACTED]				

*The FY 1970 budget requests have not yet been submitted, and FY 1970-72 costs are subject to change.

Costs Assuming HEXAGON is Cancelled

The following assumptions pertaining to the launch rate were made:

a. Six CORONA missions per year, using the longer lifetime vehicle, will be required in order to maintain the present level of CORONA coverage. This compares with the seven per year presently programmed for FY 1969 and is the same as the six per year presently programmed for FY 1970. It is assumed that the present CORONA stand-by capability will be maintained.

b. If the HEXAGON system is cancelled, it may be desirable to consider CORONA system improvements such as longer focal length to obtain improved reconnaissance resolution and the incorporation of the 12-inch frame camera to satisfy the mapping requirements. Changes such as this are feasible but would require significant booster modifications to accommodate the increased weight as well as major changes to the payload as discussed below.

c. Six successful GAMBIT missions per year will be required. This is in line with the present planning for FY 1970, which reflects the effects of the extended orbital lifetime. The GAMBIT procurement and launch rate would therefore be seven per year to insure the six successful missions. However, depending on USIB requirements, it may later be possible to reduce the required number of successful GAMBIT missions to four or five if HEXAGON resolution is adequate to cover a sufficient number of surveillance targets.

d. The cancellation of HEXAGON will cause the TIII unit cost for other programs to be increased significantly.

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~~TOP SECRET~~Possible CORONA Improvement

If it is considered desirable to improve the CORONA resolution to a value approximately half way from the present CORONA results to the level expected from HEXAGON, we would probably select one of the approaches proposed by IITEK over a year ago. This proposal suggested that either a 32-inch focal length could be incorporated using the same design approach as the current J-3 configuration or a 40-inch focal length optical bar camera could be incorporated into the CORONA system.

The operational characteristics of these proposed camera improvements would be as follows:

	<u>Enlarged J-3</u>	<u>Optical Bar</u>
Focal Length	32 inches	40 inches
Scan Angle	70° or 90°	90° or 120°
Approximate Nadir Ground Resolution from Altitude of 85 NM	4.4 feet	4.6 feet

Other factors associated with pad and launch vehicle compatibility would obviously have to be considered in any selection between the two alternatives. Both designs would require a booster modification, and the costs are approximately equal. The number of launches would have to be increased to approximately 8/year to maintain the area coverage since the area coverage per mission would be reduced.

Mapping Considerations

The 12-inch focal length stellar index camera is now being designed for incorporation into the HEXAGON system to provide the capability to produce large scale maps. However, a final decision to incorporate this system in HEXAGON has not been made. If the HEXAGON program is cancelled, it is not clear at this time whether the 12-inch camera would be flown as a separate system or incorporated into the CORONA program. As an alternative, it would be possible to complete a separate five-shot program for the 12-inch camera for approximately [REDACTED]. However, it is understood that a program limited to only five launches may not provide the repetitive coverage which is desirable for target updating and coverage of the residual areas which were cloud covered on the previous missions. This question is a requirements issue which would need separate study.

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Incorporating the 12-inch camera into the CORONA program would require the use of the THORAD SR booster and a complete redesign of the CORONA payload section. The THORAD SR uses the THORAD core and three 137,000 pound thrust solid rockets in place of the present three 56,000 pound thrust solid rockets.

Incorporating both a resolution improvement and a 12-inch mapping camera into the CORONA program would require the use of Minuteman solid rockets as the zero stage booster. Each Minuteman rocket produces 210,000 pounds of thrust and would require active nozzle steering in order to keep the booster stable. This additional complexity represents a significant reliability hazard.

A possible alternate to using the THORAD/Minuteman booster would be to change to the Titan IIIB. The use of the Titan IIIB for CORONA has been studied, but the preliminary investigation reveals a possible vibration problem. Cost estimates for this alternative are therefore not included as part of this study.

Cost Estimates

Based upon the above assumptions, the program costs are as projected in TAB B. A comparison of the costs associated with the two courses of action is itemized in TAB D. It must be emphasized that HEXAGON termination costs and CORONA improvement costs are quick and rough estimates, without benefit of discussions with contractors, and are subject to significant change. Also, the possible cost reductions associated with reducing the required number of successful GAMBIT launches from six to four or five have not been taken into account. We will shortly have available estimates of these reductions. However, such reductions would be strongly dependent on the extent to which USIB requirements for high resolution photography permitted coverage of a sufficient number of targets at HEXAGON resolution.

In considering resolution requirements, it is important to distinguish between nominal theoretical nadir ("best") resolution and the average resolution to be expected in collected photography. For example, the theoretical nadir resolution of GAMBIT, if the specification performance goal is achieved, would be [REDACTED]; however, since most photography would be at oblique angles rather than at nadir, the average theoretical resolution for a typical mission would be [REDACTED]. Both these resolution figures would be further degraded by atmospheric, weather, and other operational factors of a statistical nature. I have asked the NRO Staff to prepare a technical paper defining and summarizing the relationships between the nominal nadir resolution and other resolution figures of operational significance for all NRP systems. This should help in clarifying some of the issues which arise between statements of collection requirements on the one hand and operational planning on the other.

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I hope that the information provided herein in response to your request meets NIRB needs. The NRO Staff is prepared to provide further details at your request.

Sincerely,



Alexander H. Flax

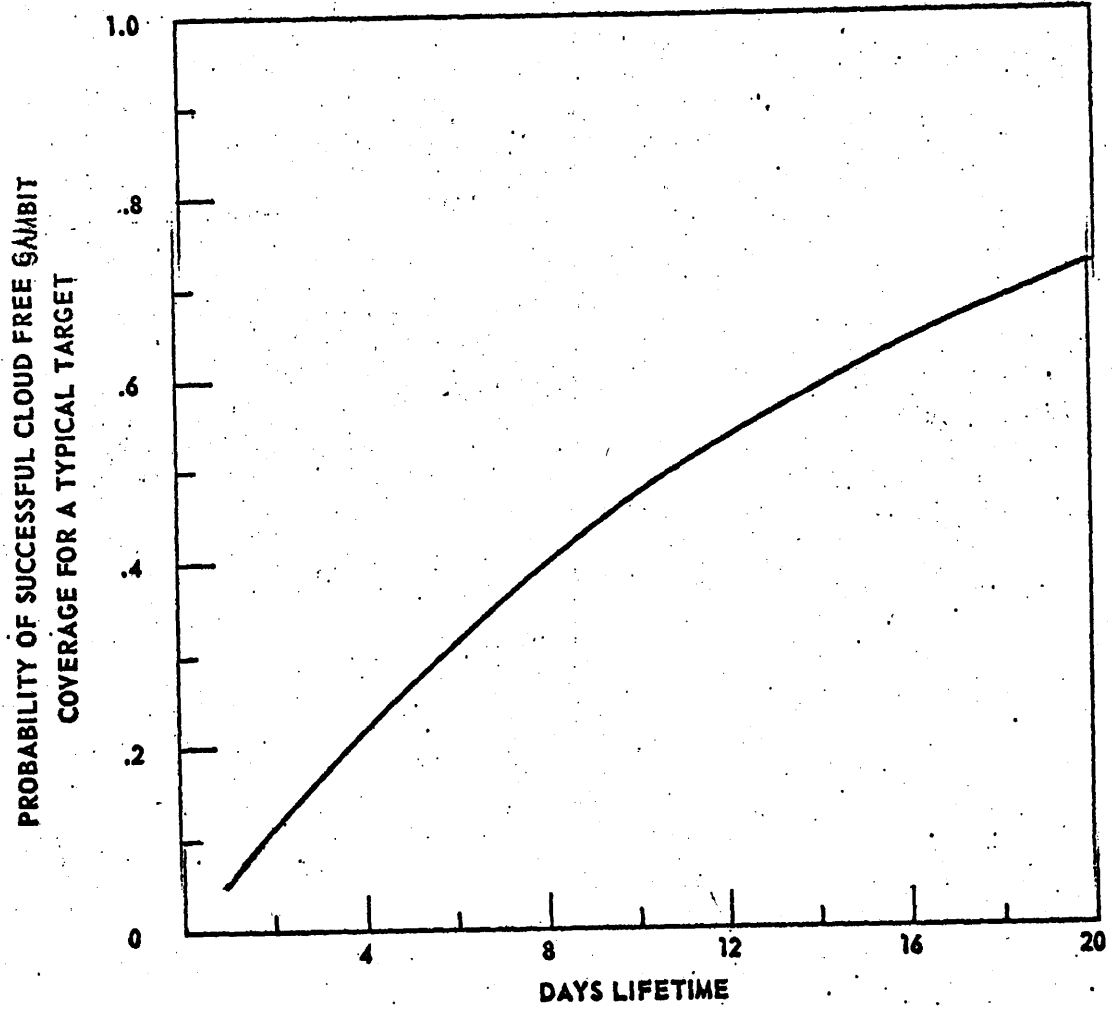
Vice Admiral Rufus Taylor, U. S. Navy
Deputy Director, CIA

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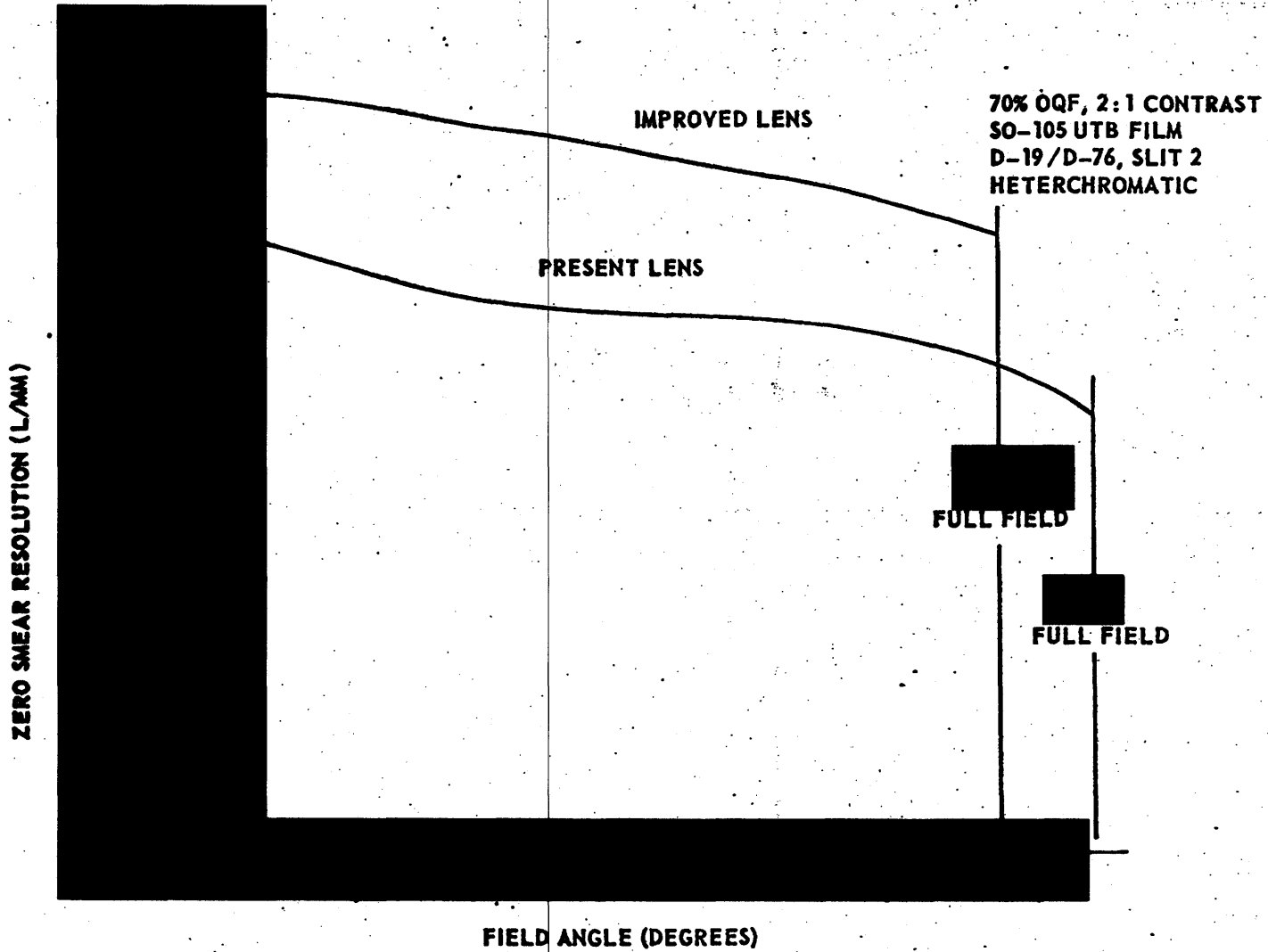
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ZERO SMEAR RESOLUTION vs FIELD ANGLE



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COSTS IF HEXAGON IS CANCELLED

(All costs are NRP internal rough estimates. No contacts have been made with the contractors.)

<u>CORONA</u>	<u>FY 69</u>	<u>FY 70</u>	<u>FY 71</u>	<u>FY 72</u>	<u>FY 73</u>
Launches	7	6	6	6	6

Costs (Launch Assumed)

Improvement to the CORONA Resolution

Launches		1	8	8
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Cost Increase

Incorporation of the 12-inch Camera in the CORONA Program

Launches		1	6	6
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Cost Increase

A Separate Program for the 12-inch Camera

Launches		1	2	2
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Cost Increase

Combined CORONA Resolution and 12-inch Camera Program

Launches		1	8	8
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Cost Increase

GAMBIT

Launches	8	7	7	7
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Costs

<u>HEXAGON</u>	<u>FY 68</u>	<u>FY 69</u>	<u>FY 70</u>
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Incurred and Termination Costs

Effect on Other Programs

TIII

Total

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COMPARATIVE COSTS FOR ALTERNATIVE COURSES OF ACTION

Case A: Continue HEXAGON

	<u>FY 68</u>	<u>FY 69</u>	<u>FY 70</u>	<u>FY 71</u>	<u>FY 72</u>	<u>FY 73</u>
HEXAGON						
GAMBIT						
CORONA						
Total						

*FY 1970 through 1973 estimates are based on latest Five Year Defense Program figures and are subject to change.

Case B: Cancel HEXAGON

	<u>FY 68</u>	<u>FY 69</u>	<u>FY 70</u>	<u>FY 71</u>	<u>FY 72</u>	<u>FY 73</u>
HEXAGON						
Effect on Titan III Programs						
GAMBIT						
CORONA						
Subtotal						
CORONA Improvement						
Separate 12-inch Program						
Total						

**NRP internal rough estimates. Contractors have not been contacted.

***FY 1970 through 1973 estimates are based on latest FY DP and are subject to change.

****NRP internal rough estimates based on six launches per year.