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14 JAN 1977

209 SEASAT

MEMORANDUM FOR THE ASSISTANT SECRETARY OF THE NAVY (RESEARCH AND DEVELOPMENT)

SUBJECT: SEASAT-A Assessment (U)

(U) The Navy's acceptance of the responsibility for conducting a systematic assessment of the SEASAT-A sensor complement, as indicated in your memorandum dated 12 November 1976, presents an opportunity to fully understand the military value and the national security concerns of the total system. It also provides a good technical base for formulation of the DoD position with respect to the follow-on operational system. Appropriate revisions to the research and development budget have been made to fund the efforts in FY 1978 and beyond. However, the funding for FY 1977 should come from existing Navy resources.

(U) The plan for accomplishing the task is generally acceptable and I agree that your efforts should start immediately. Additional points which should be considered in your analysis are: (U) ← ?

a. (U) The impact of another satellite obtaining near simultaneous observations in the same geographic area and how this might enhance the possibility of synergistic effects.

b. (U) The potential need for involvement of other services or defense agencies based on additional military requirements or technical information to expand the scope of the study.

(U) I request that you provide a status report on a quarterly basis summarizing your progress. Should significant events warrent altering the present plan, you will be so notified.

s/ Malcolm R. Currie

Malcolm R. Currie

LKUYKENDALL/env/6 Jan 77
OAD(S&AS) X-57036

AD (S&AS) 10 Jan 77

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EXEMPTION CATEGORY 3

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COVERING BRIEF

14 JAN 1977

TO: DIRECTOR, DEFENSE RESEARCH AND ENGINEERING

FROM: DEPUTY DIRECTOR, STRATEGIC AND SPACE SYSTEMS

ROSS N. WILLIAMS
RADM, U.S. NAVY

PROBLEM: (U) Endorse Navy's plan for a systematic assessment of the sensor complement on SEASAT-A and provide additional points for expansion of the analysis.

DISCUSSION: (S) As the primary user of the data, Navy agreed to assume responsibility for a detailed study of the total SEASAT-A sensor group. See Navy memorandum, 12 November 1976 (Tab B). This study is very important to DoD in establishing our position regarding the operational SEASAT system which will follow. The Navy plan is acceptable but can be enhanced by inclusion of two additional thoughts.

(U) The funding which Navy requested for the analysis was included in the FY 1978 budget submission. The only provision for the FY 1977 funds is existing Navy resources.

IMPLEMENTATION: (U) A memorandum has been prepared for your signature to the Assistant Secretary of the Navy, Research and Development (Tab A), which endorses the plan, provides funding information, and lists the additional points to expand the study.

RECOMMENDATION: (U) That you sign the memorandum at Tab A.

CONCURRENCE: None

LKuykendall/emv/6 Jan 77
OAD(S&AS) X-57036

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ASSESSMENT OF THE MILITARY VALUE OF SEASAT AND ITS FOLLOW-ONS

I. INTRODUCTION

SEASAT is a proof-of-concept satellite experiment designed to measure ocean surface parameters. The sensor complement is: Radar Altimeter (ALT), Scanning Multifrequency Microwave Radiometer (SMMR), Radar Scatterometer (SCAT), Synthetic Aperture Radar (SAR), and Visible/ IR Scanner (V/IR). The planned launch date is May 1978. Measurement objectives are: marine surface topography, surface wind speed and direction, significant wave height, directional ocean wave spectra, sea surface spectra, coastal region images, undulations associated with gravimetric anomalies, and detection of icebergs. Concerns have arisen regarding risks to national security as a consequence of unrestricted release of data from SEASAT and projected Earth observation programs and experiments.

Although the requirements of the civilian program of Earth observations from space are quite different from military objectives, a continuous improvement in resolution, coverage, data processing, etc. of various sensors developed by NASA and NOAA are expected to conflict with national security interests. This stems from the fact that there is no restriction on the distribution of the data produced, participation of foreign investigators in such programs, and potential of direct reception of raw observational data at foreign sites. Clearly, performance of these systems will reach a point at which the observations will contain information of considerable military value. Less apparent is a distinct possibility that while the information produced by a single instrument may not contain anything of military interest per se, when combined with cleverly processed outputs of other instruments on the same or other satellites, the results become militarily valuable.

The beginnings of a conflict between civilian space activity and national security interests arose in the GEOS-C program and are now surfacing in the SEASAT project. The area of concern in both cases has been high precision altimetry which affects the definition of the geoid, which in turn has SLBM targeting implications. Of additional concern with SEASAT is the possibility that data from the various sensors could be utilized in combinations (the synergistic effect) which might provide unexpected detection capabilities.

Enclosure (1)

It is the purpose of the subsequent discussion to outline a program to assess the military value of SEASAT-derived information and that of subsequent operational versions. Further, the possibility of synergistic results, when data from two or more SEASAT sensors are combined or when SEASAT-generated information is combined with that produced by other NASA, NOAA and conceivably unfriendly observational programs, will be assessed.

II. ISSUES TO BE RESOLVED

A list of issues to be considered is given with minimum discussion. The list, not claimed to be exhaustive, is divided into technical and management categories.

A. Technical Issues

1. Sensor Resolution, Precision, Coverage

The problem is to establish values at which the data output becomes of military concern. Consideration of SEASAT performance and projected follow-on improvements will be assessed in terms of all environmental parameters measured, and in terms of secondary-performance objectives.

2. Timeliness and Spatial Distribution of Observations

This is an important item. If an aircraft carrier is detected, information regarding its location loses value if the information transmission is delayed. This information is perishable. On the other hand, local details of the geoid remain valid over indefinite spans of time, and have enduring value for military applications. The spectrum of perishability will require considerable thought and trade-off analysis.

3. Ground Truth Evaluation

Underflights and shipborne measurements will be conducted jointly with SEASAT to calibrate and evaluate sensor performance. The surface measurements will be carried out with an advanced sensor complement and results extrapolated to assess performance levels expected of SEASAT follow-ons.

4. Synergistic Effects

Current experience has shown that, in some cases, information extractable from various NASA and NOAA programs exceeds design estimates. Combinations of instruments such as a 30-meter resolution mapper with a 10-meter resolution pointable imager provide a great deal more information than each one separately. Data from several sources (other satellites, ship, buoys) may be used in an interactive way to yield data of high value to military operations.

5. Orbit Precision

Geodetic accuracy is dependent on satellite altimeter data which in turn are dependent upon tracking precision. In addition, position translation (tying geodetic nets together) is dependent on precise orbital determination. Therefore, high-precision tracking data, because of its impact upon the utility of sensed data, are of military value in their own right.

B. MANAGEMENT ISSUES

SEASAT is scheduled for launch in May 1978. Important decisions are now being implemented. DOD considerations should be factored in as soon as possible before the NASA actions become irreversible.

Recommendations for Navy Policy decisions should be made by the Naval Environmental Remote Sensing Coordinating and Advisory Committee (NERSCAC) (with support by OP-60, OP-955, OP-21 and PME-106) based upon military requirements and technical information resulting from this study. Interface with NASA and NOAA shall be through the DOD/NASA/NOAA Group recently established by Dr. Currie and Dr. Fletcher. Issues to be resolved at the Management Policy level include:

1. Liaison with Program Planning Offices and Civilian Agencies

It is important to establish what problems are of concern to operational activities and what is being planned by NASA and NOAA.

2. Management Responsibility

Establish focus for

a. Security matters

b. Policy for data distribution and/or release to non-DOD users.

c. Funding responsibilities for data collection, processing and distribution.

3. Tracking Network

GEOS-C is basically tracked by the TRANET and the raw data are not supplied to NASA. With Polar orbiters, NASA is likely to expand the network and the data could no longer be

controlled easily. A policy decision is required for management of the tracking networks and for release of tracking data. The Global Positioning System (GPS) is a potential area of concern.

4. Archiving of Sensitive Data

Data will fall into four general categories of sensitivity: unrestricted data of no military concern; data releasable after a stipulated time interval; data temporarily restricted pending performance evaluation and sensitivity review; and data not releasable because of national security concerns. Decisions are required regarding the amount, format, duration, and location of restricted data that must be archived. A formal review procedure must be established to purge the restricted archive.

III. TENTATIVE PLAN (Task Definition)

Four task areas are essential to a meaningful evaluation of the military worth of space sensors. Tasks A and B are analytical in nature, Task C is experimental, and Task D analysis. These tasks are technical investigations that provide factual basis for management policy decisions. This responsibility includes a technical review of proposed policy decisions, and recommendations based on technical considerations, but does not include a responsibility for policy decision making or for interagency liaison.

TASK A: Evaluation Prior to Launch of SEASAT

1. Catalog spectral region, resolution, sensitivity, and frequency of observation for candidate sensors to be utilized in study (SEASAT, LANDSAT, TIROS, NIMBUS, DMSP, NOAA).

2. List applications areas for evaluation of potential sensing applications (terrain signatures; ASW/Acoustic frontal systems; location and measurement of shear current boundaries; bathymetric information; target detection, location and classification; weather system measurements).

3. Assess military impact of remote sensing measurements as function of stringency of measurements. Prioritize sequence of applications evaluations.

4. Identify sources, format, and mechanisms for data flow to sustain evaluation study.

5. Identify potential research experiments and military operational exercises for candidate sensor evaluations.

6. Define test plan for post-launch sensor evaluation study.

7. Provide technical data for DOD policy review of combined NASA, NOAA, DOD plans for SEASAT experiments, data processing, management of data flow, data distribution, and data archiving. This task objective must be completed in sufficient time to permit impacting SEASAT-A prior to launch.

TASK B: Laboratory Investigations

1. Obtain sample satellite data format from candidate sources (LANDSAT, TIROS, NIMBUS, SEASAT, DMSP, NOAA) to establish data handling procedures, data enhancement algorithms, and data analysis software for application to evaluation tests.

2. Conduct preliminary performance evaluations using existing data (satellite, NRL aircraft measurements) to synthesize predicted SEASAT and follow-on measurement capabilities.

3. Evaluate single- and multiple-sensor (synergistic) measurement capabilities derived from synthesized data in terms of predicted value for military applications.

4. Monitor aircraft flights of SEASAT instrument simulators to confirm measurement capabilities and evaluate data analysis algorithms.

5. Participate in, and verify, SEASAT sensor certification and acceptance test data and integration tests to verify sensor engineering parameters used in data reduction algorithms.

6. Analysis of data compiled and results obtained from previous DMA and Naval Surface Weapons Center studies, of the SLBM targeting improvements through use of SEASAT-A altimetry.

TASK C: Ground Truth Verification

1. Conduct aircraft underflights under controlled experimental conditions (as defined in test plan) to verify engineering performance, data transmission, and geophysical measurement capability of SEASAT sensors. (SEASAT sensor calibration and evaluation of data reduction algorithms.)

2. Following post-launch calibration and evaluation (90-day period), conduct periodic ground truth verification tests using aircraft calibration platforms to monitor performance of SEASAT sensors as function of experiment life and to extend performance validation over wide range of experimental conditions (high seas, storms, temporal variability).

TASK D: Post-flight Evaluation of SEASAT Data

1. Use data from single- and multiple-sensors from SEASAT and other platforms to evaluate (synergistic) impact on military operations. Aircraft underflight data to be acquired over designated test sites (terrestrial, coastal, mid-ocean, and arctic) and in conjunction with research experiments and military exercises to support operational evaluation of candidate (SEASAT and follow-on) sensor performance. The specific objectives of the analyses which will be considered are:

   a. Determine the quality of signatures possible with each SEASAT sensor and their interpretation.

   b. Establish the limits and thresholds for target identification and detection.

   c. Assess the existing and potential capability for image processing to enhance specific features with collated data from several sensors simultaneously viewing the same scene.

   d. Hypothesize the resolution achievable by the synergistic effect of future sensors.

IV. SCHEDULE/MILESTONES

See Figure 1.

V. FUNDING

See Figure 2.

Comments:

a) Indicated funding for Tasks A-D covers technical activities only.

b) Tasks C and D above assume that data are provided as specified in the test plan. If this is not the case, additional funding for data acquisition, processing and archiving will be required.

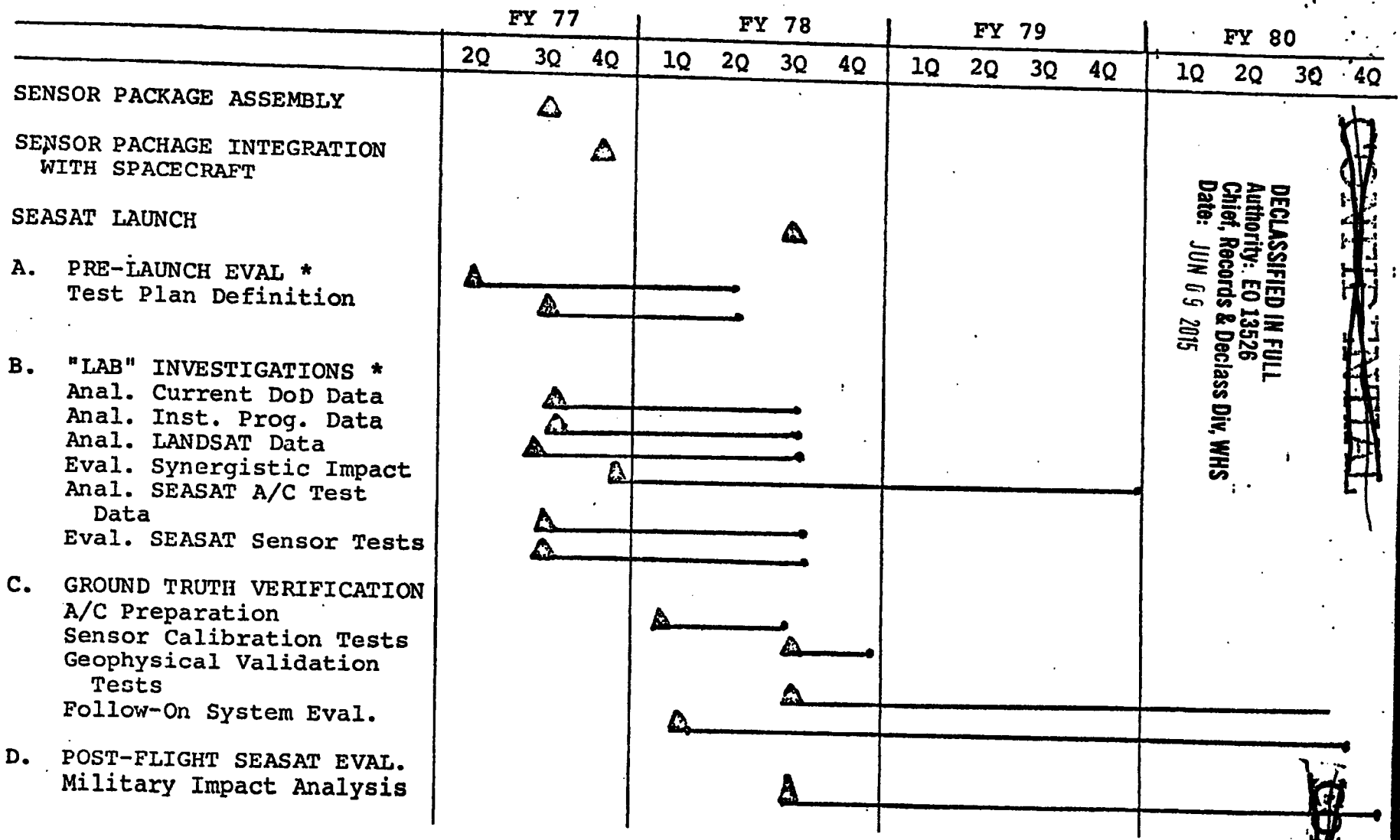
c) Analysis, evaluation and synergistic impact efforts will be a continuing program from FY 77-80 in order to provide information necessary for decision making. Therefore the man-years reflected in Figure 1 appear high because, in addition to in house effort, the following is necessary:

1. Consultation
   Jet Propulsion Laboratory
   Scripps Institute of Oceanography
   Woods Hole
   NASA Goddard
   NOAA
   UCLA
   Ohio State University
   Draper Labs
   NUC San Diego
   NUSC Newport
   NRL Washington, D.C.
   NORDA Bay St. Louis
   NCSL Panama City
   NSWC Dahlgren

2. Workshops and information exchanges
   Principal Investigators
   DOD Users

3. Travel
   In house
   Consultants

d) The large funding estimate for Task C is for the conduct of operational tests to verify results of SEASAT-A sensor analysis and obtain ground truth measurements upon which to establish synergistic effects of sensor derived data (SEASAT sensors collectively and with other systems), and appraise the potential of future military exploitation of such information. An example of the latter is that, with the existance of a target established by ground truth measurements, novel processing techniques may expose the previously undetected target. Concomitantly, a ground truth picture will facilitate establishment of false alarm probabilities in data interpretation. The ultimate goal of Task C is, through extrapolation of results, to establish a reliable basis for predicting the degree of susceptibility of future systems to military exploitation.



* Although Tasks A and B are projected for commencement in 3rd QTR FY 77, because of funding limitations, these tasks must in fact commence as soon as possible and must produce data which can be used as a basis for national policy decisions regarding National Security aspects of SEASAT utilization. These data are required as soon as possible to support decisions which must be made prior to SEASAT launch. Decisions which will impact on SEASAT-A configuration should be made prior to integration of the sensor package aboard the spacecraft (Aug 1977).

FIGURE 1

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	FY 77			FY 78				FY 79				FY 80			
	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
FUNDING (Incl: Computer, Travel, Consultants)															
TASK A	1 MY 90K			1 MY 90K											
B	3/4 MY 60K			1-1/4 MY 90K				1 MY 75K							
C				5 MY 650K				5 MY 600K				3 MY 350K			
D				1/2 MY 50K				2-1/2 MY 200K				3 MY 275K			
ACFT SUPPORT				180K				144K				108K			
TEST SUPPORT		25K		50K				50K				50K			
	1-3/4 MY			7-3/4 MY 1110K				8-1/2 MY 1069K				6 MY 783K			
	175K											24 MY $3137K			

FIGURE 2

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DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D.C. 20301

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29 SEP 1976

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MEMORANDUM FOR ASSISTANT SECRETARY OF THE NAVY (RESEARCH & DEVELOPMENT)

SUBJECT: SEASAT-A (U)

(U) In 1974 the National Aeronautics and Space Administration (NASA) initiated the SEASAT-A program. This experimental oceanographic research satellite, to be launched in May 1978, is designed to advance the understanding of ocean dynamics. The Department of Defense (DoD) has in the past contributed to the definition of the characteristics of the instrumentation on board the spacecraft, and has more recently worked with NASA on data acquisition plans, operating procedures and data release policies.

(~~S/NF~~) Among the sensors on the experimental SEASAT-A is a precise radar altimeter which offers the potential for improving the accuracy of current and future submarine launched ballistic missiles (SLBMs) through improved knowledge of the gravitational field of the earth. It is planned that the Naval Surface Weapons Center and the Defense Mapping Agency (DMA) will process the SEASAT altimetry data in much the same manner as GEOS-3 altimetry data is now processed. The Navy will also assume responsibility by the end of FY 1977 for the future satellite radar altimeter development which the Defense Advanced Research Projects Agency has accomplished in the past. Further, a NASA/Navy agreement provides for the Fleet Numerical Weather Center (FNWC) to do processing of the altimeter data and the other sensor data for an operational test of the data in Navy oceanographic support. A possible exception is FNWC processing of the Synthetic Aperture Radar (SAR) data. The SAR can provide data for the detection and classification of Navy ships and maritime vessels in the open ocean areas as well as information on military harbors and airfields. It is expected that the Naval Research Laboratory and DMA will receive and work with this data.

(~~S/NF~~) While the military value of some of the sensors and data have yet to be fully assessed, it is clear that the expected product is primarily of interest to the Navy. Additional analyses will be needed to (1) assess the military value of the experimental SEASAT-A data considering the collective value of all of the instruments, (2) assess the military value to DoD of a future operational civil SEASAT system, and (3) fully define national security concerns and practical data release policies for the SEASAT-A and follow-on operational system including the practicality of dedicating such a system to national

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~~EXEMPT FROM GENERAL DECLASSIFICATION SCHEDULE OF~~
~~EXECUTIVE ORDER 11652 EXEMPTION CATEGORY 3~~
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defense needs in time of crisis or war. A final assessment may not be possible in all areas until after SEASAT-A data becomes available.

(S/NF) The DoD has stated that the SEASAT-A data has national security implications. In particular, the altimetry data, if openly available, might be used at some future time by the Soviet Union to improve their SLBM accuracy. In addition, the DoD is concerned that when the other SEASAT-A data is combined with the altimetry data the synergistic effect may result in the discovery of new approaches for deriving militarily useful data from the multiple sensor outputs. Accordingly, DoD has taken the position that we must find a way to achieve the best balance between the national security concerns and the availability of data to the scientific community for the benefit of mankind. This balance is found in (1) allowing adequate time to evaluate the military consequences of any synergistic effects created by the combination of the total data set, (2) protecting the satellite from unauthorized use, and (3) protecting, through encryption, the altimetry data or barring that, limiting the availability of data in geographical areas pertinent to Soviet SLBM operations. Finally, DoD concerns over the SAR data led to NASA agreement that in the case of SEASAT-A they will give us advance warning of areas to be covered and will not routinely operate the SAR over harbors and coastlines. However, the coverage of a future operational SEASAT system involving several satellites with more on board power could give rise to serious national security concerns. Other more complex solutions may be required.

(S/NF) I request that the Navy assume responsibility for a systematic assessment of the military value and national security concerns of the SEASAT-A and follow-on operational SEASAT data. I request you develop a plan along the lines contained in the OASN (R&D) memorandum of 3 September 1976, Subject: SEASAT-A. This plan should include schedules, milestone dates and estimated funding costs using appropriate technological expertise in the weather, geodetic, oceanographic, antisubmarine warfare and fleet ballistic missile areas as necessary to:

a. Determine the individual/collective military benefits of the SEASAT-A and follow-on operational system sensor data, assuming reasonable improvements in resolution or sensitivity for the follow-on system.

b. Consider the need for and practicality of SEASAT-A type sensor experimentation prior to launch and define any testing considered necessary or possible to gain insight into military value of the data.

c. Determine appropriate organizational procedures necessary to process and provide SEASAT-A or follow-on system data useful to operational commanders.

d. Define fully national security concerns, provide supporting rationale, and define practical steps for protecting essential data against exploitation by foreign powers for military purposes.

(U) I request that your plan be available for consideration during the FY 1978 budget review.

(S) I am pleased that RADM Geiger has agreed to participate on the DoD/NASA/National Oceanic and Atmospheric Administration (NOAA) group which Dr. Fletcher and I have recently established to look at operational SEASAT data needs and practical ways of protecting data of concern from a national security standpoint. Your plan should anticipate and provide support for DoD participation on this group, as well as the National Security Council's Space Policy Committee where SEASAT is the subject of continuing deliberations.

s/ Malcolm R. Currie

Malcolm R. Currie