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MEMORANDUM

From: Code 7920 To: Code 7000

Via: Code 7900

Subj: Research Accomplishment

1. Mission 7107 was launched into orbit at 14121256Z December 1971. The orbit is nearly ideal in its proximity to the design goal or 535 NM altitude and 70° inclination. The spacecraft have undergone an intensive evaluation (Phase I). On 28 December 1971 the total system evaluation commenced (Phase II) where a data base library is being recorded at each site in a manner which is far more intensive than these spacecraft are likely to be used operationally. Included in the goals of Phase II is the requirement to digest this data base into a capsule form that can be tasked at three-month intervals so that the entire system will be capable of evaluation in the environment of each site.

2. The following operational characteristics have been noted.

The Gravity Gradient Stabilization boom and damper for a. 7107C has failed to deploy even though it was checked thoroughly just prior to being installed on the booster and even though there is significant redundancy in the system. The attitude detection and monitoring system has now been analyzed so that the axis of the magnetic moment of the spacecraft is now known. It is hoped that the study of this attitude history will develop to the point that the spacecraft can be tasked during those periods where its attitude will support operational use and, conversely, avoid tasking when its attitude is marginal or such as to provide too little signal strength at the data collection site. It is estimated that approximately 75% of the time, the 7107C spacecraft attitude is acceptable in for data collection operations. The study will provide a much better basis for refining this estimate.

b. The Signal Level Measurement (SLM) option has been evaluated in Phase I. Using this option to assess the parts of the spectrum where the four spacecraft were designed to perform alike in 4-bird fashion, the results show a remarkable agreement. The differences can be easily explained by slight difference in sensitivity between the collection subsystems. From this assessment it seems that the collection antenna systems are less affected by adverse spacecraft attitude than is the data link transmitter system.

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c. Data link transmitter antenna booms on all spacecraft, except 7107D, have not deployed fully, but there are indications that this does not greatly influence the signal level nor the operational usefulness of these spacecraft. The telemetry indicators for this boom system indicate they are fully stowed or fully deployed. Even 7107D, which is now fully deployed, took until the seventh orbit to give the telemetry indication. The analysis on this subject will continue.

3. Significance of Research Accomplishment:

The launch and initial evaluation of Mission 7107 has indicated that the Mission is fully capable of being used operationally with the partial loss of utility of 7107C (less than 25% of the time). The evaluation of overall Mission continues to show favorable results leading to an operational system by about mid-January.

Page 2 of 2 pages

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Second Quarter,	Research Accomplishment	s By code 7920	30 June 71
Principal Invest	igatorsV.S. Rose,	/E.G. Becke	
Subject: Condigu	ous (Comb) Filter develo	oment for X-Band.	15

1. Background:

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Since Mission 7104 the Program C ELINT Coverage has embraced the frequency spectrum up through 9500 MHz and has experienced increasingly heavier data density each year, particularily in the area of the Iron-Curtain border between Europe and Asia. Signal density in excess of 100 main beams in a single second have been observed. The solution to this problem has taken several forms in the ELINT subsystems now being developed by the principal investigators; one of these is being discussed in this paper and that is the developmement of a contiguous twenty-se section filter where each tooth is approximately 20 MHz wide and immediately adjoining its neighbor above and below it in frequency. Together these 20 teeth cover the frequency range from 9200 to 9600 MHz. 2. By reducing the overall RF bandwidth of the collection system it is obvious that certain undesirable (Friendly) radar families can be eliminated from the Program data and will no longer need burden the processing systems. Thus it is anticipated that this ability to be more selective in the assignment of X-bend collection will result in a great exploitation of this heretofore unused portion of the ELINT collection by overhead means.

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Second Quality Research Accomplishments by Code 7920 30 June 71. Principal Investiga F.V. Hellrich/GEorge Price/R.D. Mayo Subject: Augmentation of Program "C" for Ocean Surveillance 1. Background:

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Program "C" has for the past ten years been associated with the overhead collection and processing of ELINT against current USIB priority In essence this has been one of the major National resources targets. for the General Search category for the early discovery of heretofore unknown radar signals. Historically, the Program "C"data has been exploited toward the solution of the strategic ELINT mission. Aver the past two years significant demonstration has also been made of the potential available within the program to intercept, identify and locate on an increasingly timely basis, the major combatants of the Soviet Navy. It is in this direction that the Program "C" is being augmented. Thus the time critical or mobile ship target is soon to become one of the major goals in the operational exploitation of the intelligence being derrived from this program.

2. The augmentation of Program C for Ocean Surveillance has taken the form of two distinct efforts; (10 the first is the design, development and soon the fabrication of a hardware system which will allow the extraction of the time-critical portion of the data and in addition it will be reformatted into the appropriate language of the local processor. (2) the second area of effort is the selection, procurement and deployment of the second-deneration computer along with a library of Real-Time software programs.

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SECOND QUARTER 71 RESEARCH ACCOMPLISHMENTS - CODE 7920, 7-1-71

Space Systems Division Space Applications Branch

Terry W. Fisher and John R. Lindley, Principal Investigators

Subj: A Buffered Tape Storage System for Program "C".

1. Background:

Historically in Program "C" the data has been stored in analog fashion on magnetic tape and couriered back to the continental U.S. analysis facilities for exploitation. Several years ago it was possible to develop and deploy an Analog-to-Digital data conversion system and a small computer to monitor the conversion accuracy. With the advent of this Analog-to-Digital system it has now been necessary to add a means of compacting the data in time and storing it on digital form on magnetic tape for either local data reduction or for shipment to the same analysis facilities in the U.S. It is the device which compacts the data and stores it that is being reported on in this disclosure.

2. The time asychronous nature of the data and the high rates of the incoming signals posed the major problems. The instantaneous rates of the data exceeded the transfer rate of the normal digital magnetic tape transport by a factor of about 10-to-1. The second consideration was the data being received was not cooperative. One could not predict when the data would be available, nor the duration of intercept. These problems and their solution must accomplish the following:

- 1) Record the digitized data on a magnetic tape without losing any.
- 2) Format the magnetic recording to optimize tape usage and remain compatible with the computer used at the local site to process the data.
- 3) Make the system reliable with long mean-time-betweenfailure (MTBF) values.

3. It was possible by methodically studying the data environment to statistically determine the upper limit for time of intercept. With this limit, one could determine the buffer storage area to collect data at a rate faster than the tape transport and transfer the data on to a tape when the data stops momentarily. This storage time interacts with putting onto tape in the prescribed format, because the system is required to accept input data and simultaneously transfer data from the buffer on to tape.

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SECOND QUARTER 71 RESEARCH ACCOMPLISHMENTS - Code 7920, (Contd)

4. The solution to the problem resulted in a piece of hardware designated as a Buffer Tape System (BTS). This system uses digital logic and processing to handle the input data, load it into a core memory and then unload the memory and write it onto magnetic tape in the prescribed format.



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THANKE VIA BYEMAN CONTROL SYSTEM ONLY

Research Accomplishment Principal Investigator: L. M. Hammarstrom

1. Background: The POPPY ELINT satellite system has been collecting radar intelligence data from the Soviet Union and other countries for over 12 years. Through most of the history of the program, as well as all other satellite collection systems, this information has been of a strategic long-term value in assessing new radar capabilities, weapon system deployments, etc. The operational value of this data has been recognized by this Branch for a number of years. During the last quarter the research and development efforts succeeded in providing a processing system which meets the Navy's strictest satellite oriented time requirements ______ for processing and reporting to operational commands.

2. The specific system which provided this capability is the POPPY Automatic Processing System (PAPS) which was shipped to on schedule in September 1972 and without any major problems became operational in the past guarter. The history of this system was that it was conceived and presented by the principal investigator in a paper to the POPPY Program Director on April 22, 1970. By that time the POPPY system had demonstrated the capability for detecting and locating shipboard radars. Considerable controversy existed as to the approach which should be followed in making the system operational. The other concepts were presented by NSA and The initial Navy submission was that of NSG's. NSG. It was rejected and NRL's formal concept of 12 August 1970 was submitted and approved on 13 October 1970 by Dr. McLucas.

3. The POPPY system collects radar signals from approximately 10 million sq mi of air, land, and ocean areas with many combinations of broad frequency bands from 153 MHz to 35 GHz. The mixture of

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free world and Sino-Soviet Bloc commercial, experimental, and military radars are all merged and transponded to the ground unprocessed in an analog form. The problem for the processing system is sorting through this very diverse data which may exceed 2 million events in a single pass and reconstruct the hostile radars, in terms of their specific electronic parameters and the site of origin. This is achieved through a complex series of data filtering, auto/cross correlating, statistical testing, data fitting, and evaluation routines. For each radar family the control values, limits, fitting techniques, etc., are different and must be changed.

The system must have extensive bookkeeping and data management capabilities to allow forward and backward manipulation of the data as well as manual overrides for detailed examinations and unusual data conditions.

4. Specifically, PAPS is the integration of a carefully selected, medium size computer (SEL-86) with a series of complex specialized programs and data bases. These process the POPPY data automatically under the Automatic Sequence Driver (ASD) which is a special software executive system. The features of the system are listed below.

- a. High speed, modularized processing system.
- b. Automatic processing from SEDSCAF target designation entry through emitter locations.
- c. Automatic data assessment.
- d. Automatic reconfiguration and recycling.
- e. Flexible data bases for storage and recall of supporting information, e.g., processing sequences, assessment criteria, ephemeris, etc.
- f. Manual override and detailed processing information throughout the automatic processing sequences, with no loss of data, bookkeeping, etc.
- g. Automatic allocation and deallocation of all data and program storage areas.

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- h. Free formatted operator entries, common messages on status, errors, etc.
- Extensive system bookkeeping capability including module sequences, signal summaries, time of day, current storage allocations, etc.

The processing signals list can be changed or modified at any time by field personnel using software maintenance routines to reflect the changing requirements or for special signals. All the features of the system as well as manual aids are available to the operator to use as he might desire in manual data processing.

PAPS currently is automatically processing the following Soviet radar signals.

These signals are processed using ranges.

Using PAPS, is reporting (via operational communication links to of the time of intercept on the radars carried on the major combatants. This ocean surveillance processing has been using less than 30% of the total computer power.

The success of this system in exceeding the goals of the proposal as well as meeting Navy Mode IV operational requirements, as with all complex research and development tasks, is the result of many people's efforts. As the Navy and the nation further exploit this significant new operational dimension of satellite systems, the full power and versatility of PAPS will be further documented.

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C05026349 Approved for Release: 2024/06/13 C05026349 Installation E 1. During the 2nd Quarter of Cir. 1971, the complete instellation of the Digital Data Acquisition ____ and Processing System was in talted deployed and installed into the Program C. station in to the installation of the digital sometimes This about it in the objected repters of the an eighteen month effort to give the emitter location Station for Program C, thus making it the third to pera hon af

SECRET Poppag station with location capibilityo In order for the installation of the digital datas processing system be feasible, a completely new pacifity had to be constructed to house the sophisticated data processing (quipment. This Branch assumed total responsibility for defining the <u>requirements and</u>facility requirements necessary and producing The prefiminary building plans. The detailed A and E and the construction of the facility was then turned over ANDE VARAUFAC BYEMAN CONTROL SYSTEM ONLY

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with the continuous monitoring of NRL however, to verify that the facility conformed to the mandatory requirements, In parallel with the construction of the facility, the objital data acquisition and processing equipment constructed and deployment to the station. During the first week of May 1971, the entrie acquisition and processing system was aintifled consisting of 24,000 lbs of +0equipment and supplies was an lifted under the cognizacontrol SYSTEM ONLY -SEGRET

the NRL shipping departments for installation into the new facility by an installation team from this branch. In addition to the adata acquisition and processing system, a quality assessment system was installed, and the existing receiving system was completely updated and transferred from the old facility at to the newly completed facility. The complete installation process of the total system consisting of \$1.4 million & rent, from the time of HARDLEFTAN' CONTROL SISTER UNLY.

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occupancy de te to the first emitter location produced was less than three weeks. HANDLE VIA CONTROL SYSTEM ONLY

Computer Accurements (En -SECRET To In order for the Poppage System to respond to the greatly increasing demands to the attinuty of the intelligence committe be guicker and more accurate in its loca thing at copibility, this Branch under took the task of determining the digital competences the pasibility of _____ emitter location -As a result of this study, this Branch detainined that with the construction of which could special purpose hardware to be interfaced HANDLE VIA TERFACED -State -of the - and medium

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SECRET sized scientific computers currentelyavailable commercially, real-time emitty location was attainable with very little mochfied tion to the computer. Having determined the feasibility of emitter location capability, the task of defining the system architecture. the and the mandatory requirements of the scientific processor & vos beguno Complete data flow analysis and throughput regimements were studied. Processor capabilities and hardware designs SECRET turs available weener Round Stypel en

SECRET depth to determine where processing and through conflicts might occurs in each of the available systems. The interface requirements between the data acquisition hardwore and processor were analyzed. As a result of this in depth analysis, The culmination of this indepth analysis is manifested in a complete and thorough date processing system obfinition and specification which kas on cursently them been approved by Appess the Antometric SECRET Processing Equipment HANDLEboration Office BYEMAN CONTROL SYSTEM ONLY

and is currently being prepared to be released as an REP for procurement and of the Data Processing System contents which satisfies the requirements of emitter location HANDLE TEN ONLY-

C05026349 Approved for Release: 2024/06/13 C05026349 71-1-5-1 imperiority is derived from the creative integration of all the required elements a complex away of scientific I tuhnical skith, high quality production capabilities & the trund, openating military organizations of the Navy in achieving its fysteres has the within its organizations all of the Tuchning expertise needed to accomplish its systems planning auguering responsibilities in the required separate wander; within the Naval Research Laboratory The Nava has the services of This Nations outstanding scientists and engineers. PM-14 - Under The leadership of MM-16 in the last year The NRh TContractor and princers and scientists have been welded into a team without per in the sectoriting its spicalized field I posser within itself the initiation to assure have planing , It - has demonstratif a singlemindeduces & purpose ful dedication lowerd exploitation of the main peace technology particularity in The direction of Narry support Technical Spection to NWL HANDLE VIA CONTROL SYSTEM ONLY HANDLE VIA Now SpaSur. -