DEPARTMENT OF THE NAVY
NAVAL SECURITY GROUP
3801 NEBRASKA AVENUE N. W.
WASHINGTON, D. C. 20390

IN REPLY REFER TO

NSG/G54/jpl
Ser 198,003-69
17 APR 1969

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From: [redacted]mander, Naval Security Group Command
To: Commander, Naval Intelligence Command
Director, Naval Research Laboratory

Subj: Concept Paper on the Development of an Ocean Surveillance Capability

Encl: (1) NAVSECGRU Concept Paper, "Development of an Ocean Surveillance Capability", TCS-198,001-69

1. Enclosure (1) is a conceptual paper prepared by the headquarters staff of the Naval Security Group Command in an attempt to outline certain actions considered appropriate in the exploitation of the POPPY satellite locating techniques in support of the U. S. Navy requirements for Ocean Surveillance.

2. The intent of this paper is to set forth, in general terms, the first steps required of the three cognizant Navy commands to extend the current locating systems to meet U. S. Navy requirements for ocean surveillance. The proposals are not intended to be a final plan, but a working guide and framework from which a completed plan can evolve. There are areas in the concept paper which may contain inaccuracies, and others in which the desired goals of equipment development and procurement, and completion dates are overly optimistic. However, it is considered that the basic proposals contained therein, with modifications and suggestions provided by NAVINTCOM and NRL, can be made into a realistic and practical first step toward achieving an ocean surveillance capability with the POPPY developed techniques.

3. The NAVSECGRUACT [redacted] a technical description of the POPPY locating technique for shipborne emitters, is referenced in the enclosure but is not included with this presentation because of its bulkiness. A copy of the manual is available at NRL and a copy will be provided to NAVINTCOM, if desired.

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4. It is requested that appropriate areas of the enclosure be reviewed and comments, suggestions and recommendations be returned to this command by 1 May 1969 for consolidation and ultimate forwarding to the Executive Committee, Technical Operations Group (EXTOG). The NAVSECGRU Project Officer [redacted] OX-60409, Secure 2131) is available for informal liaison and preliminary coordination.

R. E. COOK

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THE DEVELOPMENT OF AN OCEAN SURVEILLANCE CAPABILITY

March 1969

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THE DEVELOPMENT OF AN OCEAN SURVEILLANCE CAPABILITY

I. PURPOSE. The purpose of this study is to outline the action required to exploit current state-of-the-art satellite locating techniques in support of U. S. Navy requirements for ocean surveillance.

II. ASSUMPTIONS. For the purpose of this study, the following are assumed without further amplification:

A. That there will be a continuing U. S. Navy requirement for locating information on potential enemy ships.

B. That the primary sea areas of the world of concern to the U. S. Navy will be the Northern Atlantic and Pacific Oceans, the Mediterranean Sea, Indian Ocean and other areas contiguous to the Soviet Union and Communist China.

C. That locating data on threat ships will be required on each observance; merchant marine ships less frequently.

D. That the information will be desired on a timely basis (within four hours or less from event time).

E. That the U. S. Navy can use a variance from true location up to thirty miles.

III. BACKGROUND.

A. The knowledge that the satellite locating technique could have applicability for ocean surveillance has long been recognized. Among the recommendations of the Supplement Report to the "Navy Space Program Review (U)"*, submitted by RAIM W. N. LEONARD to the Chief of Naval Operations in November 1967, was: "Request the conduct of tests by the NRO to evaluate satellite use for passive detection, classification and localization of ships at sea."

B. The Navy has participated since 1959 in a National ELINT collection program using satellites for the passive detection of high interest radar signals. The system was designed for and primarily used as a general search vehicle with emphasis during recent years on ABM related targets. Hardware and intercept and processing techniques have been developed which enable a high degree of location capability. Using the [redacted] the

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* Senior Member, Navy Space Program Review (1967) letter, Ser [redacted] of 6 November 1967 with enclosures.

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NAVSECGRU field site at [redacted] can process the information through a small computer and produce locations of radar emitters with increasingly greater accuracy [redacted]

C. In August 1967, the Director, Naval Security Group initiated an informal program to study the potential use of POPPY for direct support of the Navy. A compilation of radars which could be identified as Soviet shipborne emitters was requested from [redacted] field sites, [redacted] on a not to interfere with their primary mission basis. The results during the next six months, though small in number for a variety of reasons (operators required training, very small total intercept opportunity for shipborne radar frequencies due to non-dedicated tasking, among others), were extremely promising. NAVSECGRU analog analysts proved their capability to recognize and measure parameters of a good portion of all known radar types carried on Soviet warships. The stations still submit the listing on a not-to-interfere basis (e. g. during the past six months, [redacted] reported an average o [redacted] per month and [redacted] reported an average of [redacted] per month). A complete listing of the types of radars identified is included as Appendix A.

D. Most importantly, the ability to make a digital recording in addition to the analog version at [redacted] made it possible for a field site to accomplish on-site processing with results that had previously been achieved only at NSA. NRL delivered the digital recorder and computer system to [redacted] in May 1967. By the following spring, a software package had been developed and operation of the system was well enough defined and understood for location efforts to begin in earnest. [redacted] Operations Manual* describes the POPPY locating system, details the processing and location finding techniques in use and reports on results of the effort to locate and correlate shipborne radars.

E. In April 1968, the first Soviet shipborne radar [redacted] was located by [redacted] In May 1968, an engineering evaluation was established by NRO to study the location techniques of the POPPY system against shipborne emitters. The A and B balls could be used for one orbit each day. The test was inconclusive. First, the total intercept opportunity time permitted each day was far too short (a maximum of 17 minutes in overhead passes, decreasing as the path moved away from [redacted] and, second, the partial failure of A ball shortly after the test began.

F. However, the effort continued at [redacted] to locate Soviet shipborne emitters, but on intercept obtained from the normal

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* [redacted] Manual, "Shipborne Emitter Location Techniques", dated 3 February 1969. BYE-57169-69.

general search and ARM-related tasking. Even without the benefit of oriented tasking, i. e. frequently the combination of tasking and/or orbital paths offer slim chance of intercept of shipborne radars, [redacted] has made significant strides in locating Soviet shipborne ra[redacted] total of [redacted] locations have been reported in the period April 1968 to February 1969, including [redacted]

G. The determination of how precise the location technique currently utilized by [redacted] against shipborne emitters is difficult to ascertain at this stage of development. True locating data (e. g. sightings by reliable sources) is seldom available that will correlate closely with the time of POPPY location. The MOSKVA, identified through its unique radars, was located by [redacted] times during its operation in the Mediterranean in October and September 1968. A list of these locations, along with locating data from U. S. Navy ships nearby, is included in Appendix B. There is good resolution between the two sources on some locations, poor on others, but the capability demonstrated by identifying and locating a major combatant clearly demonstrates the potential value of a system even though developmental and experimental work is in its early stages. Although no formal studies on the location accuracy of the location techniques used by NSA (which are very similar to those used by [redacted]) against fixed sites is available, informal contact indicates that locations are within [redacted] of the true location routinely.

H. [redacted] has made equally important studies in a closely allied area -- that of using the [redacted] of certain shipborne radars for identification purposes. The most encouraging development has been the growing capability to locate and correctly identify certain ships by the [redacted] radar. This success has been made more dramatic by the fact that [redacted] Since the time available to devote to the project is limited, and since [redacted] appears to be the most exploitable of the Soviet shipborne radars, this radar has received the emphasis at [redacted]

1. Several other shipborne radars may be candidates for [redacted] analysis [redacted] Through digital analysis, minute [redacted]

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2. In addition to there are other techniques that can be applied to gain some knowledge of ship type and in some cases, know the specific class. Certain radars are carried only on certain types; the

3. Pioneer work is still being done in the field of radar intelligence. Radar analysis for establishing identification continuity appears lucrative simply because a radar operates with characteristics that are an integral part of filling its function: pulse repetition frequency, scan rotation rate, radio frequency, beam structure, coverage and amplitude values are unique features by design.

I. Based mainly on the accomplishments of in locating land-based radars, NRO and NSA have approved the extension of the capability to the NAVSECGRU field sites. received hardware required to record digitally, perform precise analysis and compute radar locations in March 1969. will receive the same hardware package and is expected to be operational by December 1969.

J. It is considered probable that national requirements for knowledge about ABM-related and early warning radars will be given the highest priority in all satellite reconnaissance systems for the foreseeable future. Fortunately, the ocean surveillance results from POPPY are on record and the recommendation submitted by RADM LEONARD has been fulfilled, at least in part, by the effort at the field sites. Enough has been learned to begin planning for a system evolving from POPPY that can be dedicated to the Navy need.

IV. DISCUSSION. It is clear that the POPPY location system has great potential value to the Navy -- it is a proven system that can passively detect, classify and locate radar emitting ships at sea. It can complement the other sensor systems of the U. S. Navy (i. e. Clarinet, Bullseye, SOSUS, aircraft, etc.) by providing unique information not available or obtainable from these latter sensor systems. In addition, POPPY covers limited access areas such as the Black Sea, the Baltic, Barent's and the Sea of Okhotsk. All of the hardware, operating and processing techniques developed in the POPPY Program are applicable in providing the U. S. Navy with an additional sensor in the ocean surveillance system. A concept of operations is proposed along the lines presented in the paragraphs

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A. The mission of the ocean surveillance system would be to passively locate threat shipborne radars in designated ocean areas and report their locations and identifying data to appropriate U. S. Navy and other consumers on a timely basis.

B. The POPPY systems concept would be used with little change during the initial stages of ocean surveillance operations, and be used as the basis for developing a unique and perhaps dedicated ocean surveillance system.

1. The POPPY 500 mile 70° orbit and transpond system of wideband ELINT intercept, are considered suitable for ocean surveillance.

2. Primary reliance will be placed on field station processing of the intercept and reporting to designated consumers.

3. The NAVSECGRU will assist the Chief of Naval Operations (Op-092) in developing program guidance and will man field sites in accordance with established procedures; managing the collection, processing and reporting of intercept and the communications required to deliver information to designated recipients.

4. The NRL will continue to conduct necessary Research and Development, configure and build the satellites, coordinate the launching, be responsible for the housekeeping functions of the satellites (power, batteries, etc.), assist in designing, procuring and maintaining all of the equipments unique to this ocean surveillance system.

5. The Chief of Naval Operations (Op-092) will assign tasking in accordance with established priorities and levy reporting requirements consistent with the capabilities of the system.

C. The Ocean Surveillance Program, as outlined in detail in the paragraphs below, will provide excellent satellite coverage over the primary Soviet and CHICOM Navy operating areas. The six pairs of satellites will provide almost intercept opportunity in minute alternating periods, over the Northern Atlantic, the Baltic Sea, the Northern Fleet area, and the Northern Pacific. A priority of desired targets will be established and the processing efforts of the field sites will be channelled to the more desired targets (large warships, . Reporting can be arranged also on an as occurring basis and less important targets on a periodic schedule.

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3. Satellites specifically oriented toward satisfying ocean surveillance requirements would differ from the present POPPY satellites chiefly in their frequency coverage, number of data links and radio frequency spread of each data link. The ELINT package should achieve maximum umabiguous productivity against the radars of highest interest: those carried [redacted] Instead of the POPPY general search philosophy with some consideration given to specific targets, Navy satellites would operate under the concept that the specific shipborne radars vulnerable to identification and location will determine the design of the sensor. The greatest weight would be given to exploiting fully to the hilt, any Soviet radars

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E. Selection of collection sites must follow a consideration of the following factors.

[redacted]

2. It is assumed that the primary areas of interest for ocean surveillance will be the Mediterranean Sea, the Black Sea,

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3. Each collection site requires an environment free of electromagnetic interference. An isolated area, relatively RFI free, including a 3600 square foot operations building is considered adequate for all functions as associated directly with collection, analysis, management and maintenance of equipment. Hardware at a completely equipped POPPY collection site costs about one million dollars. The existing equipment configuration is adequate for interrogation, collection and analog analysis. Processing capability could be increased by adding a second digital computer in addition to providing the time sharing capability now being planned. The SEL 810A digital computer, currently in use, costs less than thirty thousand dollars. Collection of data could be automated by using a small digital computer to interrogate the satellites and perform antenna tracking. Hardware additions and software improvements can help to reduce manual interfaces, simplify processing procedures and reduce the time lapse from signal

acquisition to location. It is estimated that with current capability and techniques, the lapse can be as little as [redacted] with first team efforts under ideal conditions.

4. CRITICOMM and, in some instances, SPINICOMM, circuits will be used to pass locations and classification data to designated direct support recipients and to an all-sensor world-wide data base for target shiming.

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F. Personnel.

1. The current billet structure for POPPY operations consists of [redacted] billets for the sites with full equipment and digital capability - [redacted] operators, analysts and supervisors, and [redacted] electronic maintenance men, including the supervisor. Base logistic support is currently provided but not identified. It is considered that this number for the present tasking and processing functions is correct, except that an officer billet is required at each site with digital programming capability. The one officer and [redacted] enlisted structure is considered also applicable for ocean surveillance tasking and processing since improvements in hardware and software included in this proposal are intended to increase productivity rather than reduce manpower. For example, automating interrogation and collection positions would free two of the three operators now assigned to those functions for work in the processing section. The manpower totals required now and under the proposal are included in Appendix D. However, as the state of the art improves and until the volume and nature of the work is more clearly known, the figures shown may have to be changed to cope with the eventual system.

2. Training of personnel for the present would continue along the lines now established: operators, graduates of the ELINT Class C School, preferably with some field experience; analysts having ELINT experience and graduates of the NSA Advanced ELINT Analysis Course (SA-580). The computer Programmer/Librarian for each site should have training in computer theory, FORTRAN and machine language and receive extensive training in computer operating and programming on the SEL-810A or follow-on computer. In addition to the normal Electronics Class A and B curriculum, the maintenance personnel require training in the following specific areas: digital electronics repair, recorder maintenance (such as the TS-300), and teletype. The computer is a commercial grade, modified for and used only for this project. Consequently, training for the digital maintenance men has been given to men with prior experience or training in Electronic Data Processing augmented by on-the-job training with the civilian contractor.

3. A stateside training site which could be used to meet

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the training requirements for both operators/analysts and the unique aspects of maintenance training is required and should be included in the program to acquire a Navy-side ocean surveillance system. This site could also be used to carry out developmental and experimental work on the project. This Training and Developmental Site would be responsible for:

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a. [redacted]g operators, analysts, equipment technicians and managem[redacted]el in areas unique to the program.

b. Formulating and testing for Standard Operating Procedures for field sites.

c. Development of processing techniques for meeting specific consumer requirements.

d. Testing and evaluation of new equipment.

e. Providing a pool of experienced personnel from which to draw teams to evaluate and up-date field sites on current and forthcoming changes and improvements.

6. Assuming resources can be made available, it is estimated that the concept of operations presented in the paragraphs above can be accomplished to a large extent by July 1970. Many of the steps are refinements of current techniques and a re-direction of tasking and processing priorities to ocean surveillance. The launching of the first ocean surveillance package with the [redacted] of satellites will be the real beginning of a system which will provide coverage of nearly one half of the world's ocean areas and provide unique intelligence on a near real time to consumers. By July 1971, the proposed launch time, additional field sites required to extend the geographic coverage will be completed, sources of errors in the present system will be eliminated, software developed to reduce operator work time by the elimination of the manual interfaces, other software programs will be developed solely to recognize, isolate and locate shipborne radars. On-line processing and locating of high interest shipborne radars is technically feasible now and could be at the field sites and operating by launch time. When the second dedicated package with an additional [redacted] satellites is launched in the 1972-1973 time frame, a capability to provide nearly 100% intercept opportunity over any given geographical location in the northern hemisphere plus the Indian Ocean will be present. On-line processing will be done at all field sites, the location and identification data fed on a near real time to a U. S. Navy all-sensor data bank.

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V. ACTION. The coordination, planning, research and documentation required to establish an ocean surveillance system, will require a long time and the efforts of many offices will be needed. Some of the more important tasks are placed into Phase I, II, or III below with a proposed action office and time reference for commencement/completion. Other tasks, developed as a result of earlier steps, will be added as required. Action Milestones are included as Appendix E for more convenient reference.

A. Phase

Action	Cognizant Office	Date
1. Statement to DIA/SCRS of Navy requirement for POPPY locations of shipborne targets.	NIC	1 May 69
2. Submit to NRO/SCRS proposal to execute evaluation tests to validate and refine info regarding intercept of shipborne radars and resulting accuracy of ship locations using current techniques.	NIC	1 June 69
3. Compile parameters of all Soviet and CHICOM shipborne radars to assist in determining ELINT band configuration in ocean surveillance satellites.	NSG/NRL/NIC	1 July 69
4. Statement of desired geographic coverage with some priority attached in order to achieve maximum productivity and flexibility from resources.	NIC	1 July 69
5. Statement of accuracy acceptable by consumers.	NIC	1 July 69
6. Statement of minimum intercept/ location opportunity time required for primary geographic areas of interest.	NIC	1 July 69
7. Statement of reporting requirements, acceptable time lag, periodicity, format, etc.	NIC	1 July 69
8. Survey NAVSECGRU sites in recommended geographical area for potential additional field processing stations.	NSG	1 July 69

9. Steps to eliminate and/or reduce sources for error in data now used in location techniques.	NSG/NRL	1 July 69
10. Steps to reduce processing time by reducing manual interfaces by initiating new software programs.	NSG/NRL	1 July 69

B. Phase II.

Action	Cognisant Office	Date
1. Evaluation of preliminary tests to validate and refine applicability of POPPY to ocean surveillance.	NSG/NRL/NIC	1 Sep 69
2. Compute the best orbital altitude and inclination based on submitted geographic target areas.	NRL	1 Sep 69
3. Submit Personnel requirement for additional stations to CCP.	NSG	1 Sep 69
4. Submit proposal for partial Navy tasking of POPPY for Navy requirements until ocean surveillance system is completed.	NIC	1 Oct 69
5. Prepare additional software designed for ocean surveillance processing and locating.	NRL	1 Nov 69
6. Prepare building and site plans for additional field sites.	NSG	1 Dec 69
7. Prepare plan to procure equipment for new field sites.	NRL	1 Dec 69
8. Design the ELINT intercept band alignment based on threat ship radar parameters and evaluation of item 1 above.	NRL	1 Jan 70
9. Begin construction of satellites.	NRL	1 Jan 70
10. Begin initial coordination with [redacted]	NRL	1 Jan 70

C. Phase III.

Action	Cognizant Office	Date
1. Prepare plans for developmental and training site in the United States.	NSO	1 Jul 70
2. State reporting requirements, i. e., timeliness, areas, type ships, consumers, for ocean surveillance system.	NIC	1 Jan 71
3. Complete approved additional field sites.	NSG	1 Jul 71
4. Launch ocean surveillance satellite system.	NRL	1 Jul 71
5. Complete plans of second generation satellite system.	NRL	1 Sep 71

LOCATIONS OF THE HELO CARRIER, MOSKVA

	LOCATION RESULT	
•	VISUAL SIGHTIN	
	231213 SEPT 68	36-47N, 19-54E
•	230035 SEPT 68	35-55N, 20-18E 150 degrees/10 knots
	181602 OCT 68	33-02N, 24-01E
•	181000 OCT 68	33-30N, 23-31E 110 degrees/20 knots
	191238 OCT 68	34-13N, 21-57E
•	201000 OCT 68	34-02N, 22-45E 000 degrees/13 knots
	210527 OCT 68	36-12N, 22-24E
•	211000 OCT 68	36-02N, 22-50E (ANCHORED)
	231127 OCT 68	32-52N, 19-45E
•	231000 OCT 68	33-03N, 20-40E 200 degrees/2 knots
	301225 OCT 68	35-18N, 14-29E
•	301000 OCT 68	33-08N, 15-30E
•	010600 NOV 68	36-01N, 21-40E
	021253 NOV 68	40-11N, 25-23E
•	031000 NOV 68	39-17N, 25-23E
•	040340 NOV 68	DARDANELLES NORTH BOUND
	050241 NOV 68	43-21N, 33-00E

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ACTION MILESTONES

REQUIREMENTS

	FY69 MAY	JUN	SEP	OCT	FY70	JAN FY71	FY72	FY73
1. Statement of location info	NIC							
2. Evaluation Tests		NIC						
3. Compile Parameters of Radar		NSG NIC NRL						
4. Statement of Desired Geographic Coverage		NIC						
5. Statement of Accuracy		NIC						
6. Opportunity Time		NIC						
7. Reporting Time		NIC						
8. Validate Tests			NSG NIC NRL					
9. Tasking				NIC				
10. State Reporting Requirements						NIC		

APPENDIX E-1

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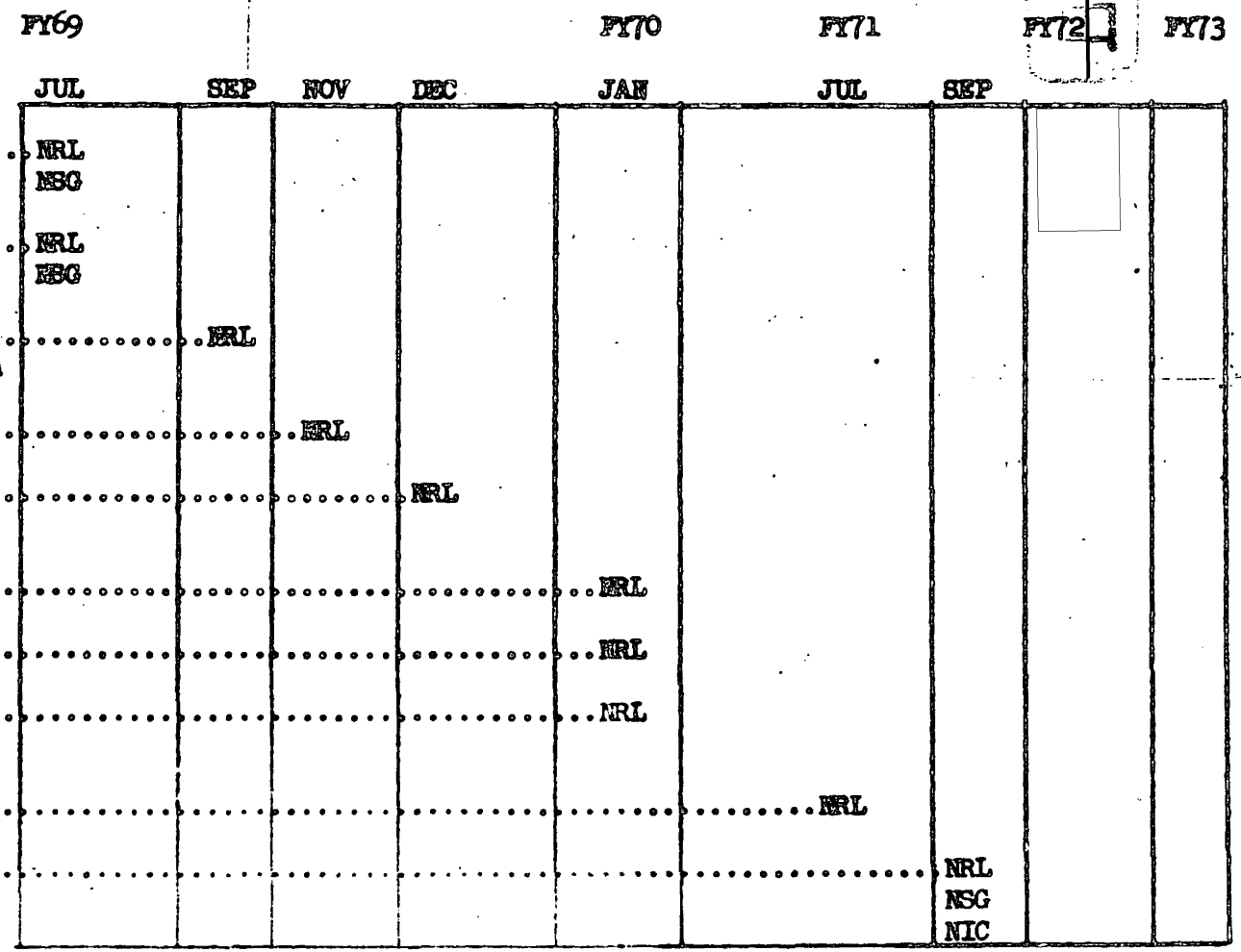
ACTION MILESTONES (Cont'd)

HARDWARE & SOFTWARE



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ACTION MILESTONES (Cont'd)

FIELD STATIONS

	FY69 JUL	DEC	FY70 JUL	FY71 JUL	FY72	FY73
1. Survey for New Field Sites	NSG					
2. Building & Site Plans		NSG				
3. Plans for Develop. & Train Site			NSG			
4. Complete Field Sites				NSG		

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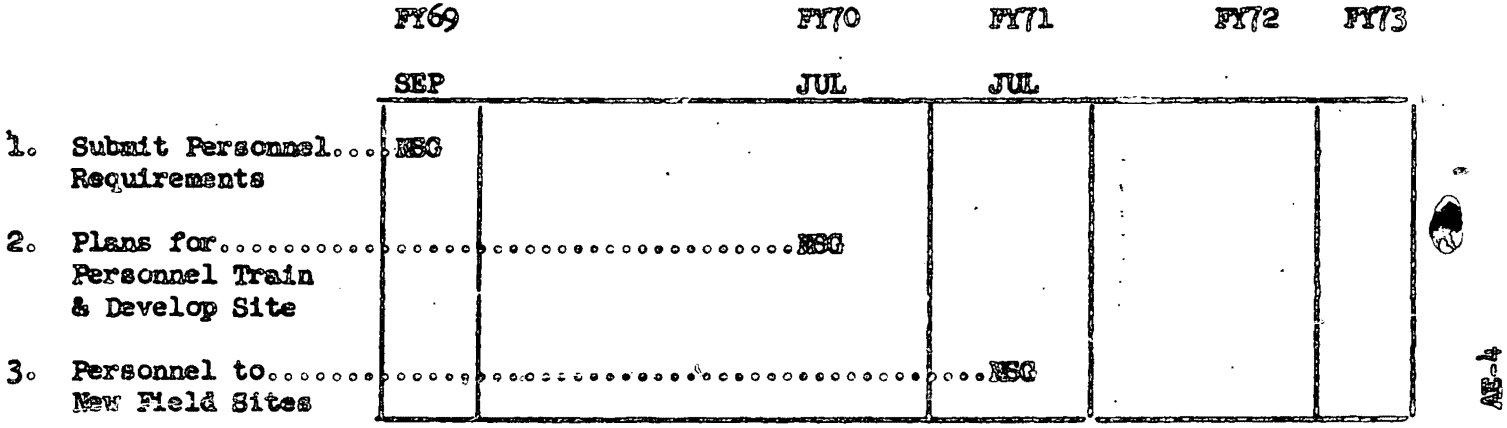
ACTION MILESTONES (Cont'd)

PERSONNEL



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