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THE WHITE HOUSE

WASHINGTON

14 00043525D

July 26, 1971

MEMORANDUM FOR

Honorable David Packard
Honorable Richard Helms

SUBJECT: Land Panel Report on FROG and EOI

Attached is a copy of the Land Panel report which I have received recently. Perhaps this will be useful to you at this time.

Edward E. David, Jr.
Science Adviser

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Attachment
B 11957-71

Cy to
Dr. McLucas

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GAMBIT ZAMAN

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July 24, 1971

Dr. Dr. David:

Acting for Dr. Land, I am transmitting to you a recent Panel report dealing with the near-real-time photo reconnaissance program. The report has now been signed by James G. Baker, Sidney D. Drell, Richard L. Garwin, Marvin L. Goldberger, Edwin H. Land, Donald P. Ling, Joesph F. Shea.

Dr. Puckett's position cannot be reported so simply. He was not asked to sign the report (7/19/71) when he reviewed it, and after that time he had considerable reservations which he expressed to to J. J. Martin and later to me in a telephone conversation 7/21/71. I arranged for him to review the material resolving from actual use of the array elements in a flight test, and to receive a report on the EOI program status from Les Dirks the morning of 7/22/71. Dr. Puckett called me soon afterwards, on 7/22/71, and said "In short, my mind has been relieved as to how ignorant we (or they) are or are not on matters of linearity, correctability, calibration, etc." ... "In conclusion I would be willing to say that the risk in this (EOI) program, on its 42 or 49 month time scale (and from here I really can't tell the difference between 42 and 49 months) is certainly no greater and probably less than that for the FROG on its slightly shorter time scale." (The quotation is as accurate as I could make it from my attempt to take verbatim notes from the telephone conversation.)

Dr. Puckett's position before his review of 7/22/71 can be encapsulated in the following question I asked of him and his answer of 7/21/71:

> Question: "Given your view of the relative risks of EOI and FROG (i.e., that the possible stretch in schedule or increase in cost is fractionally the same for EOI and FROG) and given the climate as put to me by J. J. Martin and other (i.e., not a brief period of FROG followed by EOI, but essentially FROG or EOI for quite awhile), which would you start -- FROG or EOI?"

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Answer: "I would go ahead with EOI. But I just don't want the report or the Panel to seem excessively optimistic."

I have tried since July 22 to reach Dr. Puckett to ask him, in view of his present position, whether he wishes to sign the report. Unfortunately, he is in Hawaii for a week, and I shall not be able to talk with him before this afternoon or tomorrow.

I hope the Panel's views will be of help to you in this matter.

Sincerely yours,

R L Garwin

Richard L. Garwin

Dr. Edward E. David, Jr.
Director
Executive Office of the President
Office of Science and Technology
Washington, D. C. 20506

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The Near Real Time Photo-Reconnaissance Program (EOI-FROG)

Report by the National Reconnaissance Panel
to the
President's Science Adviser
July 14, 1971

At your request we have reviewed the Near Real Time photo-reconnaissance program, both EOI and FROG. The Panel meeting of June 11, 1971 was supplemented by further discussions and visits. We have judged the expected performance and relative program risk of EOI and FROG, as follows:

1. EOI will have a best nadir GSD (ground sample distance) of [redacted] in a 188 by 383 n mi orbit, with a [redacted] mission duration. FROG will have a best nadir GRD (ground resolution distance) of 24" from 170 miles altitude, but it can probably be operated at 85 miles altitude for 15-30 days of its nominal 9 month mission, from which altitude it will have a 12" GRD.

(b)(1)
(b)(3)

A substantial experiment performed by NPIC has compared 3 examples of best actual G^3 imagery with simulated EOI imagery [redacted]

EOI will have many more accesses at GSD [redacted] than does the present G^3, at GRD [redacted] and can therefore replace G^3 (currently costing over $100M annually - the recurring annual cost of EOI), whereas FROG cannot. EOI can provide multiple views of the same structure from a range of angles on a single pass. FROG, limited to roll only, cannot.

2. Near nadir, the FROG has very little capability to monitor lines of communication (LOC) and can place only 3 to 4 frames of some 3 miles square along a road of approximately E-W direction, and would be thus limited at times to photographing as little as 10-20 miles of LOC per pass. At large obliquity, FROG has greater LOC coverage, but at substantial sacrifice in resolution.

BYE-11953/71

[redacted]

[redacted] after access. FROG with the planned continental U. S. sites will have a 12-hour delay after photographing European Russia, the Suez, or Eastern Europe. [redacted] (b)(1) (b)(3)

4. The EOI system design now includes an enhanced capability for area and LOC surveillance, achieved by the incorporation in the EOI [redacted] (b)(1) (b)(3)

We are confident that this work can be performed successfully on the required time scale.

On the other hand, FROG will require the development or adaptation of <u>many</u> techniques and pieces of equipment new to the program and to the contractors:

a. Bimat processing with 1 yr. life, involving thermal control to $1^{o}C$ accuracy at $0^{o}C$.

b. Laser scanner-film guide

c. Roll joint modifications

d. Zero-g propellant requirement

e. Flexible solar cell array

f. In general, the many systems responsible for raising the number of "relay-driver pairs" from 220 in the G system to 760 in the proposed FROG.

According to an Air Force spokesman, "every AGENA sub-system is new," as is the film-electronics module. These capabilities appear possible of achievement, no inventions appear to be required, but our experience with analogous development programs (both in this field and in the contexts in which we individually have experience) causes us to regard the successful achievement of all these capabilities on schedule as a substantial risk.

We conclude that the risk associated with FROG on the stated schedule may well be greater than that associated with EOI on its schedule with operational capability one year later.

5. At 17^{o} N latitude, the edge of swath resolution is:

EOI - 26" GSD (ground sample distance, geometric mean)
FROG - 84" GRD (ground resolution distance, geometric mean)

Scaling from the experiment performed by NPIC comparing the best of G^3 photography with simulated EOI photography, FROG would have to show about 30" - 40" GRD to give a product of value to photointerpreters "equivalent" to the EOI 26" GSD product. FROG is thus at least a factor 2 worse in its edge-of-swath resolution.

6. We believe that EOI design will not benefit from operational experience of FROG because such experience will not be available to any significant extent until mid-1975, and to delay the EOI procurement until then would postpone EOI operation to 1978 or 1979.

7. It is true that EOI has substantial growth capability which can be accommodated gradually in the present configuration.

[redacted]

Summary and Conclusion

The comparisons (1) through (5) show the performance of FROG to be substantially inferior to that of EOI. The operation of FROG would only be an interim program. The longer EOI is delayed, the longer we will be denied the much superior EOI product, but we shall eventually develop the EOI system. Thus the question is not whether we spend $675M or more (through 1977) to build FROG to fly end 1973 or [redacted] (b)(1) or more (through 1977) to fly EOI end 1974. (b)(3) (The stated EOI program cost does not take credit for a saving exceeding $100M annually, resulting from the replacement of G^3 by a very small fraction of EOI observing time). The question is whether it is worth $675M additional to have an inferior product one year sooner (with substantial risk) and with what we regard as probable resulting delay of the superior capability.

The Panel believes that recent decisions have been based on two misconceptions:

(1) that EOI and FROG are sufficiently similar in performance that the two are alternates, and

(2) that the risk in developing FROG is substantially less than that in building EOI.

The Panel is unanimous in its judgment that the FROG program has the higher risk. We respectfully urge that FROG be dropped and EOI acquired on a schedule to result in first flight November 1974.

RLGarwin/fn/14Jul71
Cy 1 File Z
Cy 2 Ling
Cy 3, 4 Land
Cy 5 Goldberger
Cy 6 Martin

RLG signed- Edwin H. Land, Chairman
National Reconnaissance Panel
RLG signed- James G. Baker
RLG signed- Sidney D. Drell
signed- R. L. Garwin
RLG signed- M. L. Goldberger
RLG signed- Don Ling
A. Puckett
RLG signed-Joseph Shea

B-11953/71

Clarifying remarks added 7/24/71 by R. L. Garwin after discussion with J. J. Martin (keyed to marginal numerals on page 1)

1. Mean mission duration comparable with FROG is 2.6 years.

2. "best of G^3" is usually stated to be [redacted] The MIP frames are commonly judged to be [redacted] These 3 particular frames were estimated to be in the [redacted] range. Since the performance of FROG is simply scaled from G^3, it is more important to recognize that these MIP frames represent the best of G^3 than to assign a numerical GRD to them. (b)(1) (b)(3)

3. This conclusion remains true for any reasonable assessment of GSD vs GRD value. In addition, EOI has the other virtues of intensity resolution as well as spatial resolution, low sun angle, etc.

Signed by
Dr Land

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Land OK

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY
WASHINGTON, D.C. 20506

14 00043526D

May 24, 1971

MEMORANDUM FOR

Land Panel

SUBJECT: Agenda, June 11, 1971 Meeting

The next meeting of the Land Panel will take place on June 11, 1971 at 547 Technology Square, Cambridge, Massachusetts. The meeting will begin at 9:00 am. An agenda is attached. I hope you will be able to attend.

Jack Martin
John Martin

Attachment

5/28/71

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AGENDA
Land Panel Meeting
June 11, 1971
547 Technology Square
Cambridge, Massachusetts

Friday

0900	1000	1055 1058	NRT Requirements FROG Capab. for area coverage
1000	1110		EOI "NRT G^3 Review
1200			Lunch
1300	1400 1430		EOI Status Report Roth Dirks
1430			~~Status Reports on~~ H
1600	1615		Executive Session
1700	1700		Adjourn

(b)(1)
(b)(3)

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(H) NRT

UNITED STATES INTELLIGENCE BOARD

OFFICE OF THE CHAIRMAN
29 July 1969

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Copy No. 17 of 8
Series "D"

MEMORANDUM FOR DIRECTOR, NATIONAL RECONNAISSANCE OFFICE

SUBJECT: Requirements for a Near-Real-Time Imagery Satellite System

1. The attached memorandum presents a statement of intelligence requirements for a near-real-time imagery satellite system as approved by the United States Intelligence Board on 24 July 1969 based on a report by the Committee on Imagery Requirements and Exploitation. Accordingly, these requirements are forwarded herewith to the NRO as formal initial guidance in defining and developing such a system, together with the further requests contained in paragraph 7 of this report.

2. In approving these requirements, however, the Board recognized that there are other SIGINT and imagery systems being considered or developed and that each of these candidate systems could entail significant acquisition costs. Consequently it should be noted that the value of a near-real-time system must also be related to the value of current capabilities or to other candidate systems. As recommended in the report, these USIB approved requirements may have to be adjusted as the feasibility and cost implications are identified and assessed and as a total NRP plan is developed.

3. As you know, this USIB statement was prepared in anticipation of consideration of this subject at the forthcoming EXCOM meeting.

Richard Helms
Chairman

Attachment
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Copy No. 1
Series B

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MEMORANDUM FOR: United States Intelligence Board

SUBJECT: Requirements for a Near-Real-Time Imagery Satellite System

REFERENCES:

a. USIB-D-46.4/29, 16 June 1969, Limited Distribution

b. USIB-D-46.4/28, 13 June 1969, Special Limited Dissemination

c. USIB-D-46.4/3 (COMIREX-D-13.7/4), 5 January 1968, Limited Distribution

d. Memorandum for Holders of USIB-D-46.4/3, 21 March 1969, Limited Distribution

1. This memorandum is in response to the USIB directive to COMIREX (reference a) to prepare a statement of intelligence requirements for a near-real-time imagery satellite system for USIB consideration pursuant to the exchange of correspondence between the Deputy Secretary of Defense and the Director of Central Intelligence (noted in reference b).

Background

2. In February 1968, the USIB noted a COMIREX study (reference c) that pointed out the desirability of developing a multi-purpose imagery reconnaissance system capable of contributing vital information applicable to strategic warning/indications and capable of collecting

information of value to current intelligence, search, and surveillance tasks. The COMIREX study was transmitted to the NRO by the USIB with the request that the NRO evaluate the study and report to USIB on the feasibility and approximate cost of a collection system which would meet the objectives outlined therein. In March 1969 the NRO provided a summary of the current state of development of key components of a near-real-time system and listed a number of areas which required more specific guidance from USIB (reference d). A CIA study completed in June 1969 was briefed to USIB on 11 June (reference b) and circulated to the USIB on 16 June (reference a). This study followed up the earlier USIB and NRO papers and concluded that the potential value of a multi-purpose near-real-time system was sufficiently demonstrable to warrant issuance of initial formal requirements and the prompt movement toward appropriate system definition.

3. The studies in references a and c both concluded that cost-effectiveness considerations would require development of a multi-purpose system that would be used against a wide variety of existing and potential intelligence problems. The referenced studies show that an appropriately configured near-real-time imagery system will be able to contribute significantly in determining enemy capabilities and vulnerabilities and to the following:

a. Analysis of crises and other fast-breaking events.

b. Strategic warning/indications.

c. Target surveillance and activity analysis.

d. Current intelligence reporting.

e. Support of military operating commands and contingency planning, to include tactical applications preceding and during periods of active warfare.

f. Monitoring arms limitation or disarmament agreements.

4. Intelligence always has needed an imagery satellite system that would be continuously on orbit and capable of providing photography of a target within hours. In that sense the present requirement is long standing, but it is only now that technology affords the opportunity of fulfilling it. Ultimate system characteristics will, of course, govern the extent of its multi-purpose applicability to various roles. Such a system should afford opportunities for savings through reductions in, or even elimination of, other collection systems. For example, a system which meets design characteristics specified in paragraph 6, below, will be able to satisfy a significant segment of the USIB surveillance requirements currently programmed for HEXAGON and GAMBIT coverage. Some requirements now levied on SIGINT satellite systems may also be satisfied. A continuing review with NRO will permit identification of the most beneficial areas of requirements trade-off.

Requirements

5. System definition and development should be based on a continuing exchange of views between USIB and the NRO to weigh and consider both the USIB's requirements and the NRO's development of a system capable of meeting them. As the feasibility and costs of various technical-engineering alternatives become clearer, the requirements will be reviewed in the light of technological developments and available trade-offs to insure the best possible results. The final formulation of requirements thus is envisaged as the product of a reiterative process.

6. Listed below are characteristics for a near-real-time system* that meet intelligence needs and which are believed, on the basis of present knowledge, to be feasible. The characteristics include elements which the NRO indicated (reference c) should be considered in future guidance:

---

*The term "system", as used in this paper, is intended to encompass the sensor satellite or satellites, the related data link, and the ground-based equipment needed to make the initial transformation of electrical signals into imagery.

a. Image Quality. In general terms, the image quality should be equivalent to that obtained from the later KH-7 missions. In terms of resolution, the reconstructed imagery should achieve two-foot resolution at nadir.

b. Ground Area Imaged. At a minimum, the ground area imaged at nadir should be at least three by three nautical miles. This format will accommodate approximately 85 percent of the targets in the present COMIREX deck. In addition, if feasible, a stripping mode or equivalent should be available to provide opportunities to conduct limited search.

c. Continuity and Target Access. A near-real-time system must be on orbit continuously and when fully operational should be able to provide daily access to all COMIREX targets in the Communist countries. As a general guideline, the scale of the imagery at extreme look-angles should be degraded by no more than two-thirds the scale at nadir.

d. Imaging Capacity and Rate. A nearl-real-time system should be capable of returning between 200 and 400 frames of imagery per day against the COMIREX target distribution. This requirement assumes most imagery will be monoscopic; however, some stereo coverage will be needed. The system should be capable of returning 15 to 20 frames of imagery per day against dense[1] target concentrations such as the Moscow area, East Germany, North Korea, or the Tyuratam, Kapustin Yar, or Sary Shagan missile test centers.

1/ 50 nm radius (?)

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e. Reliability. After a near-real-time imagery system becomes an established source of intelligence information, a total interruption in the flow of imagery could seriously impair the total intelligence process. The system when fully operational should provide a high probability of having at least one imagery satellite on orbit and functioning at all times.

✓f. Imagery Delivery Location and Time. To assure timely support to the seat-of-government and national command authorities, initial interpretation and exploitation will take place in the Washington, D. C., area. If it is technically and economically feasible, the system should be capable of delivering imagery to the ground and making some of it available for initial interpretation [redacted] after sensing has occurred. This requirement is levied in recognition that [redacted] return can be accomplished only by the use of relay satellites in synchronous orbits and by the employment of relatively rapid processing rates on the ground for at least selected targets. Further study will be needed to determine the means and timeliness of dissemination to other locations, keeping in mind the requirements of unified and specified commanders for the timely dissemination of selected imagery. (b)(1) (b)(3)

g. Tasking Response Time. It is desired that targeting response time be such that targeting on subsequent passes can, when necessary, be based on information read out from a previous pass on the same day. It is assumed, however, that the majority of targeting commands will be generated more routinely and transmitted to the imagery satellite several hours before collection is attempted.

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h. Data Transmission Security. Although the general mission of a near-real-time imagery satellite system will probably become known, steps should be taken to insure that unauthorized intercepters will be unable to reconstruct more than a small amount of degraded imagery. Because it imposes fewer system design penalties, physical denial of signals transmitting imagery is recommended as the means of insuring imagery return security. If physical denial cannot achieve an acceptable degree of security and it appears necessary to follow an encryption route, careful study of feasibility and cost should be undertaken. Targeting command data between the ground and satellites in the system should be secure.

i. Growth Potential. In choosing among design alternatives the NRO should favor concepts and hardware that will permit long run growth in terms of both the quality and quantity of imagery obtained, with the proviso that such growth potential considerations do not unduly delay the attainment of a near-real-time system.

7. It is recommended that USIB:

a. Approve these requirements for forwarding to the NRO as formal initial guidance in defining and developing a near-real-time imagery satellite system;

b. Request the NRO to indicate whether further detail or explanation is needed at this time;

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c. Request that as NRO assesses the feasibility and cost implications of these requirements it identify and advise the USIB of those which, with minor modification, might permit either a significant reduction in cost or result in a major improvement in capability; and

d. Request that NRO and COMIREX inaugurate a periodic, perhaps quarterly, joint review of progress and actions to assure continuing coordination and understanding of areas of mutual responsibility.

Roland S. Inlow

Roland S. Inlow
Chairman
Committee on Imagery Requirements and Exploitation

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