NATIONAL SECURITY AGENCY
FORT GEORGE G. MEADE, MARYLAND

27 October 1966
BYE-60511-66

TOP SECRET

MEMORANDUM FOR DR. FLAX, DIRECTOR NRO

SUBJECT: Electromagnetic Pointing System for MOL

1. Reference NRO Memorandum, subject as above, dated 1 September 1966, BYE-21208-66. NSA is pleased to have had the opportunity to study in some detail the various aspects of the proposed MOL ELINT sub-system provided in the reference and augmented via briefings, informal discussions and additional documentation. The results of our study are attached as Inclosure I.

2. Our analysis indicates that the bi-sensor approach has a unique potential for high priority intelligence collection and that addition of an automatic ELINT system in the MOL platform is definitely desirable. I am convinced that the very small percentage increase in the overall MOL program cost required for the ELINT system will result in a significantly larger percentage increase in the relative value of the overall program output, and therefore, makes economic sense.

3. It should be noted, however, that our evaluation indicates that the primary value of the ELINT sub-system is precise emitter location in which the man need play no role. A secondary advantage is the real-time correlation with the photo sensor. The capability required for this function is to determine if a target in a selected photographic field of view is, in fact, emitting. The value of the system is not considered to be as an acquisition aid for the photo sensor. These considerations may be a significant factor in the system design.

4. If the opportunity exists or arises for transfer of MOL resources to the SIGINT Satellite Program or if

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serious interference with the SIGINT Satellite Program occurs, I present the following considerations. The limited lifetime and the inherently higher costs associated with a manned program, and the subordinate role SIGINT must inevitably play in the MOL mission argue that the resources for the ELINT sub-system might produce more SIGINT results if applied to systems not associated with MOL operations. It is my conclusion that the MOL mission does not represent the best means for increasing the overall SIGINT satellite pay-off.

5. Specifically, I believe that it is more urgent to

a. [redacted] provides a system capable of routinely providing the location accuracies proposed for MOL;

b. [redacted]

c. [redacted]

d. Explore the potential advantages offered by effective, wideband, real-time spacecraft-to-ground communications, command and control. The present day practicality of a synchronous communications satellite relay makes it possible to consider extending all the manned functional capability in the spacecraft to a ground console. This would provide a means of making the best personnel resources available for SIGINT related

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judgments without requiring that they be in space.

6. I am pleased to note that most of these points are addressed in your Advanced Development Program. I look forward to a continued close working relationship between our staffs to assure the satisfactory achievement of these objectives.

Marshall S Carter
MARSHALL S. CARTER
Lieutenant General, U. S. Army
Director

Incl:
a/s

SUBJECT: Evaluation of Proposed ELINT Sub-System for Bi-Sensor Collection Program

GENERAL:

1. In order to arrive at an evaluation of the anticipated benefits of the proposed bi-sensor collection program and its possible advantages over existing uncoordinated SIGINT and photographic systems, it is first necessary to review existing and planned satellite capabilities as they apply to target nations' electronics state-of-the-art, deployment levels and patterns, and development/test activity.

CURRENT/FUTURE SIGINT SATELLITE COLLECTION:

2. Current SIGINT Satellite Programs are capable of providing the following types of intelligence information:

a. Broad spectrum ELINT general search for environmental and technical data. The main objective in this area is to provide sufficient technical detail and location information on new and/or unusual electronic signals to allow a determination of their significance as the basis for further collection action. Existing satellite collection systems, while providing some technical data, generally do not permit adequate determination of signal source(s) for correlation with photography.

b. Detailed technical data concerning identified specific emitters and emitter types which are of high priority interest to the intelligence community. It is usually necessary to devise complex payloads which are specifically designed to collect against individual emitters or classes of emitters. This requires a certain degree of "a priori" knowledge (derived from ELINT general search missions, photo interpretation, or community speculation) regarding both basic signal characteristics and emitter locations, orientation, and configuration.

c. ELINT Order of Battle (EOB) to accuracies of approximately [redacted] Accuracy of emitter locations depends upon the specific location technique employed; and, again, "a priori" knowledge of target emitter characteristics is required if optimized techniques to derive precise locations are to be employed while assuring that the target signal can be isolated from other similar signals.

3. The present trend in SIGINT Satellite collection is toward greater location accuracy and improved technical intelligence capabilities.

[redacted]

CURRENT/FUTURE PHOTO SATELLITE COLLECTION:

4. Presently, satellite photography can contribute information regarding electronics insofar as determining (a) precise site/complex locations, (b) emitter orientation and (c) emitter identification. Present photographic resolution capabilities offer a good opportunity of detecting radar complexes/sites per se; however, accurate identification of specific pieces of equipment therein is often impossible unless conditions (i.e., satellite position vs. ground site location geometry and light conditions) are optimal. Some of the larger Soviet radars (e.g. TALL KING, HEN HOUSE) however, can easily be identified from KEYHOLE photography.

5. KEYHOLE photographic systems presently in operation include the KH-4, KH-7, and KH-8. The KH-4 has a 10-foot resolution and a field of view of approximately 160 by 15 NM per frame and continuous frames. This system is utilized for reconnaissance. The KH-7 has a 3-foot resolution and a field of view cross-track of approximately 12 NM. In-track field of view, when used for stereo, is approximately 30 NM. In-track field of view, when used for mono, is unlimited. The KH-7 was the first satellite system utilized for "spotting" or detailed analysis. The KH-8 is an outgrowth of the KH-7 and has a design resolution capability of [redacted] with a field of view approximately half of the KH-7. Two missions have been flown to date and the best resolution achieved has been [redacted] Systems to be employed in the near future will not have significant resolution increases but will provide larger film storage capacity for a greater increase in target coverage. Another modification under development is a faster retrieval utilizing a number of film casettes to be de-orbited periodically. The present photographic systems are preprogrammed for target selection with a few alterations possible when satellite weather information is employed. The USSR is normally 65% cloud covered as low pressure systems advance across the land mass. A considerable amount of film is wasted due to cloud-covered targets which are preprogrammed for film exposure.

REVIEW OF INTELLIGENCE REQUIREMENTS:

6. In order to assess the potential value of the proposed bi-sensor system, a review has been made of the existing Specific Intelligence Collection Requirements (SICRs) which represent current needs for ELINT data by the Intelligence Community. There are four general areas in which requirements exist which are considered to be of high overall priority, which are not being adequately satisfied at the present time by conventional or special collection methods, and for which information gaps are likely to exist for the foreseeable future. These general areas are: ABM Requirements, Surface-to-Surface Missile and Space Requirements, Surface-to-Air Missile Requirements, and Unidentified and Developmental Signal Requirements. The following quotation from a 29 September 1966 Memorandum from The Guided Missile and Astronautics Intelligence Committee to the Chairman, Critical Collection Priorities Committee is illustrative of the present difficulties being encountered in these areas. This quotation relates specifically to ABM collection requirements:

> "One of the most critical gaps in Soviet missile defense and space intelligence is still between project definition and the on-set of a development testing program. Little evidence on the Soviet ABM R&D program is detected prior to initiation of construction of test facilities on the actual flight test program. While construction of new facilities has alerted us to new programs, we have been unable to develop the system characteristics without substantiation by other evidence. A second major gap is our inability to derive system characteristics during the test phase because of the almost total lack of ELINT from the test center. This gap is so serious that we are presently unable to determine the purpose of a defensive system that has been under development for several years and is now being deployed".

7. A contractor study performed recently for NSA presents a listing of SIGINT gaps based on photographic evidence of an installation or facility for which no correlation of signal to installation has been possible. There are twenty-three types of located facilities (representing 261 individual locations) in this listing most of which relate to one or more of the priority SICR areas categorized above (RED TAG Reports No. 4, DDL-G326, dated 17 August 1966 refers.) The listing is attached as Appendix I.

8. Additionally, there are currently a number of potentially significant unidentified or developmental signals (collected primarily by satellites) which require further definition from the standpoint of technical characteristics, location, and association with physical equipment

or systems in order to determine their intelligence significance. A review has been conducted of satellite intercept records and all notated signal continuities which have not as yet been equated to emitter hardware in order to determine to what extent the ELINT analysis and identification problem could benefit by a simultaneously collected photography product. The majority of valid, unidentified signal intercepts from satellite collection missions were discovered to be one time intercepts; however, one VHF signal (82 intercepts), one S-band (2Ø intercepts), and one X-band intercept (3Ø intercepts) stood out as exceptions to this general rule. In addition, a review of those notated signals which have not been equated to specific source hardware but which have been intercepted by satellite missions revealed few high priority signals which could be expected to result in successful signal intercept and photo collection correlation. Signals such as [redacted] which are seen frequently by satellite and as frequently (if not more frequently) by conventional collection sources, but which could be expected to be radome enclosed, were excluded from consideration. Seven notated signals presently unequated to hardware are listed in Appendix II, together with those previously referenced unidentified signals, which could constitute priority signal/photo correlation targets from the ELINT viewpoint.

LIMITATIONS IN CURRENT COLLECTION:

9. It is anticipated that conventional satellite and other collection systems, which are constantly being improved, will continue to assist in filling existing and future intelligence gaps. However, in the area of ELINT, a primary reason that gaps exist derives in large measure from limitations in current collection systems, especially their inability to locate emissions accurately and to define precisely their technical characteristics. These limitations apply especially in the area of emitters employing a Continuous Wave (CW) mode of operation. It is noteworthy that many of the target emitters determined from photography are postulated to employ CW techniques. Similarly, most photographic analysis of SIGINT emitters at present leads to an "unidentified" category because of restrictions in resolution which prevent viewing the reflectors and feeds in toto. Even an increase in imagery resolution will not provide all the essentials for adequate appraisal because of the geometry of satellite collection (e.g., a top view or sharply oblique view is all that is obtainable from the camera lens). Other restrictions include the problems in photographic interpretation posed by the use of radomes and enclosed scanners as well as such uncontrollable factors as weather and sun angle.

1Ø. When photography is available for appraisal, only a portion of the radiation characteristics can be postulated. Much of the present

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Photographic identification is by site and/or support association due to a lack of image quality necessary for detailed visual observation of the emitter. Assumptions are then made that emitters, at similar sites and with similar support components, are also similar. Presently, available KEYHOLE imagery [redacted]

11. It has often been the case that utilization of data collected by a single sensor leads to ambiguous conclusions. One example is the divergence of opinions on the present Soviet ability to wage anti-ballistic missile warfare and the concept of operations for the Tallinn-type missile launch facilities. The source of the continued discussion on this subject is the fact that data collected by only one sensor, KEYHOLE photography, has been utilized for analysis of the Tallinn-type facilities. Although photography has provided valuable information on deployment and intersite components, no precise definition of system capabilities has been possible because of the lack of correlatable ELINT data.

EVALUATION OF PROPOSED BI-SENSOR SYSTEMS:

12. The proposed bi-sensor system offers a capability (both ELINT and PHOTO) not planned for other satellite platforms in the next five years. From an ELINT standpoint, neither emitter location accuracy of approximately [redacted] or programmed satellite collection equipment. The PHOTO portion of the bi-sensor system has a design resolution of [redacted] and a field of view of 1.25 NM at perigee. In the manned version, an acquisition or target finder telescope will be utilized for assistance in target selection. Cloud covered targets will be rejected resulting in selective coverage. Since this system has a significantly higher resolution, many components such as [redacted] should be resolvable provided that light conditions and target perspective are optimized. These components cannot be in any event adequately analyzed from existing photographic systems. In addition to these apparently unique ELINT and PHOTO collection capabilities, the potential for concurrently acquiring ELINT and photographic information from a given geographic area is significant from the standpoint of intelligence value. Post facto correlation of previously located signal intercepts with photographic data which was separately collected has the inherent difficulty of compounding the errors extant in location of the satellite collection sources, a problem which is obviated when simultaneous collection by both sensors from a common base is accomplished.

13. The ability to perform pre-programmed search of the frequency spectrum in areas where facilities of interest have been identified by previous photography and to derive detailed technical intelligence and highly accurate location information is attractive. In addition, search for and acquisition of special signals of interest whose known characteristics can be stored in the computer memory is of potential value. Although the above examples primarily address the value of the ELINT sub-system as a separate entity, there is also benefit that can be derived from simultaneous ELINT/PHOTO collection. Ideally, information on development of a weapon system should be acquired as early as possible in the R&D stage to allow for assessment of system capabilities as an input to U.S. strategic planning. Specifically, the areas in which such Soviet ABM/SAM development have occurred are at Sary Shagan and Kapustin Yar. The testing areas of these locations have been identified in photography as being positioned in such proximity that even a [redacted] location capability will not, in most cases, allow positive correlation of an ELINT intercept with photographed equipment configurations. In these instances, which most certainly represent high priority targets from a National standpoint, simultaneous ELINT and PHOTO collection could allow unambiguous identification of the emitting source. This could be accomplished by providing reasonable definitive ELINT locations together with the photography which would indicate ground activity at a specific test location.

14. [redacted]

15. Although the intelligence value of accurately located and defined high priority target signals (e.g., ABM/SAM-associated emitters) is readily apparent, an evaluation of the proposed ELINT sub-system must consider some additional pertinent factors:

a. The effectiveness of the system must be examined in terms of its probability of intercepting the signals of highest interest. Based on a thirty day platform lifetime, an altitude of approximately 80 nautical miles, and an effective swath width of 120 nautical miles it is estimated that the system will cover most areas of the Sino-Soviet Bloc no more than ten times. In consideration of these factors, the duty cycle of any given emitter must approach 25% in order to assure a mathematical 95% probability of intercept. Figures recently developed by the NRO indicate that nearly 300 "looks" at any given area would be required to provide a 95% probability of intercept for an emitter with a duty cycle of 1%. To achieve a 95%

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probability of intercept for an emitter with a 3% duty cycle, about 100 "looks" are needed. Since a radar undergoing research and development will probably be located at only one place and will probably be active only a small percentage of the time, the probability of successful acquisition by the proposed ELINT sub-system is very limited. The probability of successfully acquiring a given target with the ELINT and photographic sensors simultaneously is smaller yet when defined in terms of obtaining cloud-free, high-quality imagery.

b. Additionally, from a technical standpoint, the utility of a 25 MC oscilloscope recording capability which requires rapid manual reaction on the part of the astronaut may be an unwarranted facet of the system. The ability of a non-signal analyst to make high quality photographs for subsequent analysis is questionable, and in fact the 25 MC capability itself may be an unnecessary luxury. From a signal analytic standpoint, a high quality 1 to 5 MC pre-detection recording to be used as an input to ground-analysis should be sufficient to satisfy technical intelligence requirements except in the case of frequency jumping or frequency diversity emitters which could require capabilities far in excess of 25 MC. In these instances, a bandwidth on the order of 100 MC would be necessary.

CONCLUSIONS:

16. As a result of the above study, it has been concluded that despite the inherent problem of low probability of intercept on a given low duty cycle emitter, the potential intelligence value to be derived from inclusion of an ELINT sub-system on-board the MOL is sufficiently high to justify further consideration of including such a capability.

17. There may be some system specifications, such as the 25 MC oscillograph photographic capability, which could be relaxed and thus affect reduced cost and complexity, higher reliability or both.

APPENDIX I

The following list contains 2Ø1 photo derived locations in the USSR and China for which few or no signals have been intercepted. Details available from photo sources concerning these facilities are described in Red Tag Report No. 4, EDL-G326, dated 17 August 1966.

1. HEN ROOST

   Previously at radar site No. 2, SSATC. Has been dismantled and may be relocated.

2. HEN HOUSE

   Radar site no. 1, SSATC.

3. DOG HOUSE

   Moscow

4. DUAL HEN HOUSE

   a. Site no. 13, SSATC.

   b. Angarsk

   c. Olenegorsk

   d. Skrunda

5. HEN HOUSE ADDITION

   Radar site no. 1, SSATC

6. BUFB RADAR

   a. Simferopol

   b. Moscow

   c. Yeniseysk

   d. Tyura Tam

   e. Ulan Ude

f. Sary Shagan

g. Golenki

h. Khutor

7. SS-6 GUIDANCE ELECTRONICS

a. Launch Area A, TTMTC

b. Launch Area B, TTMTC

c. Launch Area 1, Plesetsk

d. Launch Area 2, Plesetsk

e. Launch Area 3, Plesetsk

8. ODD BALL

Instrumentation Site No. 6, SSATC

9. RADAR "B"

a. Instrumentation Site No. 14, SSATC

b. Instrumentation Site No. 15, SSATC

c. Instrumentation Site No. 16, SSATC

d. Instrumentation Site No. 17, SSATC

e. Instrumentation Site No. 1 (POSS.), SSATC

10. HEN EGG

a. Instrumentation Site No. 3, SSATC

b. Instrumentation Site No. 6, SSATC

c. Instrumentation Site No. 10, SSATC

d. UKA (KAMCHATKA)

11. QUEER SCAN (Unofficial Title)

a. Tallinn

b. Cherepovets

c. Liepaja

d. Leningrad NW

e. Leningrad NE

f. Leningrad SW

g. Launch Complex "A" SSATC

h. Nizhnaya - Salda

i. Sverdlovsk

j. Nizhnyaya - Tura

k. Launch Complex 1, SSATC

l. Launch Complex 2, SSATC

m. Murashi

n. Nizhniy - Tagil

o. Kalinin

p. Babayevo

q. Kimry

r. Feodoysia

s. Volgograd

t. SAM Area KYMTR

u. Gorkiy Radar Test Area

v. Leningrad Training Complex

12. ABM TRIADS

a. Launch Complex "B", SSATC

b. Instrumentation Site No. 2, SSATC

c. Instrumentation Site No. 10, SSATC

d. Instrumentation Site No. 13, SSATC

e. SAM Site EØ5-1, Moscow

f. SAM Site E15-1, Moscow

g. SAM Site E24-1, Moscow

h. SAM Site E31-1, Moscow

i. SAM Site E33-1, Moscow

j. SAM Site EØ3-1, Moscow

k. SAM Site E21-1, Moscow

13. SATELLITE DOPPLER TRACKING EQUIPMENT

a. Khutor

b. Golenki

c. Simferopol (PROB)

d. Moscow (PROB)

e. Yeniseysk (PROB)

f. Ulan Ude (PROB)

g. Sary Shagan (PROB)

h. Tyura Tam (PROB)

14. RADAR "A"

a. Launch Complex "A", TTMTR

b. CØ713, TTMTR

c. CØ7C, TTMTR

d. CØ813, TTMTR

e. CØ8C, TTMTR

f. CØ913, TTMTR

g. CØ9C, TTMTR

h. C5113/C5413, Kamchatka

i. C51E, Kamchatka

j. C51D, Kamchatka

k. Main Instrumentation Site, KYMTR

l. Launch Complex "D", KYMTR

m. Lake Elton, KYMTR

n. Verkniy Baskunchak, KYMTR

o. Novaya Kazanka, KYMTR

p. Makat, KYMTR

q. Ten Locations, SCTMTR

r. Instrumentation Site No. 2, Ehmba

s. Instrumentation Site No. 6, Ehmba

t. Instrumentation Site No. 7, Ehmba

u. Instrumentation Site No. 8, Ehmba

v. Instrumentation Site No. 9, Ehmba

w. Instrumentation Site No. 4, SSATC

x. Instrumentation Site No. 5, SSATC

y. Instrumentation Site No. 6, SSATC

z. Instrumentation Site No. 7,SSATC

aa. Instrumentation Site No. 8, SSATC

bb. Instrumentation Site No. 9, SSATC

cc. Instrumentation Site No. 11, SSATC

dd. Instrumentation Site No. 12, SSATC

15. H-SHAPED RADAR TRACKING FACILITIES

a. G-1, KYMTR

b. G-2, KYMTR

c. Elton, KYMTR

d. Gornyy Balykley, KYMTR

e. Pallasovka, KYMTR

f. Kamyshin, KYMTR

g. Aleksandrov Gay, KYMTR

h. Site 1Ø, KYMTR

i. Site 11, KYMTR

j. Elisenvara

k. Gdov

l. Johvi

m. Kerstovo

n. Narva

o. Priozersk

p. Salmi

q. Storozhno

r. Tihkvin

s. Tolmachevo

t. Veskitaguse

u. Vyborg

16. <u>BEER CAN</u>

a. Launch Complex "A", SSATC

b. SAM Area, KYMTR

c. Cherepovets

d. Verkhnyaya - Salda

e. Kursk (Suspect)

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17. ELECTRONICS SITES

    a. Leningrad NE

    b. Leningrad NW

    c. Leningrad SE

    d. Leningrad SW

18. NINETY-EIGHT-FOOT PARABOLOID

    Simferopol

19. EIGHT-DISH-ARRAY

    a. Yevpatoriya NW

    b. Yevpatoriya SE

20. VHF INTERFEROMETER

    a. Instrumentation Site No. 1, SSATC

    b. Instrumentation Site No. 3, SSATC

    c. Instrumentation Site No. 4, SSATC

    d. Instrumentation Site No. 5, SSATC

    e. Instrumentation Site No. 6, SSATC

    f. Instrumentation Site No. 7, SSATC

    g. Instrumentation Site No. 8, SSATC

    h. Instrumentation Site No. 9, SSATC

    i. Instrumentation Site No. 10, SSATC

    j. Instrumentation Site No. 11, SSATC

    k. Instrumentation Site No. 12, SSATC

    l. Instrumentation Site No. 14, SSATC

    m. Instrumentation Site No. 15, SSATC

    n. Serpukhov (Moscow)

    o. Bronnitsy (Moscow)

p. Kirshak (Moscow)

q. Simferopol

r. Yeniseysk

s. Makat

t. Tyura Tam

u. Khutor

v. Uka

w. Yelovka

x. Talsi

y. Elton

z. Verkniy Baskhunchak

21. RATE SYSTEM (GUIDANCE) TYPES II, III

a. Launch Area, C, KYMTR

b. Launch Area A, TTMTR

c. Launch Area C, TTMTR

d. Launch AreaE, TTMTR

e. Launch Area F, TTMTR

f. Launch Area D, Plesetsk

g. Launch Area E, Plesetsk

h. Launch Area A, Kozelsk

i. Launch Area B, Kozelsk

j. Launch Area D, Kozelsk

k. Launch Area E, Kozelsk

l. Launch Area A, Tyumen

m. Launch Area C, Tyumen

n. Launch Area A, Omsk

o. Launch Area G1 - G2, TTMTR

p. Launch Area G3 - G4, TTMTR

q. Launch Area D2, TTMTR

r. Launch Area G7, TTMTR

s. Launch Area H, TTMTR

T. Launch Area I, TTMTR

U. Launch Area K, TTMTR

V. Launch Area L, TTMTR

w. Launch Area B, Uzhur

x. Launch Area H. Uzhur

y. Launch Area B, Dombarovskiy

z. Launch Area G-2(POSS), Drovyanaya

aa. Launch Area D, Imeni Gastello

bb. Launch Area C, Aleysk

cc. Launch Area A, Zhangiz - Tobe

dd. Launch Area J. Zhangiz - Tobe

ee. Launch Area A, Kartaly

ff. Launch Area N, Kartaly

gg. Launch Area A1, Tatishchevo

hh. Launch Area D7, Olovyannaya

ii. Launch Area E1, Olovyannaya

jj. Launch Area F1, Olovyannaya

22. RATE SYSTEM (INSTRUMENTATION)

a. Launch Area C, KYMTR

b. Launch Area C, TTMTR

23. NEW INTERFEROMETER

a. Tyura Tam

b. Kapustin Yar

c. Plesetsk

APPENDIX II

POSSIBLE TARGET SIGNALS

SIGNAL	RF BAND	REMARKS
[redacted]		