Approved for Release: 2024/06/12 C05026137

ARPOP

MEMORANDUM

5 July 1970

TO: NAVINTCOM (NIC024)

FROM: NRL Code 5614 R.D. MAYO

Subj: Progress Report on Program "C" effort at NRL.

1. Problem Areas:

A- Requirement for coverage from 14.6 to 15.1 GHz has been A-67 werbally made by NSA so that the emitter can be geopositioned

by the spacecraft of Mission 7107.

In the past the receiving antennas used by Program "C" Discussion: in this part of the frequency spectrum have had collection antenna patterns which measured about 30° 30<sup>°</sup>. х This provided collection from the horizon (forward of the spacecraft) back to near the zenith. The emitters which are normally intercepted by a main beam system howat high elevations ever do not look straight up so the coverage below the spacecraft is moductives not being used, in thése previous " $K_A$  band" systems. Thus on the Mission 7107 K<sub>A</sub> systems we propose to use a sectoral-horn  $\frac{1}{2}$  antenna where the p pattern is wide in azimuthal coverage from the spacecraft and very directive toward the horizon. Thus placing the emphasis on horizon intercepts where emitters will normally be intercepted by a Main-beam collection system. This change in collection antenna will give much better azimuthal coverage without adding expensive, and power consuming Fundamental The concept for Mission 7107 is that it hardware to the spacecraft. (2) it must not must be accelerated and not include designs which are not now in hand (No development dime is to be deliberately planned for any of the these. ELINT subsystem components), With the baxic restraint, the only way that Approved for Release: 2024/06/12 C05026137

the NSA request can be satisfied with Mission 7007, is for us to encorporate in the companion spacecraft to the one which has the proposed we could install collection coverage from 14.8 to 15.1 GHz,) install a duplicate set of hardware so that two-ball coverage can be obtained. We at NRL would like to see this request in print so that a change in Connally anticipated our proposed ELINT collection coverage charts can be made. The matter ment in of improved azimuthal collection coverage from the spacecraft may be croft intercepto and ultimotely K Spa the suggested desire for complete azimuthan sufficient to relieve will result nding bands. The hardware is so expensive, volumnous and power demanding not to mention the berv physical problems of adding another set of hardware to an alfready 260<sup>0</sup> can not entertane a request for complete Ŵе cked spacecraft pa ∕6f the spectrum without going to covèrage this part a larger spá ce craft shell size with the opportunity for greater -available power

1. Problem Areas: Continued.....

B- Mission 7107 as the energy the past will require some inputs from both NSA and the NRO before certain of the subsystems are completed and before the assembly period. Of particular importance is the assignments of the various "W", "X", "Y", & "Z" (80,120,060, &200/usec) data link pulse width coding to the various collection bands and transmitters of each of the spacecraft. This is particularily important now because of the addition of a THIRD TRANSMITTER to each of the spacecraft. Therefore it is recommended that this item be surfaced at the next Quarterly Program Review and that a working goorup be made up of one member each from NRL (Code 5164 and Code 5170,) NSG, NSA, K-46, STIC, and NavIntCom may\_certainly be included if-he/ wishes. The goals of this group are two fold: (1) to determine the best way to utilize the third transmitter and (20 the assignment of pulse width coding to all the collection systems and t#ansmitters of all four spacecraft.

Approved for Release: 2024/06/12 C05026137

C. Tasking estimates for Mission 7107 are of much greater necessity than have ever been the case in previous missions since it will be possible to arrange the command system so that some commands are relatively easy to actuate while others are obscure and relatively difficult. It is in the interest of operational expediency that the overseas command systems be offered insofar as is possible the greater majority of the easier command opportunities. It is therefore essential that the **xx** command or Tasking groups which are to be used most often in the operations be of the simplest nature to relie**ve** the operational burden on the sites overseas.

In order to effect this into the design of the spacecraft command systems it is essential that the most-used task groups be estimated well in advance of the commencement of operations. Therefore it is recommended that a Working Group be established to make this estimate so the design and development of the sppcecraft may proceed.

definiton D. Historically NSA has provided the/BINKXENDMAXEM of the increments used in the systems of the POPPY spacecraft. It is understood that the of Mission 7107 will be very similar to those employed in 7106, However the community that best understands the environment of the Electromagnetic spectrum as regards be solicited once again so that the opportunity will be available to benefit from any experience gained from mission 7106 operations. Therefore it is requested that NSA, NRO and NSG along with of Code 5170 MIXINGE and Mr. Mayo of NRL convene before the next Quarterly Program Review and in October and attempt to make the recommendations relative to this assignment of

incremerApproved for Release: 2024/06/12 C05026137<sup>Dns</sup>.

C05026137

Gen Approved for Release: 2024/06/12 C05026137 7/8/170 Can NIRL pubstantiali M, or de we dependent on the conservers to do so ? One three results NSHderived, as concurres analytical seculto (the difference needs to be made aleas)? So, IV SURS phoned among whether 7105tour more purponsive (or dear wo) relation to other programs. (It angular more ou.") Those assiful on less po, in the areas (plagensionents) it is recommittee for. 1 Dr. & the facture to relate collection, take to production and - possille losker like a SORS Whentersado of MSA Is this line hand of taches Dors, Ching + Nang an condoning? Vir prohages is too toos flat femotional, maybe phoned to found down pomuchet - Would Ishe to suggest number of aptrome fine grain measurements in DI, soon through stamples bu guin mi 93. VIII - Account many VIP's read only Constanting and Recommendeding, include allow tide of some of " electronic aragonay" - like ABM, and mussile systems, air defenses, hard now harad construction.

Approved for Release: 2024/06/12 C05026137

A. The general charge of costly and redundant EOB production should be reviewed. The USIB guidance specifically in Section 9, requires calls for "sampling of known emitter subsystems in certain geographical areas to provide a measure of activity levels, interrelationships and usage patterns. Satisfaction of these needs will also provide a data base for support of warning and indication analyses." Mission 7105 has been providing this type of data base for over three years on almost all weapons subsystems.

As to the indication of costly processing this is the result of collection of almost all the major weapons systems. The STRAWMAN/REAPER or P-11 collection efforts are over much more limited weapons subsystems (i.e., less frequency coverage, less time coverage). C05026137 <sup>24 21</sup> Approved for Release: 2024/06/12 C05026137 WORKING PAPER The basic logation technique for the POPPY Β. The results of the intercept data from the Mission 7105 need some elaboration. If one subtracts his tianto is Low.) all of the unlocated and deleted data from the 2,180,000 separate intercepts, a figure of 4,000 locations were derived which met the location confidence requirements. This figure is basically in club agreement with the results of the batch processing presented to the NKO NRE review on 21 November 1969 of the domestic batch processing" dNSA whice compared with MULTINERICAN and the computer-aided manual analysis used at the field stations. The summary at that meeting was that the batch processing of the was producing most of it's locations on stable, circularly field Site with its scan radars and that the manual computer\_aided approach was producing locations on almost all of the weapons systems radars. Specifically in the batch processing, in the previous seven months had produced 1140 locations primarily on etc. The manual computer-aided approach had produced 187 locations the previous week, however, the more typical values were Ligh presher about 50 per weak on the unknowse (see attachment for a sample of one month tabulation) and other complex radars such as This have & Since, that review discussions have been held to apply some etc. of the techniques used in the computer\_sided manual/analysis to the ANSA. batch processing<sub>A</sub> In the area where probably the lasges errors system, the satallite positions, NRL has been exist in the working with SRASUR and the Maval Neapons Laboratory to obtain a WORKING PAPER

C05026137 1.5 52555 5855-615 5 Approved for Release: 2024/06/12 C05026137 WUTKING PAPEN more accurate satellite position determination. The improvement of about 3 to 1 is about to be put into field operation and when this is put into operation at NSA, all low altitude systems will accuracies, however, are basically guite good; Ale The benefit. The chart on page lists some of these results. The batch propuzzle by providing the cessing result which solved the POPPy trademark of scan had a 1x4 NM confidence area on at least POPPY EOB which was not discarded from the data file. one 了自己回问的 WARFING PAPER 211 0 Approved for Release: 2024/06/12 C05026137

Approved for Release: 2024/06/12 C05026137

WORKING FARES

This amount of time depends primarily on the PRF of the emitter and increases as the PRF increases. For any visible case, the total time lapse required to resolve ambiguities for a on the ellow hand have 375 pps radar is roughly 20 minutes." POPPY with its much closer more rapid thanks spacing of the satelliter and large amount of relative motion with the radar does not suffer from this problem. POPPY will continue to provide accurate unambiguous locations on the higher PRF (1000 pps and higher) fire control radars and others which may have high densities, be noveable, or be "popcorned" in their on/off cycles.

> NOVYY'S As a search role is

> > CANTAR

reviewed the projected for various programs the basic concept of search must be reviewed. For large fixed structures which are recognizable in photography the effort is one of watching these structures for as much time as possible over as much a frequency range as possible. As a general USIB weapons system element search for all the different USIB requirements on radars which in many cases a priori knowledge does not exist. This is not just the search for



new elements but also for determining the full capabilities of existing elements. An example of this type of search was cited in VE, 1, of the draft. This was the recognition greater sector coverage of the missile this has great implications in the ABM defensive posture. A second is the detection of an extended R.F. range of the above and balow its old magnitron limits. This is highly significant to the jamming or deception equipment on our aircraft.

The ideal system would watch everywhere for everything all the time, however, it is impossible to build an ideal system. There are many factors which enter into evaluating actual collection systems collecting against actual radars and any approach even the full operation use of systems, have qualifying conditions and involve value judgments in processing and assertaining the contributions ar effectiveness of systems. One way to obtain a figureof-merit which is not all inclusive, but in this case is used to obtain a perspective of the systems in a search role to compare Uthe instantaneous collection frequency spectrum, the area collected, and the intercept time over the Communist Blob. It is true that this area is not totally within the flowing Union.

C05026137 Approved for Release: 2024/06/12 C05026137 WORKING PAPER. POPPy to provide extended monitoring of a particular missi le chaplex, etc. The second aspect of the initial statement was that of providing "full technical parametric and locational data." In viewing the USIB requirements of the Annes in comparison with the 机前 Approved for Release: 2024/06/12 C05026137

\_\_Approved for Release: 2024/06/12 C05026137



YORNING PAPER

One gauge of the scope of a satellite ELINT program is the amount of frequency coverage multiplied by the geographic area coverage multiplied by the amount of time coverage. Applying this measure to the POPPY program, using data from 1968 (Tables 1, 2, 3, 4), we find:

Total frequency coverage x number of passes from

 $71000 = .529248 \times 10^{6}$   $7105B = .639745 \times 10^{6}$   $7105C = 2.0813825 \times 10^{6}$   $7105D = 2.36619 \times 10^{6}$ 

Total = 5.616 x 10<sup>6</sup> MBE X Passes

Each pass if 13/60 hours long (13 minute pass) The area of coverage is 9.731 x 10<sup>6</sup> EM<sup>2</sup> (1760 N.M. Radius Circle) So the total coverage = 5.616 x 10<sup>6</sup> MHz x PASSES x

 $\frac{13}{60} \frac{\text{HRS}}{\text{PASS}} \times 9,791 \times 10^6 \text{ HM}^2$  $= 11.04 \times 10^{12} \text{ MHz} \times \text{HRS} \times \text{HR}^2$ 

Approved for Release: 2024/06/12 C05026137\_\_\_\_\_



Approved for Release: 2024/06/12 C05026137

JP SECRET

## WORKING PASES

## RELIABILITY AND TECHNICAL CONTRIBUTIONS OF THE POPPY PROGRAM

Since the POPPY Program provides a Satellite BLINT Collection System, it therefore must be evaluated primarily on its ELINT coninformation. However, one should not neglect the more general techsp? nilogical contributions of the program. After all, it is only through a sound technilogical base that the "better mousetrap" is ever built.

POPPY has provided some outstanding contributions to the stateof-the-art over its 10-year period. Some examples follow:

Reliability: POPPY has achieved an outstanding reliability record. Mission 7105 is today over three years old and all four of Laner ?? quantely the spacecraft are still healthy, useful producers of high quality 7105A, due to battery problems, had been in a "sunlight ELINT data. only" status for a long period. Engineering tests run several months ago at indicated a gradual improvement in the batteries to the point where, approximately one month-ago, completely normal tasking was able to be resumed on 7105A. lasted four and four and a half years respectively. The point is that the design team at NRL has, over the years, evolved a design and testing approach which yields long life systems -- in fact, the POPFY reliability record is held up as the basis of comparison for other similar systems to try to achieve. In an evaluation program, reliability is a relavent factor when compared relative to some other, competing

-C05026137-T

systems. In this context, POPPY has an enviable record. Any program, such as POPPY, which has consistantly demonstrated success in  $\mathcal{L}_{i}$ achieving advanced technilogical goals without sacrifice of reliability is making a valuable contribution.

Approved for Release: 2024/06/12 C05026137

WORKING PAPER

Technilogical Contributions: Since Mission 7105 is the system under evaluation some of its technilogical contributions should be pointed out. Mission 7105D was the first U.S. spacecraft to fly a data storage system to monitor the performance co its gravity gradient stabilization system. The performance data collected by that storage system was a "revelation" to the gravity gradient design community. It dramatically demonstrated to the entire community, at the Symposium on Gravity Gradient Attitude Stabilization in December 1968, that the basic design tools, analysis and hardware for gravity gradient systems were pacfully lacking. As a direct result of the Mission 7105D gravity gradient data, NRLy and othersx undertook the development of producine componentes, much improved gravity gradient rode dampers, configurations and This new hardware was flown on Mission 7106 and the results sensors. have shown a great improvement and revealed further areas where system optimization can be achieved. These improved systems will be flown on Mission 7107. The higtory of the gravity gradient evolution is a perfect example of how the POPPYSSystem has contributed to advancing the state of the art by flying developmental systems, learning from the results and making further improvements. It should

Approved for Release: 2024/06/12 C05026137

TOP SIGNET ' .. .

be pointed cut that these developmental systems have always been implemented in such a way that failure of that new system did not detract from the basic mission-success however did enhance it. Thus, it is by this approach that POPPY is able to increase its capability with every launch.

Approved for Release: 2024/06/12 C05026137

WORKING PAPER

Another example of a technilogical contribution is the development of the microthruster systems for station keeping. A statement was made in the first draft of the "Mission 7105 Evaluation Report" that POPPY "could not maintain optimum position" on the spacecraft. Let us examine the record. Mission 7105B and 7105D each contained microafter the initial adjustments required On Mission-7105B, thrusters. to place the satellites at the specified distance of Cob physicant R (which was accomplished during first month in orbit) the spacecraf have never been less than apart. It should be noted that the communities opinion as to what constituted an optimum spacing range have changed during the lifetime of Mission 7105。 The point is that the microthruster system is capable of providing any reasonable spacing range which is desired. Excluding the first month in orbit the 7105B microthruster has only had to be sycand used six times to accomplish this spacing history. In every case it has been done at the direct request of the community and in every case has been accomplished in a desired and predicted manner. As recently as three weeks ago 7105B was thrusted. (It had not required

WORKING PAFER

05026137

any thrusting for 13 months prior to that.) The particular thruster used in the recent operation had not been used in the last 2-1/4 years! When energized, the system performed exactly as it had 27 months ago, resulting in an excellent manuever. This system not only illustrates a technological advance but also proves that reliability has been achieved in the process. The 7105D microthruster was of a different design and did not prove to be as reliable as the type in 7105B. However in spite of this, during the period beginning one month after launch to the present time, the spacing has been maintained between the useful limits of \_\_\_\_\_\_ for 93.3% of the time. Contrary to the negative statement concerning spacing in the "Evaluation Report of Mission 7105" the actual results shown excellent performance and represent a significant technological advance.

<u>CARPOR</u>

-C05026137

Approved for Release: 2024/06/12 C05026137

WORKING PAPER



## Future POPPy Launch Costs

phase of Mission 7107, did provide POPPY with cost estimates for both a TITAN and an AGENA launch of a larger and heavier version of Mission 7107. These estimates showed, for the larger and heavier spacecraft, that the TITAN was actually less expensive then the AGENA. This results from the fact that extensive modifications would have been required for the AGENA but not for the TITAN.

## Approved for Release: 2024/06/12 C05026137

A, The general charge of costly and redundant EOB production should be reviewed. The USIB guidance specifically in Section 9 calls for "sampling of known emitter subsystems in certain geographical areas to provide a measure of activity levels, interrelationships and usage patterns. Satisfaction of these needs will also provide a data base for support of warning and indication analyses." Mission 7105 has been providing this type of data base for over three years on almost all weapons subsystems.

As to the indication of costly processing this is the result the ((2 p r))of collection of almost all major weapons systems. The Strawman/ Reaper or P-11 collection are over much more limited weapons subsystems

<del>lep</del>

C05026137 Approved for Release: 2024/06/12 C05026137 -TOP SECRET WORKING PAPER In review of the Evaluation of Poppy Mission 7105 2 number of items should be commented on. 1 Page 3 7105 A battery problem has now been rectified and the sate clife is available 24 hrs / day 2. Counch was on Thor-Agen's notion attes boister TUP OLUNE RKING PAPER

ved for Release: 2024/06/12

# TOP SECRET

C05026137

Two spartenthe first has some discrep which should be set strapht while the second section Damely the rouclusion and recommendations have what we feel are stated gross assumptions which need to be discussed in depth.

section I The statement

MORKING PAPER

The general thrust of the argument against Poppy and imforor of other a pproaches such as the P-11's and the strawman seen to stem from a general missunderstanding of all of the facts relating to the systems. the second states and the second states The first point is that Poppy Mission 720 Strend Strend in 1966 and Lounched in 2967 with the primary Sumation of contributing to the USIB unper need for ABM/AES collection . The primary sunctions were hargely met on the second day of operations ( use by the first intercept of the and on the fourth day by the Doo House in tercepto The Last ABM un known was received on the 19 th of December in stie with the Facade program. The basic comparison with other programs should be made against those that were specified designed and Leunched in the 1966 / 1967 + ime period.

C05026137 for Release: 2024/06/12 C05026137 WORKING PAPER the basic Location system for both strow man and Ploppy is that of POPPY typically has a satellite spacing and is locateting of Queyo Strawm reders spacing will continensly mary ( as is supposed to be problem with Poppy) from a lower usable separation of to separations superwith and locate radars from

C05026137 2024/06/12 C05026137 WURKING FAFER The statement is made that the petromen program will acquire signals with the full technical parametric and becational data. Ethis mission has not flown yet and just what it will contribute is affinithis time a matter of speculation For example, one of the problems Loca tion 6 F techniques which Poppy has used for Six years is that of PRF om biguity. This terests a problem when the time difference between the satellites is greates the time interval be twood pulsos. For example, & radar with soulite pps rate the first andiguity occurs 10 then information with a separatten is be up to extend the satellite specing. For Poppy the Large amount of with the radar relative motion Presolves the combiguities. For strawman, the restricted field of tiew will " medjestithe number, however, at say 3000 mc of the SA-1 + SA-2 radars these will still be a problem particullary because there are so many of these radars Located around the communist countries. orney moseling PAPER 

C05026137 Approved for Release: 2024/06/12 C05026137 Ð WUMMING THI gubrs houch as non planned. manuel 12600 two to P.11 The costs reto pt? 1. She coare recommended Surse, why not infate \$/me coverage/week for Poppy 7 P-11= Tivoli as comparing more equal collection tools. 20. = or 3 Poppy bandle = 1 Tivol;

TOP	SECRET )	, 1 ,t <sub>1</sub>		PAPER
			•	



MEMORANDUM TO FILE WORKING FAFER 25 June 1970

pproved for Release: 2024/06/12 C05026137

1. \_\_\_\_\_\_\_ reported by Ehone at about 8:30 this morning that the Working Group was making its recommendation to SORS that POPPY be phasedout with the advent of other programs which have been **smsmssfixit** recently designed...the suggestion was made that it seemed logical to Turn-it-over to the Navy for Navy use since it seemed that it is only important to the Navy. This very startling ifformation was followed with the statement that by about 10:30 \_\_\_\_\_\_ would be out at Langley with an active review of this rumor as his goal....I was tied up with the briefing for ADM Holmquist until after 4 PM.

2. \_\_\_\_\_\_ called me at my home and related that the next meeting of the Working Group was called for 9:30 of 7 July and they will submit some report of their evaluation, (under pressure from Mr. HELMS and others). It seems that \_\_\_\_\_\_ has been getting individual inputs from the various Working Group members and assemilating them on his own...he even went so far as to show some of these inputs to \_\_\_\_\_\_\_ Forinstance, MID did not find the POPPY output significant, FTDC found it only marginal. NSA testimony as to the Uniqueness was particularily devistating with only 34 SOI's in 3 years.etc.

3. What courses of action seem possible at this time?

A- Get the draft repost and prepare for a meeting on Tuesday 30 June at 9:30AM at the Hoffman Building.

B- \_\_\_\_\_\_\_ of NSA has a copy of the Draft and tomorrow when \_\_\_\_\_\_ And I go to NSA we may try to see him and get a copy and even cook up a method of getting stronger support from NSA if he feels that their testimony has let us down. Maybe he will even give us a copy of their report to the working group, so we can understand the implications of this summary conclusion by the group. It really is not a conclusion of the group at all, rather it is a summary of community response to CIA questions made by CIA personnel...it may be best refuted by asking better questions or asking the same questions of different or wider parts of the community.

Approved for Release: 2024/06/12 C05026137



7105 Evaluation Working Group:

و دا منابعات محمد المراجع ا

in <sup>O</sup>ctober I first heard of this subject in a discussion at when Ron POTTS quoted Dr. Cook of SORS as suggesting that a review of all programs would be made to assess the manner in which the entire community observed the SORS/USIB quidance in Design, Tasking and Processing/ Reporting. It was with a great deal of confidence that we next heard of the formation of a Working Group, when we were at NSA and John LIBBERT came into Charles CRAM'S meeting in January 70 and asked for a nominee for NSA participation on this working group. The answer clearly showed that this was not viewed as a choice assignment and would be collateral duty for an already over tasked staff... was nominated. We suggesting, that NRL be then sent out our given membership on the working group because of our, Pro-Poppy view and long continuous attention to the subject etc. This was not done but we did get a change to input to the Navy member to the group. We have not seen the manner in which he put out inputs to use though ...

It now appears that the "USER View" of output has been the sole criterion since the User community is the one that was questioned. In no way that is evident was the Design or the Tasking of the system reviewed. Now I submit that if the Design and the Tasking were evaluated it would be apparent that the paralysis which has buildup has been at NSA, where in many cases it was just too much trouble to publish POPPY results for Mission 7105. The launch of this mission found NSA in a complete state of disorganization due to the exchange of computers (IBM being replaced by the CDC-6600's). The operational software was only changed to the extent that 1964-65 mathematics was converted to fit on the new machines and streamlined to the extent that the manual interfaces were reduced gradually to the point that some very few emitters could be processed without human intervention if they met a set of highly demanding criteria. This criteria eliminated all except a few of the ...All with 360° emitters such as azimuth antenna scan coverage. The extremely demanding criteria have eliminated all of the important singals from the Machine-Output of Only the routine EW emitters remain and only the processing at NSA. a very few of these because of the requirement for data characteristics. As an example the NSA output will not result in locations of any Ht-Finder OR DOG HOUSE. or Sector Scanning emitter such as except as it is worked in a special Han-fed mode, not automatically. The criteria for a minimum number of pulses per burst is so demanding that almost no X-Band signalx will qualify. Approved for Release: 2024/06/12 C05026137

C05026137.

The working Group will make their report following the 7 JULY meeting. Now how can we best put this next 10 days to use?

1- Study the alternatives to such an anti-poppy recommendation. How could the NAVY support the effort with (1) People, Money (3) Data reduction, (4) data dissemination etc?

2- While we sincerely believe that as the NAVY has found this a viable program and one with high future poteneial, the ARMY and AIR FORCE would find it of value too if given the opportunity to reap their particular benefits. Now what really inhibits such exploitation???? NSA alone stands in the way and I doubt that they could withstand a full scale review of their approach to POPPY Processing. It has had too few innovations in the past few years to really get the job done.

As I understand it

has had a heavy hand in both

3- Buidd a Rebuttal which challenges the basic premise that published reports give the total view of pooductivity and the estimate of the future.



WURKING PAPER



MEMORANDUM TO FILE 28 JUNE 1970..... SUBJECT: Elements of Rebuttal for CIA position:

1- Assuming that the testimony which was presented was really inadequate then we might (1) Add to it and strengthen it or (2) refute the negative aspacts of the evidence compiled by the working group.

Approved for Release: 2024/06/12 C05026137

WUKKING FAFEK

Generally Mission 7105 was one of our most outstanding successes... it provided two very important "Firsts" during the first four days of operations; DOG HOUSE & From SARY SHAGAN, and then five months later the first intercept of SA-4 refinement leading to association with

intercept and further discovery of Extension of Sector coverage of " ".

2- Perhaps we could challenge the validity of using "A Bibliography" as the sum and total productivity of the program through this period. I submit that there were many areas of this bibliography that were not complete nor if full context. Mammarstrom has made an independant survey of the printed documents, and messages relative to the full Product for 7105 during its three years of operational use and this study shows (1)significant gaps in the NSA testimony, (20 many occasions where POPPY had produced far more intercepts and locations but had not determined the exact RF Frequency so the reports what were written were under the banner of another program with a footnote for POPPY; SA-4 is a good example. From our prejudiced standpoint it seems that over the past several years the POPPY team at NSA has not been aggressive in pushing POPPYes attributes but has been regularily willing to take a minority appologetec view of the accomplishments. I know that this is hard to document but mevertheless it seems to be quite evident that our PRESS has been lacking punch. Without getting into personnalities, How can we state this diluted and neglected historic documentation???? I think that only NSA gan remedy this by making further and much more vigerous testimony available to the Working-Group...This can be obtained if the "Management will treat this " " as more important than a minor collerateral duty for some one in the POPPY group (K-46). Also it seems that the productivity of the sites at should also be considered. Granded their outputs are Unsubstantiated Field Results but is this any worse than SAC reports for SAC use? In the November review of the Processing of both NSA and Field Sites (for the NRO) it was evident that many things could be done to improve the productivity of processing in both quarters but the most important was to get a cooperative arrangement so that the perishable job could be concentrated on at the forward-area processing facility Approved for Release: 2024/06/12 C05026137

#### TOP SECRET EARPOP ZARE

HANDLE VIA BYEMAN-TALENT-KEYHOLE CONTROL SYSTEMS

"WORKING PAPERS"

## EVALUATION OF POPPY MISSION 7105

EARPOP

#### CONTENTS

### INTRODUCTION

COMMENTS ON THE MISSION 7105 EVALUATION

RELIABILITY AND TECHNICAL CONTRIBUTIONS OF THE POPPY PROGRAM

COUNTER ARGUMENTS AND/OR ADDITIONAL FACTORS TO BE CONSIDERED IN RESPONSE TO SECTION V (VII), "CONCLUSIONS," OF DRAFT EVALUATION OF POPPY MISSION 7105

DISCUSSION AND CONCLUSIONS

ANNEX A

TOP SECRET EARPOP ZARE



-TOP-SECRET - EARPOP - ZARF

HANDLE VIA BYEMAN-TALENT-KEYHOLE CONTROL SYSTEMS JOL

## EVALUATION OF POPPY MISSION 7105

#### INTRODUCTION

The draft evaluation of POPPY Mission 7105 prepared by a working group of the SIGINT Overhead Reconnaissance Subcommittee, dated 25 June 1970, has been reviewed by the POPPY Program team at the Naval Research Laboratory. Comments are grouped into two categories: Those which address specific statements and/or sections of the draft, and those of a more general nature.

All of the comments set forth are intended to be of a constructive nature. Further discussions are encouraged.

SECRET-

i



Approved for Release: 2024/06/12 C05026137

TOP SECRET EARPOP ZARF HANDLE VIA BYEMAN-TALENT-KEYHOLE CONTROL SYSTEMS

- Ref: (a) NSA-BYE-19895-68 of 1 Nov 1968
  - (b) NRL-BYE-51906-70 of 18 June 1970
  - (c) USIB TCS-1640-69/3 of 1 Apr 1969

### COMMENTS ON THE MISSION 7105 EVALUATION

In reviewing the draft report a number of different items needed either corrections or more elaboration. With these included, a different set of conclusions and recommendations can be drawn in the evaluation.

A few of these are listed here, the rest are in the body of the paper.

a. The launch was on a THOR-AGENA.

b. Mission 7105 had a DEFSMAC alert capability (see Chart 1 for one month example).

c. Mission 7105 was designed in 1966 and launched in 1967 with the primary function of contributing to the USIB urgent need for ABM/AES collection. The primary functions were largely met on the second day of operational use with the first DOG HOUSE intercept and on the fourth day of operational use by the

The last of the ABM unknowns at that time was intercepted on the 19th of December 1967 simultaneously with the FACADE program.

d. For any meaningful judgments to be made, comparisons should be made against programs which were specified and launched in the 1966/1967 time frame. All facets of USIB guidance as it relates to (1) design of spacecraft, (2) operational tasking,
(3) exploitation of the data collected, should be considered in making these judgments.

The main body of the paper will add more points and elaboration.



TOP SECRET EARPOP ZARF

- TOP SECRET EARPOP ZARF

HANDLE VIA BYEMAN-TALENT-KEYHOLE CONTROL SYSTEMS JOINTLY

## CHART 1

## NSA-REQUESTED DEFSMAC ALERTS (OCTOBER 1968)

EMITTER

MESSAGE FIELD TIME

8 Minutes

9 Minutes 14 Minutes 18 Minutes 13 Minutes 14 Minutes

14 Minutes 6 Minutes

•	MESSAGE	NO.	

	(DOG HOUSE)
2	(DOG HOUSE)
2	(DOG HOUSE)
3	(DOG HOUSE)
2	(DOG HOUSE)
Z	(DOG HOUSE)

С	15140z	
0	12053z	
0	11122Z	
0	101028z	
0	092024Z	
0	091215Z	
0	082347Z	
0	082200Z	

-TOP-SECRET -EARPOP-ZARF-

C



 $\sim$ 

MVORVING

C05026137 -

Approved for Release: 2024/06/12 C05026137

TOP SECRET EARPOP ZARF

HANDLE VIA BYEMAN-TALENT-KEYHOLE CONTROL SYSTEMS

## RELIABILITY AND TECHNICAL CONTRIBUTIONS OF THE POPPY PROGRAM

Since the POPPY Program provides a Satellite ELINT Collection System, it therefore must be evaluated primarily on its ELINT contribution. However, one should not neglect the more general technological contributions of the program. After all, it is only through a sound technological base that the "better mousetrap" is ever built.

POPPY has provided some outstanding contributions to the state-of-the-art over its 10-year period. Some examples follow.

Reliability: POPPY has achieved an outstanding reliability record. Mission 7105 is today over three years old and all four of the spacecraft are still healthy, useful producers of high quality ELINT data. 7105A, due to battery problems, had been in a "sunlight only" status for a long period. Engineering tests run several months ago at indicated a gradual improvement in the batteries to the point where, approximately one month ago, completely normal tasking was able to be resumed on 7103C and 7104A lasted four and four-and-one-half-years 7105A. respectively. The point is that the design team at NRL has, over the years, evolved a design and testing approach which yields long life systems -- in fact, the POPPY reliability record is held up as the basis of comparison for other similar systems to try to achieve. In an evaluation program reliability is a relevant factor when compared 🐭 to some other competing systems. In this context, POPPY has an enviable record. Any program, such as POPPY, which has consistantly demonstrated success in achieving advanced technological goals without sacrifice of reliability is making a valuable contribution.

Technological Contributions: Since Mission 7105 is the system under evaluation some of its technological contributions should be pointed out. Mission 7105D was the first U.S. spacecraft to fly a data storage system to monitor the performance of its gravity gradient stabilization system. The performance data collected by that

TOP SECRET-EARPOP ZARF

"WORKING	PAPERSU
Louis sector and an and a sector as and and	s. Parana an

PAPERS"

#### TOP SECRET EARPOP ZARF

HANDLE VIA BYEMAN-TALENT-KEYHOLE CONTROL SYSTEMS

storage system was a "revelation" to the gravity gradient design community. It dramatically demonstrated to the entire community, at the Symposium on Gravity Gradient Attitude Stabilization in December 1968, that the basic design tools, analysis and hardware for gravity gradient systems were woefully lacking. As a direct result of the Mission 7105D gravity gradient data, NRL, and others, undertook the development of much improved gravity gradient rods, dampers, configurations and sensors. This new hardware was flown on Mission 7106 and the results have shown a great improvement and revealed further areas where system optimization can be achieved. These improved systems will be flown on Mission 7107. The history of the gravity gradient evolution is a perfect example of how the POPPY System has contributed to advancing the state-of-the-art by flying developmental systems, learning from the results, and making further improvements. It should be pointed out that these developmental systems have always been implemented in such a way that failure of the new system did not detract from the basic mission: Success, however, did enhance it. Thus, it is by this approach that POPPY is able to increase its capability with every launch.

Another example of a technological contribution is the development of the microthruster system for station keeping. A statement was made in the first draft of the "Mission 7105 Evaluation Report" that POPPY had "difficulty in maintaining subsystem positions" on the spacecraft. Let us examine the record. Mission 7105B and 7105D each contained microthrusters. On Mission 7105B, after the initial adjustments required to place the satellites at the specified distance of (which was accomplished during the first month in orbit), the spacecraft have never been less than It should be noted that the community's nor more that opinions, as to what constituted an optimum spacing range, have changed during the lifetime of Mission 7105. The point is that the microthruster system is capable of providing any reasonable spacing range which is desired. Excluding the first month in orbit, the 7105B microthruster has only had to be used six times to accomplish this spacing history. In every case it has been done at the direct request of the community and in every case has been accomplished in a desired and predicted manner. As recently as three weeks ago 7105B was thrusted. (It had not required any

-TOP SECRET EARPOP ZARF

KING PAPERS'

## TOP SECRET EARPOP ZARF HANDLE VIA BYEMAN-TALENT-KEYHOLE CONTROL SYSTEMS JOINTLY

thrusting for 13 months prior to that.) The particular thruster used in the recent operation had not been used in the last 2-1/4When energized, the system performed exactly as it had vears! 27 months ago, resulting in an excellent maneuver. This system not only illustrates a technological advance but also proves that reliability has been achieved in the process. The 7105D microthruster was of a different design and did not prove to be as reliable as the type in 7105B. However in spite of this, during the period beginning one month after launch to the present time, the spacing has been maintained between the useful limits of of the time. Contrary to the negative statement concerning spacing in the "Evaluation Report of Mission 7105" the actual results show excellent performance and represent a significant technological advance.

The highest collection frequency employed by SIGINT satellite programs under the NRO has been established first by Mission 7105 with the development and successful deployment of a collection system operating from 14,600 to 14,800 MHz. The system sensitivity attained in flight was in excess of -100 dbm, including 16 db gain in the receiving antenna system. This system has remained operational from launch to the present time. When one considers that this is still a crystal-video system, it certainly has extended the state-of-the-art in intelligence collection systems deployed in orbit.

Another area where POPPY Mission 7105 has extended the stateof-the-art is in the operational deployment for the Mission 7105 launch of the first high-speed, multiple channel. analog-to-digital data conversion system to the site in \_\_\_\_\_\_ This very advanced, reliable system, combined with the small computer, has provided quick response on unknown radars. This system, for example, provided the initial locational information on radar, and there have been many, many unknown radars located and reported with very short response time (see Charts 2-5) for one month results). Against the known signals this system has provided a tactical response capability (near four hours) against such major Soviet operations as the OKEAN exercise.

TOP SECRET EARPOP ZAR

5

ant. .







e age and a second

#### TOP SECRET EARPOP ZARF

HANDLE VIA BYEMAN-TALENT-KEYHOLE CONTROL \$YSTEMS

COUNTER ARGUMENTS AND/OR ADDITIONAL FACTORS TO BE CONSIDERED IN RESPONSE TO SECTION V (VII), "CONCLUSIONS," OF DRAFT EVALUATION OF POPPY MISSION 7105.

Page 12, line 2 - "... the inherent basic design of POPPY precludes accurate frequency measurement and acquisition of certain other signal characteristics necessary for detailed signal analysis."

While it is true that POPPY does not, in general, measure frequency accurately, it should be noted that:

1. POPPY does determine the magnitron family spectrum, and when an emitter migrates outside this spectrum the emitter is detected in the next collection system, either above or below the band where it is normally found.

2. In most types of radar, the exact frequency can be easily changed by tuning, and therefore frequency is not an "overpowering" piece of technical information.

3. In some types of radar, where frequency agility is the basic means of "steering the beam," POPPY can and has been instrumented to measure the frequency to 1% (Mission 7106 R&D payload).

Some of the other signal characteristics referred to are, in fact, measured by POPPY. \_\_\_\_\_\_ and Signal Amplitude measurement options \_\_\_\_\_ and SLX) were flown in Mission 7105. On the relatively few occasions when these options were exploited, some significant results have been obtained. The multi free antenna pattern of the \_\_\_\_\_\_ is a good example. The community plans on far greater exploitation of this lucrative source of "other signal characteristics" in the future.

Page 12, line 5 - "The use of POPPY systems for location purposes, providing accurate EOB, has not made a significant addition to EOB data. This latter fault apparently stems from both the difficulty in maintaining subsystem position to provide time of arrival data and the low priority emphasiss which is placed on providing EOB from these data by NSA."

TOP-SECRET-EARPOP-ZARF

10

#### -TOP-SECRET EARPOP ZARF

0202013/-

HANDLE VIA BYEMAN-TALENT-KEYHOLE CONTROL SYSTEMS JOINTLY

The primary ELINT mission assigned to the POPPY Program is general search, not EOB, and both design and operation of the program has been responsive to this assignment. At the same time there have been continuous contributions to EOB by POPPY, particularly in its early years (when there was less overhead EOB capability) and again more recently (as a result of premature de-orbiting of EOB spacecraft). POPPY's EOB output therefore has been significant in this sense.

The reason that POPPY has not made a more significant contribution to the EOB data bank is not because of "difficulty in maintaining subsystem positions," i.e., spacing between the satellites. The record clearly refutes this. 7105 ALPHA and BRAVO have been maintained between \_\_\_\_\_\_\_\_\_ since becoming operational over three years ago. Over the same period of time the 7105 CHARLIE and DELTA spacecraft have been maintained between \_\_\_\_\_\_\_\_ of the time. Spacing clearly is not the reason for lack of a significant EOB contribution. Actually the reverse is true, spacing has, in general, been close to optimum for EOB data production.

Page 13, line 13 - "Further, the increasing possibility that the required POPPY support sites on foreign soil may be lost requires immediate consideration of options to replace the POPPY collection system and its necessary ground support sites."

The POPPY program has recognized the vulnerability of its foreign ground sites for some time.

approaches to completely eliminate its need for ground stations on foreign soil. Satellite to satellite relay systems, floating stations, and/or greater use of U.S. territory will all be intensely studied. We are confident that some combination of these approaches will not only prove feasible but also cost effective and reliable.

-TOP-SECRET-EARPOP-ZARF



11

#### TOP SECRET-EARPOP ZARF

HANDLE VIA BYEMAN-TALENT-KEYHOLE CONTROL SYSTEMS JOINTLY

### DISCUSSION AND CONCLUSIONS

A. The general charge of costly and redundant EOB production should be reviewed. The USIB guidance, specifically in Section 9, requires "sampling of known emitter subsystems in certain geographical areas to provide a measure of activity levels, interrelationships and usage patterns. Satisfaction of these needs will also provide a data base for support of warning and indication analyses." Mission 7105 has been providing this type of data base for over three years on almost all weapons subsystems.

As to the indication of costly processing, this is the result of collection of almost all the major weapons systems. The STRAWMAN/REAPER or P-11 collection efforts are over much more limited weapons subsystems (i.e., less frequency coverage, less time coverage).

B. The specific EOB numbers used and the actual location techniques will be discussed. The intercept data from the Mission 7105 need some elaboration.

First, the figure of 2,180,000 intercepts seems low. There were over 22,000 tapes made on 7105 which would indicate an average intercept density of less than 100 intercepts per tape. This is a very low average figure.

Second, removing all of the unlocated and deleted data from the 2,180,000 separate intercepts, a figure of 4,000 locations were derived by automatic processing which met the location confidence requirements. While it is hoped this is not indicative of the future, this figure is in close agreement with the results of the batch

ΠOD	CECDEM	ENDDOD.	77.00
	- SHOKBI-	-AINTON	TUTT



#### -TOP-SECRET EARPOP ZARF-

HANDLE VIA BYEMAN - TALENT-KEYHOLE CONTROL SYSTEMS

processing presented to the NRO on 21 November 1969, when the domestic batch processing was compared to the computer=aided manual analysis used at the field stations. The summary at that meeting was that the batch processing of the was producing most of its locations on stable, circularly scanning radars, and that the manual computer-aided approach was producing locations on almost all of the weapons systems radars. Specifically the batch processing had produced in the previous seven months 1140 locations primarily on

etc. The manual computer-aided approach had produced locations the previous week. Typically about 50 locations per week are provided on the high priority unknowns and other complex radars such as etc. The total number of the computer-aided manual locations from Mission 7105 is about 5000, and this should be added to the overall total.

Since that review, discussions have been held to apply some of the techniques used in the computer-aided manual analysis to the batch processing.

Third, in the area where probably the largest errors exist in any \_\_\_\_\_\_ the satellite positions, NRL has been working with SPASUR and the Naval Weapons Laboratory to obtain a more accurate satellite position determination. The improvement of about 3 to 1 is about to be put into field operation, which should further improve the locational accuracy. When this is put into operation at NSA all low altitude systems will benefit. The

however, are basically quite good. Chart No. 6 on page 14 lists some of these results. The batch processing result which solved the puzzle by providing the POPPY trademark of emitter scan had a 1x4 NM confidence area on at least one which was not discarded from the data file.

TOP SECRET EARPOP ZARF



13











TOP SECRET EARPOPApproved for Release: 2024/06/12 C05026137

HANDLE VIA BYEMAN-TALENT-KEYHOLE CONTROL SYSTEMS

#### ANNEX A



One gauge of the scope of a satellite ELINT program is the amount of frequency coverage multiplied by the geographic area coverage multiplied by the amount of time coverage. Applying this measure to the POPPY program, using data from 1968 (Tables 1, 2, 3 and 4), we find:

> $7105A = .529248 \times 10^{6}$  MHz x collections  $7105B = .639745 \times 10^{6}$  MHz x collections  $7105C = 2.0813825 \times 10^{6}$  MHz x collections  $7105D = 2.36619 \times 10^{6}$  MHz x collections Total = 5.616 x  $10^{6}$  MHz x collections

Each collection averages 13/60 hours long (13 minute pass).

The area of coverage is 9.731 x  $10^6$  NM<sup>2</sup> (1760 N.M. Radius Circle), so the total coverage = 5.616 x  $10^6$  MHz x collections x  $\frac{13 \text{ HRS}}{60 \text{ Collection}}$  x 9.731 x  $10^6$  NM<sup>2</sup> = 11.84 x  $10^{12}$  MHz x HRS x NM<sup>2</sup>



#### TOP SECRET-EARPOP ZARF

HANDLE VIA BYEMAN-TALENT-KEYHOLE CONTROL SYSTEMS JOINTLY

## TABULATION BY DATA LINKS FOR 7105 ALFA 31 JANUARY THROUGH 31 DECEMBER 1968

1	2	3	4	5	6	
RF	DATA		TASK	TIMES		
BAND	LINK	CHANNEL	GROUPS	TASKED	SOI	_
	,	<b>611 7</b>	10		<b>c 1</b>	
153-165	l	CN	19	394	61	
166-200	2	BN	20	294	· 1	
550-650	3	BN	21,25	69	1	
654-855	4	BW	20,21	308	0	App
820-920	5	CN	20	294	1	orov
920-1108	6	CW		0	0	ed t
2560-2695	7	BW	19	394	0	੧ ਸ
2678-2930	8	CW	23	570	61	elea
2915-3128	9	CN	22,24	642	123	ase
3105-3315	10	BN	19	394	29	202
						12 C050261
		TABLE 1		•		, "WO
						SNIS
		TOP SECRET-EARI	<del>COP-ZARF</del>		and the second se	
		A-2				e e e e e e e e e e e e e e e e e e e



## HANDLE VIA BYEMAN-TALENT-KEYHOLE CONTROL SYSTEMS JOINTLY

TOP SECRET EARPOP ZARF

TABULATION BY DATA LINKS FOR 7105 BRAVO 31 JANUARY THROUGH 31 DECEMBER 1968

1	2	3	4	5	6
RF	DATA		TASK	TIMES	
BAND	LINK	CHANNEL	GROUPS	TASKED	SOI
154-165	1	CN	19	450	123
166-200	2	BN	20	365	6
550-651	3	BN	21,25	77	2
652-857	4	BW	20,21	379	0
820-922	5	en	20	365	5
2560-2705	6	BW	19	450	0
2675-2933	7	CW	23	626	126
2915-3130	8	CN	22,24	705	216
3102-3315	9	BN	19	450	46
3275-3615	10	BW	24,25	75	15



-----



TOP SECRET EARPOP ZARF

C05026137

.

Approved for Release: 2024/06/12 C05026137

WORKING PAPERS

HANDLE VIA BYEMAN-TALENT-KEYHOLE CONTROL SYSTEMS JOINTLY

TOP SECRET EARPOP ZARE

TABULATION BY DATA LINKS FOR 7105 CHARLIE 31 JANUARY THROUGH 31 DECEMBER 1968

6	5	4	3	2	1
	TIMES	TASK		DATA	RF
SOI	TASKED	GROUPS	CHANNEL	LINK	BAND
0	205	17	BN	1	100.5-124
0	370	4	CN	2	196-350
41	370	4	CW	3	350-550
3	724	16	CN	4	L790-2520
6	205	17	BW	5	3600-4055
8	724	16	BW	6	4910-5080
121	724	16	CW	7	6460-6710
99	277	18	BW	8	7780-8510
58	277	18	CN	9	8090-8630
87	138	13	CW	10	8480-9360
57	138	13	BN	11	9300-9520
C	552	10	BW	12	920-1855

Approved for Release: 2024/06/12 C05026137



.

#### TOP SECRET EARPOP ZARF

HANDLE VIA BYEMAN-TALENT-KEYHOLE CONTROL SYSTEMS JOINTLY

TABULATION BY DATA LINKS FOR 7105 DELTA 31 JANUARY THROUGH 31 DECEMBER 1968

έ,

C050261

ω

Approved for Release: 2024/06/12 C05026137

ORMANO

1	2	3	4	5	6
RF	DATA		TASK	TIMES	٠
BAND	LINK	CHANNEL	GROUPS	TASKED	SOI
1780-2520	1	CN	16	724	2
4920-5080	2	BN	16	724	9
6450-6725	3	CW	16	724	103
6720-7300	4	BN	17	205	9
7220-7930	5	BW	17	205	,29
7730-8450	6	BW	18	277	<sup>′</sup> 78
8100-8620	7	CN	18	277	57
8550-9370	8	CŴ	13	138	92
9300-9515	9	BN	13	138	51
14.5-14.8 GHz	10	CN	4	370	97
196-553	11	CW	4	370	42
920-1865	12	BW	10	552	0

Approved for Release: 2024/06/12 C05026137

GWINUOW)

TABLE 4

TOP SECRET -EARPOP ZARF

A-5