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SEJ W/P INTRO & BACKGROUND
FOR MIS-7105/7106

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U. S. NAVAL RESEARCH LABORATORY
WASHINGTON, D. C. 20390

IN REPLY REFER TO
12 Dec 1966

Appraisal of the POPPY Program's potential toward intercept of ABM Complex....

1. Modification of the Satellite Collection capability.

A. Addition of 220 to 550 mc band to 7105D so that it will supplement the two bands now contained in 7105C and for the basis of a

B. Addition of the 920 to 1850 mc band in 7105 B and the 1100 to 1850 mc band in 7105A will provide the basis for a in this frequency range which had been omitted in the original frequency assignment.

C. Including the in 7105C and D so that these two satellites may also be used on orbits which have hereto for been

2. These satellite modifications will necessitate a slight delay in the launch schedule (estimated at five weeks) since several of the payloads will have to undergo significant re-testing procedures. The Overall effect of these changes is to permit the

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In the same manner that wide portions of the spectrum may be covered more rapidly in the S-Band portions of 7105A and B, the ranges from 153 to 200 mc and 550 to 920 mc may also be tasked en-mass using the Geographic Location as a means of reducing the quantity of data to that which is known to emanate from specific locations and thus the magnitude of data will still be within the capability of the facilities at NSA to analyse. Understand that amibuities of Frequency will result since a narrow pulse which is seen in the data may be for example ~~seen~~ a signal intercepted in the 165 to 200 mc band from 7105A or it may be from the 550 to 650 collection band from the same satellite...both use the Narrow data pulse to identify which collection band the data originated from.

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Memorandum

From: Dir Naval Research Laboratory

To: Dir NRO

Subj: Appraisal of Mission 7105 potential against the ABM Requirement.

1. Introduction and background:

The design goals ~~of~~ which were stated in the proposal for Mission 7105 have essentially been met in the effort of the Naval Research Laboratory during the past ___ months. Four satellites (7105A,B,C, and D) have been prepared for a Launch of 14 February. At this time 7105A and B are __ % complete, while 7105 B is % and 7105D is % completed. The complete ELINT portion of each of these payloads have been furnished to the Satellite assembly and test ~~xxxxxxx~~ group for integration into the final flight configuration. This paper will detail the contribution which can be expected with the sucessful launch of Mission 7105 as it is now designed and alos will treat the variations of how Mission 7105 could be modified to enhance the potential against the ABM intercept requirements as they are presently understood. In a Future paper Mission 7106 will be treated in a similar fashion.

2. Contributions which should accrue from the sucessful launch of Mission 7105 without any design change:

1. The 100 to 3200 mc frequency band which has been associated with the ABM threat is well covered by the Mission 7105, particularily by the first two payloads, 7105A and 7105 B which have [redacted] embrace the portions of the spectrum in which the Soviets have demonstrated capability for high powered radar transmissions. It is reasonable to postulate that the availabliity of high power components and techniques is a valid ~~accurate~~ a clue in the search for the ABM ~~to expected frequency for new~~ special purpose radar.

2. Parametric measurement of intercepted [redacted] possible, one collection-band at a time, in the collection so that signals of high interest can be examined by special Tasking of these two payloads.

3. The collection bands of 7105B will have available by command either standard or ten db above standard, sensitivty thus improving the Handle via General Byeman Talent Keyhole ~~Secret~~ ~~SECRET~~ [redacted] lity of this payload against signals in the past have been too weak to be security Control ~~Sys~~ Channels jointly

4. In addition to the improvements which ave been designed into the Satellites themselves, there are improvements in the ground station Receiving, Recording and Data Processing systems which will greatly enhance the MISSION 7105 performance against the ABM Requirement. Of the greatest potential is the Analog to Digital data-conversion system which is being prepared for installation at [redacted] Inherent in this system is one mode-of-operation which will [redacted]

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4, In addit[redacted] o thexx potential which has been designed into the satellites of Mission 7105, there is also considerable possibility of using Geographical location of the emittor as a primary sort criterian in the first generation Digitization equipment which is being prepared for installation in the POPPY collection site at [redacted] after the first of the year.

[redacted] This digital data stream with time bench marks each second is recorded on a incremental type(digital) magnetic tape recorder using NRZI 800 bpi density. xxdxxxxxx this format is easily amenable to either partial data reduction on the spot or electrical transmission, CONUS for analysis.

improvements
In addition to the xxxxxxxxxxxx which have been designed into the Satellites themselves, there are xxxxxxxx improvements in the ground station systems and in the versatility of Tasking which can provide major enhancement toward the solution of the ABM Intercept requirement. The first-generation Analog to Digital conversion system is being prepared for installation at [redacted] Inherent in the[redacted] of this system is an ability to [redacted] data st[redacted]

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MODIFICATION TO [redacted]LLITES PREPARED FOR MISSION 7105 which would enhance the capability against the ABM Requirement.....

[redacted]

For instance all of the S-Band collection coverage provided in 7105 A and B contained in five bands, has in the past been handled enmass from a single pulse width modulated transmittor (DYNO I) and has shared the tramsmittor with another collection band in 7101, 7102 and 7103. In 7104 A and B thes S-Band spectrum was split into two parts thereby reducing the data density and improving the resolution of Frequency.

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The data contained in the frequency range from 2500 to 3250 mc has been collected in 1962 DYNO I on a single data link, this same data was collected in 1962-3-and 64 by 7101,2 and 3 using only one-half of this data link. or in other words, S-band Data shared the data stream with some other collection [redacted] It is now suggested that for the greatest potential in [redacted]BM signal, 7105A and B be tasked with the complete S-Band collection turned-on at the same time until the signals are heard and then tru to determine the r-f spectrum by more specific tasking.

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Thus with th[redacted]eption of the twenty megacycles between 200 and 220 mc and the eighty mc between 2500 and 2580 the entire band from 153 mc to 3300 mc has the ability to be tasked [redacted]

[redacted]

complex is expected. Significant enhancement will be possible in the instrumentation planned for installation at [redacted] at the time of launch.... Analog to digital conversion of the data stream is planned so that the errors in timing resolution inherent in the analog Record and Reproduce modes is not suffered; this has resulted in improvements in the standard deviation of the timing uncertainty to a value of about [redacted] while the older system of analog (Frequency Modulation type) Magnetic recording and NSA processing showed about 12½ microseconds standard deviation in the measurement of Pulse Repetition Interval. While this reduction of the standard deviation of the measurement of time in the data relates to the accuracy of emittor location, it is not a simple relationship. Also this reduction affects the number of pulses which may be required to give a good fix as well as the improvement in [redacted]

[redacted]

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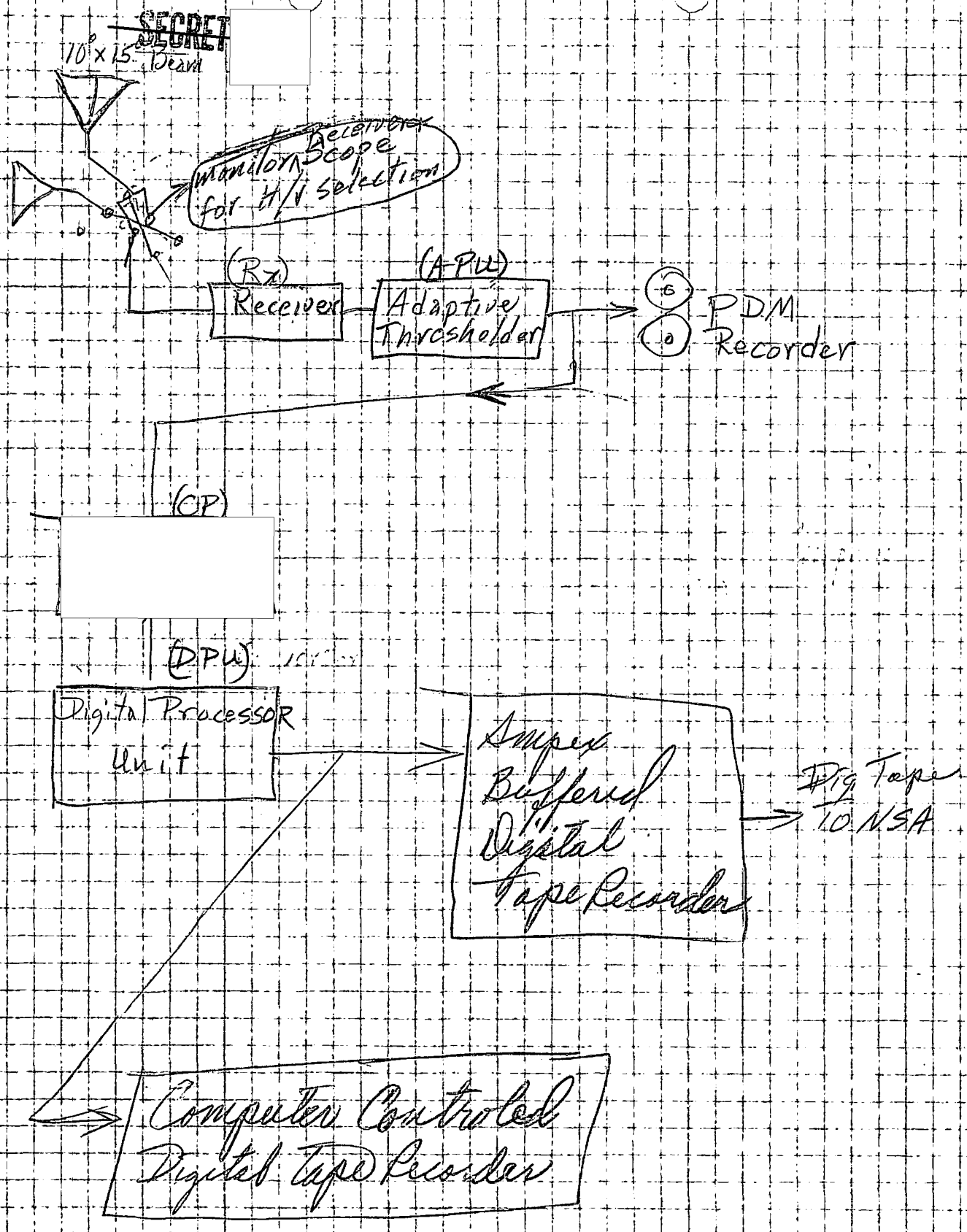

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~~SECRET~~ [redacted]

Base Goals for [redacted] Instrumentation Changes:

1- Improved (old aerials) true resolution in data by:
   1- new Receivers
   2- adaptive threshold
   3- A to D conversion before a digital tape recording made
   ~~B Decentralizing~~

2- ~~Improve Channel for~~ [redacted]
   ~~copy~~ so it can be expedited to NSA
   (To No-Go Test)

3- Providing a "CONFIDENCE Check" to assure A/D Conversion as Valid before each pass. or else make a backup Analog type recording.

4- Provide a Computerized controlled Data Sort & Data recording System so that:
   a- SOI can be identified for Tasking Alert purposes
   b- Attempt [redacted] rate
   c- Expedite initial & recorded Technical appraisal of TES thus provide guidance toward effective Tasking and operational utilization.
   d- Allow more thorough and comprehensive utilization of both ground & flight systems and provide a more accurate rapid base for judgment of R&D techniques & analyses instrumentation.

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TO DIR NRO

From DIR PROGR [redacted]

Subj: Appraisal of the ~~[illegible]~~ Program C toward Intercept of the ABM Complex.

1. INTRODUCTION AND BACKGRAOUND

With the launch ~~[illegible]~~ planned for MISSION 7105 ~~[illegible]~~ in February 1967 the satellites are nearing completion. ~~[illegible] of the Naval Research Laboratory to modify slightly the last two payloads~~ The Naval Research Laboratory has proposed several simple changes in the last two payloads which ~~can [illegible]~~ without modifying the ~~design~~ operational capability features for General Search and EOB Location-finding mission will provide greatly enhanced potential for intercepting the ABM Complex signals.

1. The Naval Research Laboratory in MISSION 7105 will fulfill the General Search and E.O.B location-finding mission. With the addition of two additional collection bands in the 7105D satellite and an additional collection band in the 7105C ~~satellite~~, (a very very minor change requiring only 5 or 6 weeks to effect) the MISSION 7105 will then have complete [redacted]

2. The Naval Research Laboratory has undertaken a program of improving the basic timing accuracy of the ground station. [redacted] This includes the instrumentation for ~~[illegible]~~ Matched Receivers, Field Digitizing, Automatic Calibration of the ground stations.

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3. The POPPY sys[redacted]an provide the highly accurate Broad Band, omnidirectional collection ELINT system needed strongly support the exploitation of the ABM Threat. By the diverse nature of the ABM Complex, many emittors with low duty cycle with one single common the denomenator of geographic location;

the collection system must [redacted] utilize this unique parameter. ABM as has amplified by members of the NRO staff.

In order for MISSION 7105 to exploit this common denomenator to the fullest, the [redacted] must be able to tag this digital unprocessed data [redacted] for priority transmittion to NSA for analysis. In tagging this signal, the feedback information fo[redacted] for more fully exploiting the [redacted]

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To Dir ~~NRO~~ ~~SECRET~~ [redacted]
From Dir NRL

Subj: Mission 7105 potential toward the solution of the ABM threat:

1. Modification of the satellites of Mission 7105 are being made to further improve the potential inherent in the POPPY system for the detection of the ABM Signals ~~has been undertaken by the Naval Research Laboratory.~~ This modification specifically does the following things:

   1. Fills the frequency gap which existed in [redacted] by adding a 200 to 550 mc collection band in the 7105D satellite.
   2. Add a [redacted] band to the 7105C and 7105D " to provide coverage [redacted] in the frequency from 920 to 1800 mc region.
   3. Profided the 7105C and D satellites with the [redacted]

[redacted]

Soviet areas which have been covered in the past only by the Southeast-going orbits across the [redacted] areas of the world.

These modifications to the satellites which have been undergoing the final preparations for launch will delay the launch until after the 4 April 1967 (about seven weeks). This small delay is the result of intensively utilizing the holiday period of Christmas and New Years by the critical personnel. Note that the modifications are restricted to the last two satellites in production so that only two units are to be subjected to the surgery of last-minute changes in the ELINT Experiments. and thus the dangers of system interface incompatibiilites. This is not an easy relaxed schedule but rather it one of being fully responsive to the requests for Urgent enhancement of the systems' capability toward the ABM Requirement solution.

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~~SECRET~~ [redacted]

U. S. NAVAL RESEARCH LABORATORY
WASHINGTON, D.C. 20390

SECRET [redacted]

IN REPLY REFER TO

SITE IMPROVEMENTS:

[redacted] ..... by Launch Date.

1. Analog to Digital Conversion
   Need Computer controlled Digital Tape Transport.

OR

2. "Geographic Location" as a Sort Criteria
   Need Honeywell Model DDP-516 ~~General Purpose~~ GP Computer
   First One by 1 Jan and the second by 1 February.

   COSTS..... $350K

TWO ADDITIONAL SITE IMPROVEMENTS:

1. [redacted] by 15 May 1967. 1 June 1967
   Need (10) new Receivees
   Honeywell DDP-516 GP Computer
   Analog to Digital Conversion system
   COSTS..... #350K

2. [redacted] . . . . . By 15 August 1967
   Need (10) new receivers
   Honeywell DDP-516 GP Computer
   Analogw to Digital Conversion system
   COSTS. $350K

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I Introduction and Background
Unique abi[redacted]o locate with accuracy in the range of interest.
Status of Mi[redacted] 7105
Status of " 7105 Ground Station instrumentation.
Status of Mission 7106.

II Potential of Mission 7105 toward solution of ABM requirement [redacted] including all bands from 153 to 3250 where they have demonstrated a high power Radar Capability.
Use of "Geographic Location" as a Major sort criteria in A/D Conv.
Tasking versatility
Recycling mode type interrogation

III Modifications to Mission 7105 Frequency coverage (Minor) 7105D: 220-550 A/C: 900-1800 Redesign 7105 C/P Pulse width based Data.
(Major)

IV Modifications to Mission 7105 Design Concept. ~~are very~~ Should be minor since this ABM requirement imposes no new reqirements other than the (100 to 3250mc) frequency range emphasis.

V Tasking Guidance for maximizing intercept of ABM Signals @ known spots.

VI Conclusions:
Launch Mission 7105 as scheduled with no changes except...
Why trade a delay of unknown ammount in a Mission with already great potential when a specific POPPY Mission can be instrumented within 8 months to go Directed search for this and nothing else.

Augmentation of 7105 for ABM/AES
Intercept, identification & geo-location.
Dec 1966

~~SECRET~~ [redacted]

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INTRODUCTION AND BACKGROUND

I. The [redacted] system when compared with the other contributing programs has some significant outstanding capabilities... it will locate the emittors in the Frequency range below 153 mcs to 3200 mc down to [redacted] of probable location. This capability coupled with the Simple Concept and resultant long orbital lifetime and Wide Coverage in Frequency have made it a Major candidate for the intercept solution to the ABM signal family. The Satellites 7105A,B,C, And D are nearly complete and are on a schedule which will have them available for a Launch of 14 February ~~and are nearly completed~~. Any significant change in these satellites will result in a corresponding delay in the launch date....this paper will attempt to set forth the alternatives and ~~the~~ appraisal These toward enhancing the "ABM" operational contribution expected, ~~to be derrived from each of these alternatives.~~ As a starting point The Mission 7105(with no modification) operational capability toward the ABM Signal intercept goal will be given, ~~first.~~

II. MISSION 7105/Capability toward the ABM Signal intercept anticipated. Assume that the four payloads of Mission 7105 are placed in the desired orbit and assume that all systems are performing up to their design level.

1. Frequency Coverage All frequency bands within the range of interest (150-3250) which have contained demonstrations of high power radar by the Soviets, will be covered by [redacted] capability. (152-200),(550-920),(1800-2500)&(2580-3300) radar systems) It is most likely that new signals designed for this difficult task will fall in a frequency band already in use where hardware, design and techniques are available. So one might conclude that with no modification the chances of finding the location of new signals in these frequencies is quite good. [redacted] Handle via Byeman/Talent Keyhole Control Channels Jointly

2. ~~SECRET~~ [redacted] nstrumentation:

~~SECRET~~ [redacted]

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III B Changes to [redacted]ION 7106 which might increase the effectiveness against the ABM R[redacted]ement:

1. In the short time available for the preparation of this paper the AD HOC committee which prepared the MISSION 7106 Proposal could not be assembled to adjust the design goals for the collection coverage. It can be estimated that the

1. The Naval Research Laboratory will at the earliest opportunity reconviene the the POPPY Proposal AD HOC committee to study the design goals of MISSION 7106 and present to the NRO an updated proposal which reflects the latest guidance relative to the ABM Signal Requirements.

III C Changes to the Basic POPPY concept which have been considered in the preparation of this paper are:

1. Variation of Flight Altitude and INClination....The 500 n. Mi 70° inclination orbit which has been chosen in the past remains the best choice since the requirements for the ABM Signal Intercept impose no new restraints or liberties with regard to the orbit used. [redacted] remains as the primary objective in the analysis of the POPPY Data EOB purposes

2. Addition of a third data-transmitter to each of the POPPY satellites has been seriously considered but the technical difficulty of the surgery necessary at this time to four payloads which are so nearly completed was ruled this out as an extreme measure which would have the same effect as increased tasking on each usable orbit...a measure which can be accomplished with no change to the payloads.

3. Pulse Width coding for each of the Collection bands would assist in reducing the ambiguities which occur when many bands are collected and joined in one data stream from a satellite transmitter. The improved timing resolution might premit the use of pulse width as a sort criteria to identify the collection band of origin in the data stream. Here again this design change at this time would be extremely costly in time to implement since the payloads would have to be alter significantly and then carefully sent through the complete series of flight certification tests, (temperature vibration and Magnetic and Dynamic b[redacted] tests)

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